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ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Iona Breakwater Project
Volume III – Technical Appendices

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APPENDIX 2.1

Sound of Iona Piers Development Framework and Master Plan

Sound of Iona Piers Development Framework and Master Plan

FINAL DRAFT REPORT

- Ver 1.1
- 30 October 2013

Sound of Iona Piers Development Framework and Master Plan

DRAFT REPORT

- Ver 1.1
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1. Introduction

1.1. Project Scope

1.1.1. In July 2013, the Sound of Iona Harbours Committee (SoIHC) awarded SKM a commission to undertake a master plan of the pier areas at Iona and Fionnphort in Mull and related nodes of activity.

1.1.2. In preparing this draft master plan, the SKM team has examined a series of development options in and around Fionnphort and Iona drawn from existing baseline information, the views of the communities and other key stakeholders and the analysis of socio economic target data and notes related to the Ross of Mull. Following commissioning, an Interim Report was produced on 3 October which identified and reported on lessons learned and the opportunities for future development. This report also described tow comparator studies on related areas at Lindisfarne in Northumberland north east England, and St David's in Pembrokeshire south west Wales.

1.1.3. The Interim Report identified the baseline conditions which formed the *Inventory of Findings* on which the recommendations on master plan options in and around the Piers at Fionnphort and Iona. A schedule of projects or development concepts that draws upon all the baseline work as well as responses from the communities in Iona and Fionnphort is found in Appendix 1 of this report.

1.2. Master Plan Objectives

1.2.1. The overall objective of this Master Plan is to contribute to the wider regeneration and revitalisation of the settlements on either side of the Sound. In broad terms this would be to reflect upon five principles set by the SoIHC and underlined in the Ross of Mull Development Plan, quoted as follows:

- *Creating safer landing facilities for tourists, fishermen and Cal Mac staff who currently require to use jetties at either side (which provide only the most primitive forms of landing and no berthing facilities)*
- *developing the marine heritage of the Sound in order to support higher forms of tourism activity*
- *improving the local economy by providing a wider range of facilities which build on the existing maritime activities*
- *increasing the attractiveness of the pier areas for visitors and local users*
- *contributing towards the longer term growth in population within the settlements*

1.2.2. The expectations are for a plan clearly articulated to answer a series of key questions, namely:

- What is the overall vision for the future of the area?

- Through what projects and proposals can enhanced economic buoyancy be given impetus?
- How can short listed projects be made fundable?
- How can 'buy in' from local partners be ensured?
- How can it all be made to work?

1.2.3. A framework to drive the economic agenda, bind the partners together and secure the needed public and private investment must be rooted in economic reality and realisable opportunity. From our perspective, this has three central elements:

- An economic role and rationale for the area that will sustain it long into the future, enabling it to perform well both as a place and economic unit in its own right and as a unique asset for improving the competitiveness of the wider area.
- Ensuring that physical development achieving a range of best value returns can be realistically incorporated.
- Providing investment opportunities which produce financial returns while also meeting the strategic objectives of the master-plan, and providing end user markets with property and operating conditions that give the area a competitive edge and produce positive advantages for the businesses that locate there.

1.2.4. Such a plan also requires to be properly grounded and prepared on the basis of clearly defined timescales where development options are described that can attract funding of the right scale and over a sustained period of time.

1.3. Project Proposals

1.3.1. Although many project proposals have been suggested, the purpose of the plan is to identify a range of proposals that have the ability to at least attract funding as well as a good prospect of being delivered in a timescale realistic for meeting the Plan's objectives.

1.3.2. Projects already highlighted in previous reports and development plans have ranged from the creation of new harbours and a causeway to more modest pier- side improvements. It is not the intention of this report to re-visit plans which have been the subject of exhaustive examination previously, such as for a Causeway.

1.3.3. The process of creating this master plan will be to refine likely options realisable in the current political and economic climate, and come forward with deliverable concepts based upon the objectives of the SoIHC and the Communities which SoIHC serves. However it is important to undertline that it will be for the Harbours Committee to reflect upon the range of development opitons described and set out their own preferences and priorities. Careful consideration has been given to the comments made by the communities over several sessions at inception, interim and final draft report stages where it is clear that two groups of projects – breakwaters and urban realm and landscape improvements at Fionnphort – have generated the greatest level of interest. The final draft Master Plan provides considerable detail on each of these groups sufficient to allow both the Committee and the wider community enough evidence to determine how best to take them forward.

1.4. The Boundaries of the Study Area

1.4.1. The Master Plan studies are resolutely focused upon the operational piers in Fionnphort and Iona. A similar pier located at Bunessan in the bay at Loch na Lathaich to the east of Fionnphort also falls within an "area of interest", but while contextually relevant for the study, it is not included as part of the detailed assessment of this study. Each of the Sound of Iona piers has differing functions but both are nonetheless integral to the effective operation of fishing, transport and tourism. The piers are all owned by Argyll and Bute Council.

1.4.2. Fionnphort and Iona piers are essential for the provision of a transport link between Iona and Mull. . The ferry link is supported by Caledonian MacBrayne (CalMac) which operates daily all year round with the total number of passengers transported to and from Iona recorded in 2009 as amounting to 232,215. This figure at that time represented a 4.48% increase on the previous year's passenger numbers. Of that figure over 70% are visitors to Iona as the island and its Abbey act as the main tourist attraction in the area. In addition the Island and the Sound bring people visiting on holiday including discernible increases in the total numbers of leisure yachts, which sail around Mull and Iona in the summer season berthing within the Sound as a safe overnight mooring. This is an opportunity for these visitors to eat locally as well as stock up on supplies.

1.4.3. In addition to the transportation of tourists and local people between the Piers, the Ross of Mull and Iona benefits from the richness of its marine resources. As a result fishing contributes significantly to the local economy with around 12 vessels operating from Fionnphort and Bunessan piers. Their principal catches are brown crab, prawns, lobster, velvet crab, crayfish and scallops, much of which is now exported internationally.

1.5. Maritime Environment within the Sound of Iona

1.5.1. While Admiralty Charts are intended to be used to inform the more detailed maritime engineering options, research has identified the following information relevant to the maritime environment within the Sound of Iona.

1.5.2. A historic chart for the Sound of Iona (1857-60) identifies the following:

- Depths ranging generally from 2 to 4 fathoms (3.6 to 7.3 metres) within the Sound;
- A shoal occupying the middle of the Sound off Iona "Landing place" where depths reduce to ½ fathom (0.9 metres);

- A spring tide rise of 11 feet 8 inches (3.66 metres);
- A neap tide rise of 8 feet 9 inches (2.7 metres);
- A tide range of 4 feet 6 inches (1.4 metres);
- A maximum flood tide current of 2 knots (1.0 metres/sec); and
- A maximum ebb tide current of 2 ½ knots (1.3 metres/sec)

1.5.3. The Sailing Directions (Enroute) – Scotland 2013 (Pub. 141 by the National Geospacial Intelligence Agency, Springfield, Virginia) identify the following:

- The Sound of Iona (56°18'N 6°23'W) lies between the west side of the Ross of Mull and the east side of Iona;
- Shoals and rocks encumber the narrows of the sound. South of the narrows, the sound is clear of dangers in the fairway. However, transit is not recommended without local knowledge. A sand bank, with a least depth of 0.1m, extends across the middle of the Sound. The channel through this area has a least depth of 1.8m.

1.5.4. Other internet sources suggest mean offshore wave heights in the Mull and Islay area vary between 1.8m in the summer to 3.6m in the winter. Maximum wave heights would be anticipated to be significantly in excess of mean heights.

1.5.5. The Sound of Iona is orientated north-by-northeast to south-by-southwest, and is open to the Atlantic Ocean particularly from the southwest. Conditions within the Sound would therefore be anticipated to be most affected by storm waves and winds driven into the Sound from the southwest and northeast. Depending also on the direction of offshore waves, mean and maximum wave heights within the Sound could be expected to be greater than in offshore locations as the depth of water within the Sound is much less than offshore.

1.5.6. Other direct evidence from those regularly sailing in the sound indicates:

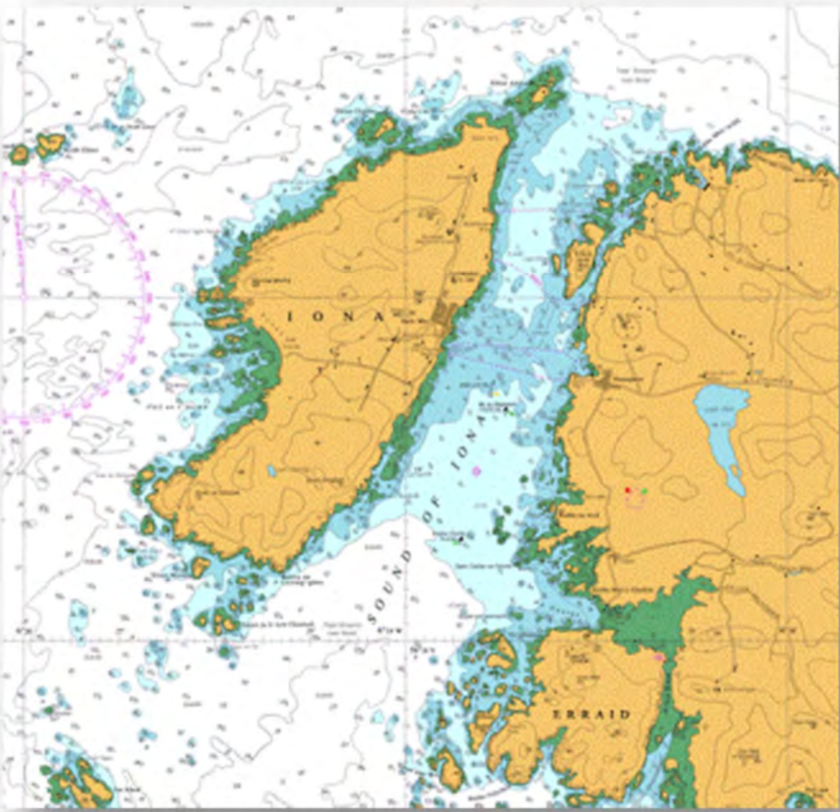
- The ferry berth at Fionnphort is exposed to swells (waves) from the southwest, gales from southwest and strong gales from the northwest.
- Iona Pier is exposed to southeast and south winds and any heavy swells (waves) setting in from the south and southwest.

1.6. Operation Constraints for Vessels

1.6.1. Discussions with local operators including the ferrymen have confirmed:

- Ferry operations at the Fionnphort are impacted by the swell and wind conditions identified and by the tidal range.
- Foot passengers and vehicles at Iona Pier are vulnerable to waves as they embark or disembark, and the ferry's ability to remain safely berthed with its ramp stationary on the slip is compromised.

- The pier at Fionnphort can become very congested as it is used by the Iona ferry, fishing vessels, tour and charter boats, and leisure boats.
- The north pier at Iona has restricted draft during low water spring tides due to a rocky patch.
- The Iona ferry (MV Loch Buie) is berthed overnight in Bull Hole, a protected anchorage to the north of Fionnphort.
- There exists no other protected anchorage within the Sound, and in particular in close proximity to Fionnphort or Iona.
- The approach to Iona for the ferry is from the southwest to avoid the shoals occupying the middle of the Sound.



1.7. Fionnphort

1.7.1. Fionnphort pier is a slipway with a relatively modest breakwater that provides some lee-side shelter from high winds for smaller yachts and other sailing vessels moored in the bay. The MV Loch Buie lands on the slipway and fishing boats and other, smaller, passenger boats can tie up on its north side depending on tidal conditions. The ferry is longer than the pier so cannot use it as a safe overnight mooring for all weather conditions

1.7.2. Limited facilities for pier users continue to present difficulties in terms of space for fishing tackle and other gear while the location of the fresh water supply situated at the top of the breakwater makes it difficult for fishing boats to use for wash down and cleaning purposes. Lighting is poorly positioned on the pier making landing difficult for fishermen and other smaller vessels in poor light. There is no electricity available on the pier to cater for alternative forms of lighting. In addition to these key factors there is limited parking for fishermen and their vehicles around the top of the pier. This often results in the pier being congested in the summer months with large number of visitors queuing for the Iona ferry and island boat trips in close proximity to fishermen landing their catches.

1.7.3. Alongside berthing is only possible in Fionnphort in good weather conditions, and so when not in service and overnight the ferry is berthed in Bull Hole alongside the island, Eilean nam Ban. While this represents a secure berthing location for the ferry and other boats it does present issues of safety for the ferrymen who require to undertake a journey in all weathers and conditions (with its attendant risks) by dinghy to transfer the ferry to the slipways. Shelter for ferry passengers at Fionnphort is limited to the small scale facilities at the coffee kiosk and hence queuing to board is generally undertaken unprotected and open to all weather conditions.

Figure 1-2 Pier and Slipway Arrangements at Fionnphort

1.9. Iona

1.9.1. Iona pier on the other side of the Sound has a slipway used by the ferry without any shelter for ferry passengers in times of unfavourable weather conditions. Cars are not authorized on Iona without a permit. There is no indoor waiting area near the ferry slipway where passengers can wait with their luggage. This often presents difficulties where the weather is either wet or windy.

1.9.2. There is also a small jetty alongside the slipway (now suffering from significant structural weaknesses) used by passenger boats, which mainly visit Staffa and the Treshnish Isles. Other small vessels including the shuttle boats transporting passengers from visiting cruise ships will also use this jetty. The multiple uses present difficulties where there is little capacity at the pier for other visiting leisure boats, which are obliged as a result to moor in the bay either to the north or south of the pier.

- **Figure 1-3 Approaching the Pier at Iona**

1.10. Bunessan

1.10.1. While we understand that Bunessan pier falls out with this study it is nonetheless useful to describe the context of this pier in the wider area relative to Fionnphort. Bunessan is constructed from granite material and was built to provide a place for cargo ships and cruise ships to tie up and unload. The pier has been renovated twice in twenty years and facilities include parking, water, lighting and electricity.

- **Figure 1-4 Bunessan Pier at High Tide**

1.10.2. There is a deep water anchorage along the coast at Bendoran with a deep water channel linking the pier. Other than in very low spring tides, the pier is available for use in all tidal conditions.

1.10.3. The sheltered nature of the anchorage at Bunessan has represented a favourite berthing place of yachtsmen in previous years. However with the closure of the local boat yard in and the closure for sale of the Argyll Arms Hotel in Bunessan, the number of yachts in the bay has declined considerably.

- **Figure 1-5 Looking North to Bull Hole and the Sound**

2. Economic Assessments

2.1. Format and Components

2.1.1. The economic and market approach of the master-plan provides an answer to a series of key socio-economic issues as follows:

- Providing the overall economic vision for the future of the area?
- Specifies a range of projects and proposals, which would enhance the economic buoyancy of the Sound of Iona hinterland;
- Specifies in what ways these projects address market weaknesses and adds economic, business and community opportunities;
- Identifies indicative funding sources; and
- Through the master-plan process of assessment, analysis and consultation aims to provide community ‘buy in’ from local partners by answering the needs and priorities set out by the local community.

2.1.2. The rationale for the future economy of the Sound of Iona has three central elements as follows, namely to focus upon:

a) Economic role and rational for the study area
b) Finding realistic and business development opportunities; and
c) Describing investment opportunities and financial returns.

2.1.3. Each of thse elements underpin the logical sequence of recommentations made within the master plan and are intended to provide an evidence base on which the Committee and the communities in Iona and Fionnphort can base their decisions and support for future project development.

2.2. The economic role and rationale for the area

2.2.1. The future of the area would be one of a combination to two components, the first being an improved tourism and recreation attraction with enhanced infrastructure, facilities and services increasing visitor expenditure through:

- Extending the visitor season in both Fionnphort and Iona;
- Increasing ‘dwell-time’ and longer stays in Fionnphort by offering an improved range of facilities and services, and improved environment;
- Retaining visitors in Fionnphort / Ross of Mull through providing opportunities and facilities to increase the numbers of overnight stays; and
- Improving the visitor offer and product on Iona through infrastructural improvements encouraging a major uplift in leisure boating expenditure through providing a series of protected moorings and improved pier-side services and

facilities thereby allowing full exploitation of the existing market in terms of numbers of visiting leisure craft and aiming to exploit the predicted shoulder season growth in the market and significantly increase visiting leisure craft numbers.

2.2.2. The second component of the economic rationale would be a continuation and consolidation of the existing basic economic activities with improvements particularly for fishing sector through:

- Providing improved slipway facilities and greater more manageable pier-side area for cost-efficient operation;
- Providing opportunities for chandlery, repair and maintenance and fuelling services for leisure and other marine vessels; and
- Attracting a more diverse range of businesses to the area

2.3. Realistic physical and business development

2.3.1. The Master-plan provides for this economic rationale and role, through:

- Addressing the weaknesses identified in the economic structure of the area;
- Providing a range of infrastructural, facility and improvement projects, which aims to answer both emerging market needs and requirements, and needs for successful business operation;
- Aiming to encourage new investment and visitor expenditure;
- Aiming to extend the visitor season and increase market activity over a longer period and into the shoulder months of Spring and Autumn; and
- Providing local business and economic opportunities to enable un-interrupted prosperity over a full calendar year, not just during the visitor season.

2.4. Investment opportunities and financial returns

2.4.1. The master-plan not only specifies physical improvement and development projects, which will enhance short, medium, and long-term economic and community prospects, but also identifies potential opportunities for business investment and development, which meet current and emerging market opportunities, providing that the necessary investor interest can be identified and ensured. Such business investment opportunities are designed to make the local Sound of Iona economy less dependent upon a concentrated four month visitor season and permit sustainable all year economic prosperity.

2.5. Rationale and Economic Options

2.5.1. The delivery of the master-plan could be implemented in a series of stages or phases as funding resources permit. Hence, major infrastructural works including breakwaters would be defined as medium term projects within 1-5 years, with the revision of visitor management arrangements, car and bus-parking, and visitor signage etc implemented within a short term 12-18 months period.

2.5.2. In this way identifiable improvement in the onshore facilities and services can be achieved within one to two visitor seasons as can small scale environmental enhancements.

2.5.3. The attraction of new business investment will be a function of promotional and marketing activity on the part of the Project Board or Trust, whose job it will be to work together with other partners to implement the range of specified projects. Of particular value will be the improving economic conditions within the wider economy, which offer enhanced prospects of attracting such investor and entrepreneurial interest.

3. Principal Development Concepts

3.1.1. The following section reflects more detailed thinking on development options drawn from the discussions with individual stakeholders and following presentions on the draft development concepts to the communities in Iona and Fionnphort. Brief commentaries follow in this section with a detailed schedule of development concepts in Appendix A of the report. The Deveopment Schedule sets out more detailed target notes on the follow key development factors:

- Broad Range of Cost
- Feasibility and Timescales
- Advantages and Disadvantages
- Delivery
- Sources of Funding

3.1.2. These summaries are by their nature outline and intended to inform thinking and priorites at a strategic level rather than offering detailed analysis on individual development options. We have advised SoIHC of the need for further detailed study where priorities are being set and projects identified as taking precendence.

- **Figure 3-1 The MV Loch Buie arrives in good time**

3.2. Breakwaters off Fionnphort and Iona

3.2.1. As a major project activity each proposed breakwater will require a significant investment in its design, consenting, and construction. The precise location of the breakwater would be dependent on detailed technical studies includign hydrographical; bathymetric and marine geotechnical surveys in the first instance together with detailed analysis modelling to understand issues such as wave propagation and energy absorption, residual wave conditions within the protected waters, the impact on currents and the risks of any resultant erosion/accretion of mobile sands and sediments, The approaches to Fionnphort and Iona would also need careful assessment to ensure the safe navigation of vessels.

3.2.2. The form of the breakwaters would require careful consideration as ultimately, a significant environmental assessment as part of an [planning] application and marine licence would be required. In this respect, fully- or partially-submerged reef breakwaters constructed with natural rock boulders may be an option depending on factors such as the tidal range and the impacting/residual wave heights and energies. A rendered image (Figure 3-2 overleaf) provides an indication of the scale and massing of the structure.

3.2.3. In addition to these assessments and as part of a wider application for consent, the Planning Authority and statutory agencies would expect to see a Cost Benefit Analysis of improved ferry operation, frequency of sailings and tangible benefits in berthing. In particular where improved ferry operations are possible in all sea states so an analysis would expect to identify enhancements in safety for passengers and crew particularly where at present there is a reliance on Bull Hole as the sole sheltered mooring for the MV Loch Buie and Island Ferries.

- **Figure 3-2 Rendered Images of Breakwaters at Fionnphort**

3.3. Improved Ferry Berth arrangements

3.3.1. The ferry vessel is moored overnight at a berth in the sheltered waters of Bull Hole (see Figure 3-3 below) some 1.5km north of Fionnphort. Cal Mac support the construction of a solid breakwater/pier structure to provide an all-weather berth off the end of the Fionnphort slipway. This would require an engineering feasibility study on the basis of a structure of at least 60 meters reflecting a 2 times vessel length to permit fore, aft and mid-ship mooring lines.

3.3.2. In the absence of a new breakwater off Fionnphort, the new berth would need to be provided with a wave wall extending to 4m above HAT and would perhaps involve the construction of a double wall sheet pile structure with rock infill and a reinforced concrete deck and wave wall.

- **Figure 3-3 Berthing at Bull Hole**

3.4. The Fionnphort "Promenade"

3.4.1. While individual projects might be identified and taken forward in a piecemeal manner a single multifaceted and radical overhaul of the visitor experience is regarded as fundamental to a sustainable future success of the "Iona Experience". As a single area master planned redevelopment of Fionnphort including at least seven elements:

- Removal of existing visitor car and coach parking and narrowing of carriageway as a redefined and re-landscaped "promenade" from the top of the village to the edge of the pier.
- Overhauled terminal building / ticket centre with space to include toilet, changing and commercial spaces
- Turning circle at the head of the pier capable of efficient offloading of passangers direct onto the pier and reception facility
- Extended viewing deck as an integral "experience" within the Reception Facilty at the head of the pier
- Open or stepped access to the beach
- Stepped / secondary slipway access
- Construction of a new access route from the edge of the village redirecting car and coach visitor traffic to an alternate car and coach park

3.4.2. An indicative conceptual plan at Figure 3-7 Analysis of Fionnphort Figure 3-9 illustrates some of the key principles in a redefined landscaped area where car and coach parking currently exists around the bay at Fionnphort. Its intention is to highlight the potential for change drawing out the assets that exist but are currently undervalued or ignored where the imperative of quick visitor offloading (see Figure 3-5) onto the ferry pier takes precendence ovar all other activities.

3.5. Visitor Reception at Fionnphort

3.5.1. Complete redesign / rebuild of the current facility combined waiting room and viewing platform; ticket facility; shop and toilets. The proposal would require a detailed design and construction of a new larger facility suitable to accommodate summer passenger numbers. Temporary accommodation to east of current facility would exist during the construction period however the justification would be to significantly improve the experience of passengers onto the ferry through a managed system of ticket distribution on numbered basis designed to improve passenger management and counts, and reduce queuing stress during high congestion periods.

▪ **Figure 3-4 Award winning Ferry Shelter in Tiree**

3.6. Car and Coach Movement and Parking at Fionnphort

3.6.1. A significant measure proposed as a means of managing the flow of passengers and traffic onto the pier is the removal of a substative area of visitor car and coach parking near the pier terminal. The project would require a phased alignment with the development of a visitor reception facility with turning circle at the head of the pier to allow passangers and visitors off buses and onto the pier.

3.6.2. Resident (permitted) parking would be retained as would the setting out of a new parking area adjacent to the pier for the use of regular users of the piers such as ferrymen and fishermen.

3.6.3. The whole project requires detailed road geometry and streetscape assessment designed to improve the experience overall of visitors as well as residents and existing users of the pier.

3.6.4. It would take advantage of direct access onto the shoreline with landscaped seating areas and drop off points for a short cycle shuttle service between the Visitor Reception Facility and the pier.

3.7. Ferry Passenger management Fionnphort

3.7.1. The lack of shelter for queuing passengers points to the need for design and construction of shelter on the approach to and along part of the edge of the pier. It would require an appropriate design complying with aesthetic quality of area. It would similarly require breaks in the structure to afford vehicular and pedestrian access to pier side houses. Alternatively a study might include the construction of a shelter nearing the upper reaches of the approach to the pier.

3.7.2. Supporting the design and construction of a shelter structure would be the installation of indicator boards with ferry timings and sea state at key point or points to the entrance of the pier and carpark

3.8. Ferry Passenger management Iona

3.8.1. As with Fionnphort a similar study should be undertaken on the design and construction of a queue shelter on Iona in which the design would demonstrate compliance with aesthetic quality of materials and scales given the sensitivity of the area. Also the study would include supporting an improvement in the indicator board systems on sea state and times of ferry crossing etc. directly linked to the tannoy/comms system on the ferry.

- **Figure 3-5 The Rush for the Ferry**

3.9. Columba Centre

3.9.1. Redevelopment of the Columba Centre as a multi-user commercial, edicational, community and additional interpretive facility.

3.9.2. Agree with Historic Scotland new management arrangements and design and refurbish for new visitor facility. This proposal would include a requirement to negotiate land ownership for direct access road from entrance to Fionnphort south round existing built up area to Columba Centre.

3.9.3. The project would require extended and repaved car parking area at Columba Centre to accommodate additional car and coach capacity redirected from ferry pier where this car and coach parking has been removed as part of a new Fionnphort "promenade" .

- **Figure 3-6 Columba Centre Fionnphort as a Community Resource?**

- **Figure 3-7 Analysis of Fionnphort**

- **Figure 3-8 Analysis of Fionnphort**

Figure 3-9 Conceptual Design Options for the Fionnphort "Promenade"

- **Figure 3-10 Conceptual Anaysis Best Practice and Sourced Materials for the Fionnphort Promenade**

3.10. Repairs to main and lower (north side of) pier at Iona

3.10.1. Essential repairs are needed to prolong the life of the landing pier on Iona. This will require an additional concrete slab or similar over the exposed rebar on main pier landing point. In addition there is a requirement to repair a lengthy section of the supporting slipway by breaking away and replacing the longitudinally cracked part of existing pier structure.

3.11. Extension to the main pier at Iona

3.11.1. As an alternative to a breakwater off Iona, extension of the main pier in reinforced concrete could be considered in order to provide a sheltered berth for the ferry and to extend the protection to the bay where other vessels moor on swinging moorings.

▪ **Figure 3-11 Staffa Ferry alongside the Iona Slip**

3.12. New Fishermen’s slipway and laydown area Fionnphort

3.12.1. Construct a new, widened and extended slipway over the current old slipway with a new reinforced concrete slab and provide vehicular access to head of slipway. Install hard surface area between ferry pier and old fishermen’s slip as additional fishing equipment storage.

3.12.2. In the absence of a new breakwater off Fionnphort, the extended slipway would require a local breakwater in order to provide an all-weather facility.

Figure 3-12 Gear loaded on the pier at Fionnphort

3.13. Land Use, Tourism and Economic policy

3.13.1. Align land use policy more closely with Fionnphort and Iona development aspirations. Argyll and Bute Council are committed to produce locally orientated, flexible and transparent plans that will:

- Provide guidance and recommendations to assist current and future planning, regulation and management of marine and coastal activities.
- Encourage a diverse, balanced mix of sectors to operate and develop sustainably with consideration of other interests and environmental capacity.

- Recognise, promote and help safeguard areas important for marine and coastal wildlife, habitats and heritage.
- Enable a better understanding of the socio-economics of the area and incorporate this into management and planning.

3.13.2. There is a policy commitment to take these principles forward through an Area Action Plan for the Ross of Mull Development Plan and Housing Opportunity Areas. The completion of a master plan for the Pier at Fionnphort and Iona is regarded as a key opportunity to address the perceived policy constraints that exist currently and the community is being encouraged to take a direct role in addressing amendments at first revision stage of the Local Development Framework.

3.13.3. Additionally A&BC is seeking to extend its representation on key policy areas in particular it is looking to support initiatives with Scottish Government, HIE, Scottish Tourism and other key stakeholders to achieve congruence of policy objectives and local aspirations.

4. Local Economy and Business Opportunities

4.1. All Season Operation

4.1.1. A number of project opportunities present themselves to provide for all-season year round economic and business activity unaffected by visitor flows. These are set out below with background high level market analysis to establish potential levels of economic benefit and impact.

4.2. Segmentation of the Tourism and Visitor Market

4.2.1. The tourism and visitor market can be sub-divided into the following segments:

- Low spend ‘volume’ day-trip visitors – largely bus and coach parties based;
- High spend ‘value’ overnight stay visitors – largely independent car borne groups;
- Lower spend day-trip visitors – cruise ship based; and
- High spend ‘value’ groups – largely yachts and leisure boating based

4.3. Nature of visitor markets

4.3.1. Currently, the congestion experienced on an on-going basis in Fionnphort is derived largely from the ‘wave’ effect of the arrival of numerous lower value spending bus-borne visitor groups, who have arrived on Mull on the Oban to Craignure Calmac ferry and make use of the Fionnphort service bus or chartered coaches. This puts pressure on the infrastructural and services’ capacity of the area, without contributing major benefits to the local economy. Where expenditure has been made this is largely to off-island tour companies, coach/bus operators, and Historic Scotland at Iona Abbey. Other economic benefits naturally accrue to Calmac the ferry operator. However, there appears to be only modest amounts of spend by these visitors made in the shops and food and drink providers in Fionnphort, due to their short time spent passing through the village in each direction en route to and from Iona.

4.3.2. The average daily expenditure of day-trippers in Argyll & Bute has been estimated at £30.76 per head per day1.

4.3.3. The high spend high value visitors are generally independent travellers or groups travelling by car (sometimes service bus) who are either day trippers of overnight stays. These visitors make us of the range of commercial and retail facilities, through food and drink purchases, meals, merchandise, accommodation, trips and entrance to visitor attractions and other facilities.

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[1] Tourism Destination Baseline Study to inform Scottish Enterprise Tourism Framework for Change: SQW Consulting for Scottish Enterprise (January 2008)

4.3.4. The average daily expenditure of overnight stay visitors has been estimated at £56.93 per head per day[2].

4.4. Visitor accommodation

4.4.1. Visitor accommodation on Iona is limited to two hotels, a number of B&Bs, self-catering units, and a camp-site. Information from the hotels on the island, which open for the season between March and October, indicates that these are running with room occupancy rates of 85-90% from May until September with often full occupancy during the peak months of the season. Even in April and October occupancy rates can be 70-80% or slightly lower.

4.4.2. No information is available for the Ross of Mull and Fionnphort visitor accommodation providers. However, anecdotal evidence through the consultations indicates that during the peak months of the season B&Bs and self-catering do experience high levels of occupancy, and the Fidden Farm camp-site often accommodating 2-300 tents during the high season.

4.5. Leisure boating market visitors

4.5.1. In support of the economic assessment of the master plan and development framework an detailed Leisure Boating Market Assessment was completed. A supporting paper (found in Appendix B of this report) has highlighted the scale of the opportunity open to Iona and Fionnphort with perhaps some 750-1,000 boat visits per annum. The different levels of spending of such leisure visitors is marked with day visits, which represent the vast majority calling at Iona due to the lack of protected moorings, estimated to be a similar level to onshore day trippers at approximately £30 per boat per day. However, over-night stays were protected moorings to be available are estimated to spend £130 per boat per day, a major increase in expenditure and economic benefit to the local economy.

4.5.2. In addition, while the construction of a breakwater at Iona would provide the necessary protected moorings on the Iona side of the Sound as the key attraction in the area, the construction of breakwater(s) at Fionnphort creating protested berths within a harbour would also provide a basis upon which the RYA would be likely to define the village as a stopping point / berthing point on cruising maps and guides, further encouraging leisure traffic to call at the Ross of Mull aside of the Sound.

4.5.3. This would be likely to encourage leisure boating visitors to moor at Fionnphort to take advantage of the facilities and services on offer in preference to the other mooring points at beaches around the southern point of Ross of Mull, and would add additional facilities encouraging a growth in the market in the area, complementing the protected moorings and stopping point in the bay at Bunessan.

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[2] As above (4)

4.6. Cruise tourism visitors

4.6.1. Information and data on cruise tourism visitors to Iona is limited, with local consultations estimating the number of visiting cruise vessels to be approximately 17 during the 2013 season, with 50% of these visits occurring during May. These visitors are transferred by tender from the cruise vessels to Iona pier and remain on the island for only a limited period generally between 2-3 hours at most. Similar to day trip visitors arriving by the Calmac ferry, these visitors are viewed as bringing moderate levels of spend and economic benefit to the island, with the primary beneficiaries being the village shops on arrival and departure and the craft shops and retail outlets on the route to the Abbey and Iona Abbey and shop itself. No separate data for cruise visitors levels of spend are available, hence onshore day trip visitors' levels of spend are assumed to occur within this market segment.

4.7. Development of a Micro-Brewery

4.7.1. Micro-brewery – A year round economic and business activity exists in the form of development of a micro-brewery. The market for such breweries has dramatically expanded in recent years for the production and consumption of 'craft beers.' It is estimated that there are currently 600 such breweries in the UK, with over 50 in Scotland, eight having opened during 2013 alone. This market growth has been encouraged by the Progressive Beer Duty Scheme, which permits breweries producing under 5,000hectolitres per annum to pay only 50% excise duty.

4.7.2. The potential economic benefit, which derives from such limited scale business enterprises, can be extensive. Remote and rural locations are no barrier to the development of these breweries, with recently opening examples in Cromarty (2011), Shetland (2013), and other in remote locations existing successfully over a number of years – Fyne Ales (2001), Islay Ales (2003), and Colonsay (2007), amongst others.

4.7.3. Numbers of jobs generated through these businesses vary depending on production scale, but generally the starting level of output at 4-5barrels/660-825litres will employ 4-5 FTE jobs, and more were the brewery to increase production or be allied to a 'brewery tap,' pub, or shop. A two-and-a-half barrel capacity, which produces around 760 bottles per brew, is generally viewed as the appropriate level to supply local farm shops, restaurants and the occasional artisan alcohol shop in larger Scottish cities and elsewhere.

4.7.4. The comparative example of Lindisfarne making use of the Lindisfarne Castle Ale and Lindisfarne Gospels Ale, demonstrate the use of the local attractions as marketing devices. Iona and Iona Abbey, and the Isle of Staff all represent similar iconic brand attractions, which could offer potential for a business start-up. While 'Red Monk of Iona' labeled beer is currently produced by Argyll Breweries Ltd trading as Oban Bay Brewery (incorporating Isle of Mull Brewery) this would not necessarily constrain the market opportunity for a brewery start-up in the Sound of Iona area.

4.7.5. Table 4-1 below illustrates the current range of comparator micro-breweries, their output and level of employment created.

Table 4-1 Comparator Micro-Brewery Scale

Micro-Brewery Name	Location	Start Date	Production Scale	Job Numbers
Fyne Ales	Ciarndow, Argyll	2001	10bbl/1,659l	11-15FTE
Eden Brewery	Guardbridge, Fife	2012	20bbl/3,300l	8FTE
Islay Ales	Bridgend, Islay	2003	4bbl/660l	6FTE
Colonsay Brewery	Isle of Colonsay	2007	5bbl/825l	3FTE
Lerwick Brewery	Staneyhill, Shetland	2013	12bbl/1,980l	3.5FTE
Cromarty Brewery	Davidston, Cromarty	2011	10bbl/1,650l	3FTE
Oban Bay Brewery/Isle of Mull	Waterfront, Oban	2010//2005	5bbl/825l	n/a

4.7.6. The requirements for business start-up of a micro-brewery are an interest in brewing, entrepreneurial ability, marketing nous, limited scale buildings, and moderate level of funding and finance. A number of the brewery examples were originally set up making use of redundancy money from other employment. Remoteness is no impediment per se to a successful operation, given business start-up support available from HIE, and the increasing market for consumption of craft beers. Equally neither is the size of the local market an impediment to start-up and success, as while the indigenous population of Mull is limited in scale, the number of visitor to Mull and Iona offers a major uplift, and good quality output swiftly commands interest from the mainland supermarkets, with the Cromarty Brewery, Eden Brewery, St Andrews Brewery, and Alchemy Brewery in Livingston all swiftly having their products on sale within only a short period post-start-up of production. Similarly, the scale of output from such micro-breweries is well able to be delivered by 'white van' o wider markets and is an all season year round activity.

4.8. Identification of a Hotel Investor and Operator

4.8.1. **Hotel operator** – The attraction of a sizeable hotel to the Fionnphort area would be a major boost to the local Sound of Iona economy. With visitor accommodation limited on the Ross of Mull largely to bed and breakfasts, self-catering, and camp sites, good quality hotel accommodation would fill a key gap in the local market. During the peak season, local consultations indicate that the two hotels on Iona are running at 80%+ occupancy and are often at capacity.

4.8.2. The major impediment to the attraction of hotel investment is the restricted season, with tourism largely constrained to the non-winter timetable period of the peak Calmac Oban to Craignure ferry route, which operates from early April until late October. Thereafter over the November to March period visitor numbers decline steeply. However, even on the mainland many tourism and visitor businesses operate only between March and October, unless they are in a winter sports type environment or have an all-year all season type of operation.

4.8.3. Generally the economics and viability of conventional hotels denote that the operation requires 30-40 rooms to be a viable proposition. However, specialist small scale hotels, which also provide a high quality food and drink offer are viable and economic on a much smaller basis of 10-20 rooms. Where the standard of accommodation and service is 3-star or better these generally employ two members of staff per room. However, smaller hotels will normally provide a more limited level of staffing, with perhaps a maximum of 8-10 staff only.

4.8.4. Paradoxically, the lodge type of hotel accommodation with perhaps up to 40 rooms would only employ 5-10 staff as a maximum. However, this is not the format of hotel, which would be likely to locate on the Ross of Mull, it being much more likely that should hotel investment be attracted to the area that this would be of the specialist smaller-scale variety.

4.8.5. It is difficult to see in current market conditions, and with the constrained transport arrangements of accessing Ross of Mull that there would be significant market interest. However, were the attractions of Iona together with improved facilities and visitor offer in and around Fionnphort lead to a significant increase in visitor numbers and over a prolonged season, then hotel and food and drink investor interest might be encouraged.

4.9. Creation of a Local Renewable Energy Hub

4.9.1. Renewable **energy hub –** The prospects of either Iona or Ross of Mull being promoted as a hub of renewable energy generation or production are generally constrained by limitations on the grid connection in the area, as does the environmental quality and scenic value, which would act as a constraint to any larger scale onshore wind generation. However, two aspects of renewable energy, which do perhaps offer potential to underpin the local community and its economy, are as follows:

- Improved energy efficiency through the fitting of high performance insulation in all residential and business accommodation, thereby reducing heat loss and electricity consumption, and as appropriate potential installation of solar panelling for both solar water heating and / or PV and also biomass/wood burning stoves; and
- Assessment of the potential for wave and tidal energy generation through limited scale next generation wave and tidal devices; such devices are specified to be lower cost and designed for the supply of electricity to remote coastal or island communities with a power output of 10kw – 500kw, particularly where the communities are either off-grid or have restrictions on grid capacity.

4.9.2. It might be possible to initiate a project – via the Energy Saving Trust, Resource Efficiency Scotland, the Renewable Heat Initiative, the Community and Renewable Energy Scheme, and/or other initiatives similar to the former HIE Community Renewable Energy Support Programme (CRESP). Such a comprehensive community based project would assess the individual need for increased energy efficiency, the technological opportunities, the potential benefits, the individual business cases, and the funding resources available to provide for greater energy efficiency and sustainability and hence improved economic and business performance in the area.

4.10. Renewables and Marine energy devices (tidal stream and/or wave)

Constraints on potential

4.10.1. Lack of grid capacity particularly in the Taynuilt to Inveraray section of the line

4.10.2. Generation of electricity in the Sound of Iona would be restricted by the capacity of the 132kV grid connection to the Ross of Mull. This is particularly the case with problems experienced over the Taynuilt to Inveraray section, where overheating is believed to occur. Extra power loads from Ross of Mull would n ot be capable of being accommodated until such time as this section of the grid was upgraded and reinforced. It is understood that such reinforcement is not considered to be a current priority to SSE/SHETL.

4.10.3. While the introduction of 'smart grid' technology might improve the capability of the grid connection to better match the demands of the consumers and the output of the generators, such technology currently is not widely operational and also its introduction would be dependent upon a detailed assessment of the overall network in the area, the basis of demand and the potential supply. However, even with such an understanding to enable ‘smart grid’ technology, the ability and capacity of the Ross of Mull grid connection to accept any significant additional generation for export off Mull is compromised until such time as grid reinforcement occurs in the future.

No current designation by the Crown Estate of the Sound of Iona as a marine energy zone

4.10.4. The Sound of Iona currently does not possess the status as a Crown Estate lease area for the potential development of marine energy devices, without which such development cannot take place.

4.10.5. While Marine Scotland is currently conducting a consultation and screening exercise as to the potential of additional offshore wind and marine device zones around Scottish Territorial Waters, this will not be completed until Q1 2014. Assuming the Sound of Iona was to be selected by Marine Scotland and the Crown Estate as the location of such a zone, this would not be likely to be tendered for expressions of interest by developers for sole development rights before 2016-2017; and hence subject to the consenting process marine devices would not be in the water before 2020 at the earliest.

Concentrated energy generation versus distributed energy

4.10.6. Energy market developments and energy master-planning have seen the focus on energy generation in remote locations move towards the concept of ‘distributed energy’ making use of smaller scale compact energy centres based upon non-fossil fuel generation namely a combination of hydro, biomass, wind and solar, feeding local communities and hence being less dependent upon long-distance grid connection capacity. Such an approach avoids the inefficiencies and energy losses of larger scale energy generation (often 40%+) and longer distance transmission losses (generally 8-10%), hence being a more efficient and cost-effective low Co2 source of supply. Further, locally based generation and distribution also avoids the risk of bad weather damage to transmission lines and reduced the risk of ‘outages’.

4.10.7. Potential does exist in the Sound of Iona for limited scale marine energy generation to provide local supply, potentially on a ‘private wire’ basis of dedicated user supply ‘off-grid’ or to supplement the main grid supply. Comparative examples of this type of approach are the SPR Sound of Islay project and the proposed DP Energy West Islay Tidal Energy project each of which has a portion of its supply targeted at usage by the local Islay malt whisky industry.

4.11. Conclusion on suitability of tidal and wave energy devices.

4.11.1. Extensive assessment and appraisal work would be required to ascertain the scale and nature of the marine energy resource in the Sound, the feasibility, and viability of undertaking such a project, and indeed the scope of technology, its specification, and its scale of commercial output. Until such time as this is undertaken no potential project can be considered to be a feasible proposition for inclusion in the master-plan.

4.11.2. Further, until such time as the Sound is designated as being appropriate for marine energy generation device development by the Crown Estate, and the grid connection is reinforced, the prospect of such a project must be viewed as no more than a remote possibility and only in a longer term timescale.

4.11.3. Finally, the prospect of combining the proposed breakwaters at either Fionnphort or Iona with a marine device project is unlikely to be tenable given the long-term timescale involved with addressing constraints on such marine energy development and the probability of constructing the breakwaters within a much shorter timescale.

4.12. Village Environmental Improvement

4.12.1. As part of the overall environmental improvement of Fionnphort, which would include reconfiguration of the visitor management, bus and car parking, and redevelopment of pier-side facilities, to act as a focus for overall improvement in the visitor (and local indigenous community) experience, there should be an aim of achieving a **Beautiful Scotland** competition[3] prize win within 3 years through an entry in either the:

- 'Wee Village' category (up to 300 population); or
- 'Coastal Village' category (up to 2,500 population)

4.12.2. Judging criteria for this competition comprise: the range of horticultural achievement and activity, the level of environmental responsibility adopted and achieved, and the level of demonstrable community participation. This form of environmental project has essential benefits in:

- Drawing the local community together;
- Acting as a focus for environmental improvement and enhancement;
- Improving the experience of visitors;
- Being likely to promote longer 'dwell-time' in the village by visitors; and
- Low cost activity with access to a wide range of funding

4.13. Summer and Shoulder Months Operation

Columba Visitor Centre Redevelopment

4.13.1. As a new focal point of the relocation of visitor car and coach parking in Fionnphort, the redevelopment and re-opening of the Columba Centre would represent a new business opportunity for the promotion of Fionnphort and the Ross of Mull. It would

[3] http://www.keepscotlandbeautiful.org/media/169068/EntrantManual-2013.pdf

also act as a 'taster' for the attractions in and around the Sound of Iona. The concept would be one of acting as a 'sign-posting' centre in much the way that the Bowmore Visitor Centre on Islay acts as a sign-post to the wider attractions of the Isle of Islay.

4.13.2. In addition to the visitor information role, the centre should also offer showcase facility for the craft and local produce from the area, a shop retailing such goods and merchandise and a modest level of food and drink offering such as a café.

4.13.3. Subject to analysis of the business community's needs and requirements the centre could also act as a Business Point of Presence (PoP), which would provide high-speed digital and internet access to the available range of business advice and information, and hence operate as an out-reach Business Gateway portal.

4.14. Other Business Opportunities

4.14.1. **Attraction of a specialist nursery / garden centre** - This would act as both an attraction and a retail nursery. The garden of the St Columba Hotel on Iona offers a good example of a small-scale nursery garden, the produce of which is used by the hotel. Other comparative examples, each of which is open from March to October, and trade successfully on that basis include:

- Inshriach Alpine Plant Nursery[4] and Potting Shed café, Kincraig, Aviemore; and
- Benmore Gardens Nursery and café[5]

4.14.2. Such nurseries are low cost start-up businesses, but the key is to identify a market niche or specialism similar to the comparative examples above, the former in alpine plants, and the latter trading on the back of the adjacent specialism of Benmore Gardens and its Rhododendrons and Azaleas.

4.15. Leisure Boating Market – summer and shoulder months

4.15.1. The leisure boating market assessment has been presented within the master-plan report under a separate heading. However, this activity offers the greatest market potential for the Sound of Iona economy, through encouraging growth in the leisure boating market. Two options in this market present themselves:

- **Market consolidation and improvement (lower investment) option** – provision of improved onshore facilities and services providing the level of modern facilities expected by visiting yachtsmen and visitors, including the range of utilities and services as described below; and
- **Market Development and Expansion (higher investment) option** – provision of breakwater(s) at either/both Iona and Fionnphort to provide all-weather protection

[4] http://www.inshriachnursery.co.uk/
[5] http://www.rbge.org.uk/the-gardens/benmore

and facility for overnight stops; including provision of pontoons, and utilities and services as in the lower investment option.

4.15.2. Facilities and services necessary to attract the visiting leisure craft market include the following:

- Provision of protected berthing capacity and moorings, to accommodate the existing local leisure vessels and also to attract a greater number of visiting leisure boats to increase expenditure from this visitor market (higher cost investment option only);
- Provision of washing and toilet facilities;
- Improvements to the electricity supply; and
- Provision of adequate lifebuoys, throw ropes, fire fighting equipment, first aid points, signs, fuel provision, water supply, and any security required.

4.15.3. The economic and business benefits, which would accrue from this investment could easily be a doubling or quadrupling of the jobs numbers on Iona currently (estimated as 3-4FTEs) dependent on this market, and an extension of the season into the shoulder months of the Spring and Autumn.

5. Project Governance

5.1.1. While many of the projects identified in the Development Schedule are relatively straightforward to deliver by a Sound of Iona Harbours Committee, the complexity and scale of the procurement and construction of breakwaters off Fionnphort or Iona or the procurement of a new Fionnphort Promenade for example require a range of skills and resources that are currently not available to the Committee.

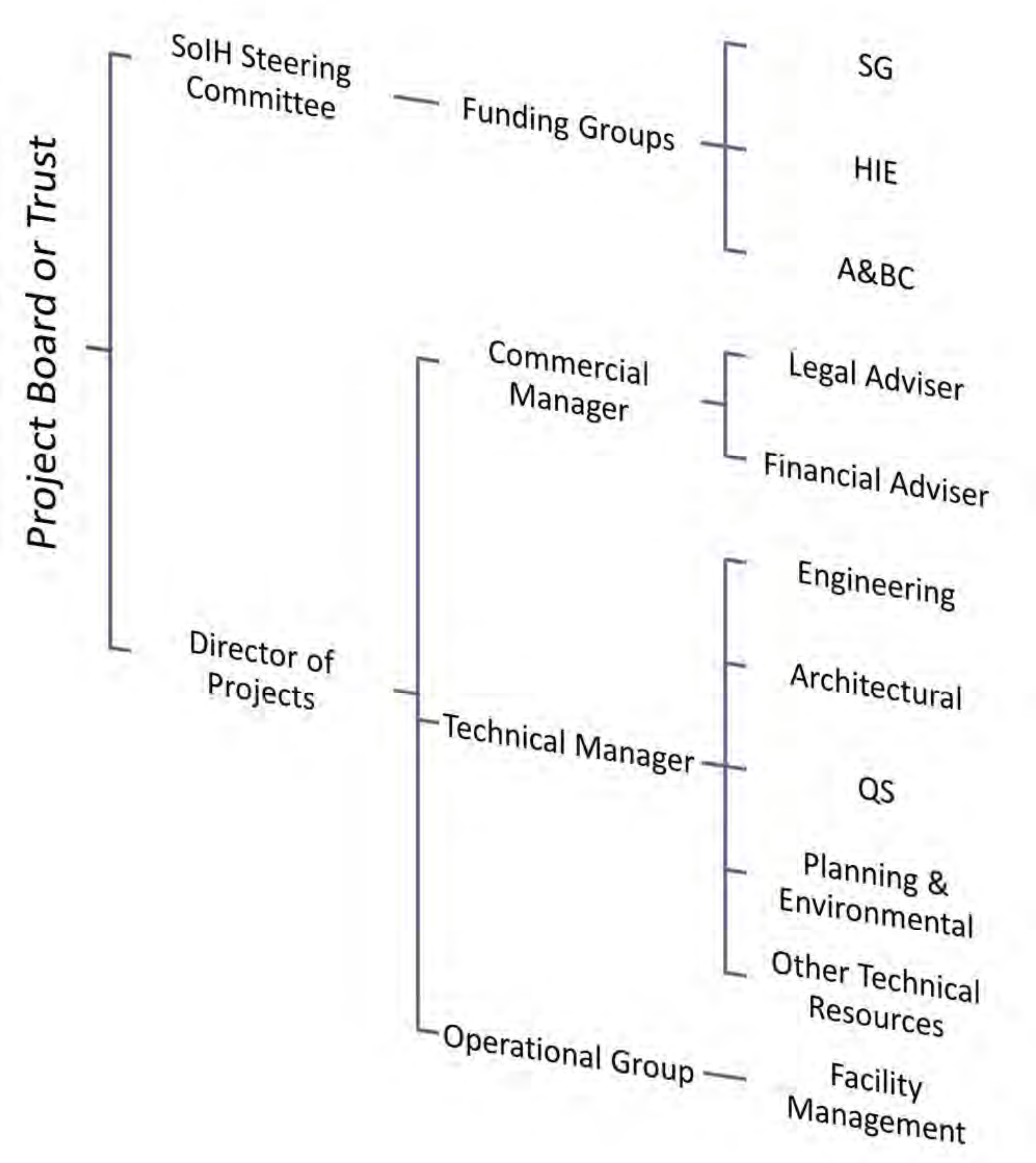
5.1.2. However a common way of implementing effective project governance for project development is by a system of boards or project committees. Different systems can be considered, but they normally include:

- A project board, or steering committee, comprising the main stakeholders and led by a senior representative responsible for delivering the project; and
- A project management team, responsible for managing the project day-to-day (including managing advisers) and reporting to the project board or committee.
- Appointing a project director is of particular importance. During the intense procurement phase, this will be a full-time job and be someone who has experience of both the public and the private sector.

5.2. Resources

5.2.1. The quality of project resources is one of the most important factors in the success of any of the projects proposed. Therefore, an appropriate team structure with clear lines of accountability should be in place.

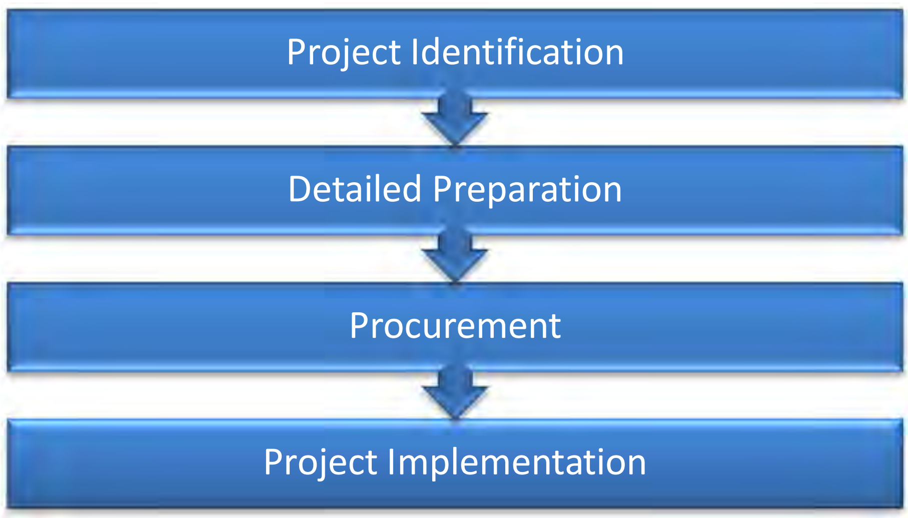
- **Table 5-1 Board Structure and Interfaces**



5.3. Project Planning

5.3.1. Where projects have been identified a key task for the project management team or teams are to develop a detailed project plans, including a timetable for project preparation and procurement. The plan needs to take into account all the key steps in the process including:

- Further detailed scoping;
- Stakeholder consultation;
- Bidding process and private sector interface; and
- Approval processes.



5.3.2. Project preparation is a complex undertaking with parallel activities feeding into critical paths. It is important that activities that are on the critical paths be initiated at the right time and monitored closely to ensure that they proceed as planned and do not cause delays to other activities.

5.4. Further Studies

5.4.1. Even though the core technical, financial and economic studies will have been carried out during the feasibility phase, there may be a need for further, updated and more focused studies prior to procurement:

- Preparing the case for appraising the project may have brought to light aspects where more detailed work is needed.
- The studies during the feasibility phase will have been geared most of all to helping a Board or Trust to take “yes/no” decisions on projects and procurement route is most appropriate.
- As project design advances, decisions about risk allocation may require additional studies. For example, with breakwaters it may be useful for the Board to carry out and ratify hydrographic or coastal modelling studies prior to any construction activity.
- The Board would also seek to maximise any sources of funding for meeting the project’s financing requirement.

5.5. Concluding next steps

5.5.1. While the identification of a set of concepts is an crucial first step, the Committee will now be faced with a number of potential projects which they need to assess and prioritise. The ultimate goal of the project selection process is to ensure that the investments that will be carried out best value.

5.5.2. Experience suggests that programme or project success will best value when all or most of the following conditions are met:

- the right expertise to design and implement complex projects;
- effective management of risks associated with construction and delivery.;
- the scope is clearly defined ensuring effective and accountable delivery of services;
- risk allocation can be clearly identified and implemented;
- the value of the project is sufficiently large to ensure that procurement costs are not disproportionate; and

5.5.3. The project identification phase therefore involves an early assessment of what is feasible, deliverable and fundable, what can be afforded (and when funds will be available), the impact on the project and the service that it achieves. The best available outcome is based on the vision and objectives of the Committee which will be the driving performance indicator that will demonstrate that account has being taken of all benefits, costs and risks of the project. In other words irrespective of which project is identified as a priority it will be for the Sound of Iona Harbours Committee to demonstrate the benefits to be derived from the project outweigh the costs.

Appendix A: Development Schedule

The following schedule of development projects are described in broad outline against a number of key headings of cost, timescales and fundability. While they are described in conceptual terms they are projects which we believe have the ability to attract funding. Both the cost and the delivery time for each are indicative at this stage in the understanding that following more detailed studies they are projects with good prospect of being delivered in a realistic timescales.

We do not intend to list projects that are either subject of exhaustive examination previously, such as for a Causeway or projects falling outwith the scope of the commission. In other words the process of creating this master plan is to present and where possible recommend options that are realisable in the current political and economic climate, and that are resolutely deliverable concepts based upon the objectives of the SoIHC.

	Ref	Project	Proposed Works	Detail of Proposal	Range of Cost	Feasibility/ Timescale	Advantages	Disadvantages	Delivery Model	Funding Sources
FIONNPHORT	FP1	**North and South Breakwaters**	Construct new breakwaters from shorelines north and south of the current ferry pier	• Two breakwaters located to the south (Carriag Bheigh Head) and north of the pier / bay area (possibly off the small island to the north of the FP bay) • Location to be determined via consultation, hydrographical and geotechnical survey, and detailed analysis modelling; • Conceptual designs and cost estimates prepared to inform any cost-benefit analysis in terms of improved ferry operation and frequency, plus berthing benefits • Investigation of potential sources of tidal energy as power sources for piers • Rock boulder breakwaters in order to permit tidal flows through the body of the breakwater whilst absorbing the energy of waves impacting the breakwater; or reef breakwater permitting waves and high water to pass over the top – to be determined by detailed survey and design • Complex marine and onshore consenting environment centred on Planning, Marine and Environmental Impact Regulations. • Key regulatory agencies statutory consultees would include; SG, SNH, SEPA, A&BC	High	1-5 years	• Extended/improved ferry operations in adverse sea states; especially during south westerly and northerly gales • Improved scope for berthing ferry overnight; • Safer anchorages for fishing and leisure craft. • Additional recreational / Viewing point • Navigational aid • Would obviate need for improved access arrangements for crews starting or berthing the ferry from Bull Hole mornings and evenings (e.g. improved access road between FP and Kintra)) • With addition of floating pontoons,, easier access to small fishing and leisure craft would be achieved improving appeal of FP as a berthing facility for small craft • Significant economic benefit through extended appeal to leisure craft	• Single large investment may detract from access to funds from same sources for incremental measures. • Complex consenting and potential (design, schedule, cost) constraints imposed by regulators • Requires proper survey, scoping, preliminary design and costing exercise before a funding application is possible • Additional navigation hazard as ferry will have to track further north to avoid the mid channel shoal after clearing the breakwater during low water • Navigation hazard would also affect craft tracking north or south through Sound to the east of the mid channel shoal at low water.	Project or Trust Board Formed Constituted to deliver projects with Board representation including Community Reps from Iona & FP as well as each of the funders, and technical adviser/rapporteur	HIE SG ABC
	FP2	**Southern Breakwater**	Construction of a single breakwater southern of the ferry pier	• Location to be determined via consultation, hydrographical and geotechnical survey, and detailed analysis modelling; • Conceptual designs and cost estimates prepared to inform any cost-benefit analysis in terms of improved ferry operation and frequency, plus berthing benefits • Rock boulder breakwaters in order to permit tidal flows through the body of the breakwater whilst absorbing the energy of waves impacting the breakwater or reef breakwater permitting waves and high water to pass over the top – to be determined by detailed survey and design • Investigation of potential sources of tidal energy as power sources for piers • Complex marine and onshore consenting environment centred on Planning, Marine and Environmental Impact Regulations. • Key regulatory agencies statutory consultees would include; SG, SNH, SEPA, A&BC	High	1-5 years	• Extended/improved ferry operations in adverse sea states; • Scope for berthing ferry overnight; • Safer anchorages for leisure craft. • Additional recreational / Viewing point • Navigational aid • Would obviate need for improved access arrangements for crews starting or berthing the ferry from Bull Hole mornings and evenings (e.g. improved access road between FP and Kintra)) • With addition of floating pontoons,, easier access to small fishing and leisure craft would be achieved improving appeal of FP as a berthing facility for small craft • Significant economic benefit through extended appeal to leisure craft	• Single large investment may detract from access to funds from same sources for incremental measures. • Complex consenting and potential (design, schedule, cost) constraints imposed by regulators • Requires proper survey, scoping, preliminary design and costing exercise before a funding application is possible. • Minor additional navigation hazard as ferry will have to track further north to avoid the mid channel shoal after clearing the breakwater during low water. • Navigation hazard would also affect craft tracking north or south through Sound to the east of the mid channel shoal at low water.	Project /Trust Board Structure as above	HIE SG ABC

	FP3	**Improved Ferry Berth arrangements**	Extend existing mole	• Extend to 60 metre overall length mole structure off end of existing mole • Install power and lighting as well as improved access/egress to laydown areas • Location to be determined via consultation, hydrographical and geotechnical survey, and detailed analysis modelling; • Conceptual designs and cost estimates prepared to inform any cost-benefit analysis in terms of improved ferry operation and frequency, plus berthing benefits • Complex marine and onshore consenting environment centred on Planning, Marine and Environmental Impact Regulations. • Key regulatory agencies statutory consultees would include; SG, SNH, SEPA, A&BC	High	1-5 years	• Saves berthing the ferry overnight in Bull Hole and dinghy crossing to access ferry reducing morning start up and evening berthing time; • Ferry can be secured fore and aft for loading and unloading if necessary and overnight berthing • Measure 1 will resolve need for wave wall to 4 metres above HAT • Would obviate need for improved access arrangements for crews starting or berthing the ferry from Bull Hole mornings and evenings (e.g. improved access road between FP and Kintra)) • Minor benefit for leisure craft	• High cost for temporary advantage • Requires proper survey, scoping, preliminary design and costing exercise before a funding application is possible	Project or Trust Board Formed Constituted to deliver projects with Board representation including Community Reps from Iona & FP as well as each of the funders, and technical adviser/rapporteur	HIE SG ABC
	FP4	**Visitor Reception Facility Ticket/ Toilet / Viewing Deck / Shops at FP**	Demolish current facility and re-build combined waiting room; viewing deck; ticket facility; shop and toilets.	• An integral feature of a site master plan / FP promenade • New larger facility suitable to accommodate summer passenger numbers on same site. • Temporary accommodation to east of current facility in meantime • Issue tickets on numbered basis to improve passenger management and counts, and reduce queuing stress during high congestion periods.	High	1-5 years	• Will provide better integrated ticketing/ refreshment/ toilet and waiting facility at FP • Improved street and architectural quality • Opportunity for architectural competition and sustainable building design. • Provides opportunity to have ferry and Staffa Boat passengers visit a tourism centre and have all FP and Iona facilities explained prior to ferry embarkation; • Opportunity to provide local community businesses joint food & drink and 'showcase' facility; • New focus of activity to expand commercial offering in FP; • Enables majority of ferry passengers to walk or travel past potential service offerings in FP village when accessing the ferry pier and new promenade	• Disruption during demolition and re-build • Reduces focus of ferry and Staffa boats activity in one area requiring more coordinated visitor management; • Potential minor increased retail and food & drink competition to existing FP businesses	Project Board Structure including Funder Representation	SG CMAL LEADER
	FP5	**Ferry Passenger management**	Design and Build Queue shelter and segregated queuing area	• As part of a site master plan / new promenade : • Devise appropriate design complying with aesthetic quality of area (i.e. not plexi glass!) • Allow for breaks in the structure to afford vehicular and pedestrian access to pier side houses; or start the shelter further uphill on left of road when facing the pier; • Install electric indicator board with ferry timings and sea state etc •	Medium	12 to 18 months	• Provides shelter in queue for waiting passengers; • Provides information for passengers • Improves ferry passenger safety • Improves overall visitor experience • Improves access to Iona/area of high environmental amenity	• Reduces access to pier side housing unless suitably designed. • Visual impact from pier side housing unless sensitively designed	Project Board Structure including Funder Representation	SG CMAL LEADER

	FP6	**Car Parking Proposals**	Close all car parking near ferry terminal	• As part of a site master plan / new promenade • Make available lower car parking area for full turning circle for coaches and cars; • Make available part of lower car parking area and site of temporary ticketing/ passenger toilets and waiting area facility while Measure 10 implemented; • Extend car parking at Columba Centre; • Provide road train / navette-type electric shuttle mini-bus facility for those unable or reluctant to walk	Medium	1-5 Years	• Provides opportunity to have ferry and Staffa Boat passengers visit a tourism or 'signposting' centre / TIP and have all FP and Iona facilities explained prior to ferry embarkation; • Provides food & drink business opportunity at Columba Centre • Ensures visitors walk/pass by main visitor and retail facilities in FP en route to ferry of pier; • Reduces traffic congestion near ferry pier	• Initial resistance from passengers familiar with current direct access to ferry and boat pier • Potential inconvenience / disturbance to local residents from increased traffic volumes	Project Board Structure including Funder Representation	ABC HIE SG Green Bus Fund SG Future Transport Fund
	FP7	**New Fishermen's slipway and laydown area**	Construct new and extended facility over current old slipway	• Widen and lengthen current degraded slipway and provide vehicular access to head of slipway; • Install hard surface area between ferry pier and old fishermen's slip as additional fishing equipment storage • Conceptual designs and cost estimates prepared to inform any cost-benefit analysis in terms of improved ferry operation and frequency, plus berthing benefits • Less challenging marine and onshore consenting environment, although work would nonetheless centre on Planning [Policy], Marine and Environmental Impact Regulations. • Key regulatory agencies statutory consultees would include; SG, SNH, SEPA, A&BC	Medium	1-4 years	• Segregation of fishing and ferry activity from main FP pier; • Scope for growth of fishing activity; • Improved safety of both operations • Improved operational fishing activity efficiency and economic benefit	• Will require fishermen's and fish buyers' agreement to new loading and unloading arrangements	SolHC	HIE SG European Fisheries Fund (EFF)

	Ref	Project	Proposed Works	Detail of Proposal	Range of Cost	Feasibility/ Timescale	Advantages	Disadvantages	Delivery Model	Funding Sources
IONA	I1	**Breakwater**	Construct new facility	• Location to be determined via consultation, hydrographical and geotechnical survey, and detailed analysis modelling; • Will probably require Cost Benefit Analysis in terms of improved ferry operation and frequency; • Conceptual designs and cost estimates prepared to inform any cost-benefit analysis in terms of improved ferry operation and frequency, plus berthing benefits • Investigation of potential sources of tidal energy as power sources for piers • Rock boulder breakwater in order to permit tidal flows through the body of the breakwater whilst absorbing the energy of waves impacting the breakwater; or reef breakwater permitting waves and high water to pass over the top – to be determined by detailed survey and design Complex marine and onshore consenting environment centred although work would nonetheless centre on Planning [Policy], Marine and Environmental Impact Regulations. • Key regulatory agencies statutory consultees would include; SG, SNH, SEPA, A&BC	High	1-5 years	• Extended/improved ferry operations in adverse sea states; Safer anchorages for leisure craft • Significant potential economic benefit derived from extended over-night stays and greater share of growing market in off-season leisure boating	• Single large investment may detract from access to funds from same sources for incremental measures	Project or Trust Board Formed Constituted to deliver projects with Board representation including Community Reps from Iona & FP as well as each of the funders, and technical adviser/rapporteur	HIE SG LEADER
	I2	**Repairs to main and lower (north side of) pier**	Repairs to prolong life of the landing pier	• Lay additional concrete slab over exposed rebar on main pier landing point; • Break away longitudinally cracked part of existing pier structure and replace; • Conceptual designs and cost estimates prepared to inform any cost-benefit analysis in terms of improved ferry operation and frequency, plus berthing benefits • Less challenging marine and onshore consenting environment centred although work would nonetheless centre on Planning [Policy], Marine and Environmental Impact Regulations. • Key regulatory agencies statutory consultees would include; SG, SNH, SEPA, A&BC	Medium	12 to 18 months	• Will extend life of existing pier	• Disruption during repair and need for temporary alternate landing point for Staffa boats	A&BC	A&BC
	I3	**Extension or re-configuration to main pier at Iona , providing a mole wall as part of southern side buttress to the pier**		• Extend pier in reinforced concrete • Hydrographical and geotechnical survey, and modelling; • Design and cost estimates already prepared and underway although it would / should be considered in any cost-benefit analysis of improved ferry operation and frequency, plus berthing benefits • Less challenging / risky marine and onshore consenting required. • Key regulatory agencies statutory consultees would include; SG, SNH, SEPA, A&BC	Medium to High	1-2 years	• Subject to design and method of coming alongside or frontally onto the pier, this could provide sheltered berth for ferry and extends protection to bay to the north where other vessels moor • Ferry could be secured fore and aft for loading and unloading if necessary and possible longer term berthing with engines off. • Alternative to measure 2	• Improvements to protection to ferry berth and bay are unlikely to be as great as measure I2	Project or Trust Board as above	HIE SG LEADER

	I4	**Ferry Passenger management Iona**	Design and Build Queue shelter	• Devise appropriate design complying with aesthetic quality of area; • Improve current electric indicator board for control from the ferry.	Low to Medium	12 to 18 months	• Provides shelter in queue for waiting passengers. Devise appropriate design to enhance aesthetic quality of area	• Reduces access to pier side housing unless suitably designed. • Limited in scale	SoIHC	HIE A&BC
	I5	**Pier-side Services Upgrade**	**Provision of new and improved services at pier-side**	• Provision of pressurised water for cleaning, showers, changing facilities, improved toilets, fuelling, and other related services and facilities for leisure and other visiting craft	Low to medium	12 to 18 months	• Provides necessary standard of facilities and services for visiting leisure craft	• none	Project or Trust Board	HIE LEADER ABC

	Ref	Project	Proposed Works	Detail of Proposal	Range of Cost	Feasibility/ Timescale	Advantages	Disadvantages	Delivery Model	Funding Sources
POLICY	DP1	**Land Use policy**	Align current Land Use Plan policy with FP and Iona development aspirations	• Review and align current A&BC Area Action Plan and Ross of Mull Development Plan and Housing Opportunity Areas; • Work towards key policy support on each of the favoured development options; • Work with other key stakeholders in particular Scottish Government, HIE and Scottish Tourism to achieve congruence of policy objectives and local aspirations	Low	1-2 years	• Mobilises support for FP and Iona development in A&BC policy/Area Action Plan; • Emphasise Community nature of the plan as this is a stated priority of all such plans across A&BC • Gradual approach enables changes of emphasis to become established	• Slow process with competing areas perhaps seeking higher priority;	SoIHC	HIE A&BC
	DP2	**Tourism and Economic Policy**	Align current Tourism policy with FP and Iona development aspirations; Align applications for grant funding with Scottish Govt and HIE funding criteria	• Review and align current A&BC Area Action Plan and Ross of Mull Development Plan and Housing Opportunity Areas; • Work towards key policy support on each of the favoured development options; • Work with other key stakeholders in particular Scottish Government, HIE and Scottish Tourism to achieve congruence of policy objectives and local aspirations	Low	1-2 years	• Mobilises support for FP and Iona development in A&BC policy • Emphasise Community nature of the plan as this is a stated priority of all such plans across A&BC; • Gradual approach enables changes of emphasis to become established	• Slow process with competing areas perhaps seeking higher priority;	SoIHC	HIE A&BC

LOCAL ECONOMY & BUSINESS OPPS

Ref	Project	Proposed Works	Detail of Proposal	Range of Cost	Feasibility/ Timescale	Advantages	Disadvantages	Delivery Model	Funding Sources
EBO1	**Visitor Accomodation**	Small speicalist (3 star) hotel (10 – 20 rooms) offering higher quality food and drink	• As a means of addressing the restricted season – visitor traffic largely constrained to the non-winter timetable period of the peak Calmac Oban to Craignure ferry route - • Specialist small scale hotels, which also provide a high quality food and drink offer on a the basis of 10-20 rooms. • Normally such hotel offers provide a more limited level of staffing, with perhaps a maximum of 8-10 staff only.	Medium	2 – 5 years	• Increase local employment opportunities by at least 10 - 15% • Extend tourism season including increases in overall visiitor numbers following the improvement of the visitor experience and encouragement to explore further into the Ross of Mull.	• Timescales extended and dependent on implementation of urban realm / landscape improvements • Singificant marketing effort requried to tackle limited season , through ticketing, etc with ferry and bus timetabling.	Private Investor	HIE
EBO2	**Local Renewables Energy Hub**	• Energy efficient / solar panelling/biomass etc • Wave & tidal energy devices	• Improved energy efficiency through the fitting of high performance insulation in all residential and business accommodation, thereby reducing heat loss and electricity consumption, and as appropriate potential installation of solar panelling for both solar water heating and / or PV and also biomass/wood burning stoves; and • Assessment of the potential for wave and tidal energy generation through limited scale next generation wave and tidal devices; such devices are specified to be lower cost and designed for the supply of electricity to remote coastal or island communities with a power output of 10kw – 500kw, particularly where the communities are either off-grid or have restrictions on grid capacity.	Low to Medium	2 – 5 years	• Improved economic performance including job provision and cheaper / sustainable sources of local sourced power	• Constraint on Grid Capacity • No designation by the CE on Sol Marine Energy Zone • Concentrated energy generation against distributed energy provision • Technological constraints	SoiHC	• Energy Saving Trust • Resource Efficiency Scotland • Renewable Heat Initiative • Community and Renewable Energy Scheme • Other initiatives similar to the former HIE Community Renewable Energy Support Programme (CRESP)
EBO3	**Columba Centre**	• New extended parking car andcoach parking provision in Fionnphort • Redevelopment and re-opening of the Columba Centre as a community resources	• Imporvded / extension to existing community eduction and UHI • Act as a Business Point of Presence (PoP), providing high-speed digital and internet access to the available range of business advice and information • Operate as an out-reach Business Gateway portal. • Local information role, the centre should offering showcase facility for the craft and local produce from the area, • shop retailing local goods and merchandise • Limited facilities for food and drink catering such as a small restaurant / café	Medium	2 – 5 years	• Extending visitor experience beyond Iona and into Ross of Mull • Improved showcasing of local goods and services • Removal of visitor / coach parking from the Fionnphort sea front • Improving the land scape / pedestiran accessibility • Improved community provision targetting local needs and extending the commerical / job opportunites	• Require considerable support from HS in supporting local initiatives against exisitng HS impreatives of "stone" storage and maintenacne	SoIHC	HIE HS A&BC SG

LOCAL ECONOMY & BUSINESS OPPS	**EBO4**	**Leisure Boating Market**	Extending facilities and services on a reesigned pier / breakwater and harbour bay at FP	• Provision of protected berthing capacity and moorings, to accommodate the existing local leisure vessels and also to attract a greater number of visiting leisure boats to increase expenditure from this visitor market (higher cost investment option only); • Provision of washing and toilet facilities; • Improvements to the electricity supply; and • Provision of adequate lifebuoys, throw ropes, fire fighting equipment, first aid points, signs, fuel provision, water supply, and any security required.	Medium to High	2 – 5 years	• Encouraging growth in the leisure boating market. • The leisure boating market assessment (See Appendix B) presented within the master-plan report provides evidence of this activity offering the greatest market potential for the Sound of Iona economy	• FP and Iona lagging behind other visitor offers on the west coast of Scotland and beyond, gradually losing share and value	Project or Trust Board	HIE A&BC SG
	EBO5	**Micro-Brewery**	Micro-Brewery requiring small / limited scale premises conversion for vats and brew prepariton and storage.	• Starting level of output at 4-5barrels/660-825litres will employ 4-5 FTE jobs, and more were the brewery to increase production or be allied to a 'brewery tap,' pub, or shop. • A two-and-a-half barrel capacity, which produces around 760 bottles per brew, is generally viewed as the appropriate level to supply local bars, hotels, shops, restaurants and shipped further afield tp artisan alcohol shop on the mainland	Low	12 – 18 months	• A year round economic and business activity exists in the form of development of a micro-brewery • The potential economic benefit, which derives from such limited scale business enterprises, can be extensive. • Limited level of finacnce and funding necessary • Remote and rural locations no barrier to the development of a breweries. •	• Requires an investor with an interest oin brewing, entrepreneurial falir, marketing experience	Private Investor	Market growth has been encouraged by the Progressive Beer Duty Scheme, which permits breweries producing under 5,000 hectolitres per annum to pay only 50% excise duty.
	EBO6	**Nursery / Market Garden Centres**	Low start up business with Café/shop	• Supporting nursery and market garden produce grown locally (Argyll and Columba Hotels on Iona) and sold to local businesses and visitors	Low	12 – 18 months	• Encorange local busienss development support • Additional local and visitor offer • Already established uses for local hotels	• Available facilitiies are limited • Cost / resoruces and capacity limited on Iona to extend exisitng facilities • New premises required on exisitng route from ferry to Abbey needs to be found / aquired	Private Investor	HIE A&BC

Appendix B: Assessment of Leisure Boating Market

An assessment of the leisure boating market has been carried out at national, west of Scotland, and Mull and Iona level (where information has permitted). This sets the context for the identification of potential opportunities and constraints to their development.

Sailing in Scotland

Scotland's sailing tourism industry has been growing at an unprecedented rate over the last two decades. Growing demand has quickly absorbed new marina berths and extensions to existing facilities. Recent industry research[6] indicated that the sailing industry in Scotland is sufficiently strong that the recent recession and economic downturn is having little impact on the market and all indications point towards further growth.

Volume and Value

Current performance

Sailing Tourism in Scotland[7] (a Scottish Enterprise commissioned report) estimated that sailing in Scotland[8]:

Generates over £101m per year from sailing activity;

Accounts for £53m in Gross Value Added (GVA); and

Supports 2,700 jobs.

Non-Scottish

£27m is generated from non-Scottish boat owners;

Accounting for £14m in GVA; and

Supports 724 jobs.

Future potential

Planned development of the industry could:

Increase expenditure by £44m to £145m after 10 years;

Grow non-Scottish tourism by 57% from £27m to £42m; and

Increase GVA by £8.2m.

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[6] http://www.tourism-intelligence.co.uk/develop-your-business/research-summaries/sailing-tourism-in-scotland

[7] Sailing Tourism in Scotland- Scottish Enterprise and Highlands and Islands Enterprise (2010) http://www.researchonline.org.uk/sds/search/download.do;jsessionid=0BEF7EF1E3B178F4C7006078929DAA6A?ref=B15606

[8] http://www.scottish-enterprise.com/your-sector/tourism/how-we-can-help/our-top-tourism-markets/tourism-sailing.aspx

Table 1: Strengths and Weaknesses of Scotland as a Sailing Destination

Strength	Weakness
Beautiful scenery	More sailing facilities needed (berths and moorings)
Appealing sailing waters	More onshore facilities needed (restaurants, pubs, etc.)
Friendly people	Often under qualified boat owners
Abundant wildlife and wilderness	Perceived inclement weather

Customer profile

Sailing is typically an expensive activity, and hence sailing visitors are generally affluent with a high disposable income. Visitors are also typically 45 years or older. *Sailing Tourism in Scotland* reported the following age profile: 25-34 (2%), 35-44 (7%), 45-54 (26%), 55-64 (38%), and 65+ (26%). A yacht was the most popular type of boat (71%), followed by a motor cruiser (11%), motor yacht (9%), and narrow boat (1%). Most groups were made up of partners/spouse (54%), friends (54), children (18%), boating group (8%), and individuals (5%).

Infrastructure requirements

Sailing Tourism in Scotland identified berthing facilities and ancillary facilities and services as the key issues that need to be addressed to realise the full economic potential of sailing tourism in Scotland.

Berthing capacity

Resident berthing and visitor berthing and moorings are critical and essential infrastructure. Demand and supply of these facilities for residential berths is 'generally in balance' in Scotland.[9] *Sailing Tourism in Scotland* splits Scotland's key sailing areas into four geographic areas, with average occupancy for resident berths in these areas as follows: Clyde (94%), West (95%), North (97%), and East (100%).

The lack of availability for berthing for day/ longer trips is considered to be a potentially significant weakness in Scotland's waters. The report states that: "*it is not yet a major issue curtailing significant levels of demand in all locations but is of significant concern in certain locations – notably the west coast during the popular summer season and with further growth in the sector will become an issue.*"

[9] Sailing Tourism in Scotland- Scottish Enterprise and Highlands and Islands Enterprise (2010)

The report also states that: "*this shortage of formal berthing is undoubtedly constraining onshore spend from boats and their crew in fragile rural economies.*"

Ancillary facilities and services

Land based services, supporting infrastructure and quality were identified as issues that need to be addressed to enhance Scotland's sailing tourism product. The scale of this problem varies from region to region. The report identified Tobermory on Mull as an exemplar of good practice and wider community involvement in the delivery of facilities.

West Coast Performance

Origin

Visitors to the West Coast predominantly originate from the Clyde region, other parts of the UK, Northern Ireland, and Ireland.

Supply and Demand

Supply and demand for berthing on the west coast is generally in balance. The West Coast also accounts for a relatively high proportion of visiting berths and total boat nights spent in Scotland (see Table 2 and Table 3).

Table2: West Coast Berthing Facilities

	Pontoons	Moorings	Total	% of Scotland
Supply				
Resident Home Berths	695	2,351	3,046	28%
Visiting Berths	335	286	621	37%
Demand				
Occupied Berths	632	2,253	2,885	95%

Source: Sailing in Scotland. Scottish Enterprise & HIE (2010)

Table 3: West Coast Visiting Craft Demand

Available Berthing Stock	Current Boat Nights per Berth	Visiting Boat Nights	Anchor Boat nights	Total Boat Nights	Boat Nights as % of Scotland Total
621	65	40,496	55,474	95,970	57%

Source: Sailing in Scotland. Scottish Enterprise & HIE (2010)

Projected Demand

Sailing in Scotland also identified the West Coast as one of two areas capable of accommodating future market activity. Table 4 illustrates the level of projected demand for berths and boat nights on the west coast, which shows high demand for west coast berths. These estimates are based on growth levels that are '*commensurate with, but less ambitious than those achieved in the past'*.

Table 4: West Coast Visiting Craft Demand

To 2014				To 2019			
Resident Berths Occupied	**% Increase on Current**	**Visiting Boat Nights**	**% Increase on Current**	**Resident Berths Occupied**	**% Increase on Current**	**Visiting Boat Nights**	**% Increase on Current**
3,303	8%	107,407	12%	3,370	20%	137,083	43%

Value of Sailing

The West Coast area accounts for over a quarter (28%) or residential berths but over half (59%) of all visitor berths and it is also the only area in Scotland to derive more revenue from visitors than residents.

Table 5: Value of Sailing Tourism in Scotland (£million)

	ResidentsBerths	VisitorBerths	Total
Clyde	£34.0	£10.1	£44.1
West	£18.1	£21.1	£39.2
North	£6.6	£3.5	£10.1
East	£6.6	£1.3	£7.9
Total	**£65.4**	**£36.0**	**£101.3**
West as % of total	**28%**	**59%**	**39%**

These features highlight the importance of the visitor market to the West Coast and highlight the opportunities for further development (see Table 5).

The report also identifies the West Coast as one of two areas capable of accommodating future market activity.[10]

Sailing routes

Sailing Route Definitions

Figures 1.1 and 1.2 show Royal Yachting Association (RYA) sailing routes around Scotland, and the West Coast. The latter includes routes around the Sound of Mull and the Sound of Iona in terms of heavy, medium and light route classifications; and these are defined are follows:

- Heavy – very popular routes on which a minimum of six or more recreational vessels will be seen at all times during summer daylight hours.[11]
- Medium – popular route on which some recreational craft will be seen at most times during summer daylight hours
- Light – routes known to be in common use, but which do not qualify for medium or heavy classification.[12]

Scotland

Figure 1.1 shows the number and frequency of sailing routes along the West Coast relative to other areas of Scotland. The West Coast and Clyde area are the only areas with heavy sailing routes. This demonstrates the relative importance of sailing on the West of Scotland and emphasises the scale of opportunity available.

Iona and West Coast

There are no heavy sailing routes in the immediate study area. A medium sailing route passes through the Sound of Iona. Light sailing routes are evident between Iona and Coll/Tiree and Iona and Colonsay. Heavy sailing routes are visible alongside the West Coast mainland and through the Sound of Mull.

The Sound of Mull

The Sound of Mull (SOM) is a popular and well used passage route for sailing and cruising. It is also a race location used by the Western Isles Yacht Club, for the Round Mull yacht race, which is a well-attended three day event held in late June or early July. The race is considered to be one of

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[10] West Coast and Clyde area identified as main focus for development. Modest levels of development needed in the North and minor development required in the East where the boating market is focused on local boating activity by Scottish residents.
[11] These also include entrances to harbour, anchorages and places of refuge
[12] It should be noted that many lightly-used routes are the only routes available and therefore have a considerable local importance.

the highlights of the West Coast yachting calendar and attracts around 40 boats split into four different handicap categories. Leg 1 is from Oban to Tobermory (24 nautical miles (nm)), Leg 2 is Tobermory to Bunessan (28 nm), and Leg 3 is Bunessan to Oban (41 nm).

Sailing activity on the SOM is increasing.[13] The sailing season is also extending as more people visit the area outside the main tourist season. Table 6 shows the range of SOM sailing facilities, and also shows that Tobermory has the largest number of moorings and associated facilities in the area.

Table 6: Sound of Mull Sailing Facilities

Location	Moorings	Anchorage	Other
Tobermory	69 associated moorings 30 visitor moorings	Yes	Public access slip way Public slipway at beach Pontoon berthing with access to fuel, water and electricity Toilet, showers and washing machine Western Isles Yacht Club base
Craignure	12 associated moorings	Yes	Public access stone pier 3 public access slipways
Salen	15 associated moorings	Yes	
Fishnish Bay	-	Yes	
Lochaline	35 associated moorings 2 private moorings	Yes	
Scallastle Bay	-	Yes	
Drimnin	-		Push ashore pontoon SOM Transport Group Public access slipway
Kilchoan	4 associated moorings		

- Source: Sound of Mull - Scottish Sustainable Marine Environment Initiative (SSMEI)

Tobermory

Tobermory has benefited from improvements in sailing technology and enhanced communication. Improvements in perceived safety arising from constant communication, better weather forecasts and bigger boats has led to increased demand to explore more distant or remote locations. This

[13] Sound of Mull - Scottish Sustainable Marine Environment Initiative (SSMEI)

has transformed Tobermory from an ‘end of the line’ destination into a hub from which to embark on journeys further afield.

Tobermory has over 9,000 boat night visitors per annum and is now considered to be one of the last ports of refuge for boats awaiting a weather window to venture west to: Iona, Coll, Tiree, Staffa, or North West to Skye or the Western Isles.

Planned Development

The following facilities are planned:

A new breakwater with attached pontoon attenuator to protect the existing Tobermory pontoons; and

An onshore boat servicing area.

The Tobermory Strategic Plan 2013 gives valuable insight into benefit that could accrue to the harbour area; Isle of Mull and West Coast sailing region from investment improved facilities.

Benefits and Opportunities

Tobermory Harbour

- Protection from adverse weather conditions;
- Safer and more protected harbour will extend visitor period (earlier and later in season);
- Increased facilities for local and visiting boats;
- Enhanced landing facilities for bigger boats with more passengers;
- Separation of commercial and fishing boats from leisure; and
- Protection from excessive wave motion in winter months for local and visitor boats.

Mull

Encouraging additional visitors, especially in winter months;

- Improved fishing and commercial operations with spin offs for local businesses;
- Improved landing facilities;
- Opportunity for tours and local businesses; and
- Job creation through additional retail and leisure spending from increased passengers

West Coast Sailing Region

Improved facilities would enhance commercial links between adjacent islands and mainland; and

Sheltered marine leisure hub will also encourage visitors to stay longer while awaiting clear weather

The Sound of Iona - Iona and Fionnphort

Berthing Locations

Leisure boating infrastructure, facilities and services are relatively limited in and around the Sound of Iona, with only Iona (providing limited services and facilities) and Bull Hole identified as anchorages in cruising literature, charts and maps. The RYA cruising charts show Iona as a medium cruising route anchorage and mooring point, and also the protected bays and inlets of Bàgh a' Chnoic Mhaoileanaith (to the south east of Erraid) and Rubha nam Bràithrean (to the south east of Scoor), neither of which offer any services and facilities for visiting vessels. To the north east Loch na Làthaich / Bunessan Bay is shown as an anchorage for light cruising routes (see Figure 1.3), where the services and facilities at Bunessan are available.

The Island of Iona

Iona Pier acts as the main focus for leisure boating in the Sound, due to the historic and natural attractions of the island, for both local and visiting traffic, with moorings largely to the north of the pier in St Ronan's Bay, although some boats do moor in the bay to the south of the pier. Overall, this area accommodates approximately 10-20no small local boats of <15feet and 3-4 larger local boats, the latter providing commercial trips for visitors to Staffa and other surrounding islands. The main pier acts as the landfall point and slipway for the Fionnphort – Iona Calmac ferry with a secondary smaller and parallel section of pier to the northern side of the main pier used for leisure craft purposes.

Official data on numbers of visiting leisure boats are not available, but information derived from local consultations indicate that on average during the summer peak season 3-4-5no yachts per day visit the island with up to approximately 15-16no yachts visiting on a very popular day.

Due to a lack of protected moorings most visiting yachts only stay for a limited time moored in the Bay or close to the pier at the island and generally do not stay overnight. Local insight suggests that such visiting vessels overnight for only a handful of days during the summer season. However, a number of these vessels do overnight at the protected mooring at Bull Hole at the other side of the Sound north of Fionnphort with 10-12no visiting vessels often moored there during the peak of the summer season in July and August. In recent times leisure boating sailors have become accustomed to mooring at berths and pontoons rather than sitting at anchor. Hence the preference and prevailing practice is to seek either berthing or pontoon facilities, or else a protected mooring point to reduce the risk should poor weather develop.

The Iona pier during the summer season often becomes congested with competition between the Staffa boats operating their regular trips from Iona, intermittent cruise ship tenders transferring cruise tourists to and from the island, and other visiting yachts making use of the pier to call at the island. More extensive mooring arrangements would be likely to overcome these congestion problems.

Facilities and services are limited for visiting leisure traffic with toilets near the pier but no provision for showers, changing, washing, pressurised water supply, or power in immediate proximity of the pier. However, food and drink and other provisions can be obtained from shops and other outlets in the village of Baile More clustered around the wider pier area. Local information indicates that the economic benefit derived from such visiting craft largely accrues to the food and drink outlets, restaurants, cafes, etc, local village shops and the Abbey and Abbey visitor shop.

Fionnphort on Ross of Mull

The bay and harbour at Fionnphort is protected from the weather from the south to some extent by the main pier used by the Calmac ferry and provides facilities for approximately 5no local crab/fishing vessels and 5-6no local smaller leisure boats at a number of moorings. These moorings however are open to the prevailing swell and weather conditions and are not protected from bad or severe weather. Hence these are used during the good weather of the summer season, but little used during the winter and poor weather conditions.

In bad weather, Bull Hole to the north of Fionnphort is used as a protected mooring or anchorage and is also popular for mooring and stop-overs by vessels visiting the area. This popularity can present problem for visiting vessels as Bull Hole can become congested it being occupied by fishing boats on ‘spreader chains’ over the winter so restricting potential space for moorings for other vessels.

Fionnphort is not generally seen as an anchorage or identified in cruising charts or literature by cruising or visiting leisure boats so such visiting vessels generally visit or berth at Iona and pass-by Fionnphort. Neither are there any notable attractions for visitors, in and around the village to attract visiting vessels. Local knowledge derived from consultations indicates that perhaps as few as only 5-6no visiting yachts per month call in the bay over the summer season, contrasting with the attractions of Iona on the other side of the Sound. These visiting yachts do bring some limited economic benefits from expenditure in the local shop and food and drink outlets albeit at a very modest level.

Were there to be an increase in numbers of visiting leisure vessels, the pier is already often subject to congestion with competition for slipway space between the local fishing boats, the Staffa and island tour boats, and local small leisure and other working craft.

Similar to Iona, facilities and services at Fionnphort are also limited for visiting leisure traffic with toilets near the pier but no modern provision for showers, changing, washing, pressurised water supply, or power in immediate proximity of the pier. However, fuel supply is available as required, as are food and drink and other provisions, which can be obtained from the shop and other outlets in the village at some small distance from the pier area.

Potential Economic Value of Leisure Boating in the Sound of Iona

While data on visiting yachts to the area are limited, based upon local knowledge on numbers of visiting yachts observed and their pattern of stay, it might be reasonable to assume that this market from several hundred visits per annum is potentially worth between approximately £100,000 - £130,000 per annum to local businesses, which would support between 6.0 and 8.0 full time equivalent jobs on Iona. This estimate is based upon the assumptions set out in table 7. However, this top of the range number of boat visits is only some 11% of the annual number of visits to Tobermory Harbour, illustrating the potential ‘headroom’ which could exist in the Sound of Iona, through infrastructural improvements.

In practice, the economic benefit is likely to be well below the bottom of this range, as the average spend of £130 per boat is based upon an overnight stay. As the vast majority of visiting boats do not stay at Iona overnight the true level of expenditure is likely to be significantly less.

Table 7: Estimation of Potential Value of Visiting Leisure Boating

Value	Shoulder Season Average	High Season Average	High Season Peak	High Season Average	High Season Peak
Season days	**70**	**120**	**9**	**120**	**18**
Yacht visits per day	**2**	**4**	**15**	**5**	**15**
Number of visits	**140**	**480**	**125**	**600**	**270**
Total number visits			**745**		**1,010**
Average spend per stay			£130		£130
Total expenditure			£96,850		£131,300
Average tourism pay per annum[14]			£16,460		£16,460
Number FTE jobs supported			6.0		8.0

What this estimation demonstrates however, is the potential value that would accrue from maximising the expenditure from these visiting boats, were the numbers of visits to be at the upper end of the range as a result of the appropriate infrastructure and facilities being provided. The number of jobs able to be supported by this market is potentially able to easily double from the likely current figure of 3-4 jobs to the estimated 6-8 jobs. Were high quality facilities including breakwaters and onshore facilities and services available at both Iona and Fionnphort, the total employment supported by leisure boating expenditure might be in the order of an additional 12-16 jobs, yet still only reaching some 20-22% of the number of visits to Tobermory Harbour.

Key Infrastructure, Facilities and Services for Market Growth

All available leisure boating and sailing market research and assessment identifies the development of leisure marine infrastructure, facilities and onshore services as key elements in expanding opportunities in the market and encouraging the growth in visiting yachts, particularly where the current level, capability and capacity of the infrastructure, facilities and services is limited. The following is required on the West Coast generally and particularly for the purposes of this assessment in the Sound of Iona, for greater economic benefit to accrue to the area:

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[14] Average gross pay for leisure employee UK (£17,300), Scottish average as % of UK (98.6%), Argyll & Bute average as & of Scottish (96.5%), resulting in £16,460. - http://www.ons.gov.uk/ons/dcp171778_286243.pdf and http://www.argyll-bute.gov.uk/council-and-government/about-argyll-and-bute-local-context

Infrastructure:

- Increased number of protected anchorages, moorings and berths; and
- Increased availability of pontoons;

Facilities :

- Fuel supply and pressurised water supply;
- Showers and toilets; and
- Waste disposal;
- Services:
- Supplies and provisions;
- Transport;
- Information;
- Serviced laundry;
- Chandlery, equipment and repairs; and
- Maintenance slipway.

Comparator infrastructure

Locations in the wider surrounding area have benefited from investment in sailing and marine leisure facilities and infrastructure in attracting additional sailing visitors.

Versatile Berthing and Landing Pontoons

A new berthing and new landing pontoon has been developed at Barcaldine Marine at Loch Creran in Argyll, north of Oban. The 116m long pontoon with a 20m hammerhead significantly enhances the services available to visiting and resident yachts in the area by providing moorings, storage and service facilities for yachts. Up to six yachts can be accommodated at any one time.

Access to shore at all states of tide is significantly enhanced providing business opportunities form extra footfall. The moorings are particularly attractive to hotel operators seeking to attract leisure craft; mooring associations and yacht clubs, community associations, country estates, angling and leisure boat operators and fish farming operations.

Storage facilities

Considerable investment (£300,000) has been made in storage and pontoons at Acarsaid on the Isle of Lewis. Improved storage facilities for fishermen are designed to improve the efficiency at the previously congested port, with additional pontoons aiming to attract visitors and expenditure to the area.

Comprehensive Infrastructural Investment

Such infrastructural improvement is broadly similar to that sought by the authorities at Lindisfarne/Holy Island, identified in the Case Study. Detailed assessment of the leisure boating market at Holy Island has indicated that the economy would benefit extensively from the provision of improved infrastructure, services and facilities. The range of improvements proposed includes the:

- Extension of berthing capacity by an additional 12-20 moorings, to accommodate the existing several operational fishing vessels and also to attract a greater number of visiting leisure boats to increase expenditure from this visitor market;
- Heightening, lengthening and widening of the pier to provide greater weather protection, and which would also allow fishing boats, commercial leisure boats and cruise tenders to come alongside;
- Provision of washing and toilet facilities;
- Improvements to the electricity supply; and
- Provision of adequate lifebuoys, throw ropes, fire fighting equipment, first aid points, signs, fuel provision, water supply, and any security required.

Summary and Conclusion

The conclusion to be drawn from this brief high level market assessment are that the lack of appropriate infrastructure, facilities and services available to visiting leisure craft at both Iona and Fionnphort restricts the potential market to current levels for leisure boating and the commensurate economic benefit, which potentially can derive from this higher than average spending type of visitor. Despite the potential growth market in the wider West Coast area, without investment in these aspects economic benefit will accrue directly to other locations, where such investment has been made. In addition, the growth in the market is generally in lengthening of the season, with more boating visitors in the 'shoulder months' of the late Spring and Autumn. It is precisely these periods, which any increase in tourism and visitor numbers would most benefit Iona and Fionnphort.

Of key importance is the lack of weather protection and protected berths or moorings, without which the market for increased leisure boating visits will continue to be constrained.

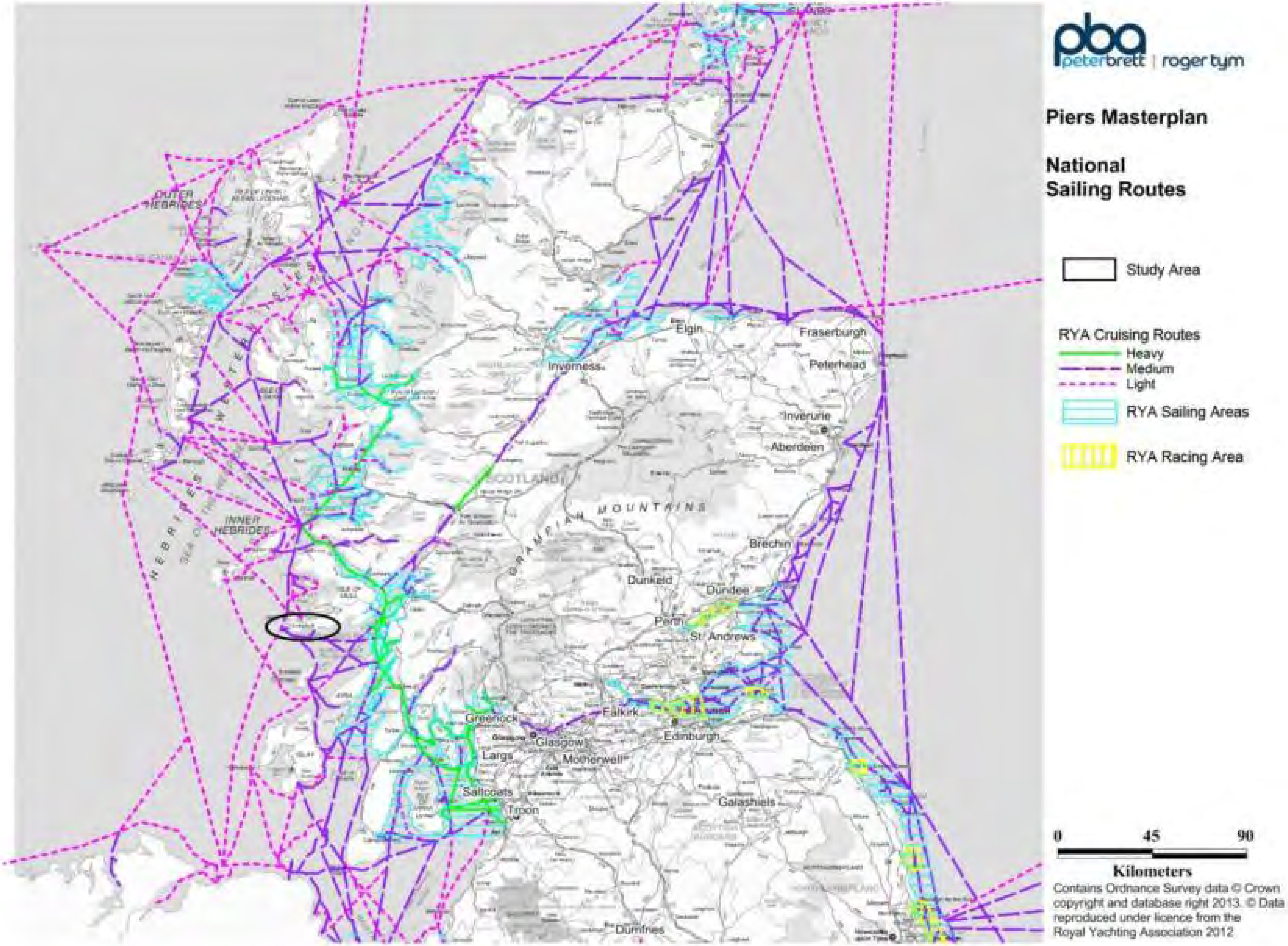
To encourage growth in the leisure boating market two options present themselves:

Market consolidation and improvement (lower investment) option – provision of improved onshore facilities and services providing the level of modern facilities expected by visiting yachtsmen and visitors, including the range of utilities and services as described in paragraph 1.36 above; and

Market Development and Expansion (higher investment) option – provision of breakwater(s) at either/both Iona and Fionnphort to provide all-weather protection and facility for overnight stops; including provision of pontoons, and utilities and services as in the lower investment option.

While, locations in the wider surrounding area have benefited from investment in sailing and marine leisure facilities and infrastructure in attracting additional sailing visitor expenditure, the lack of a range of modern good quality facilities and services and key infrastructure to provide protected overnight berthing continues to restrict potential economic benefit from this growth market in the Sound of Iona.

Should appropriate infrastructure, facilities and services be available at Iona the numbers of jobs supported by the sector would likely double from the current 3-4 jobs to 6-8 jobs. Were infrastructural investment in breakwaters and other facilities and services to be provided at both Iona and Fionnphort, the growth in numbers of visits and expenditure is very likely to support approximately a further 12 to16 full time equivalent jobs.



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Piers Masterplan
National Sailing Routes
Study Area
RYA Cruising Routes
Heavy
Medium
Light
RYA Sailing Areas
RYA Racing Area
0
45
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Kilometers
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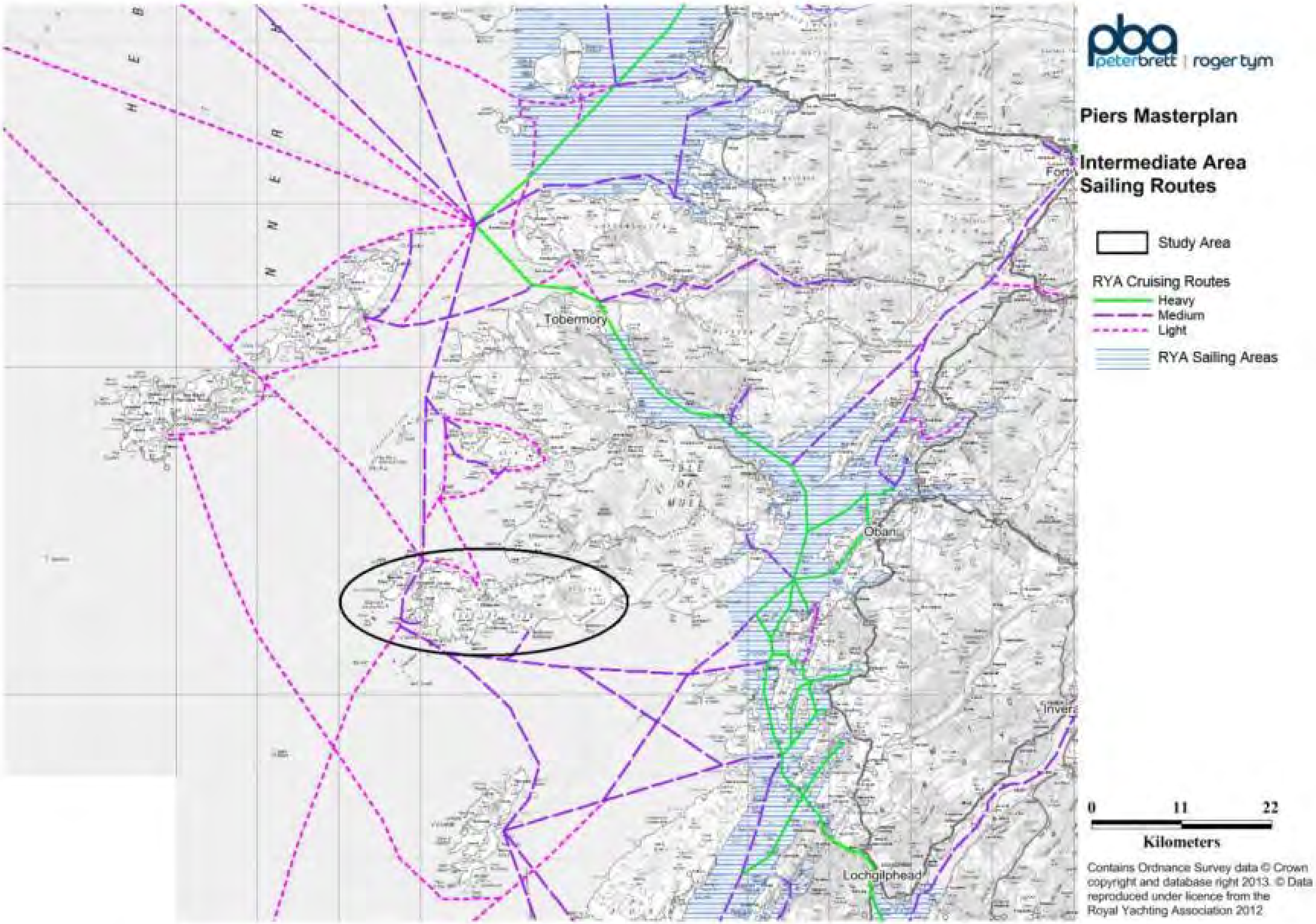
Elgin
Fraserburgh
Peterhead
Inverness
Inverurie
Aberdeen
SCOTLAND
GRAMPIAN MOUNTAINS
Brechin
Dunkeld
Dundee
Perth
St. Andrews
Falkirk
Edinburgh
Greenock
Glasgow
Motherwell
Largs
Saltcoats
Troon
Galashiels
Dumfries
OUTER HEBRIDES
INNER HEBRIDES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Piers Masterplan
Intermediate Area
Sailing Routes
Study Area
RYA Cruising Routes
Heavy
Medium
Light
RYA Sailing Areas
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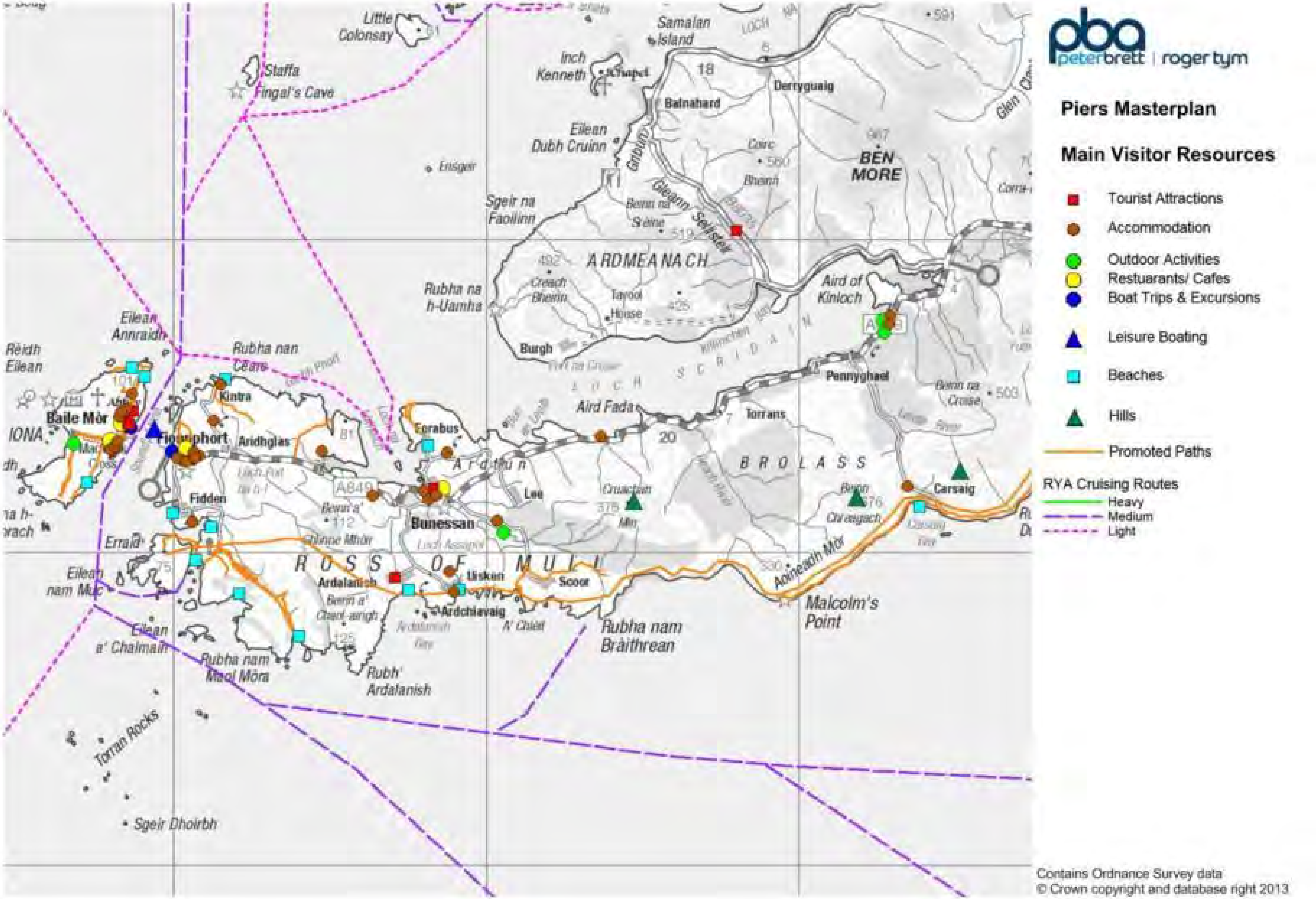
Tobermory
Oban
Lochgilphead
ISLE OF MULL


Piers Masterplan
Main Visitor Resources
Tourist Attractions
Accommodation
Outdoor Activities
Restuarants/ Cafes
Boat Trips & Excursions
Leisure Boating
Beaches
Hills
Promoted Paths
RYA Cruising Routes
Heavy
Medium
Light
IONA
Baile Mòr
Fionnphort
Fidden
Kintra
Bunessan
Ardtun
Ross of Mull
Pennyghael
Carsaig
Staffa
Fingal's Cave
Little Colonsay
Inch Kenneth
Ben More
Ardmeanach
Loch Scridain
Brolass
Malcolm's Point
Rubha nam Bràithrean
Torran Rocks
Sgeir Dhoirbh
Erraid
Uisken
Scoor
Ardalanish
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Appendix C: Comparators Experiences

Holy Island of Lindisfarne Visitor Profile and Management

Background

Lindisfarne is located some 1.6km off the Northumberland coast at the village of Beal and connected to the mainland by a tarmac causeway, which is impassable due to the tides for about 5hr per day.

The island itself - in many ways similar to Iona - has been famous as a place of pilgrimage and retreat for over 1,300 years since the Priory was founded by St Cuthbert in the 7th century AD, with subsequent development of the monastery, Parish Church of St Marys in the 12th century, and the first castle built in the 16th century. The castle having fallen into disrepair was restored in the early 20th century, and the first section of tarmac causeway connecting the island to the Northumbrian mainland was built in 1954 with final completion in 1966. A further **similarity between Lindisfarne and Iona is the size of the resident population with** Lindisfarne having a resident population of 160, not dissimilar in scale to that of Iona with some 180.

Visitor Profile and Characteristics

Currently Holy Island is one of the most visited places in England and with approximately 650,000 visitors per year is by some measure the most visited location in the North East of England, significantly ahead of the 2nd placed Alnwick Gardens, which attracts some 500,000 visitors per year.

In turn individual attractions on the island record substantial numbers of visitors, making these themselves amongst the top 10 most visited attractions in North East England including the St Aiden's Lindisfarne Mead Winery, which was visited by 225,000 visitors making it the 7th most visited free attraction, and Lindisfarne Castle attracting 103,000 visitors making it the 7th most visited paid attraction in the North East.

Both Lindisfarne and Iona / Fionnphort experience a 'tidal surge' effect of visitor arrivals and departures, with Iona dependent upon the frequent Calmac ferry, but visitors also constrained for time by the scheduling of ferries from Craignure to Oban and the mainland; while Lindisfarne experiences a similar peak and trough depending upon the tides and the ability of visitors to arrive and depart across the tidal causeway.

Both locations also have a constrained scale of infrastructure and visitor facilities to deal with large numbers of visitor arrivals with Lindisfarne having only 40 letting bedrooms for visitors, being less than those available on Iona, which has 43 letting hotel bedrooms alone, not including B&Bs, hostel accommodation, and those facilities provided by the Iona Community. In addition, there is no hotel accommodation available in Fionnphort, although numerous B&Bs, self-catering facilities, and a camp site are available for overnight staying visitors.

Constrained Infrastructure Capacity and Visitor Management

One major difference between the islands is the ability to drive across the causeway to Lindisfarne, while vehicle access is restricted to permitted vehicles via the ferry to Iona. Hence the problems of vehicle management and car parking capacity experienced on Lindisfarne largely addressed at the Chare Ends car park is equivalent to the car and bus parking issues experienced in and around the pier and its hinterland of Fionnphort. On Lindisfarne bus parking is provided closer to the village centre and the castle at Green Lane.


Chare Ends main car park


Coach parking at Green Lane

On Lindisfarne, the majority of vehicles other than those belonging to residents are directed into the large Chare Ends car park at the entry to the village. From there the alternatives are either to walk to the centre or catch the transfer mini-bus. While regarded by the authorities as not being ideal either for sign-posting or operation, in general the management of visitor arrivals appears to work reasonably well. The car park charges a nominal pay and display charge (£2.40 for 3 hours and

£4.40 for all day)15, which is similar to the £0.80 per hour charged at the pier car park at Fionnphort16, although not on an all-day basis. There are also extensive warning signs cautioning visitors on being marooned on the island following the incoming tide, and also the dangers of being caught on the causeway mid-tide.

There are current plans to address the issues of car parking and visitor management and develop the visitor car parking, and entry to the village through a series of physical measures, which are set out in detail in the recent report for the Holy Island Partnership 'Holy Island of Lindisfarne - Village Life and Visitor Access: Maintaining a Balance'.17

[15] http://www.northumberland.gov.uk/default.aspx?page=1520
[16] http://www.argyll-bute.gov.uk/sites/default/files/car-parks/car%20parks.pdf
[17] http://www.peregrinilindisfarne.org/wp-content/uploads/2012/11/BHB-Village-Traffic-and-Parking-Report-Final.pdf

The distance to walk from the main car park to the main focus of the centre of the village, where the Lindisfarne Priory, Museum and Exhibition, Lindisfarne Heritage Centre,[18] and the St Aiden's Lindisfarne Mead Winery[19] each of which offers interpretation facilities, retail outlets and craft shops, and other food and drink outlets and shops are located is approximately 0.5km, with a further walk to reach the castle of approximately 1.2km. A castle shuttle bus service operates to transport those less mobile. All along the approach road (Green Lane) into the village are occasional opportunities to purchase local produce from stalls, cafes, and the post office on arrival in the centre.

Despite the constrained supply of visitor accommodation, opportunities for day-visitor spending are relatively extensive particularly at the Lindisfarne Heritage Centre, the Priory Museum and Exhibition, and St Aiden's Winery, as well as a limited number of other small scale retail outlets, retailing high quality gifts, crafts, food and drink, and souvenirs. With the main Chare Ends car park and bus-park at Green Lane at the northern edge of the village, and the priory and harbour to the south along with the Castle and new visitor centre to the south east, visitors have numerous opportunities to spend money in a variety of locations. Essentially the majority of visitors are directed past or through the points where retail services are present in and around the village.

[18] http://www.lindisfarne-centre.com/shop.html
[19] http://www.lindisfarne-mead.co.uk//Shops.aspx

The Holy Island Partnership, which is made up of the community and other organisations operating on the island recognises that tourism brings a significant economic and cultural benefit to the Island, which has developed an international reputation as a destination of historic, cultural and environmental importance. The Partnership is made up of the Holy Island Community Development Trust, a charitable company which manages the Lindisfarne Centre, inner harbour as well as a number of properties providing affordable housing for local people; the Holy Island Parish Council; Natural England, which manages Lindisfarne National Nature Reserve; English Heritage, which manages the Priory and museum; the National Trust, which owns and manages the Castle; Northumberland Coast Area of Outstanding Natural Beauty Partnership who guide the conservation and enhancement of 39 miles of coastline between Berwick and Amble, including Holy Island; and Northumberland County Council.

A priority for the Partnership is to create a visitor management strategy, which will develop long term solutions across the following areas:

- Visitor services and experience;
- Visitor flow and access;
- Car parking and toilets; and
- Whole island interpretation.

Each of these strategy areas has a resonance for the visitor management and development challenges faced by the tourism and related economy of the Sound of Iona.

Markets for Visitor Expenditure

Leisure Boating and Marine Activities

In addition, there are other parallels between Lindisfarne and Iona / Fionnphort for in both locations each has potential for exploiting the leisure boating market and improving facilities for the existing fishing industry and related activities, and improving their compatibility at pier-side.

Currently Lindisfarne offers a limited number of moorings in the harbour (the 'Ouze') for both operational fishing boats and leisure craft, whether the latter are based on the island or are visitors. There are estimated to be approximately 30 small leisure boats kept at the harbour, 60% of which are believed to be owned by people not permanently resident on the island. However, there are plans to extend this capacity and capability[20] by an additional 12-20 moorings, to accommodate the existing several operational fishing vessels and also to attract a greater number of visiting leisure boats to increase expenditure from this visitor market, through a phased Harbour Development Business Plan extending to a capital cost of £0.75million. The scope of works envisaged through this plan provides for heightening, lengthening and widening of the pier to provide greater weather protection, and which would also allow fishing boats, commercial leisure boats and cruise tenders to come alongside, provision of washing and toilet facilities, improvements to the electricity supply, and provision of adequate lifebuoys, throw ropes, fire fighting equipment, first aid points, signs, fuel provision, water supply, and any security required.

[20] http://www.peregrinilindisfarne.org/wp-content/uploads/2012/11/Holy-Island-Harbour-Business-Plan-FINAL.pdf

The key leisure boating markets targeted through the Plan would include the following:-

- Commercial sightseeing boat trips from nearby harbours;
- Small diving groups and clubs;
- Sea Kayaks and canoe clubs;
- Outdoor activity operators;
- Visiting Yachts;
- Cruise companies operating smaller ships with a maximum of 100 passengers on board; and
- Commercial film crews.

There is potentially much that can be drawn from the Holy Island's experience and future plans, which is potentially of benefit to the future development of Iona and Fionnphort's leisure boating and fishing facilities and operational capabilities.

Merchandising and Retailing of 'Local' Products

In terms of merchandise and products available for purchase, a number of the items available labelled as being in some way from Lindisfarne are made elsewhere in the North East. This includes a variety of drinks including Lindisfarne Castle Ale (brewed in Whitley Bay), Farne Island Ale (brewed in Tweedmouth), and Insular Art of Lindisfarne Gospels Ale (brewed in Coxhoe, County Durham) amongst others, although the famous Lindisfarne Mead and other fruit wines are made locally.

This illustrates the selling power of the Holy Island or Lindisfarne 'brand' with goods made elsewhere on the mainland (due to the limited production capacity on the island) able to be marketed and sold as being from Holy Island itself.

Such an approach might well offer opportunities to businesses in both Iona and Fionnphort to produce locally made items or have them produced elsewhere, and have them labelled as being produced in the area. This enables retail sales out of peak season, when visitor numbers decline but on-line sales and exporting of locally made or branded goods are a means of maintaining cash-flow for indigenous local businesses during the off-peak visitor season.

Conclusions on Comparative Assessment

There are broad similarities between Lindisfarne and Iona/Fionnphort in terms of the tidal surge' effect of visitor arrivals and departures experience in both locations, and each having a constrained infrastructure and supply of facilities to deal with these visitor flows.

Clearly, with 650,000 visitors per annum Holy Island has a much greater market draw than the perhaps 80,000-100,000 visitors attracted to Iona. In addition, the season is much more prolonged for Lindisfarne being almost all-year, whereas Iona/Fionnphort experiences a peak season of some four months – June to September – and hence Holy Island has a more evenly spread and much more extensive visitor market to sustain individual businesses year round. Such a scale of visitor market on the ground provides a critical mass for businesses on Holy Island, which is lacking in Iona/Fionnphort.

Nevertheless, much can be drawn from the Lindisfarne example and experience for the Iona / Fionnphort assessment in identifying the key challenges of visitor management particularly of high throughput in a short space of time and options for how these can be addressed. In addition, the nature of customer markets are not dissimilar between the islands with retail sales, enhancing visitor expenditure opportunities, providing the broadest possible but sustainable range of expenditure opportunities, merchandising and products, and the leisure boating market all being of relevance in each location.

St David's Cathedral and Visitors Centre

St David's is Britain's smallest city (pop 1,500) situated on the south west coast of Wales, in the centre of the northern of two peninsulas comprising the main coastal features of Pembrokeshire. The Cathedral lies to the west of the urban area hidden in a valley and sheltered from the sea about a mile away to the south, west and north.

Pembrokeshire and St David's share many characteristics with Scotland's western Isles, a strong sense of local pride and separateness from metropolitan influences (Cardiff as well as London) as well as independence of spirit beyond merely political or linguistic expression. St David's is usually 6 hours by road from London and about 3 from Cardiff.

The population of the city and county (120,000) are slowly growing thanks to incomers and a slowly reviving farming economy, but the prevailing local economic mood remains depressed 5 years after the onset of its worst recession in living memory. The fishing industry used to be strong out of Milford Haven but is much reduced, replaced with oil refining from the 1960's and '70's, partly replaced with LNG processing and storage during the last decade. There are two ferry services to southern Ireland, from Pembroke to Rosslare with Irish Ferries; and Fishguard to Rosslare with Stena. The county town of Haverfordwest is the largest locally at 15,000, some 17 miles (and hills) south east of St David's.

The coasts of Pembrokeshire were designated as Britain's only coastal National Park in 1952 and the Park is the physical and management focus of a thriving tourist industry, the largest direct or indirect income generator in the county for several decades.

St David's Cathedral

St David is patron saint of Wales and lived in a monastic community on the site of the cathedral in the 6th century. He died in 589. Viking and Flemish settlement added to the Welsh and, post Norman Conquest, English and French influences, all still evidenced today through place names, castles and fortified houses across the county. The Nordic termed Landsker line still sharply separates Welsh and 'English' place names and settlement patterns from west to east across the middle of the county.

The cathedral has been a focus of pilgrimage since it was founded in 1181, and now receives over 270,000 visitors each year. The pattern of visits is highly seasonal, normally in excess of 50,000 per peak summer month and less than 5,000 in most Januarys. This is a consistent pattern observed from over 10 years of detailed data collated by the cathedral administrator (Moyra Skenfield), though it is not published.

The original 12th century structure was added to progressively through the 14th century before becoming a victim of monastic clearances in 1538 under the first Tudor king Henry VIIth, then subsequently anti-clerical theft of building materials under Cromwell during the 17th century civil war.

Recent refurbishment of the cathedral's most precious shrine includes a triptych to the 3 principal Celtic saints, David, Andrew and Patrick.

Oriel y Parc Visitor Centre

The Pembrokeshire Coast National Park Authority in conjunction with Amgueddfa - National Museum of Wales obtained Objective one funding , to extend the visitor centre in 2008 on the eastern entrance to the city, together with parking for over 200 vehicles 135,000 visitors pass through the centre annually, the great majority of them accessing the cathedral on foot along the city's High Street. There is restricted visitor parking elsewhere in the city's centre and at the OK supermarket, but only limited parking including disabled access around the cathedral itself at Quickwell Hill.

Oriel y Parc visitors centre has won many awards for both design and build quality but principally the sheer diversity of its offer. Apart from the usual gift shop and a locally sourced home food café, it provides a discovery centre for both children and adults, a museum of local artefacts; in and outdoor lectures on sheep farming, local archaeology etc. The Amgueddfa Cymru – National Museum Wlaes is a major feature of the building which was builty to house changing exhibitions for the national collection which include Graham Sutherland works bequeathed to Pembrokeshire The centre accommodates an artist in residence programme. There are theatre, concerts, poetry readings and social events throughout the year, both in and outdoor in the sheltered inner courtyard, aimed at Pembrokeshire residents as much as longer distance visitors.

The centre manager (Paula Ellis) was recruited from the private sector tourist sector and she has herself recruited reception and catering staff with the same 'can do' attitude as her own. Over the last 10 years, Oriel y Parc has become a beating heart of the community, city and county wide.

Its location is crucial, not only to its own success but to the way visitors to St David's are managed through the whole destination. On the principal entrance to the city from the east, it is the natural stopping point to have the whole St. David's Peninsula explained and put into context. Road signage to the centre could be more prominent for car borne visitors but coach drivers know the car park as the only practical stopping off point in the city.

Most of the Cathedral visitors walk through the city from the Visitor Centre car park to reach the Cathedral, passing on the way a wide range of tea shops, pubs and clothing outlets, together with boat trip vendors to nearby Ramsey Island and wetsuit and surfboard hire shops for Whitesands and Caerfai Bays. 8 large cruise liners dock at Milford Haven annually and most run coach trips to St David's with their usually high spending clientele being much encouraged both by the centre and Cathedral authorities, provided they have ample warning.

There is a high level of coordination for planning, management and operation of tourist business in Pembrokeshire between the National Park Authority, Pembrokeshire County Council, Milford Haven Port Authority, and local bus companies. The local Chamber of Commerce in which local hoteliers and Bed and Breakfast operators are well represented are also involved closely in planning events and improvements to the management of a steadily growing tourist demand. These authorities all agree things could be improved, but there is broad consensus that the physical infrastructure of the area lends itself well to catering to the tourist demand and its anticipated future growth.

Contrasts and Comparisons with Iona and Lindisfarne

We have deliberately chosen St David's and Lindisfarne as suitable comparators for Iona for several reasons:-

- All three are relatively remote locations from major population centres;
- They are all iconic destinations with strong spiritual and religious connotations as well as natural beauty;
- The above factors pre-select the type of visitors who choose to go to all three destinations – people who accept that 'getting there' will require a degree of tolerance of remoteness expressed through the length and complexity of the journey;
- Visitors to such destinations have a high degree of interest in the social and physical context of the location and take a holistic interest in understanding it;
- Such visitors are not a 'populist' demographic, but they are one which will spend money wisely on good products and services related to the destination and means of travel.

We also found a range of contrasts between Iona and the other two destinations. The rest of this section explores those where St David's compares well with FP and Iona in terms of making a 'whole destination' offer to the visitor:-

The juxtaposition of St David's Visitor Centre at Oriel y Parc to the city's main attraction the cathedral provides the key to traffic management throughout St David's – both vehicular and pedestrian.Visitor vehicle parking other than limited disabled access is not banned throughout the city,but parking facilities are restricted other than at Oriel y Parc. Coaches do drive down the High Street to drop off and pick up passengers, but they cannot park in the centre. , So although the Pembrokeshire County Council road authority has not banned city centre access, many visitors who visit both Oriel y Parc and the cathedral walk past most commercial outlets in the city's main street, having little other choice in terms of easy vehicular access.

These outlets include a range of hotels, public houses B&B's and teashops providing a full range of refreshments and accommodation to visitors. However as St David's is also the centre of Pembrokeshire's northern coastal peninsula, with sea coast within a mile to the north, west and south, there are also a wide range of coastal and maritime leisure offers available on the main street, via wet suit, surfing, sailing and fishing equipment sale and hire, together with boat, canoe and kayaking charters for trips round Ramsey and the smaller Islands, and along the immediate coast itself. The TYF maritime adventure centre immediately south of Oriel y Parc has been credited as one of the UK's foremost promoters of 'coasteering' an activity which was almost non-existent until about 25 years ago - walking, and swimming, along rocky portions of coast just above the tide level. This is made possible not only through use of marine clothing and safety kit which was too expensive or otherwise not available 2 decades ago, but through focused marketing at schools and sports clubs on a national level. All these facilities both sedentary and physically demanding provide scope for leisure from the most reflective to the most active, but all are contributing to wide ranging income opportunities for local businesses.

The second apparent variant between St David's and Iona is the degree to which public authorities seem currently to be collaborating in delivering coherent tourism and land use policy and activity. This was not always the case and previous differences in strategic emphases between the National Park (NP) and Pembrokeshire County Council (PCC) authorities have been well documented. However the NP was the key initiator of the St David's visitor centre and continues as its key funding source,. The Port of Authority at Milford Haven also shares its strategy for attracting cruise ships to the county by way of on shore visit planning to key locations such as St David's and Tenby. This emphasis on the operational period beyond the installation of key built infrastructure is a key to current success of the tourist offer at St David's.

Case Study Conclusions

Both St David's and Lindisfarne have well developed facilities providing visitor information about their respective destinations. This may be both cause and effect of a more evolved business focus around the commercial opportunities presented by significant visitor numbers. This is perhaps not so marked yet in Fionnphort and on Iona. There may be many reasons for this, such as the greater remoteness of the Ross of Mull to centres of political decision making, local response to date to pursuit of funding, and the availability of land or property to provide the right visitor welcoming facilities. However there is no reason why FP and Iona cannot exploit the potential of Iona to become a 21st century destination worthy of the 15 centuries of the location's history which have preceded it.

Appendix D: Community Presentations

Draft Master Plan

Appendix E: Visitor Survey & Questionnaire

The Sound of Iona Harbours Committee is undertaking an assessment and master plan of the pier areas at Iona and Fionnphort in Mull, which aims to improve and increase the attractiveness of the pier areas for both visitors and local users.

We wonder if you would spend five minutes filling in this brief survey form and provide your views and opinions of your visitor experience. Your answers will be used to help the Committee inform the master plan process and improve the pier areas' facilities. On completion please return this form to ……………………………….

Please tell us your opinion of your experience of visiting and travelling between Fionnphort and Iona?

Q1: Fionnphort/Mull - Iona Ferry information (If only or also visiting Staffa please go to Question 3)

Please tick a box for each (√)	Yes	No
Is there clear and adequate passenger information available?		
Would more information be helpful?		
Would illuminated ferry times signs at Fionnphort be helpful?		
Is the illuminated ferry information sign at Iona satisfactory?		

Q2: Buying tickets for the Fionnphort/Mull- Iona ferry

Please tick a box for each (√)	Yes	No	Requires Improvement	If improvement required briefly please state how?
Is buying tickets easy and straightforward ?				
Is sign-posting for ferry tickets clear and simple to follow?				

Q3a: Car parking at Fionnphort Pier /Mull

Please tick a box for each (√)	Yes	No	Requires Improvement	If improvement required please state how?
Is sign-posting for car parking clear and understandable?				
Is there sufficient car parking available?				
Is the principle of parking near the pier satisfactory?				
Could the car parking space near the ferry pier be put to more effective use?				

Q3b: Car parking at Fionnphort Columba Centre (Visitor facility at the entrance to the village) /Mull

Please tick a box for each (√)	Yes	No	Requires Improvement	If improvement required please state how?
Is parking at the Columba Centre car park satisfactory?				
Is the Columba Centre car park close enough to walk to the ferry or for assisted access for disabled passengers?				
Would you be prepared to pay to park at the Columba Centre car park?				

Q4: Bus parking at Fionnphort/Mull

Please tick a box for each (√)	Yes	No	Requires Improvement	If improvement required please state how?
Is bus and coach parking at the pier satisfactory?				
Could a coach drop off at the Columba Centre (Visitor facility at the entrance to the village) and pick up near the ferry pier work more effectively?				

Q5: What is your opinion of the range of visitor facilities at the piers at Fionnphort/Mull and Iona?

	Fionnphort Pier Area			Iona Pier Area			
Please tick a box for each (√)	Very Good	Acceptable	Requires Improvement	Very Good	Acceptable	Requires Improvement	If improvement required please state how?
Range of food and drink facilities							
Quality of food and drink facilities							
Range and quality of shopping							
Visitor and tourist information							
Visitor waiting facilities							

Toilets and baby changing facilities							
Rubbish and litter bins							
Standard of cleanliness of the area							
Appearance of the pier area							
Safety of passengers and visitors							
Comfort of passengers and visitors							
Seating for passengers and visitors							
Children's play facilities							

Q6: Visitor Information - Please tick a box (√)

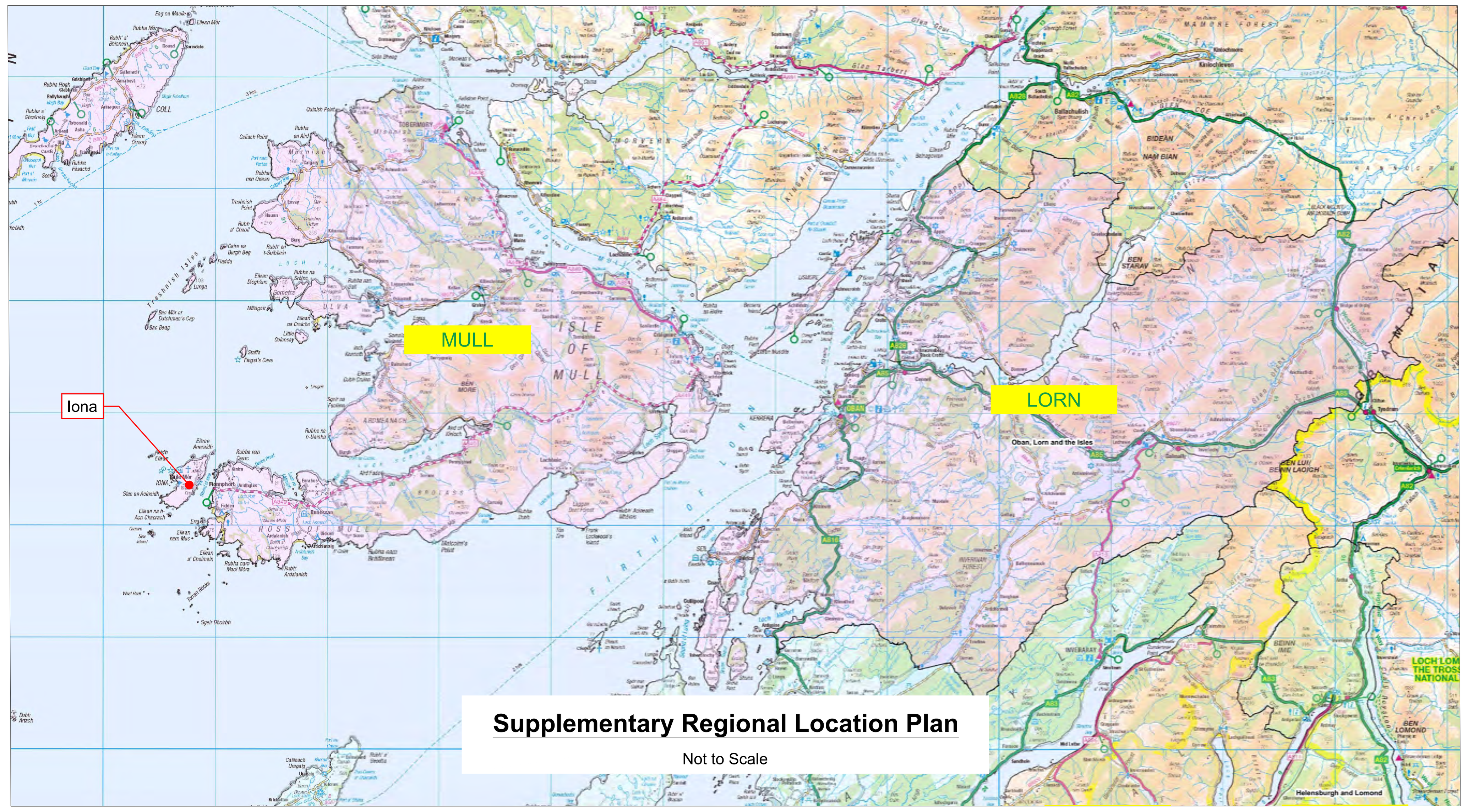
Where are you from?	Scotland		Other UK		Non-UK (Please state)	
Are you staying overnight on Iona or Mull?	Yes		No			

APPENDIX 3.1

Proposed Development – Detailed Drawings

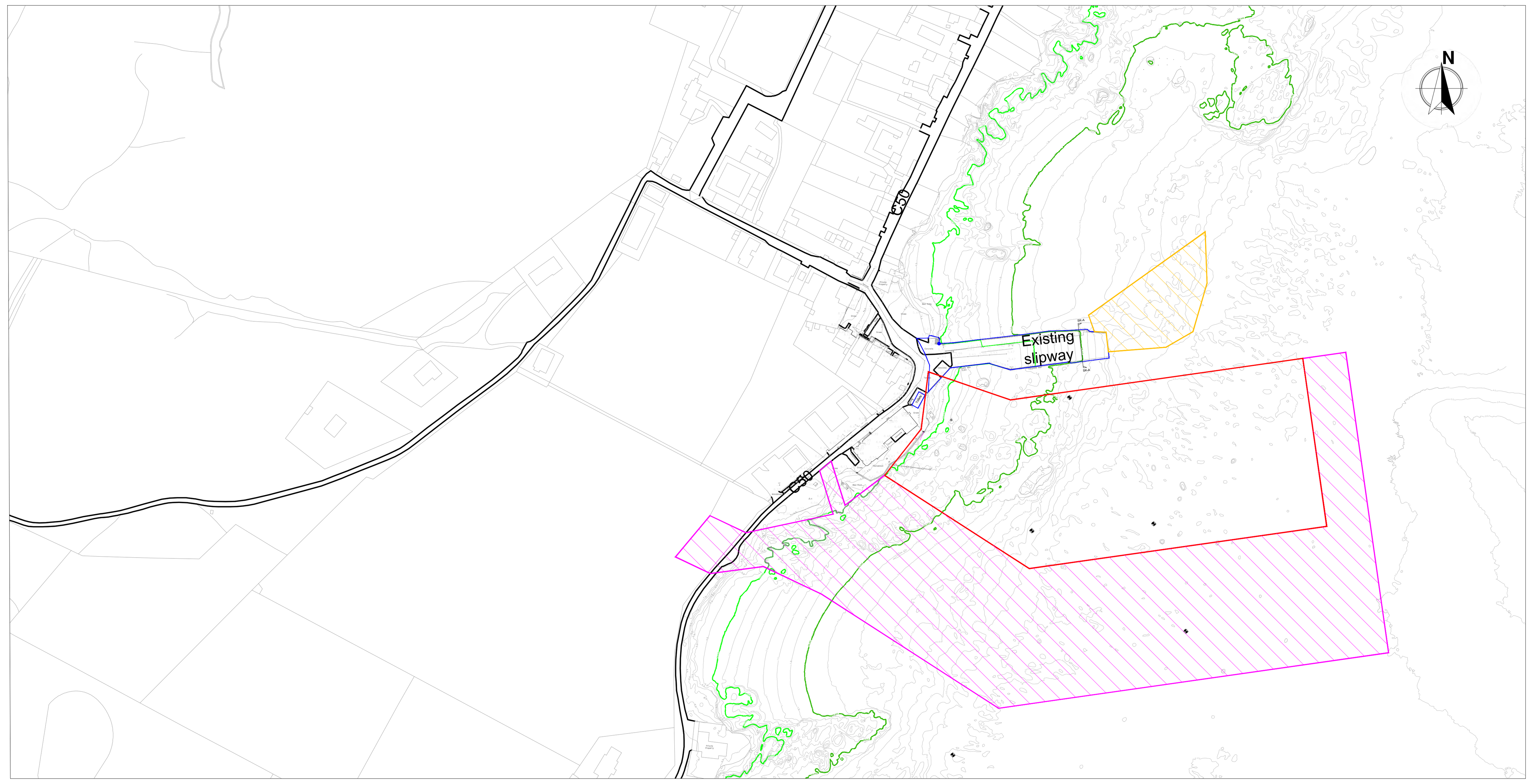
- 00040-33-01E Iona location plan, ownership boundary and site boundary;
- 00040-33-02F Iona existing general arrangement and elevation;
- 00040-33-03F Iona proposed general arrangement and elevation;
- 00040-33-04G Iona proposed sections and typical details; and
- 00040-33-102A Proposed dredge deposit location.

ARGYLL & BUTE COUNCIL --- DEVELOPMENT AND INFRASTRUCTURE SERVICES



Supplementary Regional Location Plan

Not to Scale

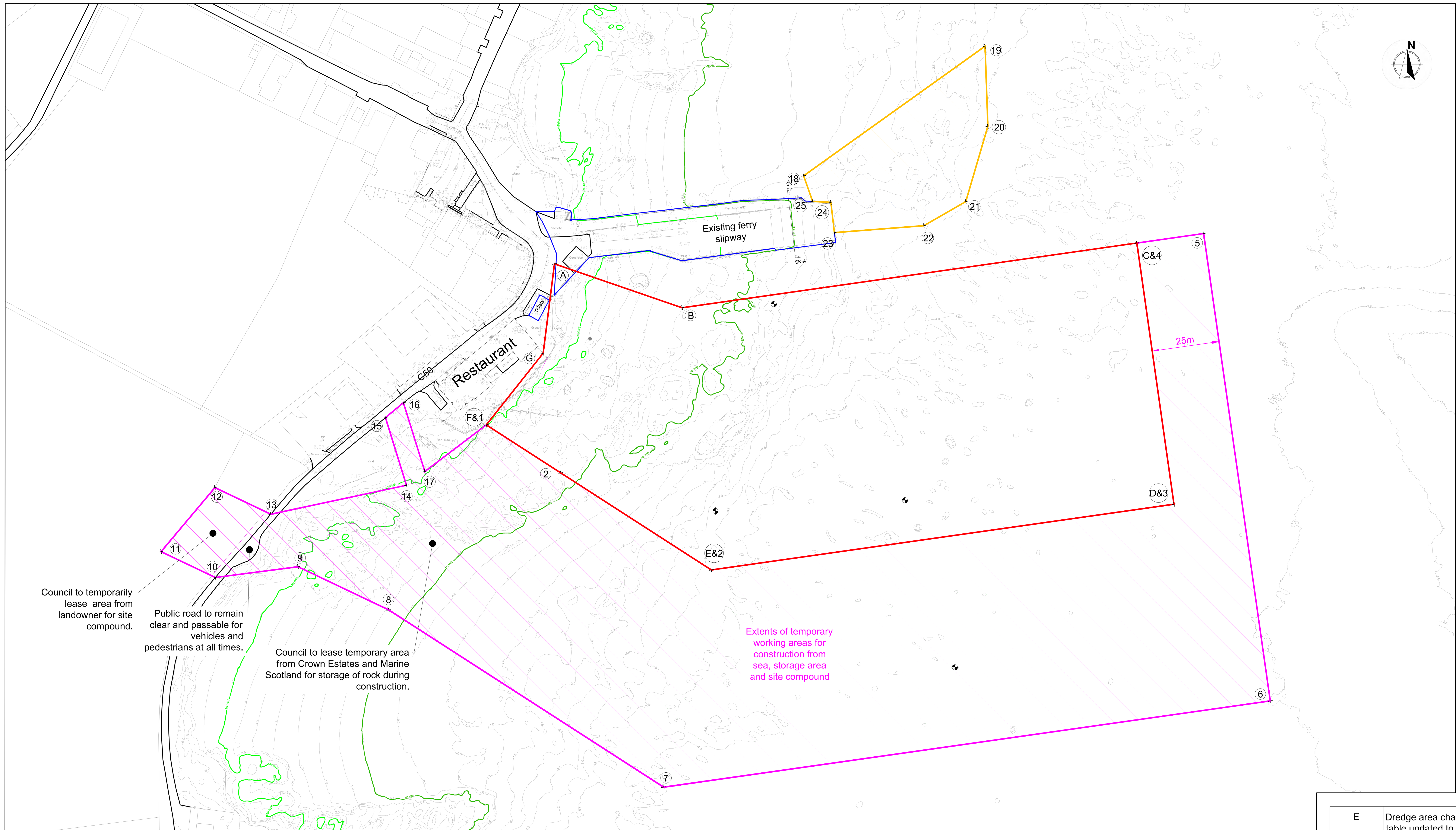


metres - scale = 1:2500

0.0m 25m 50m 75m 100m

Location Plan

Scale 1:2500



metres - scale = 1:1000

0m 10m 20m 30m 40m 50m

Site Plan

Scale 1:1000

Surface area of proposed development / Site Boundary				
Point	**Easting**	**Northing**	**Latitude**	**Longitude**
A	128593	723990	56°19′49″N	006°23′32″W
B	128640	723973	56°19′49″N	006°23′30″W
C	128809	723997	56°19′50″N	006°23′20″W
D	128822	723901	56°19′47″N	006°23′19″W
E	128651	723876	56°19′45″N	006°23′28″W
F	128568	723930	56°19′47″N	006°23′34″W
G	128589	723957	56°19′48″N	006°23′32″W

Proposed site compound / storage areas				
Point	**Easting**	**Northing**	**Latitude**	**Longitude**
1	128568	723930	56°19′47″N	006°23′34″W
2	128651	723876	56°19′45″N	006°23′28″W
3	128822	723901	56°19′47″N	006°23′19″W
4	128809	723997	56°19′50″N	006°23′20″W
5	128833	724001	56°19'50"N	006°23'15"W
6	128858	723828	56°19'44"N	006°23'16"W
7	128633	723796	56°19'43"N	006°23'29"W
8	128532	723861	56°19'45"N	006°23'35"W
9	128498	723878	56°19'45"N	006°23'37"W
10	128467	723874	56°19'45"N	006°23'39"W
11	128447	723883	56°19'45"N	006°23'40"W
12	128467	723907	56°19'46"N	006°23'39"W
13	128488	723897	56°19'46"N	006°23'34"W
14	128538	723908	56°19'46"N	006°23'35"W
15	128530	723933	56°19'47"N	006°23'36"W
16	128537	723938	56°19'47"N	006°23'35"W
17	128545	723913	56°19'47"N	006°23'31"W

Proposed dredging areas				
Point	**Easting**	**Northing**	**Latitude**	**Longitude**
18	128685	724022	56°19′50″N	006°23′27″W
19	128752	724070	56°19′52″N	006°23′24″W
20	128753	724041	56°19′51″N	006°23′23″W
21	128745	724013	56°19′50″N	006°23′24″W
22	128730	724004	56°19′50″N	006°23′25″W
23	128697	724001	56°19′50″N	006°23′26″W
24	128695	724012	56°19′50″N	006°23′23″W
25	128689	724013	56°19′50″N	006°23′27″W

Legend:-

- Surface area of proposed development / Site Boundary (Breakwater area = 2.18 ha)
- Extents of temporary working areas for construction from sea, storage area and site compound
- Argyll & Bute Council Land Ownership
- Dredging Working Area
- Mean High Water Spring (MHWS) +4.00m CD
- Mean Low Water Spring (MLWS) +0.50m CD
- Existing ground level / seabed contour to Chart Datum

Note: Chart Datum is 1.82m below Ordnance Datum

NOTES:

1) Do not scale from this drawing
2) To be read in conjunction with drawing series 00040-33
3) All levels are in metres relative to a Chart Datum.
4) Indicative safety buoys to be deployed by the contractor at approximately 10m centres to delineate site boundary and temporary working areas.

SUFFIX	REVISION	DESIGNED BY INIT.	DESIGNED BY DATE	APPROVED BY INIT.	APPROVED BY DATE
E	Dredge area changed to an orange outline, key and table updated to suit.	SAJG	20/02/22	ES	20/02/22
D	Site compound added, coordinates updated and viewport scales amended.	SAJG	10/12/21	ES	10/12/21
C	Site Boundaries and coordinates updated.	SAJG	24/11/21	ES	25/11/21
B	Footprint of breakwater, dredging area, site boundary and coordinates amended, breakwater toe added and piles removed.	SAJG	15/11/21	ES	15/11/21
A	Drawing reassembled, legend and notes amended.	SAJG	08/07/21	SAJG	08/07/21

Head of Roads and Infrastructure Services
Jim Smith

DESIGN OFFICE, MANSE BRAE,
LOCHGILPHEAD, ARGYLL, PA31 8RD

TITLE

Iona Breakwater

Location Plan, Ownership and Site Boundaries

SCALES As Shown @ A1

DESIGNED BY	JS
DRAWN BY	ST
CHECKED BY	ES
APPROVED BY	ES
DATE	16/10/2020

DRAWING No.

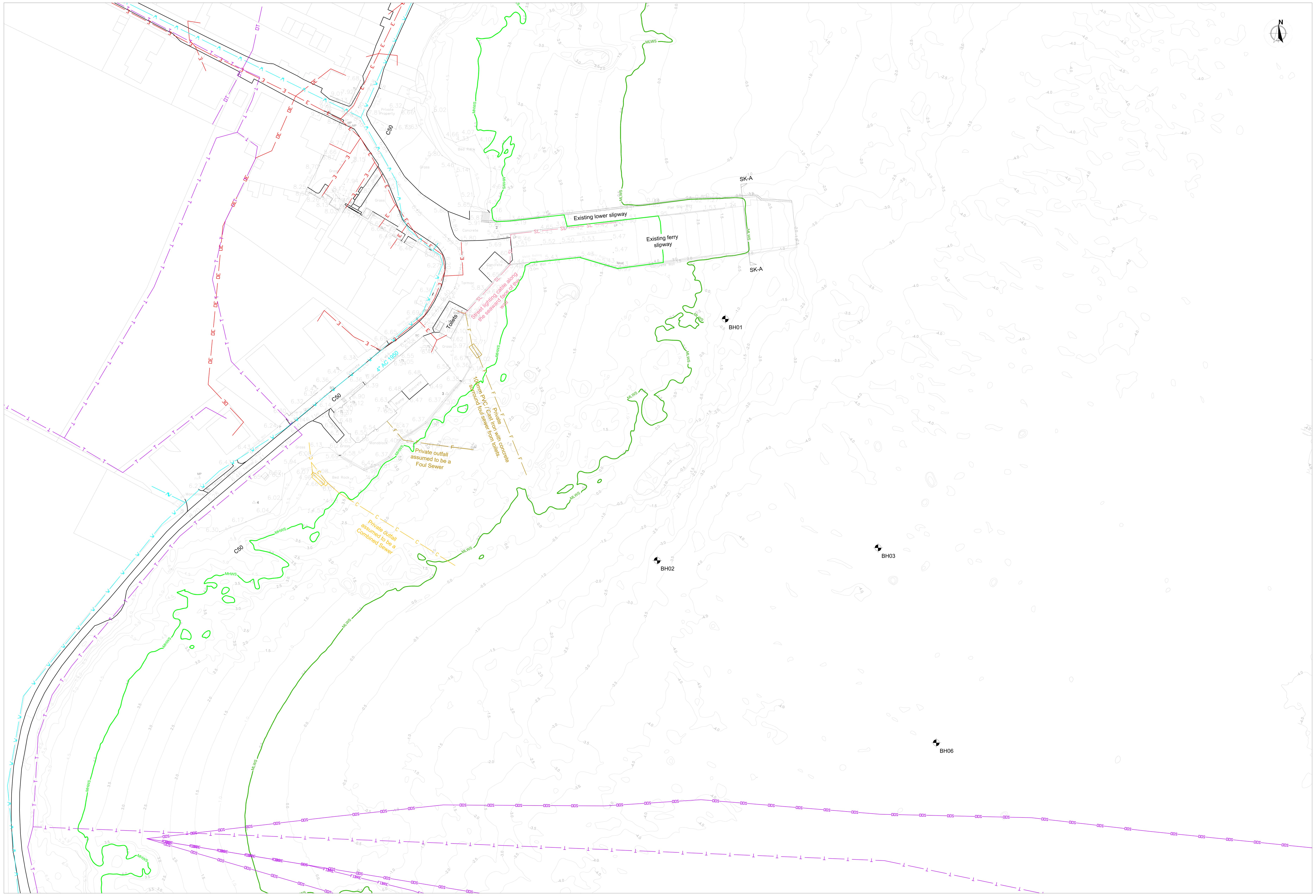
00040-33-01E

Argyll & Bute COUNCIL

ARGYLL & BUTE COUNCIL --- DEVELOPMENT AND INFRASTRUCTURE SERVICES

Elevation A-A - Existing

Scale 1:100



Existing General Arrangement Plan

Scale 1:500

Legend:-

- Mean High Water Spring (MHWS) +4.00m CD
- Mean Low Water Spring (MLWS) +0.50m CD
- -2.0 Existing ground level / seabed contour to Chart Datum
- BH01 Borehole Location and number from Causeway Geotech 2018 GI

Note: Chart Datum is 1.82m below Ordnance Datum

Public Utility Legend:

- S — Surface water sewer
- F — Foul sewer
- C — Combined sewer
- OT — Telecom overhead
- T — Telecom underground from Openreach online search tool.
- W — Water main
- W — Abandoned water main
- G — Gas main
- E — Electricity underground
- OE — Electricity overhead
- FIBRE — BT Fibre Cable from document "IS_Cables_Sound_Of_Iona.shp"
- OOS — BT OOS Cable from document "OOS_Cables_Sound_Of_Iona.shp"

Notes:

1) All levels are given in metres, relative to Chart Datum.
2) Do not scale from this drawing.
3) Topographic data extracted from Drawing: A7482 Topographic & Bathymetric Survey Fionnphort to Iona Ferry Route Sound of Iona Scotland by Aspect Land + Hydrographic Surveys dated 9th November 2020.
4) Public Utility locations are shown indicatively from utility plans only, the contractor must confirm the exact locations on site prior to the commencing of the works by undertaking CAT and GENI scans or equivalent.

SUFFIX	REVISION	DESIGNED BY INIT.	DESIGNED BY DATE	APPROVED BY INIT.	APPROVED BY DATE
F	Full Fibre and OOS cables added across the sound from BT files BT Fibre Cable from document "IS_Cables_Sound_Of_Iona.shp" and "OOS_Cables_Sound_Of_Iona.shp".	SAJG	02/06/22	ES	02/06/22
E	Dredge area changed to an orange outline, key updated to suit.	SAJG	20/02/22	ES	20/02/22
D	Site compound / storage areas added.	SAJG	10/12/21	ES	10/12/21
C	Site boundary and Legend amended and Borehole locations added.	SAJG	26/11/21	ES	26/11/21
B	Site boundary amended, toilet foul outfall and public utility legend added.	SAJG	15/11/21	ES	15/11/21
A	Drawing reassembled, Public Utilities added, Legend and Notes amended.	SAJG	08/07/21	SAJG	08/07/21

Head of Roads and Infrastructure Services
Jim Smith

DESIGN OFFICE,
MANSE BRAE, LOCHGILPHEAD, ARGYLL, PA31 8RD

TITLE

Iona Breakwater

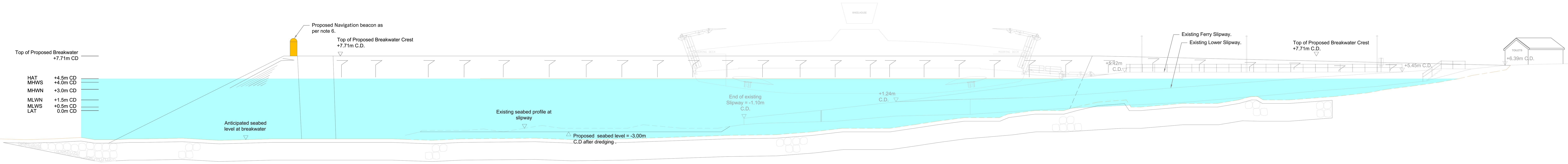
Existing General Arrangement
Plan and Elevation

SCALES: As Shown @ A0

DESIGNED BY	JS
DRAWN BY	ST
CHECKED BY	ES
APPROVED BY	ES
DATE	16/10/2020

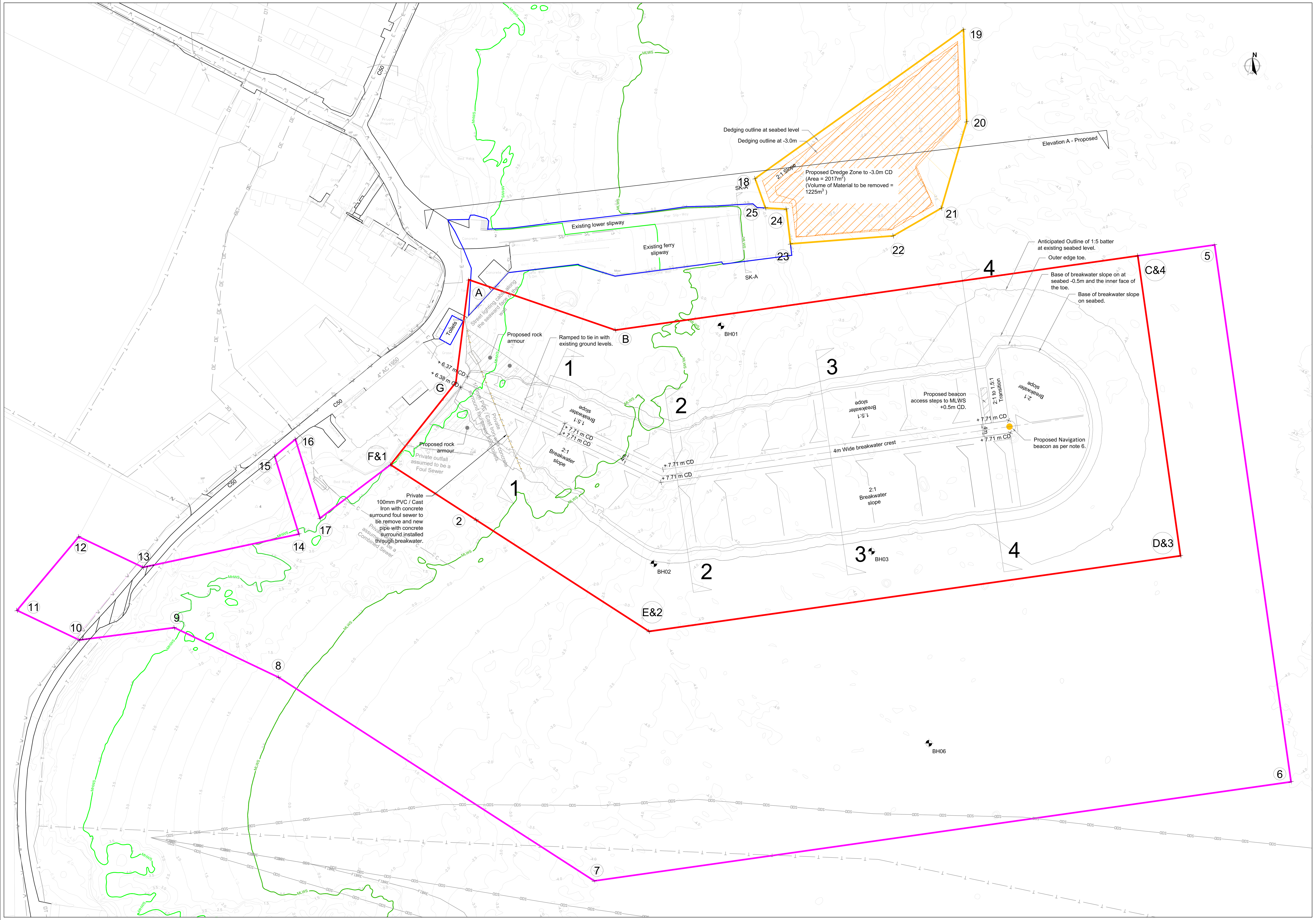
DRAWING No. 00040-33-02F

Argyll & Bute COUNCIL



Elevation A-A - Proposed

Scale 1:200



General Arrangement Plan

Scale 1:500

Legend:-

- Dredge area
- Breakwater beacon
- Surface area of proposed development / Site Boundary (Breakwater area = 2.18 ha).
- Extents of temporary working areas for construction from sea, dredging , storage area and site compound.
- Argyll & Bute Council Land Ownership
- Mean High Water Spring (MHWS) +4.00m CD
- Mean Low Water Spring (MLWS) +0.50m CD
- -2.0 Existing ground level / seabed contour to Chart Datum
- BH01 Borehole Location and number from Causeway Geotech 2018 GI

Note: Chart Datum is 1.82m below Ordnance Datum

Public Utility Legend:

- S Surface water sewer
- F Foul sewer
- C Combined sewer
- OT Telecom overhead
- T Telecom underground from Openreach online search tool.
- W Water main
- W Abandoned water main
- G Gas main
- E Electricity underground
- OE Electricity overhead
- FIBRE BT Fibre Cable from document "IS_Cables_Sound_Of_Iona.shp"
- OOS BT OOS Cable from document "OOS_Cables_Sound_Of_Iona.shp"

Notes:

1) All levels are given in metres, relative to Chart Datum.
2) Do not scale from this drawing.
3) Topographic data extracted from Drawing A5314: Multibeam Bathymetric Survey Proposed Breakwater Iona Slipway by Aspect Land + Hydrographic Surveys dated 13th June 2014.
4) Bathymetric data extracted from Drawing: A6099: Multibeam Bathymetric Survey Iona by Aspect Land + Hydrographic Surveys dated 6th June 2017.
5) Public Utility locations are shown indicatively from utility plans, the contractor must confirm the exact locations on site prior to the commencing of the works by undertaking CAT and GENI scans or equivalent.
6) The proposed breakwater must to be marked with an Aid to Navigation (AtoN) at the most seaward extent; the breakwater should be marked with a red light flashing twice every six seconds [Fl(2)R6s 2M] and the light should have a nominal range of 2 miles and be at least 2 metres above the surface of the breakwater.
7) Indicative safety buoys to be deployed by the contractor at approximately 10m centres to delineate site boundary.

SUFFIX	REVISION	DESIGNED BY INIT.	DESIGNED BY DATE	APPROVED BY INIT.	APPROVED BY DATE
F	Full Fibre and OOS cables added across the sound from BT files BT Fibre Cable from document "IS_Cables_Sound_Of_Iona.shp" and "OOS_Cables_Sound_Of_Iona.shp". BW Footprint updated based on new tidied 3D model. Foul sewer (toilet septic tank pipe) note amended.	SAJG	02/06/22	ES	02/06/22
E	Breakwater termination slope start point moved seaward, Ferry updated, steps added.	SAJG	02/02/22	ES	02/02/22
D	Breakwater toe and outline amended, coupound / storage area added .	SAJG	09/12/21	ES	09/12/21
C	Breakwater toe lowered 0.5m into the seabed, 5:1 toe batter slope and borehole locations added, Site boundary and Legend amended, beacon note added.	SAJG	18/11/21	ES	18/11/21
B	Breakwater, Dredge Area and Site boundary amended, beacon, toilet foul outfall and public utility legend added.	SAJG	18/11/21	ES	18/11/21
A	Drawing reassembled, Public Utilities added, Legend and Notes amended.	SAJG	08/07/21	SAJG	08/07/21

Head of Roads and Infrastructure Services
Jim Smith

DESIGN OFFICE,
MANSE BRAE, LOCHGILPHEAD, ARGYLL, PA31 8RD

TITLE

Iona Breakwater

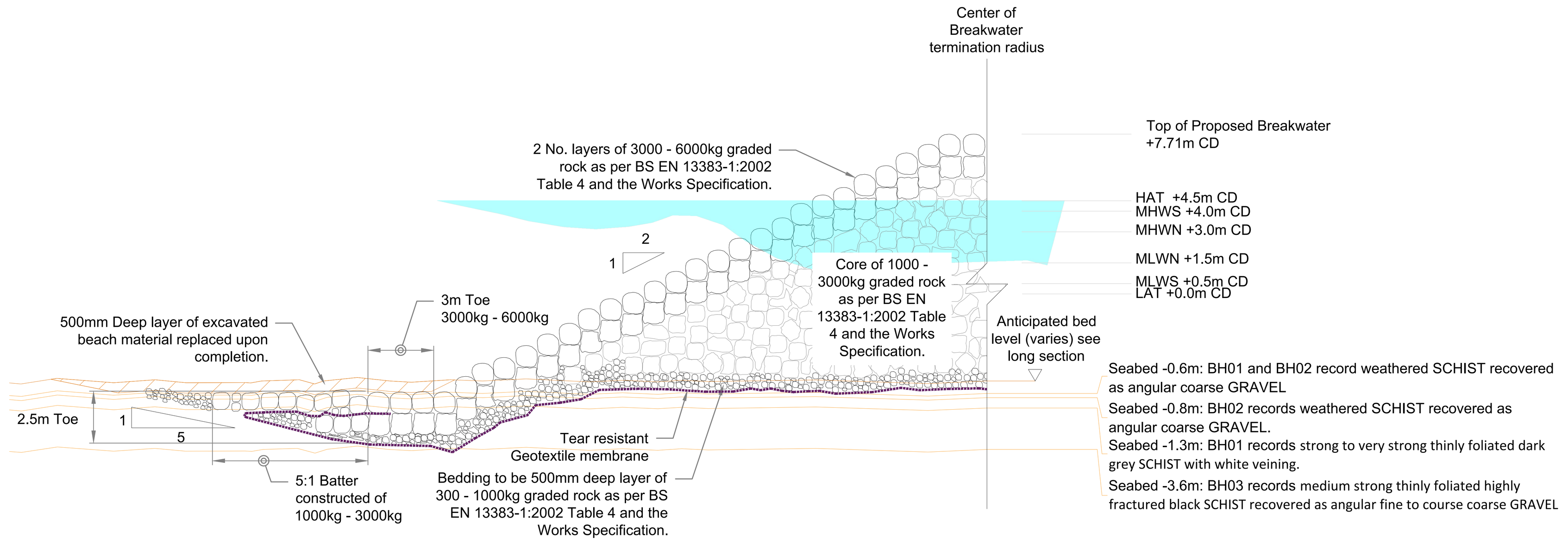
Proposed General Arrangement and Elevation

SCALES: As Shown @ A0

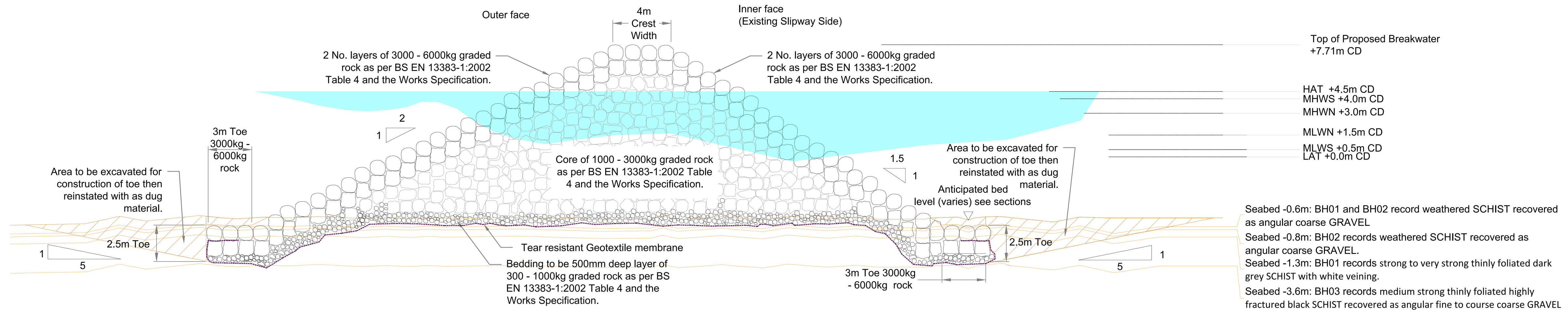
DESIGNED BY	JS
DRAWN BY	ST
CHECKED BY	ES
APPROVED BY	ES
DATE	16/10/2020

DRAWING No. 00040-33-03F

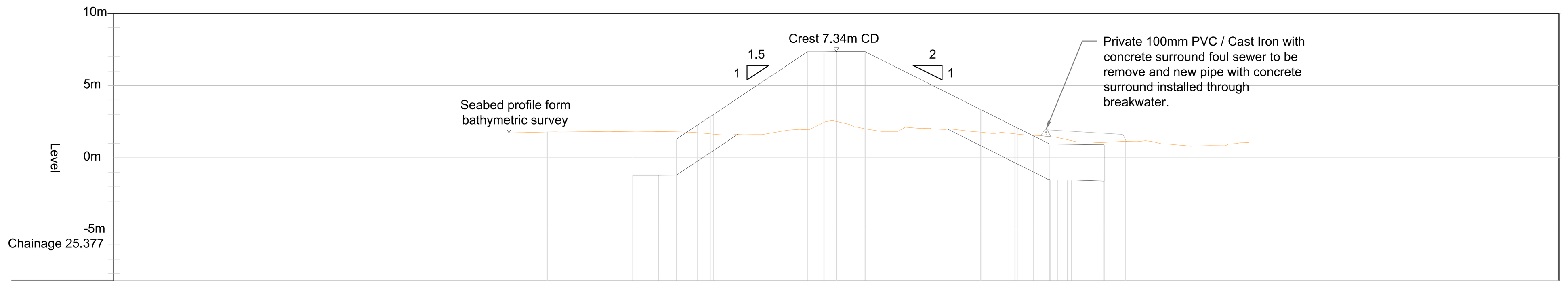
Argyll & Bute COUNCIL



Typical Detail Through Proposed Breakwater at Radios Termination
Scale1:200

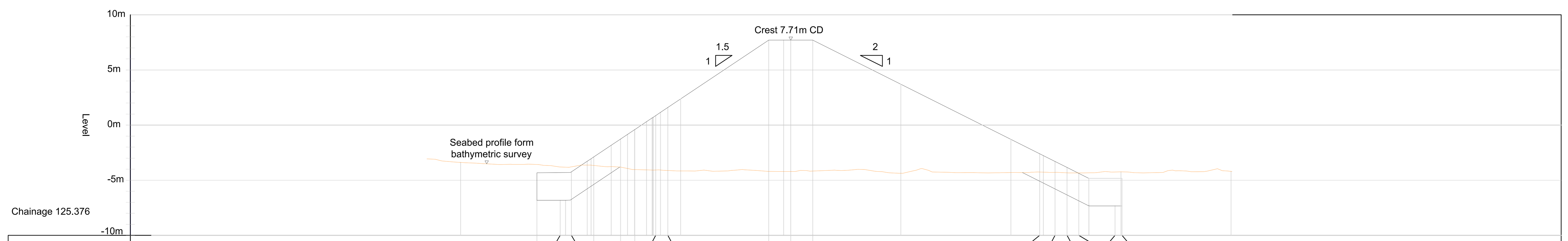


Typical Detail Through Proposed Breakwater With Toe
Scale1:200



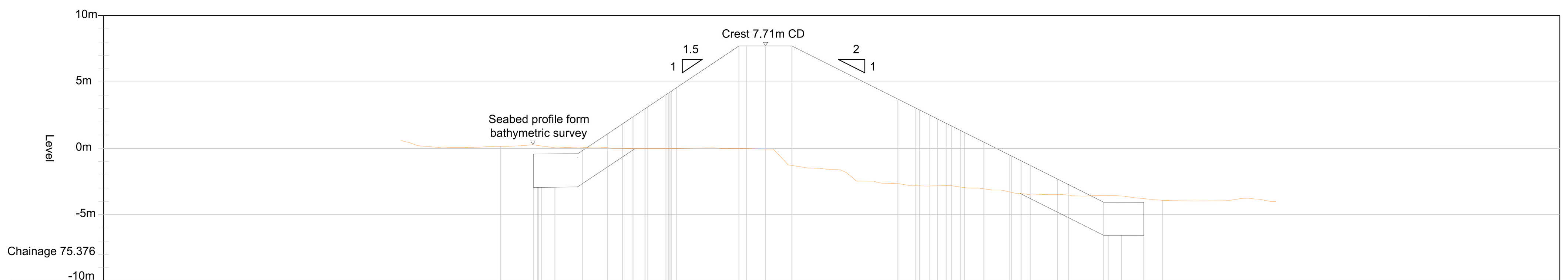
Offsets	Existing Levels	Proposed Levels
-14.081	1.833	-1.212
-12.305	1.824	-1.205
-11.054	1.800	1.300
-9.590	1.736	2.276
-8.508	1.644	2.997
-2.000	1.947	7.336
0.000	2.526	7.338
2.000	2.007	7.343
12.364	1.658	2.161
13.660	1.562	1.513
14.724	1.468	0.981
15.987	1.257	-1.524
18.539	1.077	-1.595

Section 1-1
Scale1:250



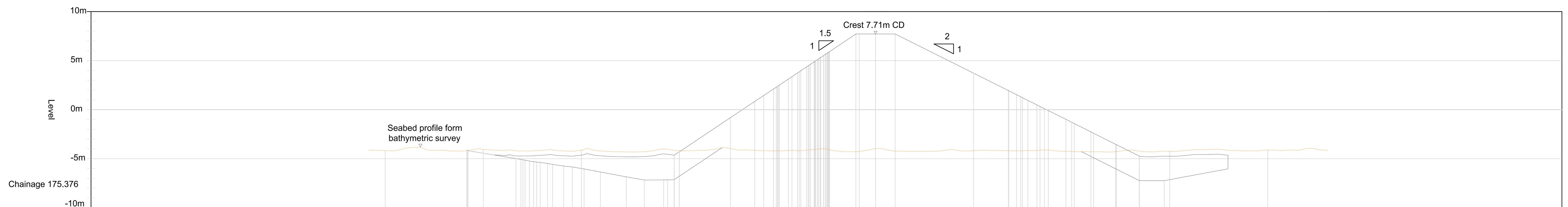
Offsets	Existing Levels	Proposed Levels
-23.067	-3.572	-6.829
-20.949	-3.802	-6.828
-19.927	-3.790	-4.241
-17.898	-3.663	-2.889
-15.463	-3.812	-1.265
-14.178	-4.034	-0.408
-12.271	-4.075	0.863
-11.168	-4.121	1.598
-2.000	-4.201	7.710
0.000	-4.216	7.710
2.000	-4.167	7.710
22.615	-4.263	-2.597
24.017	-4.283	-3.298
25.102	-4.329	-3.841
26.171	-4.337	-4.376
29.467	-4.259	-7.333
30.094	-4.244	-7.332

Section 3-3
Scale1:250



Offsets	Existing Levels	Proposed Levels
-17.230	0.262	-2.940
-16.731	0.177	-2.948
-15.867	0.041	-2.930
-13.825	0.078	-0.174
-11.946	0.044	1.079
-10.802	-0.004	1.842
-8.883	-0.033	3.121
-6.735	-0.015	4.554
-1.428	-0.035	7.710
0.000	-0.059	7.710
2.000	-1.293	7.710
11.351	-2.823	3.035
12.410	-2.843	2.505
13.649	-2.810	1.886
14.738	-2.924	1.341
16.494	-3.057	0.463
18.457	-3.292	-0.518
22.062	-3.471	-2.321
25.545	-3.563	-4.063
26.886	-3.595	-6.570
28.568	-3.794	-6.575

Section 2-2
Scale1:250



Offsets	Existing Levels	Proposed Levels
-41.680	-4.168	-4.168
-41.560	-4.150	-4.185
-36.678	-4.212	-4.992
-35.301	-4.216	-5.239
-34.195	-4.161	-5.383
-32.923	-4.093	-5.583
-30.928	-4.242	-5.846
-29.725	-4.055	-6.041
-28.053	-4.213	-6.365
-25.427	-4.311	-6.853
-23.574	-4.283	-7.181
-21.199	-4.053	-7.156
-20.010	-4.184	-4.296
-14.793	-3.977	-0.818
-11.397	-4.184	1.445
-9.806	-4.200	2.506
-7.948	-4.204	3.745
-6.870	-4.116	4.464
-5.818	-4.020	5.164
-4.692	-4.103	5.915
-1.661	-4.267	7.710
0.000	-3.968	7.710
2.000	-4.225	7.710
13.542	-4.190	1.939
14.802	-4.195	1.309
16.455	-4.169	0.482
17.621	-4.116	-0.100
19.406	-4.253	-0.993
21.955	-4.291	-2.268
24.489	-4.280	-3.535
26.894	-4.239	-4.737
29.437	-4.243	-7.242

Section 4-4
Scale1:250

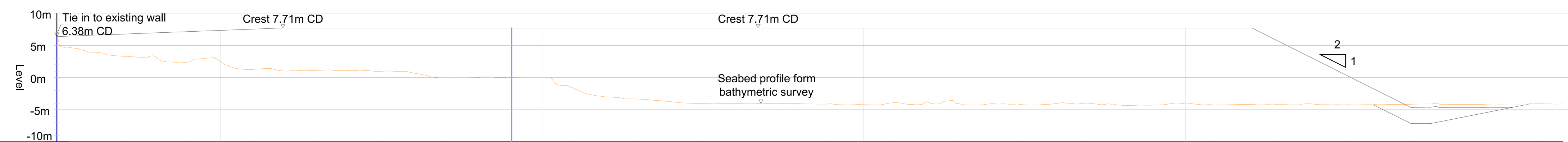
Plan
Scale 1:1000

Legend:-

- Dredge area
- Breakwater beacon
- Surface area of proposed development / Site Boundary
- Argyll & Bute Council Land Ownership
- Mean High Water Spring (MHWS) +4.00m CD
- Mean Low Water Spring (MLWS) +0.50m CD
- Existing ground level / seabed contour to Chart Datum
- BH01 Borehole Location and number from Causeway Geotech 2018 GI

Public Utility Legend:

- S Surface water sewer
- F Foul sewer
- C Combined sewer
- OT Telecom overhead
- T Telecom underground from Openreach online search tool.
- W Water main
- W Abandoned water main
- G Gas main
- E Electricity underground
- OE Electricity overhead
- FIBRE BT Fibre Cable from document "IS_Cables_Sound_Of_Iona.shp"
- OOS BT OOS Cable from document "OOS_Cables_Sound_Of_Iona.shp"



Chainage	Proposed Levels	Existing Levels
00.000	6.375	6.365
10.000	6.755	3.328
20.000	7.135	2.359
30.000	7.514	1.264
40.000	7.710	1.105
50.000	7.710	0.942
60.000	7.710	-0.044
70.000	7.710	0.053
80.000	7.710	-1.537
90.000	7.710	-3.322
100.000	7.710	-4.032
110.000	7.710	-4.002
120.000	7.710	-4.067
130.000	7.710	-3.900
140.000	7.710	-4.037
150.000	7.710	-4.214
160.000	7.710	-3.972
170.000	7.710	-4.291
180.000	7.710	-4.262
190.000	5.534	-4.142
200.000	0.535	-4.241
210.000	-4.465	-4.169
220.000	-5.850	-4.179
230.000		-4.055
233.998		-4.095

Long Section Through Breakwater
Scale1:500

NOTES:

1) Do not scale from this drawing
2) All levels are in metres relative to Chart Datum.
3) To be read in conjunction with drawing series 00040-33
4) Public Utility locations are shown indicatively from utility plans, the contractor must confirm the exact locations on site prior to the commencing of the works by undertaking CAT and GENI scans or equivalent.

SUFFIX	REVISION	DESIGNED BY INIT.	DESIGNED BY DATE	APPROVED BY INIT.	APPROVED BY DATE
G	BW Sections and footprint updated to match new tidied 3D model. Levels and chainages added to sections. Page up-sized to A0 and rearranged. foul sewer (toilet septic tank pipe) and note added to Section 1-1.	SAJG	02/06/22	ES	02/06/22
F	Section 1-1 updated to new crest level as per plan.	SAJG	04/04/22	ES	04/04/22
E	Toe batter rock size amended, Breakwater transmission slope start point mover seaward.	SAJG	02/02/22	ES	02/02/22
D	Toe batter remover from sections 1 -1 to 4 - 4 and detail, BW footprint amended.	SAJG	09/12/21	ES	09/12/21
C	Plan and typical section updated, sections and long profile added.	SAJG	26/11/21	ES	26/11/21
B	Breakwater and Site boundary amended, beacon, toilet foul outfall, public utility legend and Typical Section added. Piles removed.	SAJG	18/11/21	ES	18/11/21
A	Drawing reassembled, Public Utilities added, Legend and Notes amended.	SAJG	08/07/21	SAJG	08/07/21

Head of Roads and Infrastructure Services
Jim Smith

DESIGN OFFICE, MANSE BRAE,
LOCHGILPHEAD, ARGYLL, PA31 8RD

TITLE

Iona Breakwater

Proposed Sections and Typical Details

SCALES: As Shown @ A0

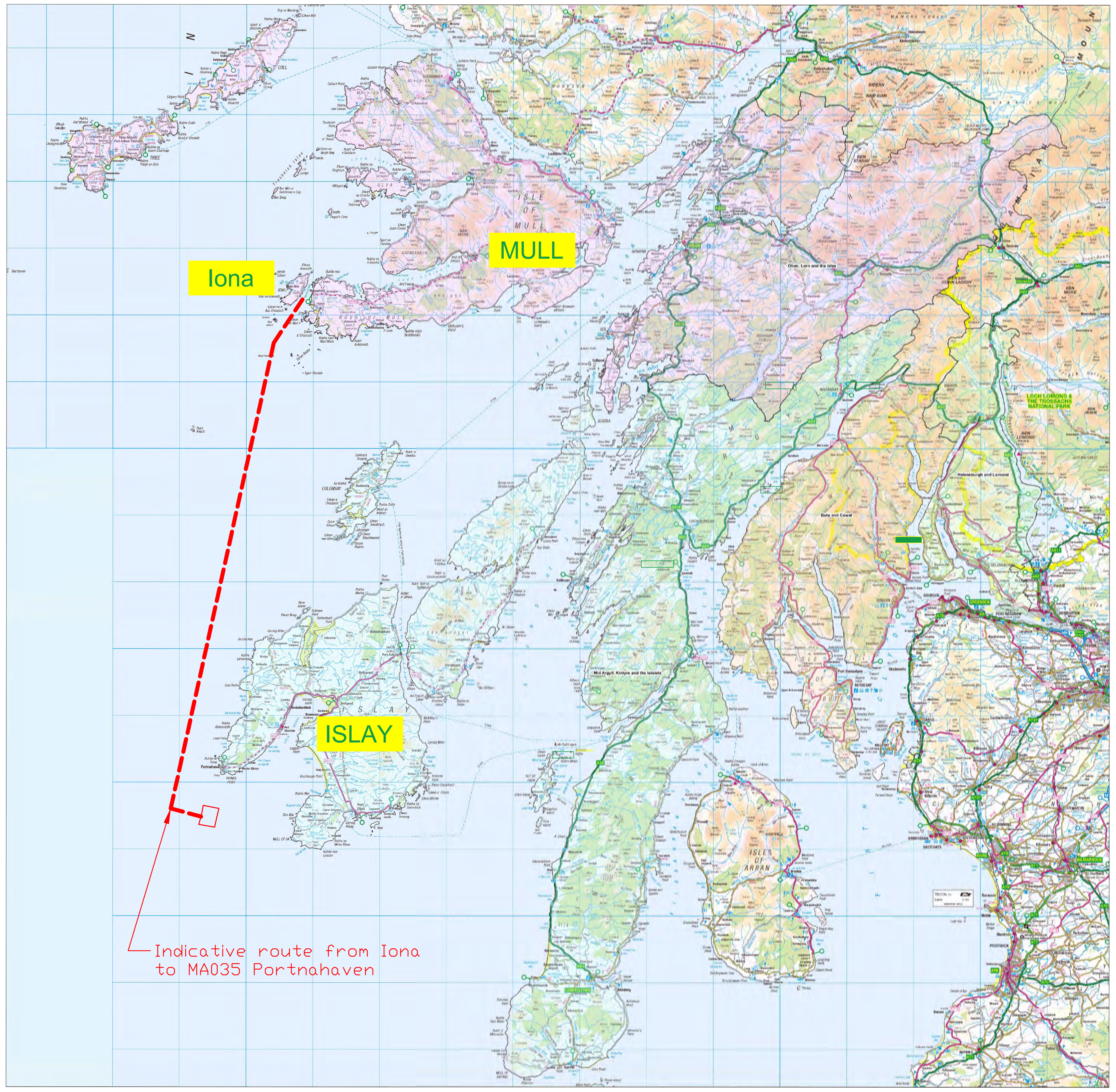
DESIGNED BY	JS
DRAWN BY	ST
CHECKED BY	ES
APPROVED BY	ES
DATE	16/10/2020

DRAWING No. 00040-33-04G

Argyll & Bute COUNCIL

Central coordinate for Open Dredge Disposal Site MA035 Portnahaven				
Co-ordinates (WGS84)				
Point	Eastings	Northings	Latitude	Longitude
X	115785	647334	55.63621 N	-6.51789 E

Proposed Dredge Disposal Site
MA035 Portnahaven, Isle of Islay
Not to Scale



Supplementary Location Plan
Not to Scale

NOTES:

1. All dimensions are in millimetres unless noted otherwise.
2. All levels are in metres relative to Chart Datum / OS Grid (OSTN02).
3. Do not scale from this drawing.

To be read in conjunction with Drawing Series 00040-33

Head of Roads and Infrastructure Services
Jim Smith

DESIGN OFFICE, MANSE BRAE,
LOCHGILPHEAD, ARGYLL, PA31 8RD

TITLE

Iona and Fionnphort

Proposed Dredge Deposit Location

SUFFIX	REVISION	DESIGNED BY INIT.	DESIGNED BY DATE	APPROVED BY INIT.	APPROVED BY DATE
A	Amended Dredge Disposal area to MA035 Portnahaven, Islay	NC	25/07/2023	ES	25/07/2023
-	-	-	-	-	-
-	-	-	-	-	-

SCALES	As Shown @ A1
DESIGNED BY	NC
DRAWN BY	NC
CHECKED BY	ES
APPROVED BY	ES
DATE	18/11/2021
DRAWING No.	00040-33-102A

Argyll & Bute COUNCIL

APPENDIX 6.1

Navigational Risk Assessment (NRA)

RPS

Iona Breakwater Project

Navigational Risk Assessment

August 2023





Innovative Thinking - Sustainable Solutions

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Iona Breakwater Project

Navigational Risk Assessment

August 2023

https://www.argyll-bute.gov.uk/marriage/2022/02/isle-of-mull/

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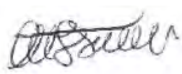
10 August 2023	4	Issued for client use -includes disposal ground alteration

Prepared (Author)	Approved (QM)	Authorised (PD)
Paul Moughtin-Leay	Richard Vaughan	Monty Smedley
		

Suggested Citation

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Notice

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Executive Summary

Baile Mòr is the Isle of Iona terminal for the Iona Ferry. The port has a slipway providing passenger and vehicle access to the ferry, as well as being used by local fishing vessels, recreational and privately-owned craft. The Iona ferry route is operated by CalMac Ferries Ltd (CFL) and provides a lifeline service linking the Isle of Iona to the Isle of Mull. The Iona Slipway is particularly vulnerable to waves from North, East and South; reducing the time available for safe launching/landing at the pier. Wave action can also result in excessive movement of the vessel at the berth, making landing and holding of the vessel in position difficult.

The Iona Breakwater Project consists of a new rock armour breakwater and associated access dredging. This will result in a much-improved service, improved ability for lifeline services to travel to and from Iona and the facilitation of wider forms of economic development on both sides of the Sound.

RPS commissioned ABPmer to carry out a Navigational Risk Assessment (NRA) in support of the marine licensing application for the Iona Breakwater. In total, this NRA has identified 20 hazard scenarios which have been assessed. A total of 16 hazard scenarios were identified for the construction phase and 4 hazard scenarios for the operational phase. Consultation has been conducted with stakeholders to draw out local user opinion. To inform the consultees, information defining the baseline navigational environment has been used, including a traffic assessment from one year of AIS data collected between 01 November 2021 to 31 October 2022.

The initial assessment identified 10 assessments with a current risk score outcome of significant or higher. Following the NRA process, 17 mitigation measures were identified, split between the Construction and Operational phases of the proposed development. After implementation of appropriate mitigation, marine risk to navigational receptors was reduced to a level of 'as low as reasonably practicable' as required by the Port Marine Safety Code (DfT, 2016) through the adoption of future mitigation controls.

Contents

Appendices

Tables

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1 Introduction

1.1 Background to project

Baile Mòr is the Isle of Iona terminal for the Iona Ferry. The port has a slipway providing passenger and vehicle access to the ferry, as well as being used by local fishing vessels, recreational and privately-owned craft. The Iona ferry route is operated by CalMac Ferries Ltd (CFL) and provides a lifeline service linking the Isle of Iona to the Isle of Mull. The current vessel on the route is the Motor Vessel (MV) *Loch Buie* (RPS, 2021).

The Iona Breakwater Project consists of a new rock armour breakwater and associated access dredging. This will result in a much-improved service, improved ability for lifeline services to travel to and from Iona and the facilitation of wider forms of economic development on both sides of the Sound.

The Iona Slipway is vulnerable to waves, particularly from the South; reducing the time available for safe launching/landing at the pier. Wave action can also result in excessive movement of the vessel at the berth, making landing and holding of the vessel in position difficult. The ferry holds its position at Iona using the weight of the ramp and the friction between the ramp and the slipway deck. The current berthing practice has a negative impact on service provision. These problems have had a direct impact on the lives of the people who live there. A day without a ferry operating results in essential services to the island being affected; such as medical, educational, refuse collection and other business deliveries (RPS, 2021).

1.2 Scope of work

RPS has commissioned ABPmer to carry out a Navigational Risk Assessment (NRA) in support of the marine licensing application for the Iona Breakwater. This NRA considers the effects of the proposed project on navigation and marine safety within the area proposed for the marine works, plus the wider effects of vessel traffic transiting to locations outside of the immediate area of study. The NRA assesses both the construction and operational phases of the proposed project, identifying appropriate mitigation measures for marine safety.

1.3 Study area overview

The Isle of Mull is located in the Inner Hebrides just of the west coast of Scotland in the council area of Argyll and Bute. Iona is located just off the west coast of the Ross of Mull, see Figure 1. The study area for the navigation assessment comprises the marine works within the Sound of Iona, plus the route the dredger and disposal craft will take between the dredge site at Baile Mòr and the proposed disposal site at Portnahaven, see Figure 2. The water space is outside of Statutory Harbour Authority limits, with the Maritime and Coastguard Agency (MCA) the responsible authority for marine safety.

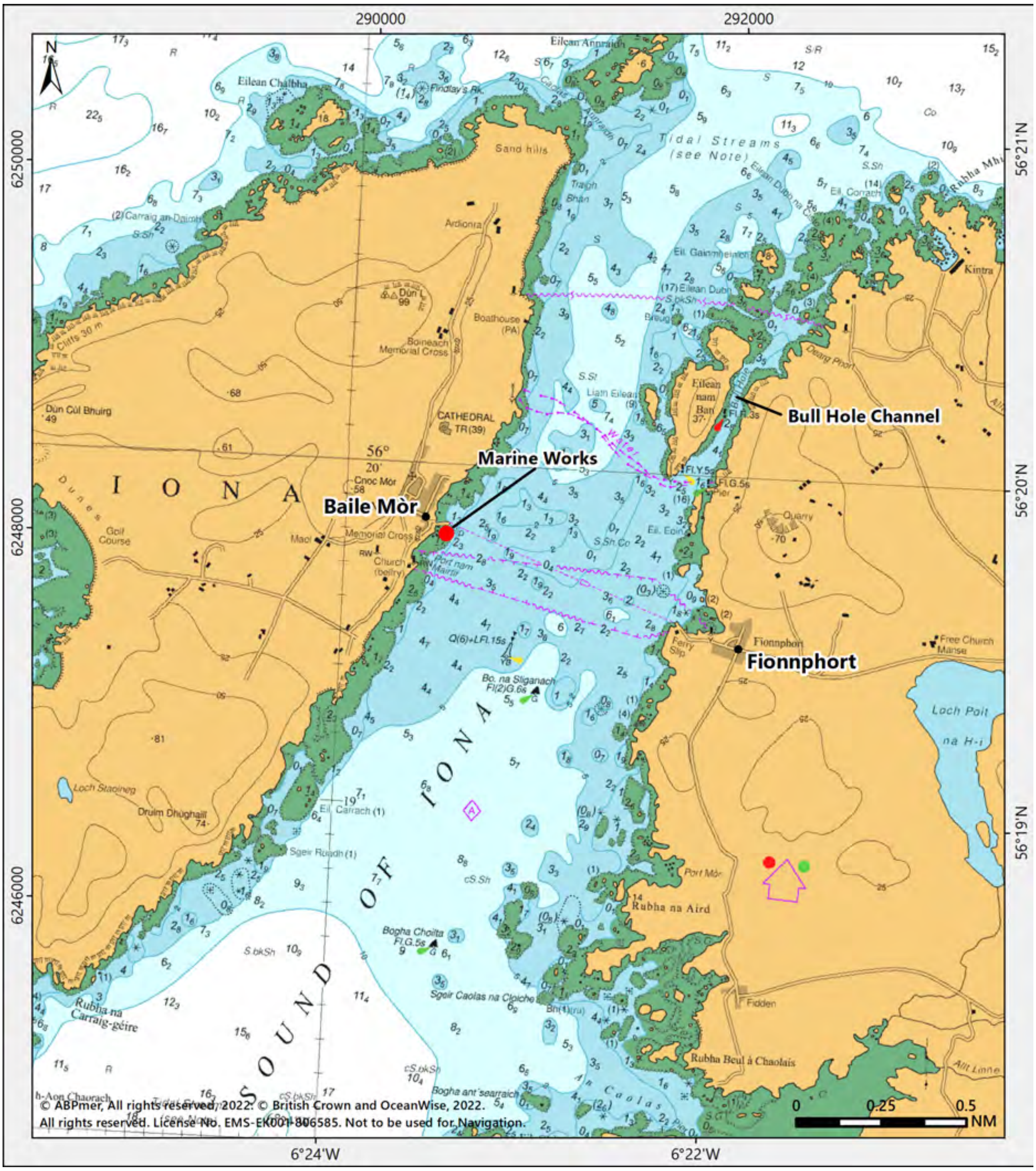

Figure 1. Sound of Iona Study Area

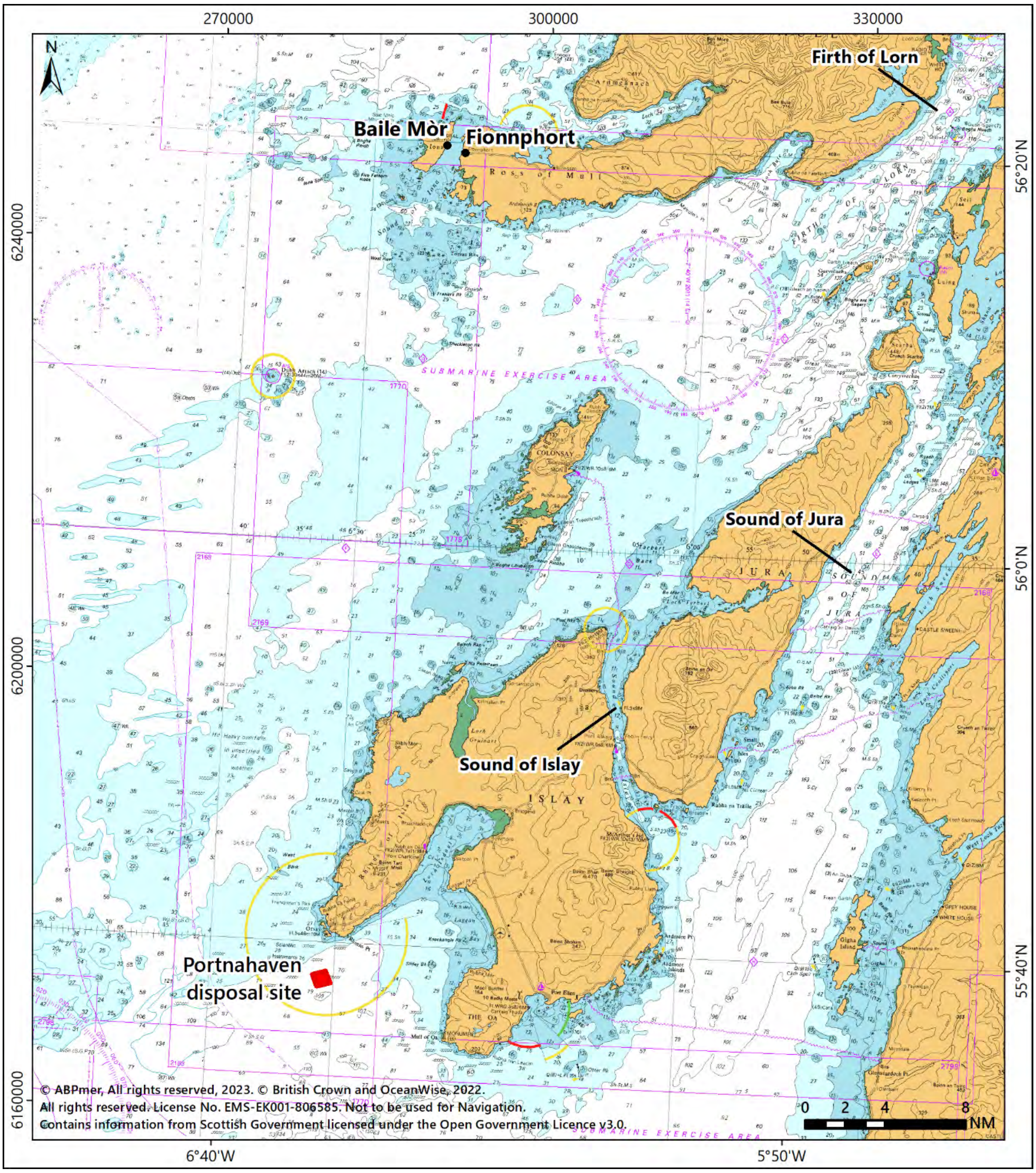

Figure 2. Wider Area Showing Portnahaven Dredge Disposal Site

1.4 Legislation and guidance

The following section identifies relevant legislation relating to navigational assessments for marine developments.

1.4.1 Primary legislation

International protocols and conventions relating to safety, laws of the sea and pollution apply to shipping and ports. The UK Government has a responsibility to ensure that measures are implemented in order to honour its commitments to these protocols. Not least of these is the UK's responsibility under Article 60 (7) of the United Nations Convention on the Law of the Sea (UNCLOS) relating to provisions for 'Artificial islands, installations and structures in the exclusive economic zone'. An NRA is one process by which the necessary considerations of developments can be evaluated.

Within UK territorial waters the UK Government uphold the right of innocent passage as defined in Article 17 of UNCLOS; beyond the 12 Nautical Mile (nm) limit of UK territorial waters shipping has the freedom of navigation. The regulation of shipping should be carried out by the 'flag state control' operated by the country in which the ship is registered. As this has proved unsatisfactory, 'port state control' has become common in national jurisdictions. Under this regime the UK Government represented by the inspection division of the MCA exercises the rights of the port state to inspect and, if appropriate, detain sub-standard ships. Sea ports and harbours provide the interface between the land, near shore and open sea. The UK Marine Policy Statement (UK Government, 2011) identifies, in relation to port developments and marine safety, that:

> *Marine plan authorities and decision makers should take into account and seek to minimise any negative impacts on shipping activity, freedom of navigation and navigational safety; and ensure that their decisions are in compliance with international maritime law"*
>
> UK Government, 2011

The majority of port operations are administered by a Statutory Harbour Authority (SHA). Every SHA is self-governed with specific local legislation (Acts of Parliament) creating the SHA as an entity, with further powers and amendments made over time in response to the changing scope and remit of the SHA. Underpinning the powers of a SHA is a range of national legislation which places statutory responsibility on the Harbour Master to ensure navigation and safety within the harbour limits; this includes the 'Harbours, Docks and Piers Clauses Act 1847' and the Harbours Acts 1964. Under such legislation, the Harbour Master may issue general or specific directions to control movements of vessels within their SHA in order to ensure safety. The breakwater and berth are located outside an established SHA and therefore the competent authority with respect to navigation is the MCA.

1.4.2 Secondary guidance

The UK National standard for the safe and efficient running of ports is the Department for Transport's (DfT) 'Port Marine Safety Code' (DfT, 2016) and its accompanying document 'A Guide to Good Practice on Port Marine Operations' (DfT, 2018). Certain sections of the following documents, which provide supplementary guidance, have also been considered in the preparation of this NRA:

- International Maritime Organization (IMO) Revised Guidelines for Formal Safety Assessment (FSA) for use in the IMO rule making process (IMO, 2018); and
- Marine Guidance Note (MGN 654) Offshore Renewable Energy Installations (OREI) safety response. Incorporating: Annex 1 Methodology for assessing marine navigational safety and emergency response risks of OREIs. Maritime and Coastguard Agency (MCA, 2021a).

As the competent authority for marine safety, the MCA has been consulted in the planning and creation of the supporting NRA. In addition, in its capacity as the General Lighthouse Authority (GLA), Northern Lighthouse Board (NLB) has been consulted with respect to the lighting and marking of the proposed project. In its capacity as the marine facility owner, Argyll and Bute Council has also been consulted and has referenced its operating instructions in the form of its Marine Safety Management System. (A&BC, 2023).

1.4.3 ALARP and tolerability principles

Risk assessment is based on a comprehensive and formal assessment of hazards with a view to either eliminating unsafe activities or reducing risks to 'as low as reasonably practicable' (ALARP). ALARP is an industry-wide concept, applying to both health and safety and port marine safety. Regardless of whether a scenario produces a minor or significant hazard, mitigation in the form of risk controls need to be taken into account to ensure that the risks overall are ALARP. Central to this standard is the term 'reasonably practicable'. To meet this standard, the NRA has applied the ALARP principle with respect to each individual assessment, the purpose being, to consider if the identified hazard can be reduced to a point which is both 'reasonable' and practicable' to do so. ALARP has not been defined as a threshold or benchmark target.

Further, the concept of 'tolerability' seeks to define the point at which a risk has an unacceptable outcome (a function of frequency and consequence) when measured against key criteria. Those criteria in respect of marine risk are defined in the Code's Guide to Good Practice as:

- Human life;
- The environment;
- Port/port user operations; and
- Port/shipping infrastructure damage (DfT, 2018).

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

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

When used as part of the NRA assessment process, relevant authorities (such as a Statutory Harbour Authority or developers) may determine whether a hazard outcome (risk) is both tolerable and ALARP.

2 Data Sources

2.1 Automatic identification system

Automatic Identification System (AIS) data from 01 November 2021 to 31 October 2022. AIS signals are broadly classified as 'Class A' and 'Class B'. AIS-A is carried by international voyaging ships with gross tonnage (GT) of 300 or more tonnes, fishing vessels with a Length Overall (LOA) of 15 m or more and all passenger ships regardless of size. AIS-B is sometimes carried by smaller vessels and is intended for use by smaller commercial vessels, the fishing sector and recreational vessel users; however, the use of AIS-B is non-compulsory and uses a lower strength transmitter than AIS-A. Both AIS-A and AIS-B data have been used within this study. The AIS data has been broken down using the following vessel categories which are taken directly from the AIS data transmissions, though not all vessel types are necessarily present in the observed area:

- Non-Port service craft;
- Port service craft;
- Vessels engaged in dredging or underwater operations;
- High speed craft;
- Military or law enforcement vessels;
- Passenger vessels;
- Cargo vessels;
- Tankers;
- Fishing; and
- Recreational.

The data used in this study has been sourced from a commercial provider by ABPmer to create a geodatabase of anonymised vessel transits. The data was collected from a network of AIS receivers between 01 November 2021 and 31 October 2022.

2.2 Recreational activity

Data for recreational activity in the study area has been collated using a variety of methods. Quantitative data has been derived from AIS-B records; however, it is recognised that this will not represent all recreational craft as many vessels of this type do not carry AIS transceivers as the use of AIS-B is non-mandatory. Using anecdotal information, it is known that the area is routinely used as a cruising route, local searches have identified that there are no yacht or sailing clubs within the study area.

2.3 Navigational features

Navigational features have been considered in this assessment and have been identified using information from UK Hydrographic Office (UKHO) Admiralty Chart Number 2617 'Sound of Iona'.

2.4 Maritime incidents

To characterise maritime incidents occurring within the study area, available data has been collated from a number of sources. These included records held by the Royal National Lifeboat Institution (RNLI) call-out data and Marine Accident Investigation Branch (MAIB) records.

2.5 Metocean

Wave and tide conditions for the study have been taken from RPS wave and tide models. The wave model predicts the wave height and mean direction for a 1 in 1 year storm using different wind directions. The tidal flow vectors are from spring and neap ebb and flows. Wind conditions for the study area have been compiled using the SEASTATES[1] dataset provided by ABPmer. The data represent historical hourly wind and wave characteristics for a 40-year period to provide analysis of conditions for the area.

1 ABPmer SEASTATES: www.seastates.net

3 Navigational Baseline

3.1 Navigational environment

The Sound of Iona separates the Islands of Mull and Iona, it is approximately 0.7 nm wide at the ferry crossing point. The Sound is approximately 4 nm long with the Isle of Erraid at the southern end and a number of smaller islands and skerries including Eilean nam Bàn, Eilean Dubh na Ciste and Eilean Ghòmhain. The Sound provides sheltered waters but can be exposed to south-westerly winds and swell from the south. There are multiple sand bars in the Sound which are known to shift after storm events. The tidal stream runs at a maximum of 2.5 knots (kts), which typically creates a choppy sea on the south running ebb tide when there is an opposing south-westerly wind (RPS, 2021).

Baile Mòr on the Isle of Iona is the location of Iona slipway and pier used by the Iona Ferry. Fionnphort is the Mull terminal for the Iona Ferry. Both ports have a slipway providing passenger and vehicle access to the ferry, plus a pier which is used by local fishing vessels, recreational and privately-owned craft.

Vessel traffic within the Sound of Iona can be characterised into two groups. The first is the ferry traffic which navigates between Fionnphort and Baile Mòr on the Isle of Iona (approximate east to west route, linking the Isles of Mull and the Isle of Iona). The second, is traffic transiting through the Sound (approximate north-east, south-west direction) which is comprised of fishing vessels, recreational vessels and the Staffa Tour boats which operate from Fionnphort and Iona Baile Mòr, see Figure 1 for locations.

The Iona ferry route is operated by CFL with the MV *Loch Buie* as the assigned vessel. The MV *Loch Buie* is 30.2 m length overall, with a beam of 10 m and a draught of 1.6 m. The crossing time is typically 10 minutes with the lifeline ferry service providing for passengers and occasional vehicles transported between the Isles of Mull and Iona.

3.2 Statutory responsibilities and management procedures

The marine access facilities at Baile Mòr slipway are owned by Argyll and Bute Council. However, the area does not form part of a Statutory Harbour Authority. This means the MCA, which is an executive agency of the Department for Transport (DfT), has the responsibility to ensure that the area is competently managed. The Iona to Fionnphort ferry is operated by CFL who provide the safety and management processes for all aspects of the shipboard operations including berthing.

The overnight berthing facility for the ferry is in a sheltered deep-water location in Bull Hole, see Figure 1. Bull Hole Jetty is located on the Isle of Eilean nam Ban, which CFL ferry staff access by boat from Dhearg Phort. The crossing is approximately 500 m, taking around 5 minutes to complete. There are safety risks associated with accessing the ferry via the 4.5 m boat, particularly during winter months. This means that in certain weather conditions the ferry is inaccessible and so the service is disrupted. The overnight berthing facilities at Bull Hole Channel and the access facilities at Dhearg Phort are owned by Caledonian Maritime Assets Limited (CMAL). It should be noted that the CFL crew are also available to carry out emergency medical evacuations from Iona when needed. This normally includes the crew accessing the ferry and then making the passage to Fionnphort to pick up the emergency services, before carrying out the crossing to Iona and back.

The overnight berthing facilities at Bull Hole Channel, located on the island of Eilean nam Ban are owned by Caledonian Maritime Assets Limited (CMAL). The waterside access facilities at Dearg Phort, used by CFL to board the transfer vessel to make the crossing to Eilean nam Ban are also owned by CMAL.

3.3 Aids to navigation

The Iona side of the Sound has (on average) greater water depth that the Mull side. At the southerly end of the Sound of Iona, depths are 6 to 8 m dropping off to 23 m. In the cross section between the two ferry terminals depths are *circa* 2 to 4 m. Lateral buoyage is arranged in a south to north orientation (i.e., port hand buoys on the Iona side, starboard hand buoys on the Mull side).

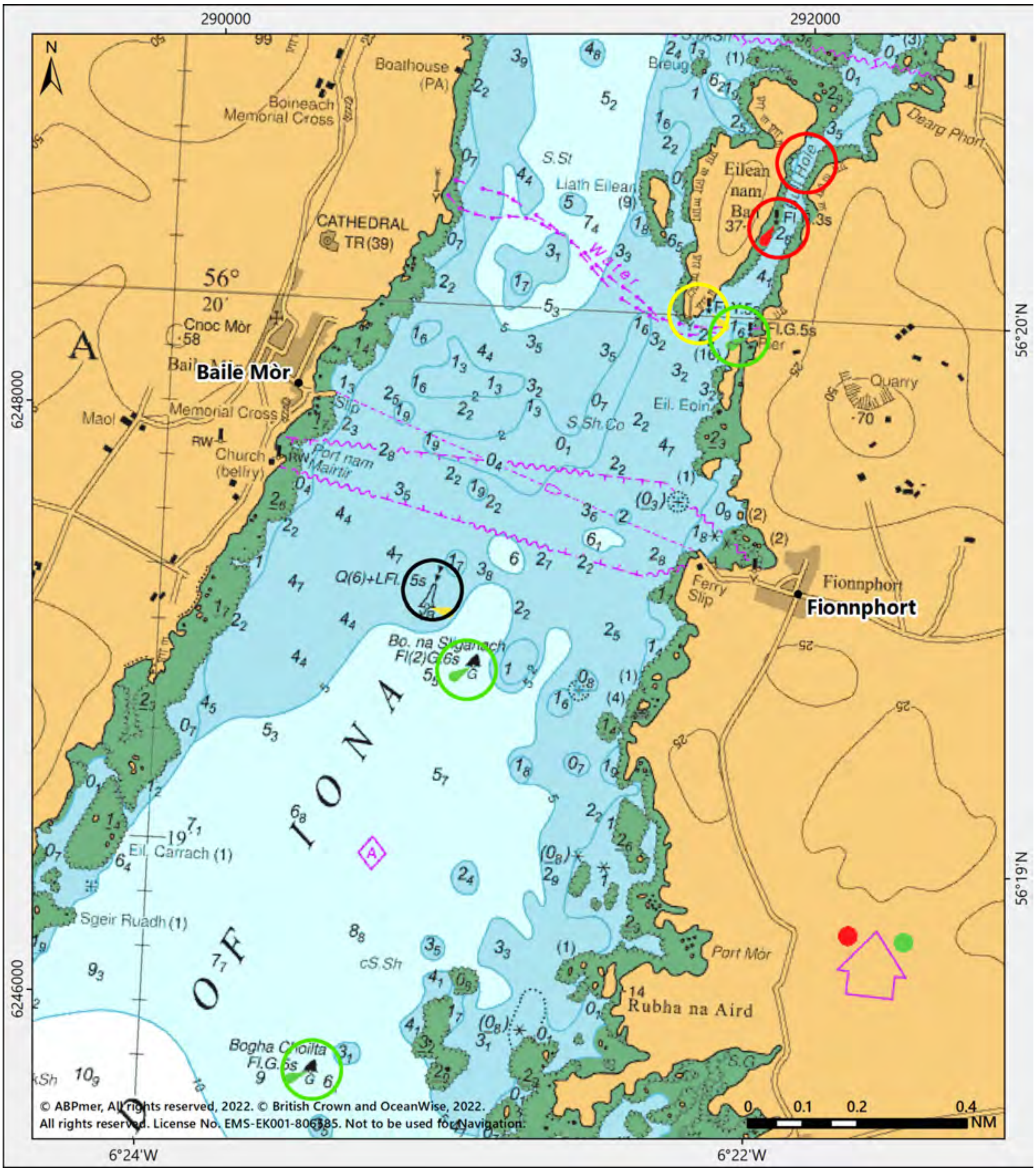

Figure 3. **AtoN in the Sound of Iona**

The following AtoN are established:

- Two lateral green marks (named as Bogha Choilta and Bo. na Silganach) in the Sound of Iona;
- One lateral red mark in the Bull Hole channel);
- A southern cardinal marker to marker approximately mid-way along the Sound of Iona;
- Two lateral port markers in Bull Hole Channel (on the berthing structure and one marking Little Bull Rock)
- One lateral starboard marker at the southern end of Bull Hole Channel; and
- One special mark at the southern end of Eilean Nam Ban.

3.4 Emergency response

A range of emergency response is available within the study area. The following organisations provide resources to assist if a marine emergency occurs.

3.4.1 HM Coastguard

The MCA is responsible for the initiation and coordination of all civilian maritime search and rescue operations within the UK Maritime Search and Rescue Region. This includes the mobilisation, organisation and tasking of adequate resources to respond to persons in distress at sea, or to persons at risk of injury or death along the shoreline within the UK. HM Coastguard has access to a range of resources including aircraft and coastal search teams. The study area falls within the jurisdiction of the Stornoway Coastguard Operations Centre in Lewis.

3.4.2 Local rescue organisations

There are nearest lifeboat stations to the Sound of Iona are listed below with a brief overview. The closest is located in Tobermory.

- **Islay Lifeboat Station** is manned by a voluntary crew operating an all-weather Severn Class lifeboat
- **Oban Lifeboat Station** is manned by a voluntary crew operating an all-weather Trent class lifeboat.
- **Tobermory Lifeboat Station** is manned by a voluntary crew operating an all-weather Severn class lifeboat.

3.5 Marine incidents

This section reviews marine incidents that have occurred within the study area over the past 10 years (subject to the availability of data). The analysis is intended to provide a general indication as to whether the study area is in an area of low or high risk in terms of marine incidents. Data from the MAIB and the RNLI has been obtained, covering the following timescale:

- RNLI: complete dataset of all callouts from 2010 to 2019 inclusive.
- MAIB: information includes accidents to ships and personnel reports to the MAIB from 2010 to 2019 inclusive.

Where possible, duplication of data has been removed (as the same incident may have been recorded by both organisations). The complete combined dataset has been presented spatially in Figure 4. This identifies that there were two RNLI recorded incidents in the 10-year period. The first was in 2010 and was recorded as a grounding; the other was in 2016 and was recorded as a vessel equipment failure.

There were three MAIB recorded incidents in the same 10-year period. The first was in 2012 and was categorised as a person in distress. The second and third were both in 2017 and recorded as a vessel equipment failure and a vessel grounding. Notably, both groundings were near Erraid in an area with numerous rocky outcrops which the chart identifies to cover and uncover with the tide.

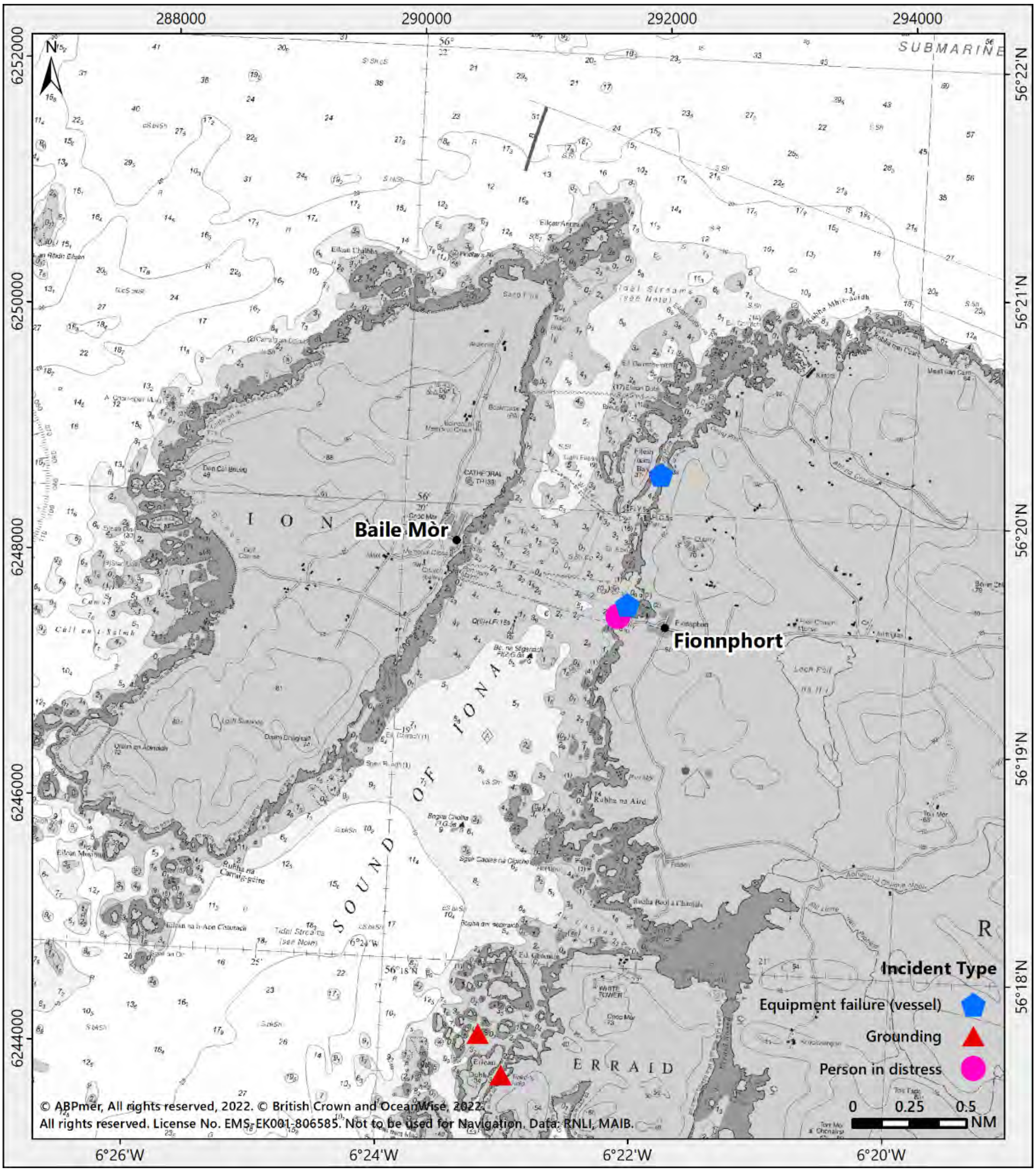

Figure 4. **Marine Accidents and Incidents by type – 2010 to 2019**

4 Metocean

4.1 Tides

Figure 5 shows a neap flood tide where the current flows in a northerly direction. The majority of the tidal flow is aligned to the Sound of Iona. The peak neap tide flow is around 1.56 knots (equivalently 0.80 m/s) and mainly occurs to the north of the villages of Baile Mòr and Fionnphort.

Figure 6 displays a neap ebb flow and shows the tidal current moving in a southerly direction. Again, this aligns to the orientation of the Sound of Iona. The peak tidal flow is approximately 2.0 knots (1.0 m/s) and located just to the north of the approximate midpoint between Baile Mòr and Fionnphort. Back eddies are likely close to shore of the Isle of Mull where small islands break up the flow at the northerly entrance to the Sound.

The tidal flows for a spring flood through the Sound of Iona are shown in Figure 7. The spring tide has a It has a peak flow of 2.02 knots (or equivalently 1.04 m/s) just north of the midpoint of the intersection between Baile Mòr and Fionnphort.

In Figure 8 the spring tide ebb flow is shown for the Sound of Iona, its peak flow is over 2.0 knots (1.0 m/s) just north of the midpoint between Iona and Fionnphort. This is the maximum tidal flow for both spring and neap ebbs and floods. It is likely that close to the island's shoreline there are back eddies, particularly on the Isle of Mull coast.

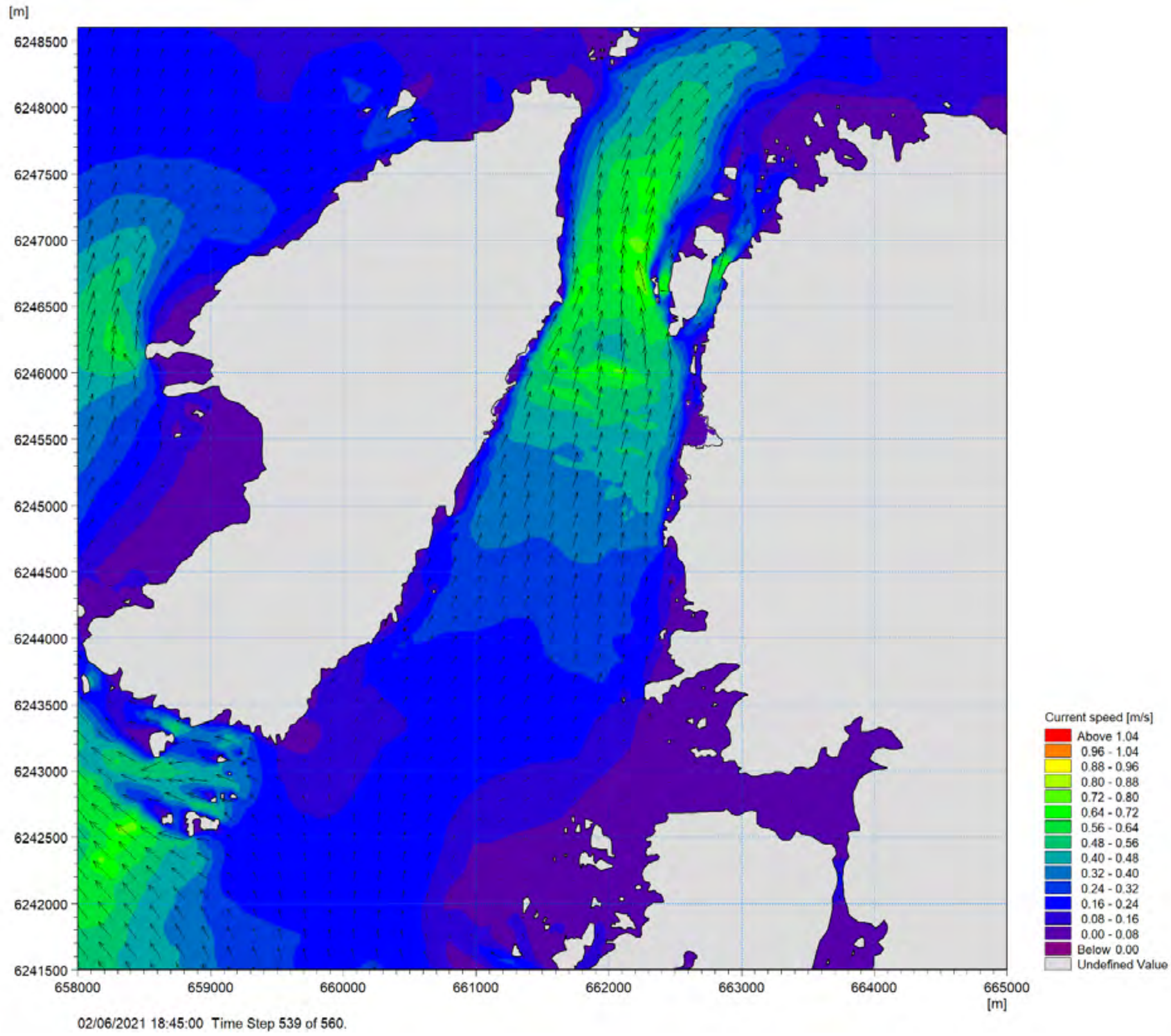

Figure 5. Typical neap tidal flood (north going) current flow through the Sound of Iona

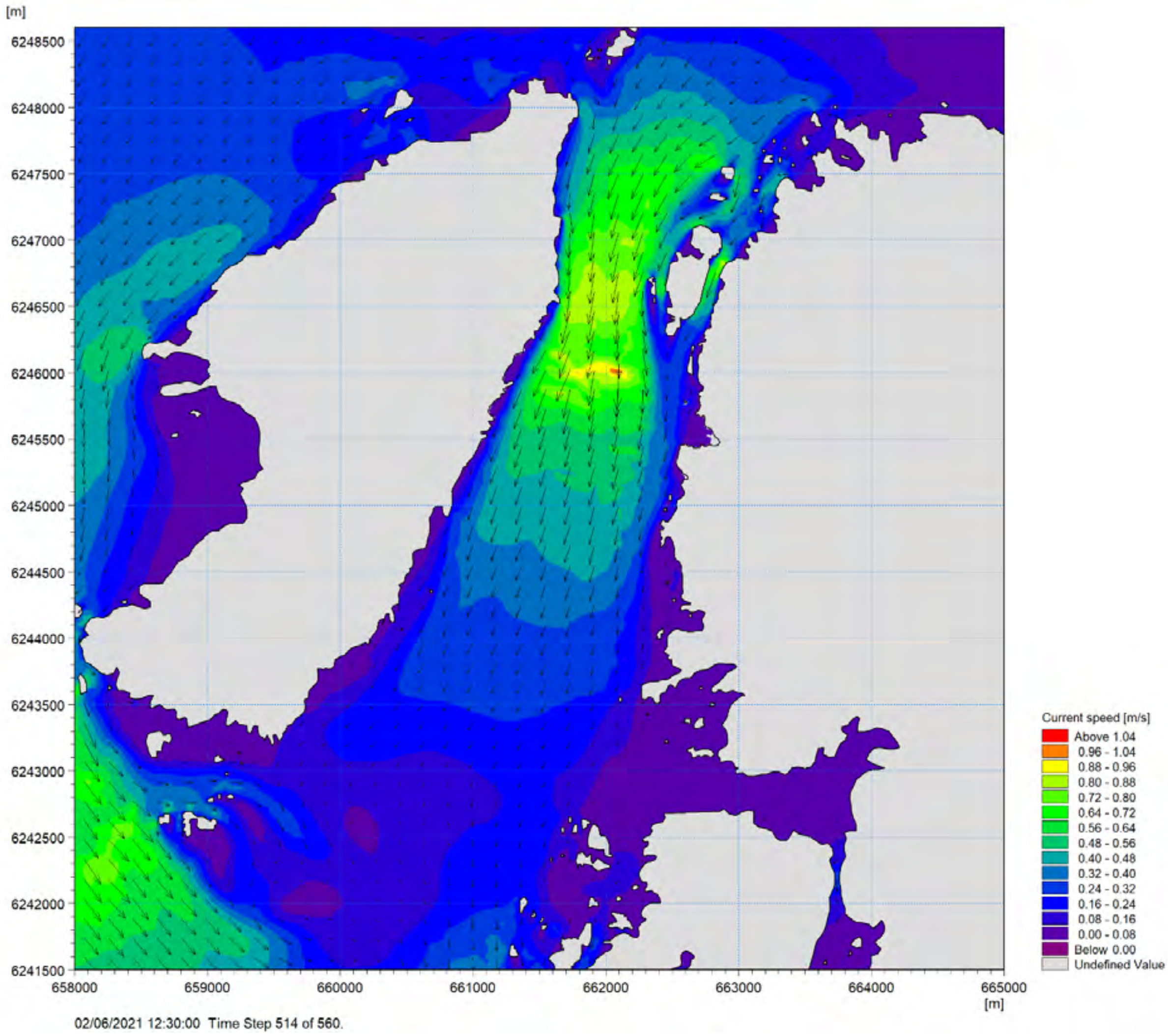

Figure 6. Typical neap tidal ebb (south going) flow through the Sound of Iona

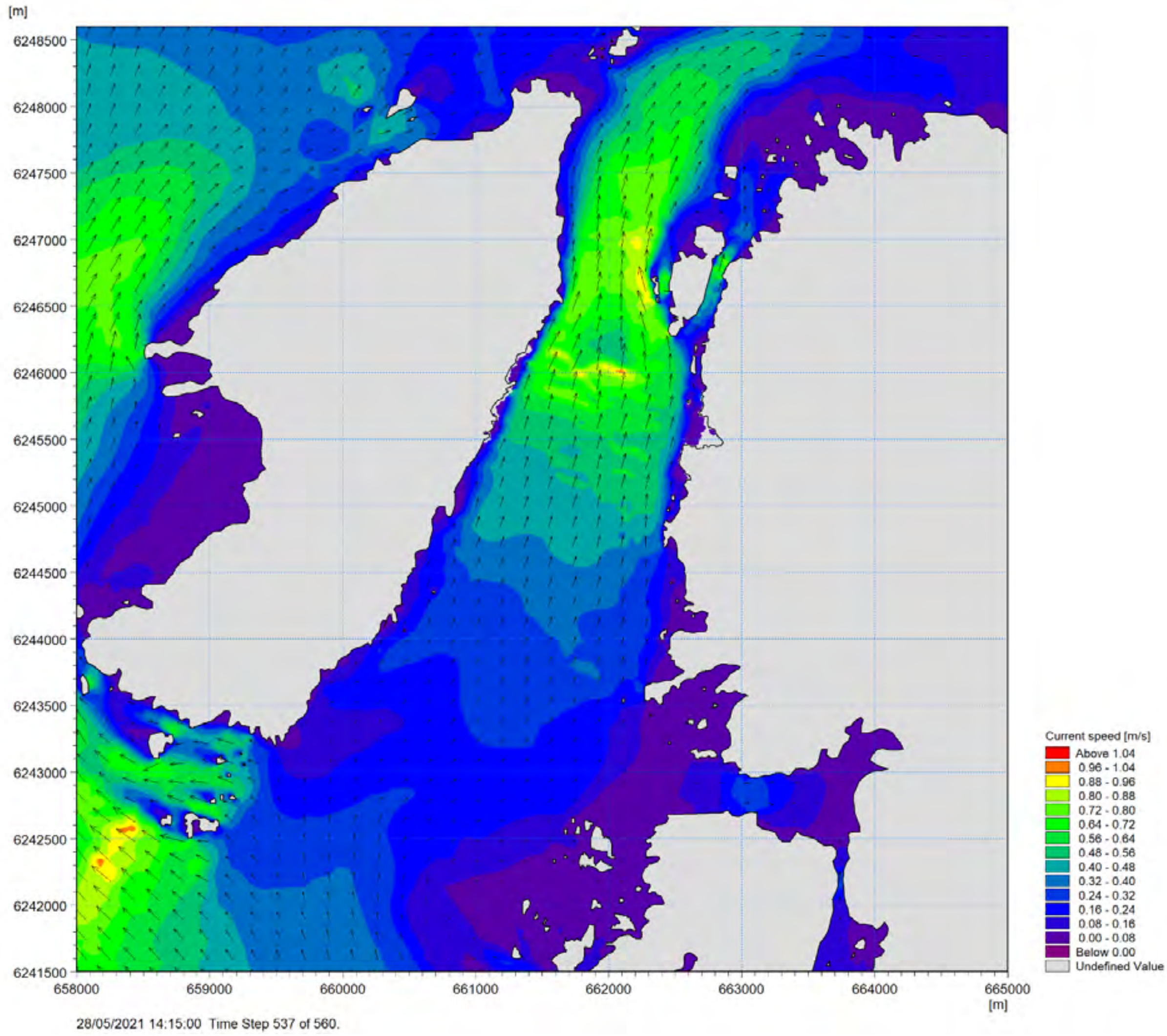

Figure 7. Typical spring tidal flood (north going) flow through the Sound of Iona

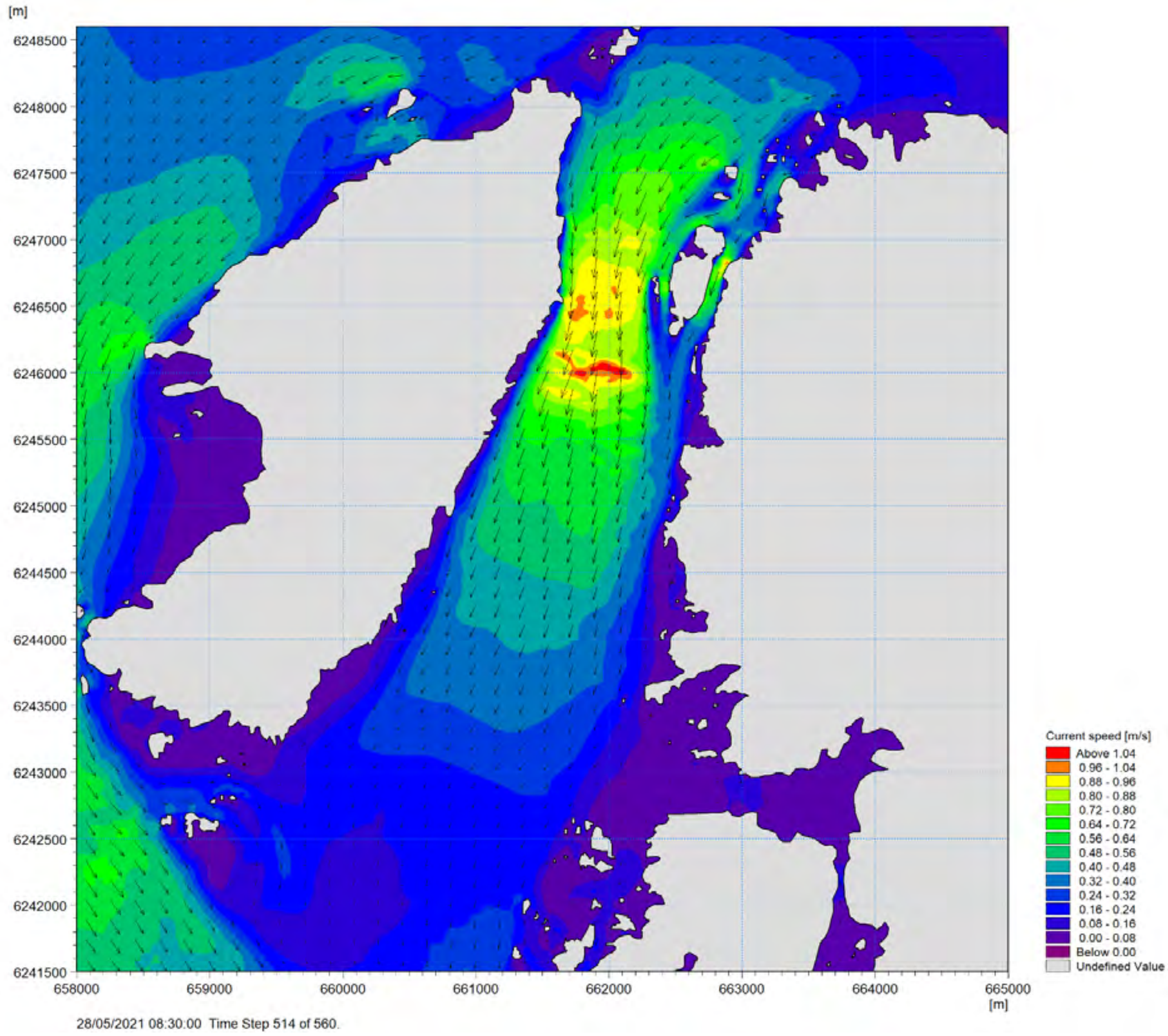

Figure 8. Typical spring tide ebb (south going) flow through the Sound of Iona

4.2 Waves

The model uses different wind directions in order to predict significant wave height during high water (since this will have higher waves due to the nature of tides). This has been carried out for a 1 in 1 year storm return period meaning these wave heights are likely to be experienced annually. The model has been run with wind coming from north (0°), west-southwest (240°), northwest (315°) and south-southwest (210°). Outputs from the wave model are shown Appendix A.

When wind is coming from 240 degrees (which roughly corresponds to west-southwest) the wave heights are much greater towards the southernly end of the Sound. Along the line roughly corresponding to the transect line between Iona and Fionnphort, the maximum wave heigh is 3.0 m. At the southern end of the Sound waves are over 5.0 m in height. The waves travel northerly aligned with the Sound.

When the wind is coming from 315 degrees (which roughly corresponds to northwest) Iona shelters the Sound. Maximum wave heights in the central area of the Sound are 1.0 m but this height increases closer to the northerly and southerly ends of Sound of Iona. The majority of waves travel towards the Isle of Mull.

With northerly winds, the most significant wave height in the Sound of Iona is 1.12 m with wave height decreasing towards the islands. Waves travel southerly aligned with the Sound of Iona.

When the wind is from 210 degrees (which roughly corresponds to (south-southwest)) waves travel northerly up the Sound of Iona parallel to the islands. Wave heights decrease northerly up the Sound with maximum wave height on the transect line between Baile Mòr and Fionnphort being 2.4 m. Maximum wave height at the southern end of the Sound is 3.6 m.

4.3 Wind conditions

Figure 9 shows a wind rose diagram for a location to the south of the proposed project area. This provides an indication of wind conditions. Figure 9 identifies that the wind is predominantly from the south, south west and west of the site and to a lesser extent from the south east. The strongest winds of greater than 16 m/s (Beaufort wind force 7) are predominantly from the south through to the south west. Due to the position of the Sound, it is likely that Iona provides some protection from north westerly winds.

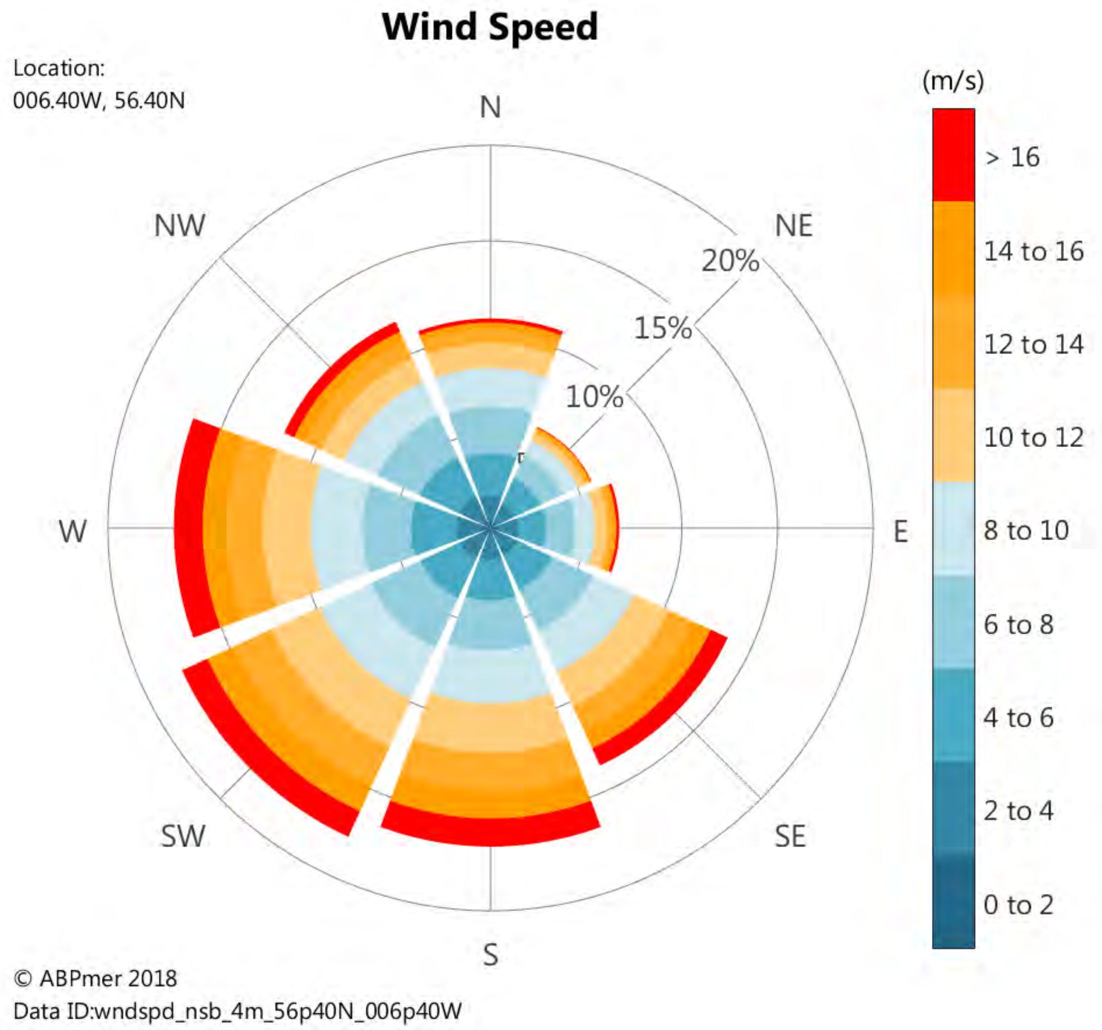

Figure 9. Wind rose for the study area

5 Marine Traffic Analysis

This section analyses the vessel traffic routeing through the study area using 365 days of data (from 01 November 2021 to 31 October 2022). Figure 10 to Figure 18 shows the AIS transits for the Sound of Iona, Figure 19 to Figure 27 show the AIS transits for the wider study area. Traffic density is presented in Figure 28 and Figure 29.

5.1 Recreational vessel movements

Figure 10 shows AIS transits for the recreational vessel movements through the study area. Whilst it is acknowledged that a large proportion of recreational vessels do not use AIS, the information still provides an indication of the vessel routeing through the area.

It can be seen from Figure 10 that recreational vessels tend to transit past the marine works close to the shore on either the Iona or the Fionnphort side, avoiding the shallower water at the centre of the Sound. A number of vessels transits can be seen in Bull Hole Channel which is a popular anchorage as it is sheltered from the prevailing wind and wave conditions for the area.

It is known from anecdotal information that a passage around the Isle of Mull, including transiting through the Sound of Iona is a popular cruising route. Vessels visiting the Western Isle may also plan an overnight anchorage in the Sound if the wind and wave conditions permit. Bull Hole Channel provides access to Fionnphort where a short tender ashore provides access to welfare services.

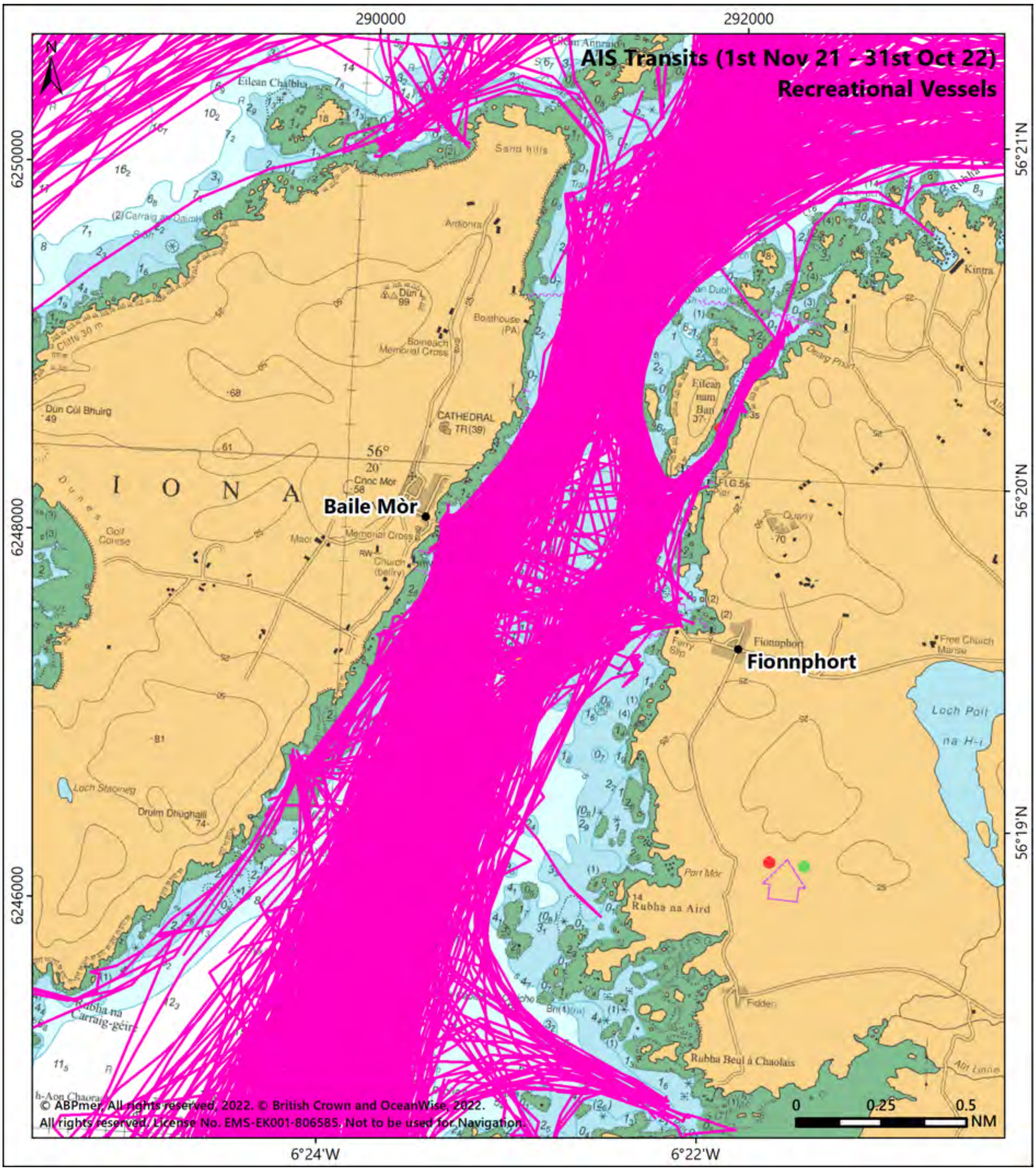

Figure 10. **AIS Transits – Recreational vessels**

5.2 Passenger vessels

The majority of passenger vessel transits are between Baile Mòr and Fionnphort as seen in Figure 11, these transits are predominantly the CFL ferries (including the MV Loch Buie, MV Loch Linnhe and MV Loch Tarbert). The differences in the routeing between Baile Mòr and Fionnphort are due to the ferry using a different passage around the shallower area in the centre of the Sound due to weather and tidal conditions at the time of the passage. A number of passenger vessel transits are also seen proceeding into/out of Bull Hole Channel. These are the ferry moving to its overnight mooring which is located on the north-eastern side of Eilean nam Ban.

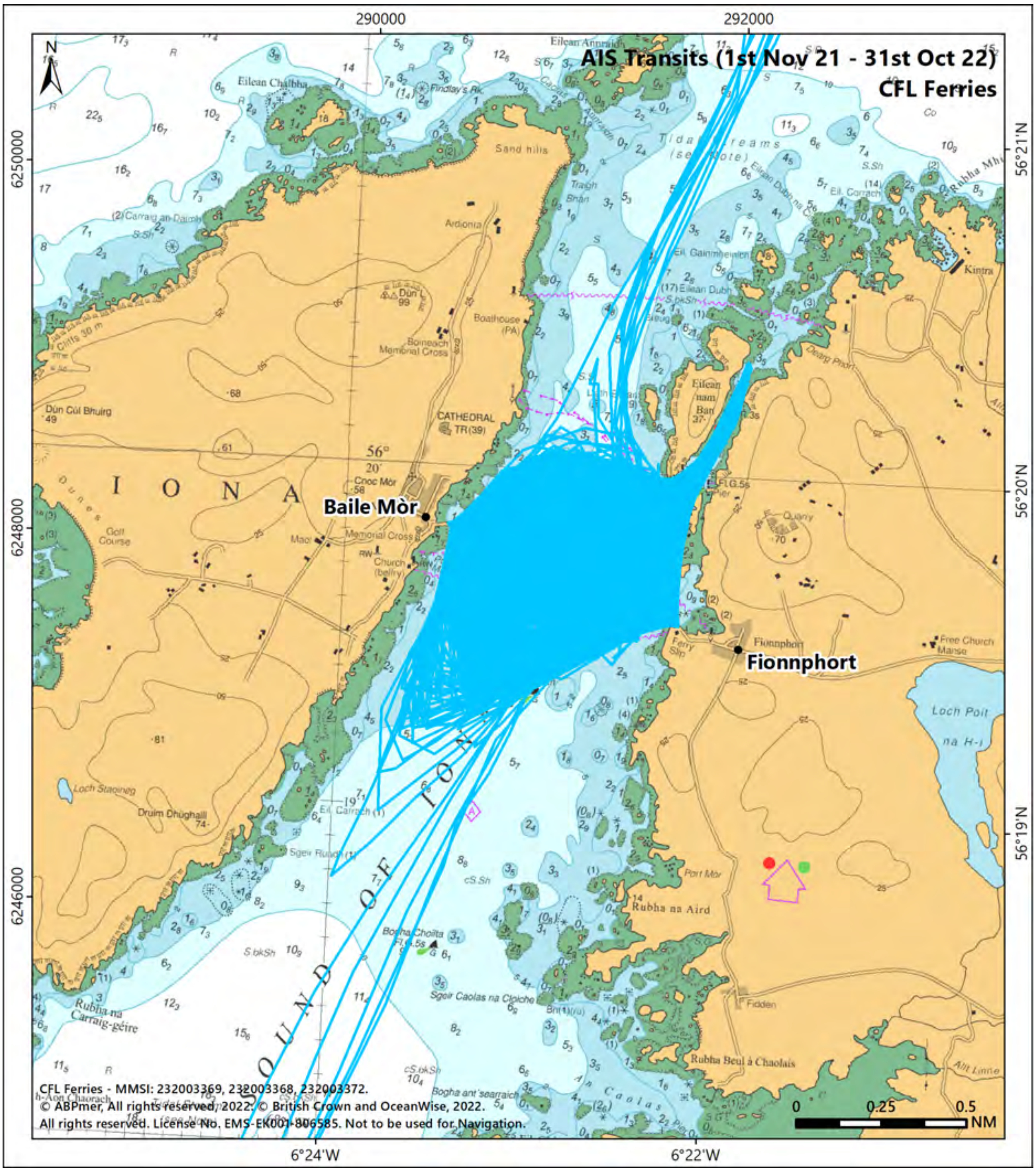

Figure 11. AIS Transits – Passenger Vessel – CFL Ferries only

There are also a number of passenger vessel movements along the Iona Sound, some of these transits will be associated with tour boats operating in the area, see Figure 12. Others are small passenger coded craft that ferry people across the Sound independently of the CFL ferry. Cruise ships also anchor at either end of the Sound.

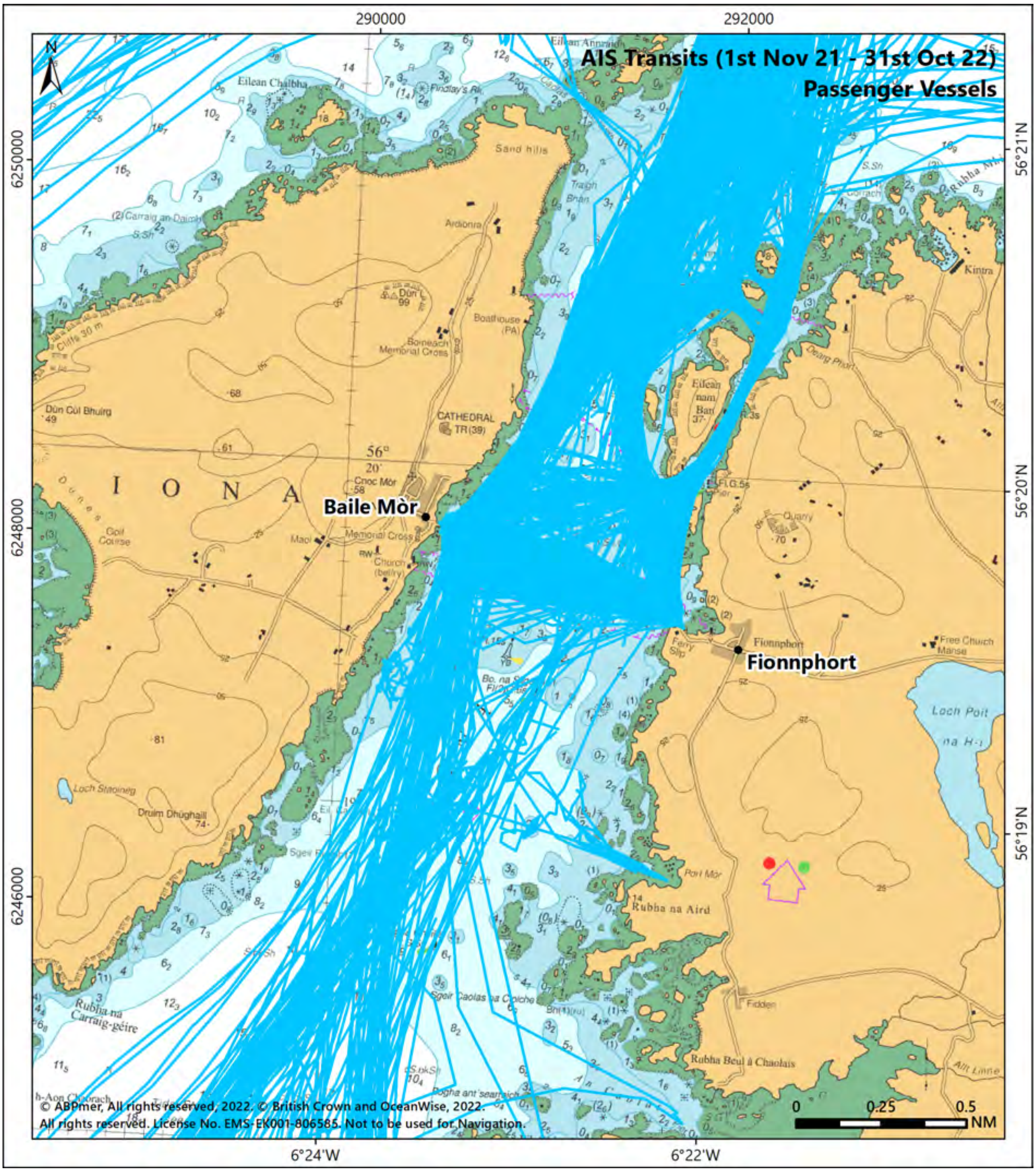

Figure 12. AIS Transits – Passenger Vessels (excluding CFL Ferries)

5.3 Fishing vessels

Fishing vessel activity is provided on Figure 13 which depicts AIS vessel activity in the study area. It can be seen from the limited data that fishing vessel transits are through the Sound of Iona, to/from Fionnphort as well as in close proximity to the shoreline. Interrogation of the AIS data shows that the majority of the transits have been made by two small AIS equipped fishing vessels. There is no requirement for fishing vessels less than 15 m LOA to use AIS and it is known that there many other small day fishing and potting boats operating within the area.

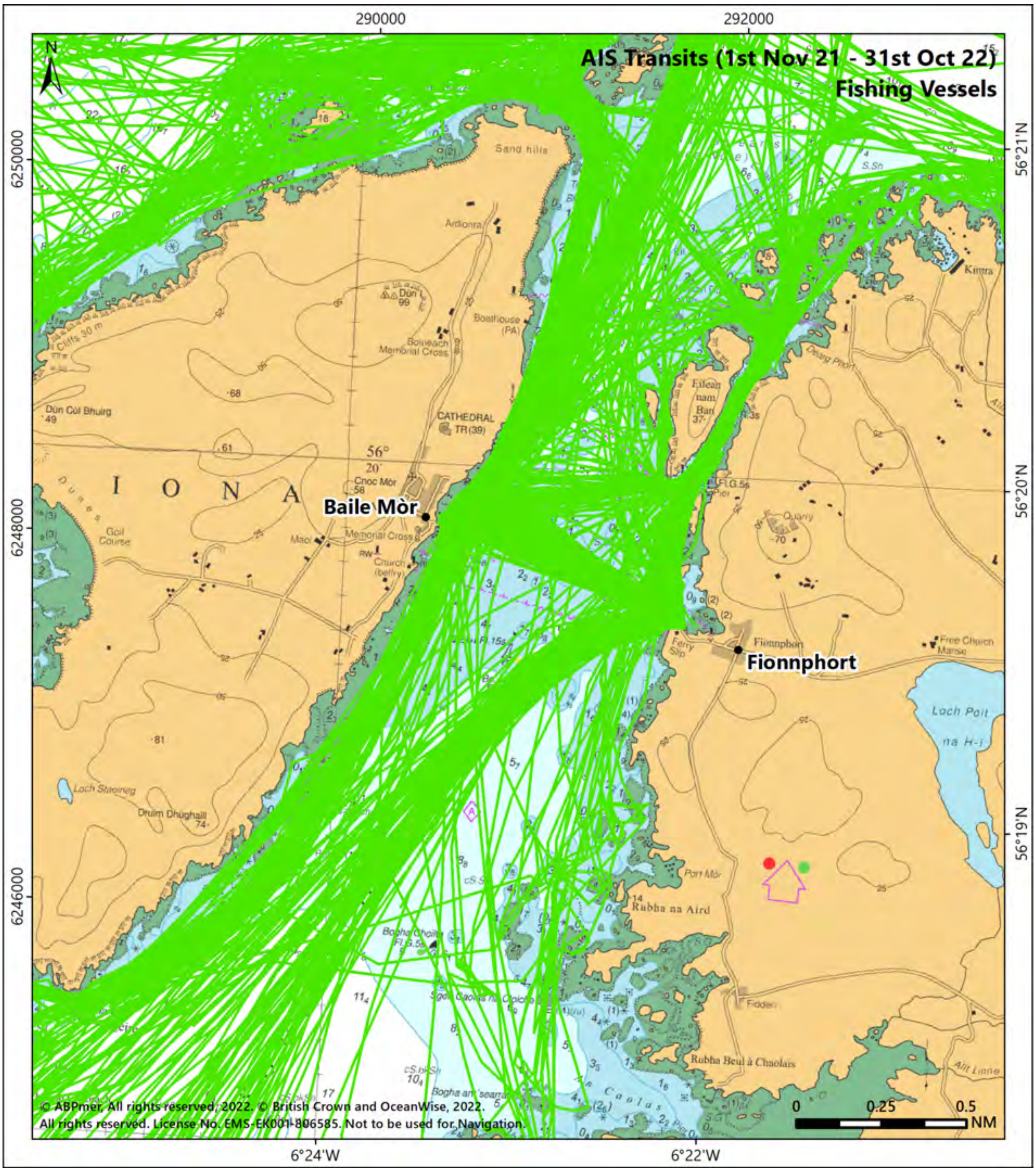

Figure 13. AIS Transits – Fishing vessels

5.4 Dredging or underwater operations

Figure 14 shows vessels categorized as being involved in dredging or underwater operations. Interrogation of the vessel tracks showed two different vessels which were being used for diving operations. As the limited number of tracks show this is not a vessel type that frequents the study area very often with a limited number of transits during the year dataset.

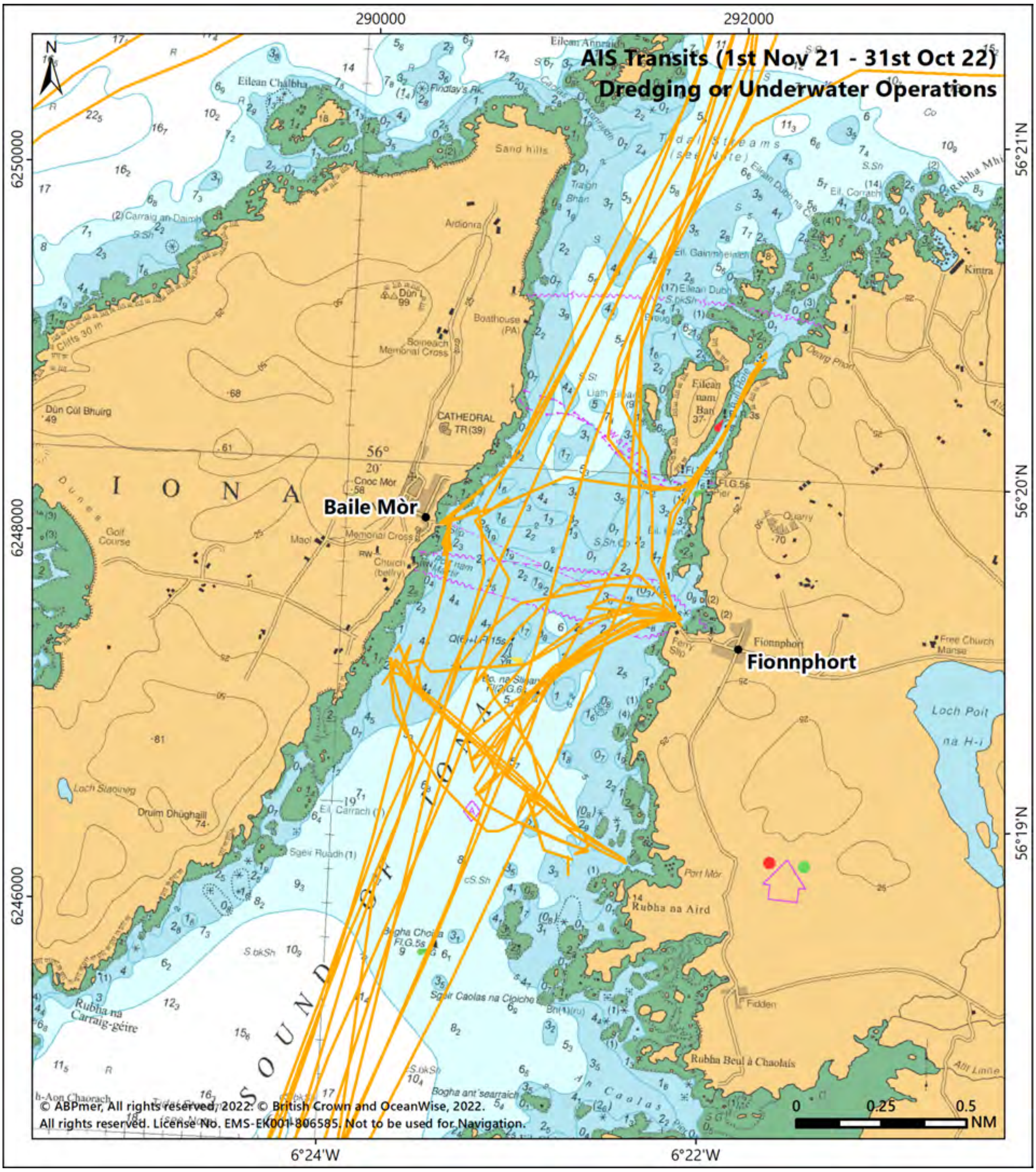

Figure 14. AIS Transits – Dredging or underwater operations

5.5 High speed craft

This AIS data shows high speed craft using the study area, investigation of specific craft routeing identifies vessels that are predominantly used for bathymetric and inshore survey work, multi-role private hire commercial craft and vessels used for sightseeing trips. As seen in Figure 15 the vessels in this category mainly operate in and out of Baile Mòr and keep to the west side of the Sound. Crossing traffic to the south of the Sound is generally indicative of survey work being carried out.

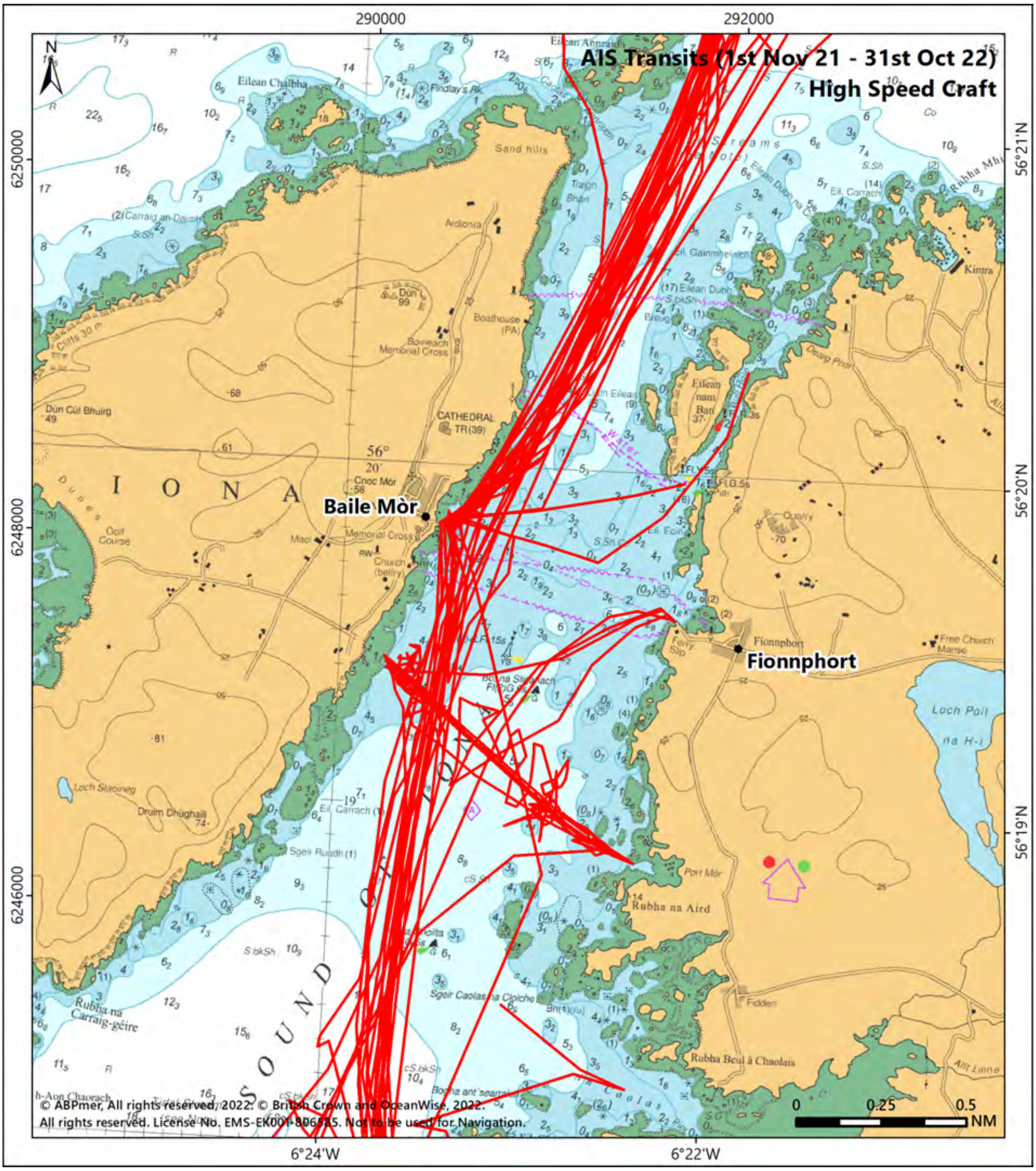

Figure 15. AIS Transits – High speed craft

5.6 Cargo vessels

There are very few movements made by cargo vessels in the Sound. Interrogation of the AIS data shows the cargo vessels to be small workboats and landing craft. The tracks shown in Figure 16 indicate that most of the transits were passing through the Sound, with only one transit indicating a port call at Baile Mòr.

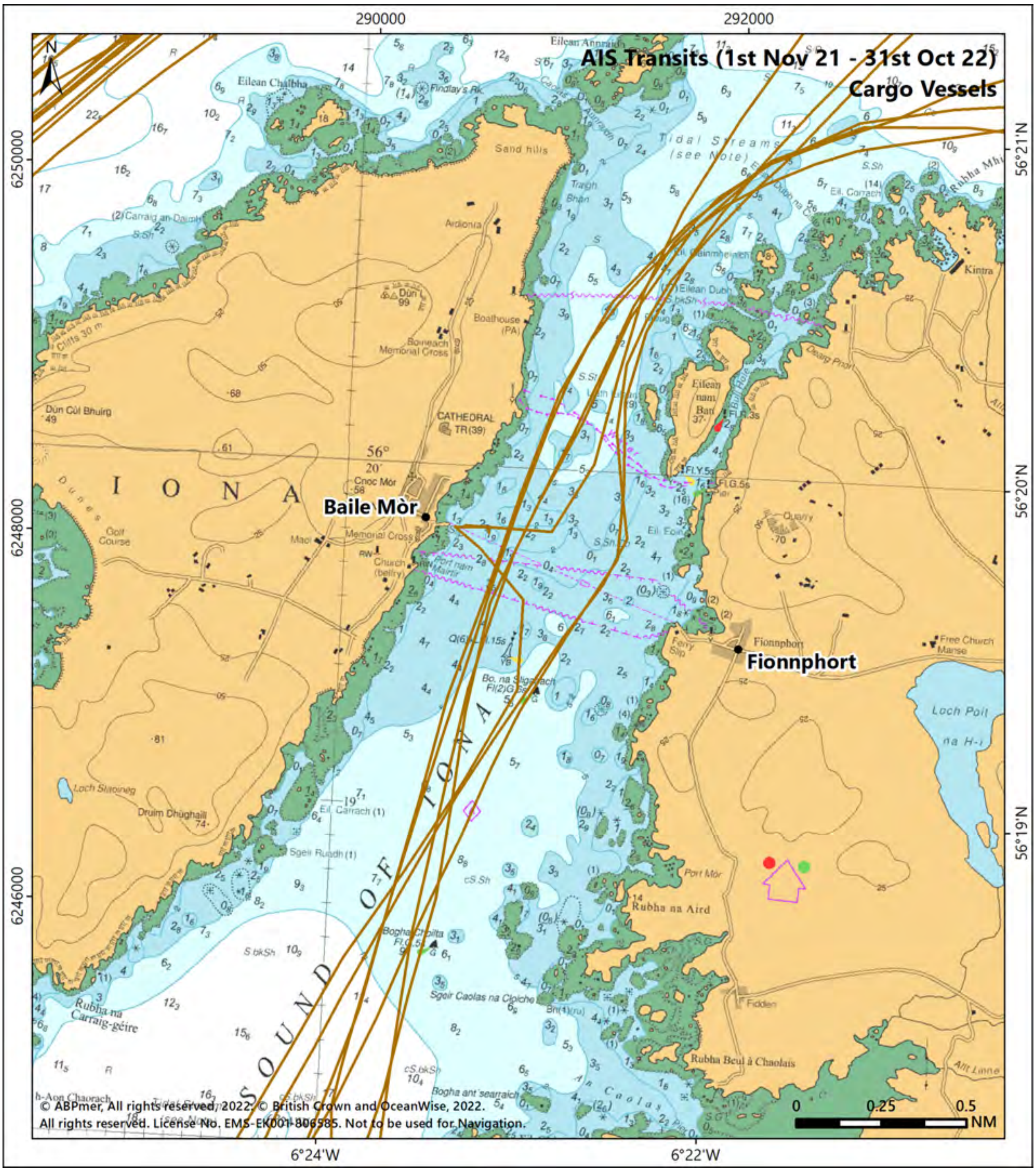

Figure 16. AIS Transits – Cargo vessels

5.7 Port service craft

Iona receives calls from several cruise ships throughout the year. These ships have too deep a draught to be able to safely navigate the Sound. As such they berth in safe water to either the north of south of the Sound and use tenders to ferry the passengers ashore. Figure 17 shows vessel tracks from a number of such cruise ship tenders. They typically disembark passengers at Baile Mòr, though a smaller number of vessel tracks indicate visits to Fionnphort. This category may also include workboats.

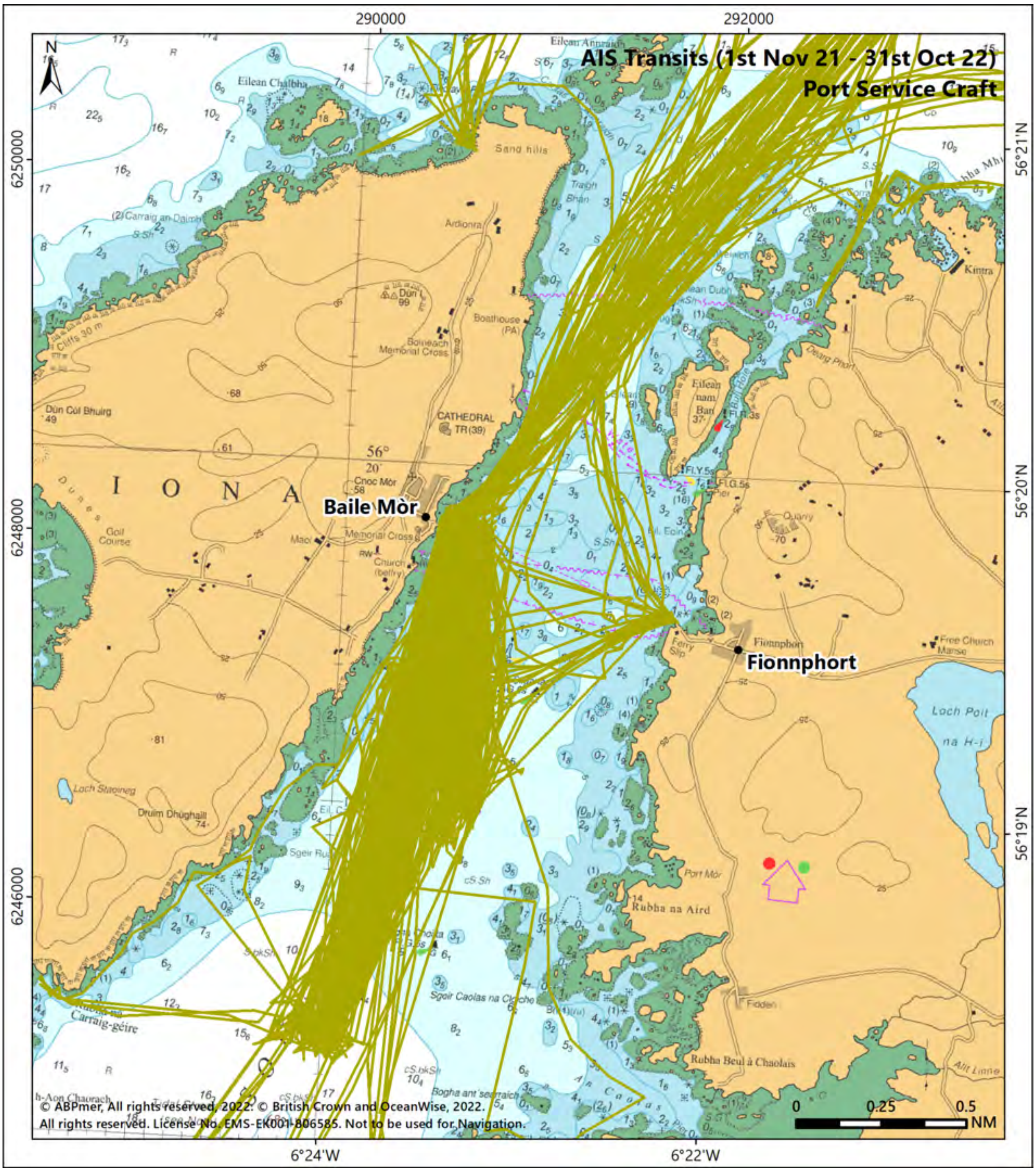

Figure 17. AIS Transits – Port service craft

5.8 Non-port service craft

Examination of the AIS data shows different vessel types within the category including workboats, Rigid Hull Inflatable Boats (RHIBs) and small tugs. Although Figure 18 indicates that few vessels falling into this category are present in the Sound, it should be noted that a number of similar small craft may be operating that are not broadcasting AIS signals. The majority of the transits are towards to the south of the Sound with calls into both Baile Mòr and Fionnphort. Some transits are in the vicinity of Bull Hole where it is known that workboats are used to ferry crew to and from the MV Loch Buie at its overnight berth on Eilean Nam Ban from Dearg Phort.

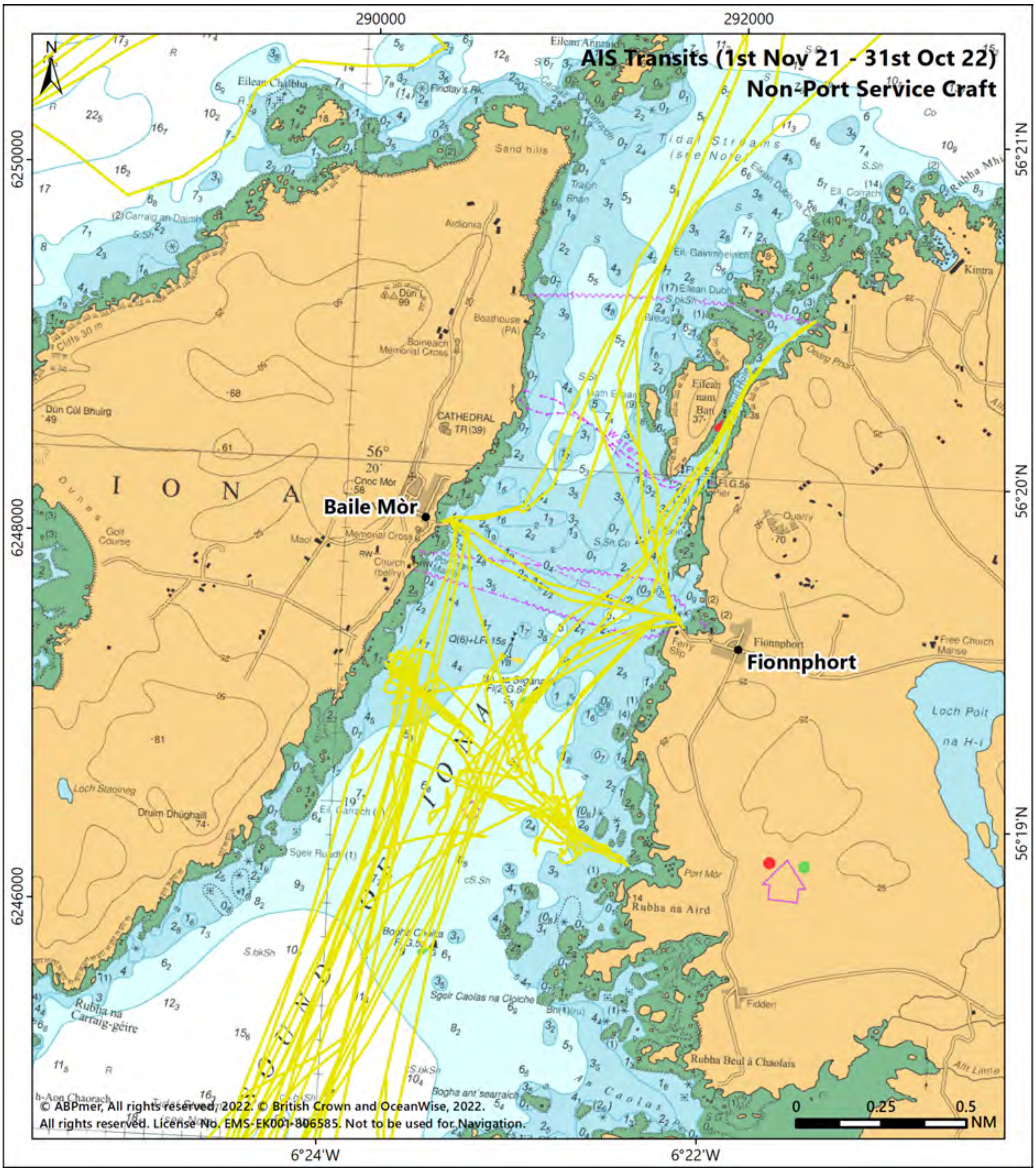

Figure 18. AIS Transits – Non-port service craft

5.9 Transit movements in the wider study area

This section provides a brief commentary on vessel routeing within the wider study area. This is of relevance to marine craft transiting to the work and dredge site from outside of the study area.

5.9.1 Recreational vessels

The west coast of Scotland is a popular yacht cruising destination. Figure 19 identifies the vessel transit patterns for recreational vessels in the wider study area. Many routes can be noted linking the bays and anchorages of the Western Isles, this is due to the typical size of recreational vessels being relatively small so they can transit close inshore. Many of the recreational vessels will be cruising during the summer months and will typically avoid areas offshore with commercial traffic.

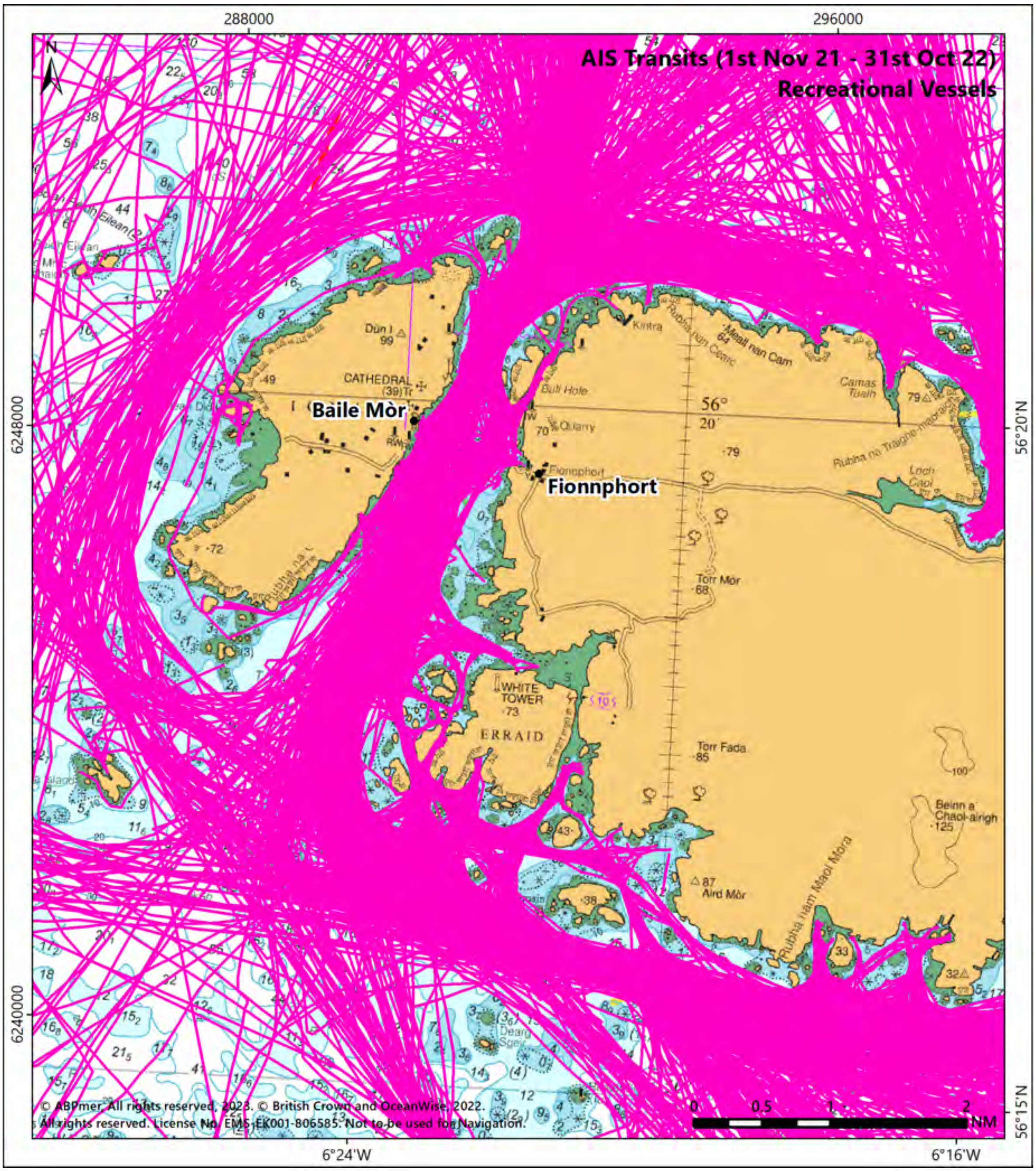

Figure 19. Wider area AIS Transits – Recreational vessels

5.9.2 Passenger vessels

There is a range of different passenger vessel routes in the wider study area as shown in Figure 20. There are multiple passenger vessel routes between the islands in the wider study area associated with the CFL ferry service, cruise vessels and tour vessels. A number of companies operate sightseeing boat trips to the islands of Staffa and Lunga which account for a large number of the vessel transits heading north of the study area.

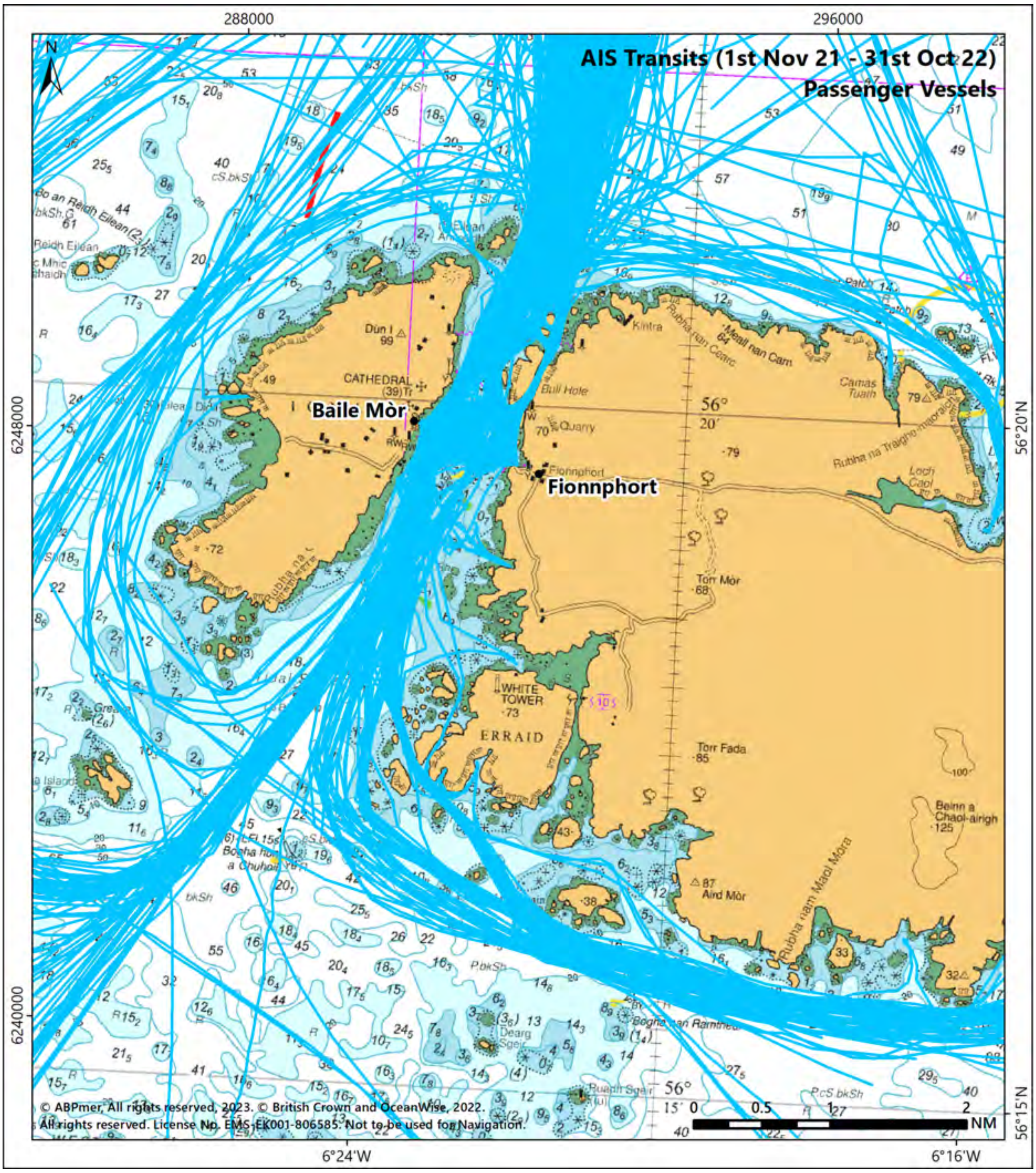

Figure 20. Wider area AIS Transits – Passenger vessels

5.9.3 Fishing vessels

Figure 21 shows that the wider study area is heavily used by fishing vessels with a large number of transits seen in the deeper waters to the west and south of the wider study area. It should be noted that information presented is not representative of all fishing craft, with smaller fishing vessels under 15 m in length unlikely to use AIS. This means particularly inshore around the islands; small day boats will add to the transits shown Figure 21.

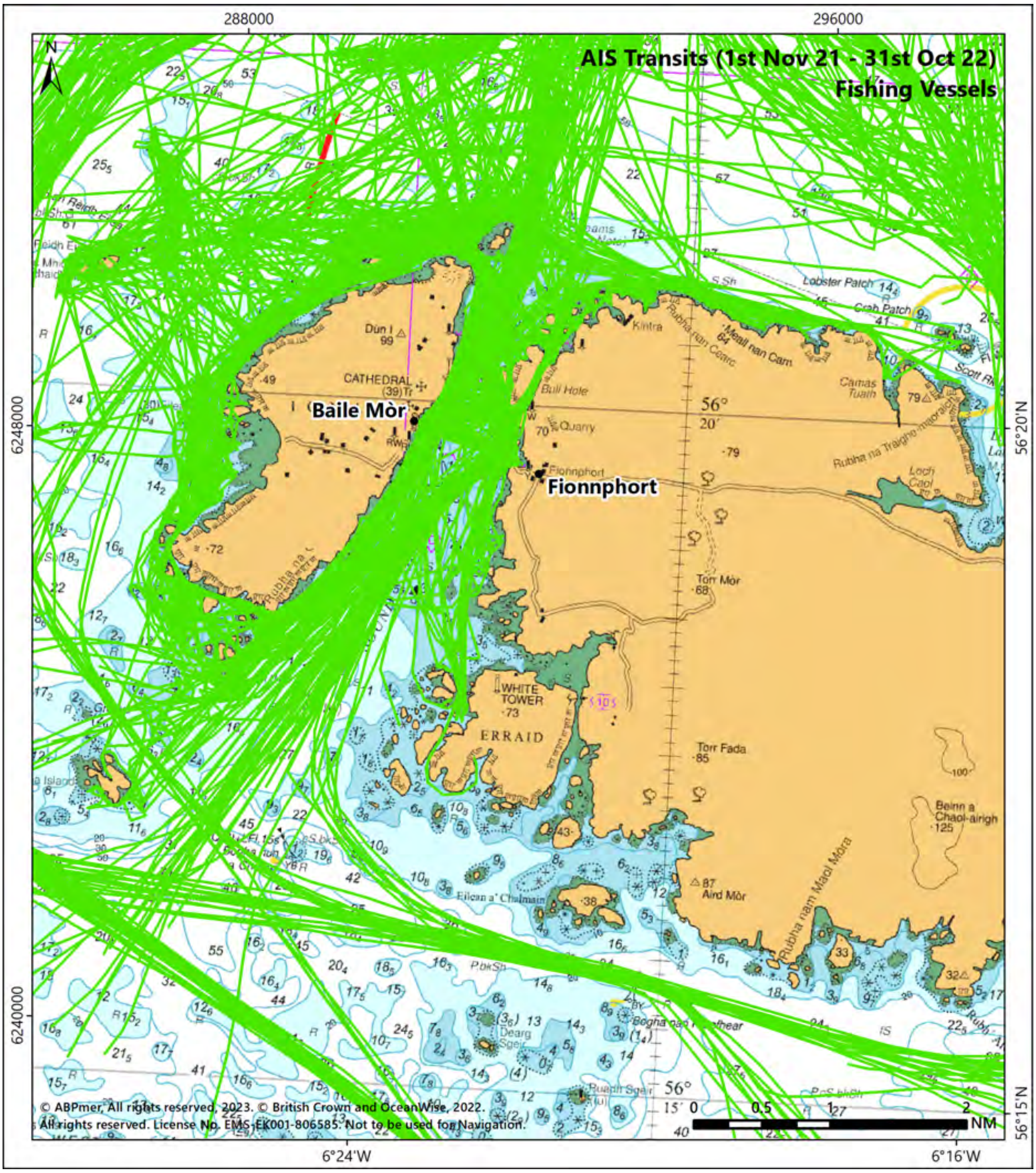

Figure 21. Wider area AIS Transits – Fishing vessels

5.9.4 Dredging or underwater operations

As indicated by Figure 22, there are relatively few transits within the wider area made by vessels falling in the dredger or underwater operations category. Interrogation of the data shows that most of the vessels are small boats that support recreational diving activities. The transits show that the Sound of Iona is used as a shortcut by some vessels.

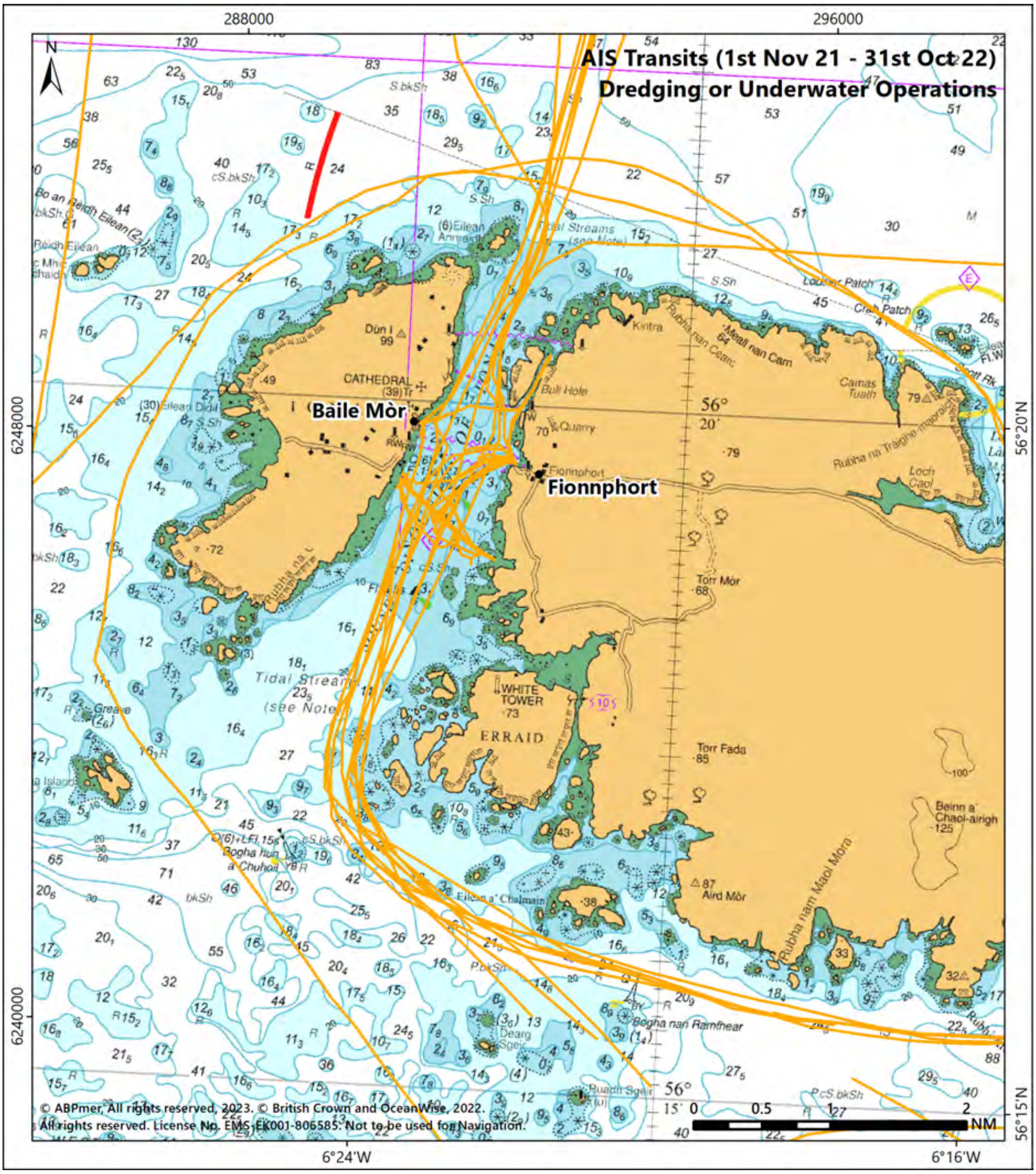

Figure 22. Wider area AIS Transits – Dredging or underwater operations

5.9.5 High speed craft

Figure 23 shows that a number of high speed craft operate in the wider area, both to north and south of the Sound and to south of Mull, but that these transits generally include passage through the Sound.

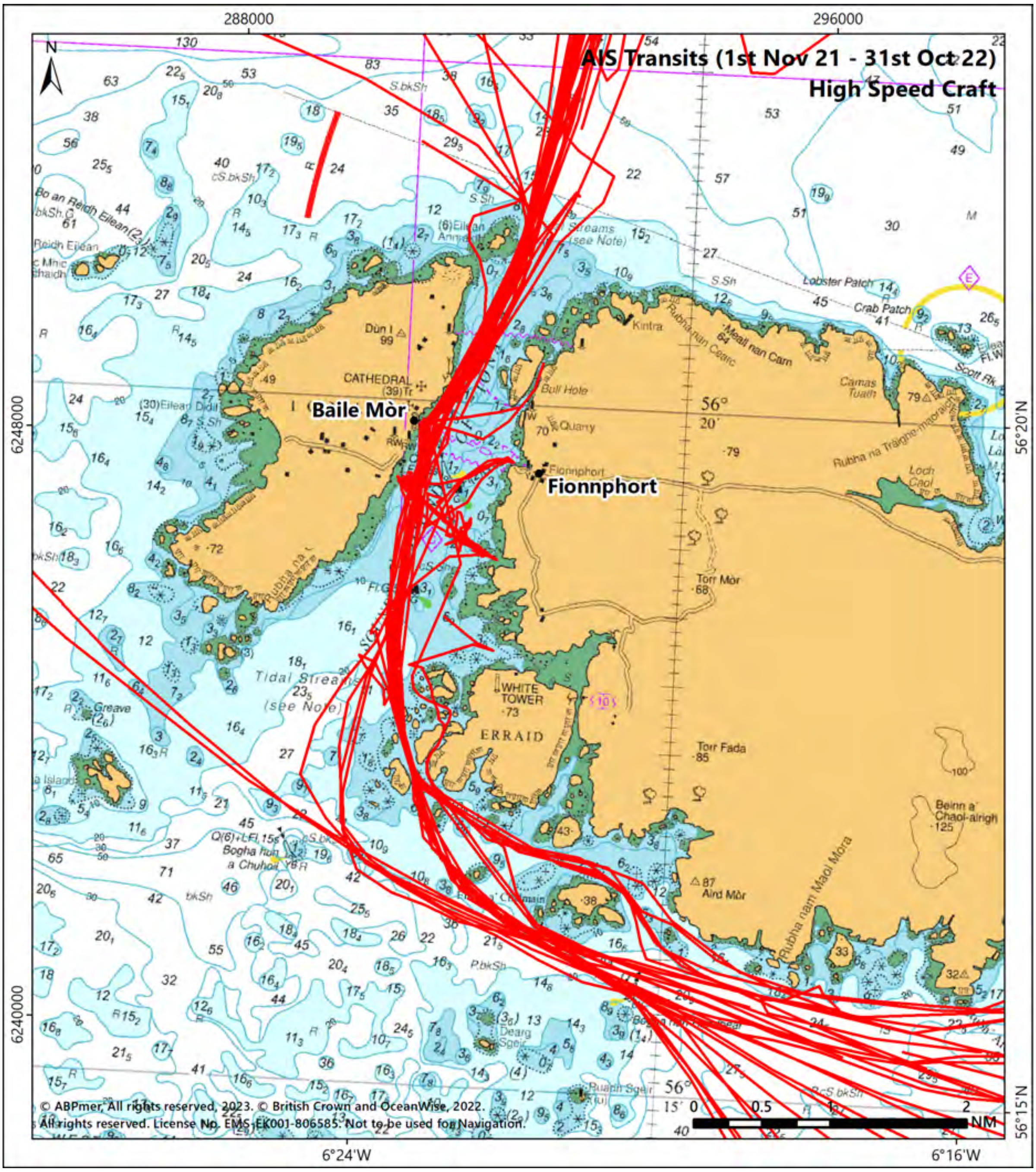

Figure 23. Wider area AIS Transits – High speed craft

5.9.6 Cargo vessels

Figure 24 shows that cargo vessel movements are predominately in the wider study area as opposed to the Sound. These tracks show that cargo vessels transit around the western side of the Isle of Iona and the north shore of the Isle of Mull when on passage to or from ports along Scottish west coast.

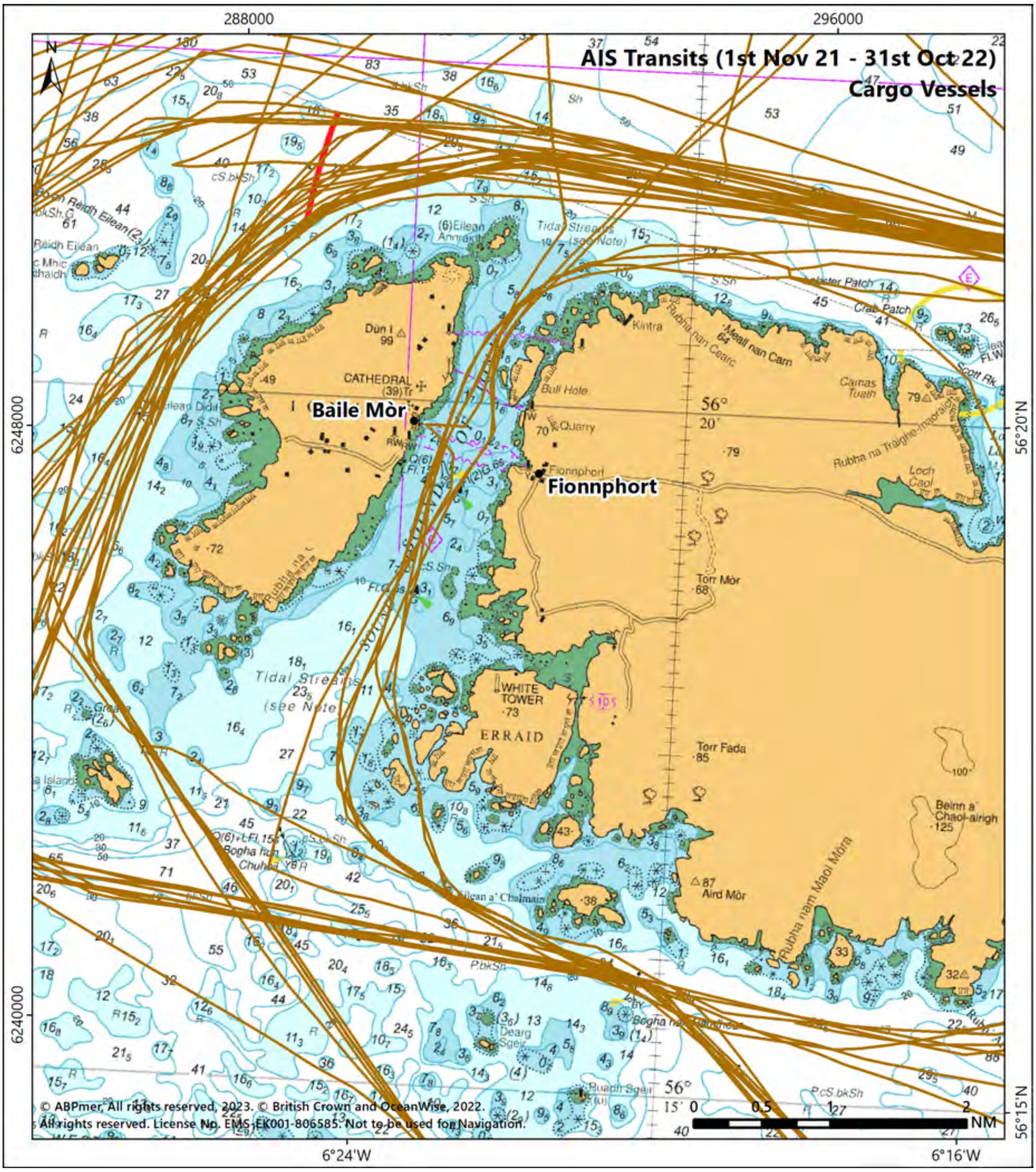

Figure 24. **Wider area AIS Transits – Cargo vessels**

5.9.7 Port service craft

The majority of non-port service transits through the wider study area are likely associated with workboats, tugs and towage operations. The transit routes of this category of vessels are shown in Figure 25 These transits are unlikely to be routine movement and will result from specific operations or towage requirements in the surrounding area. Most of the transits through the Sound are made by cruise ship tenders.

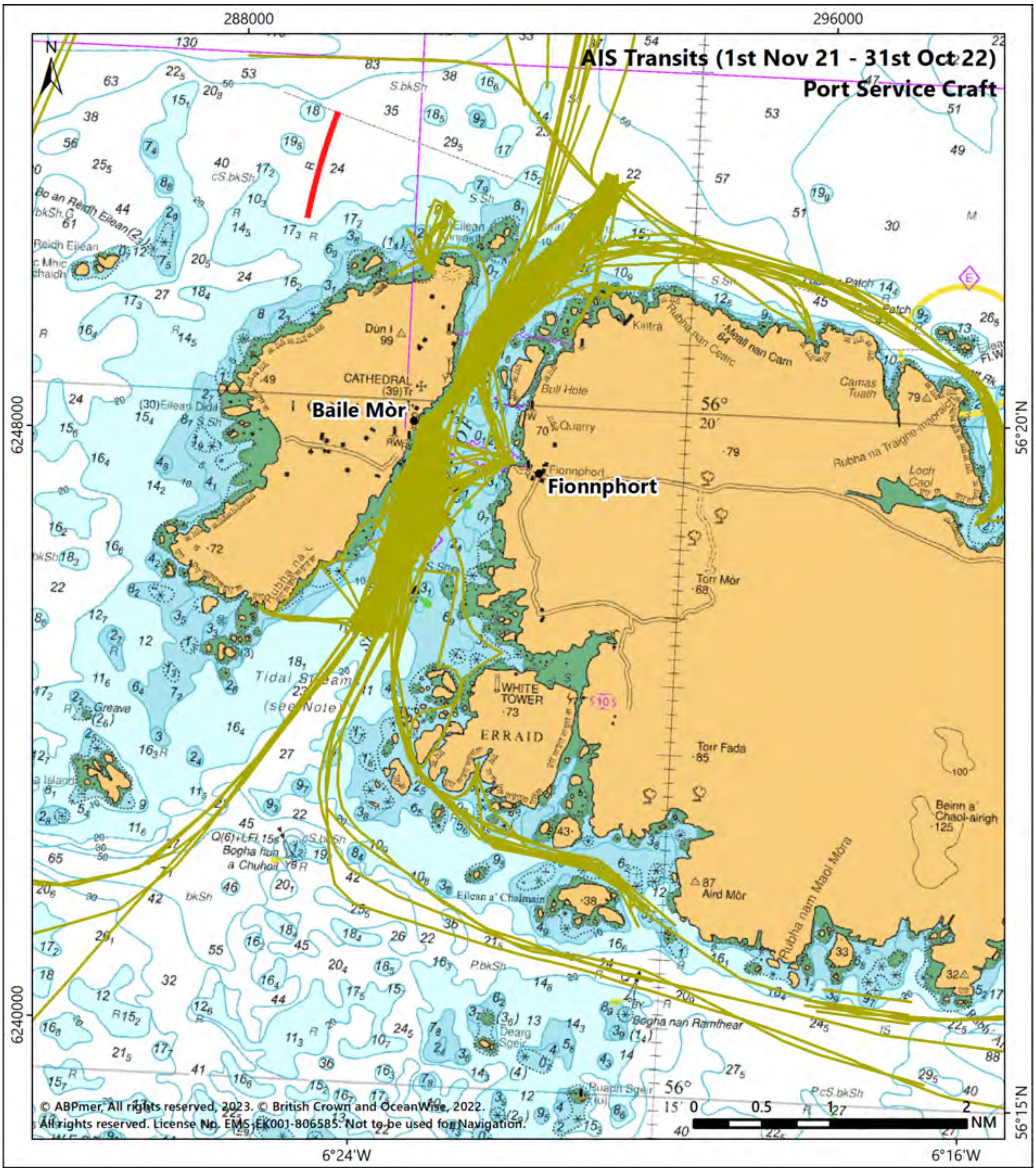

Figure 25. Wider area AIS Transits – Port service craft

5.9.8 Non-port service craft

Similarly to port service craft, the majority of non-port service transits through the wider study area are likely associated with workboats, tugs and towage operations. Vessels within this category are sometimes described as utility vessels. The transit routes of this category are shown in Figure 26. These transits are unlikely to be routine movement and will result from specific operations or towage requirements in the surrounding area.

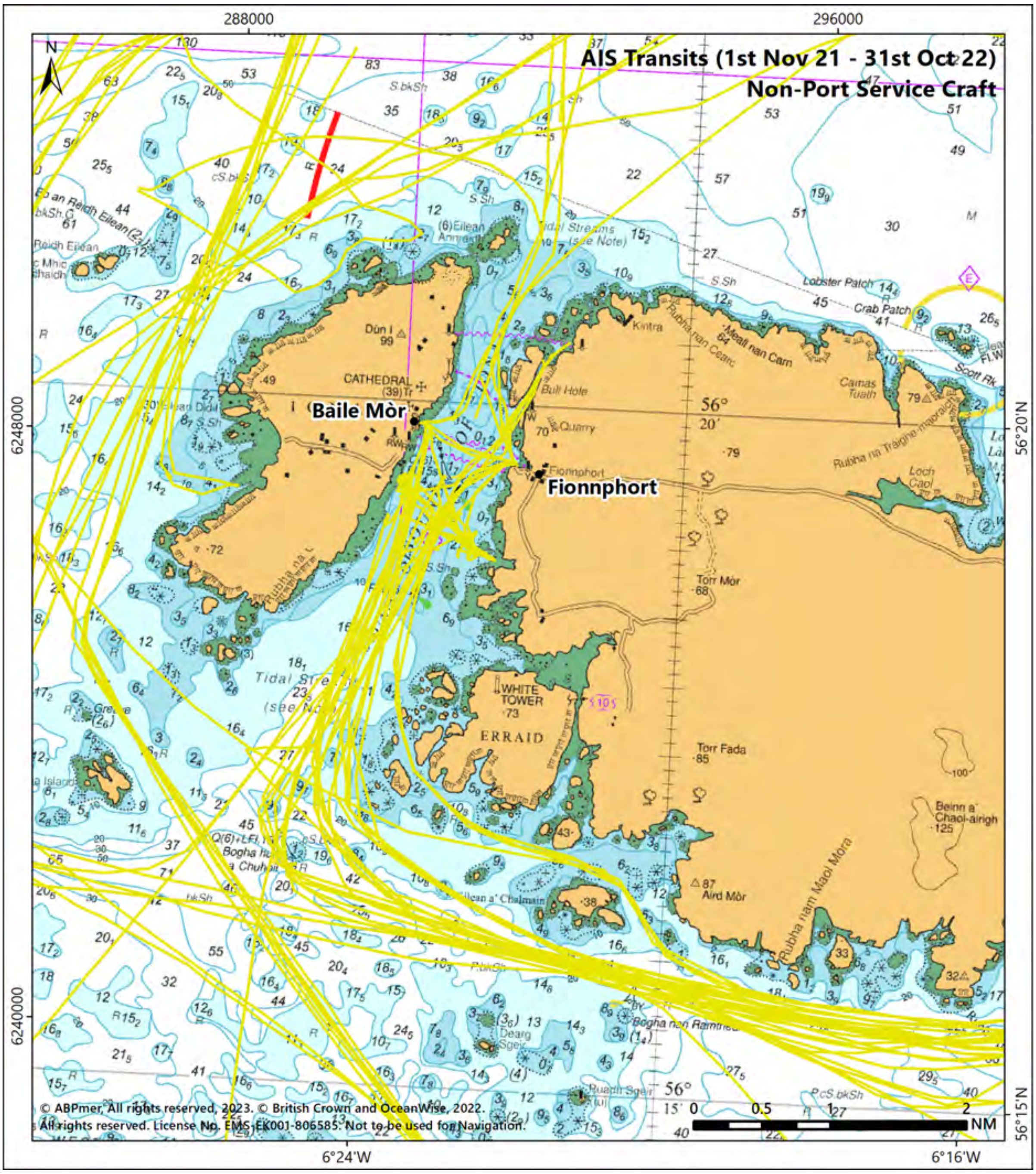

Figure 26. Wider area AIS Transits – Non-port service craft

5.9.9 Unknown vessels

Figure 27 shows the wider study area is frequently used by vessels of which do not define their AIS and are therefore classified as 'unknown'.

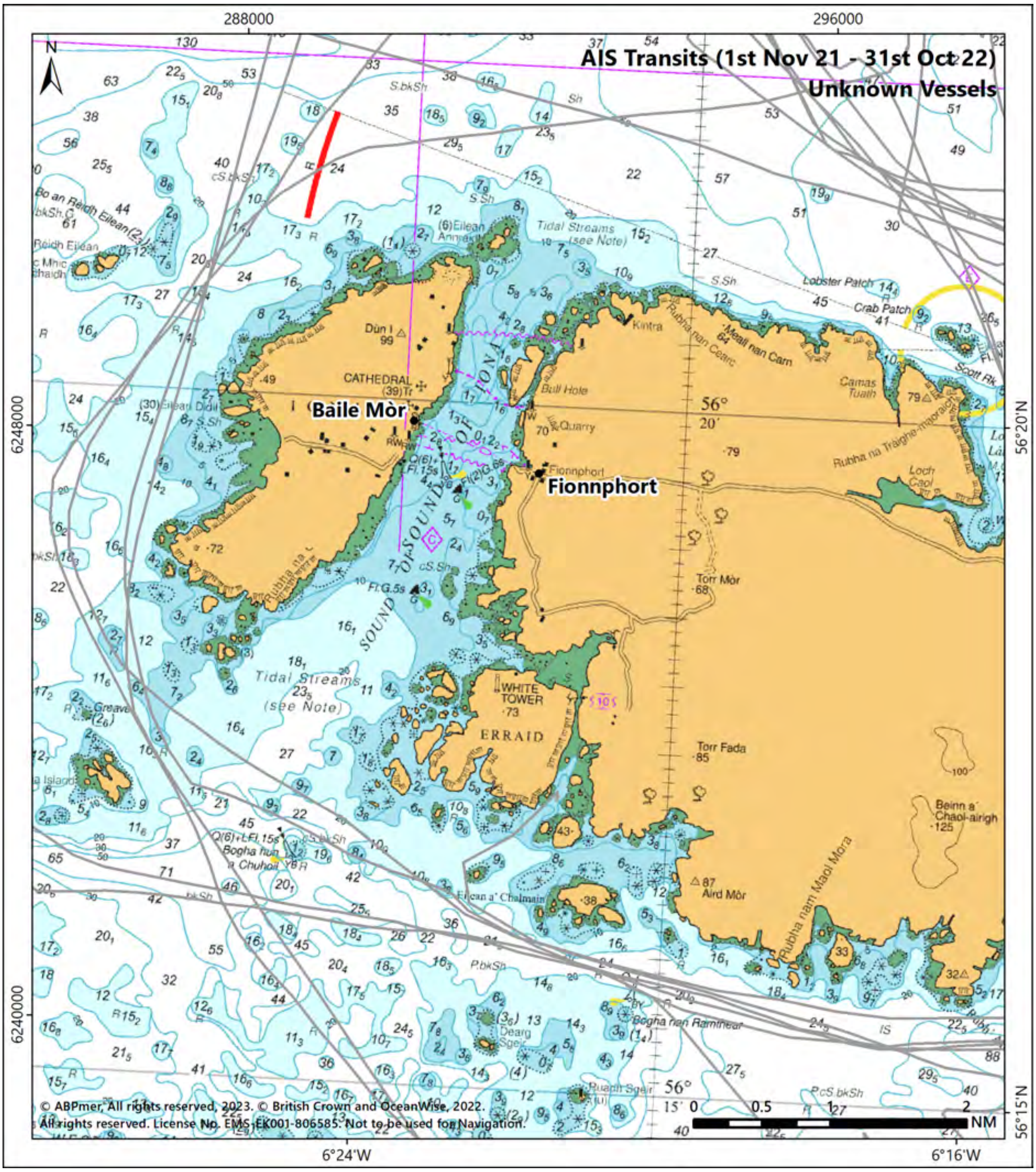

Figure 27. Wider area AIS Transits – Unknown vessels

5.10 Traffic density

Vessel density is shown in Figure 28 and identifies that within the study area there is a high-density of traffic crossing the Sound of Iona between Fionnphort and Baile Mòr. This is consistent with the ferry transits between these two locations. The other area that shows an increased level of vessel density is the area between Fionnphort and the Bull Hole Channel. This is likely due to the ferry proceeding to its overnight berth and the vessels that use Bull Hole Channel as an anchorage. There is comparatively light vessel density through the Sound of Iona due to the increased navigable width and quantity of vessels making the passage.

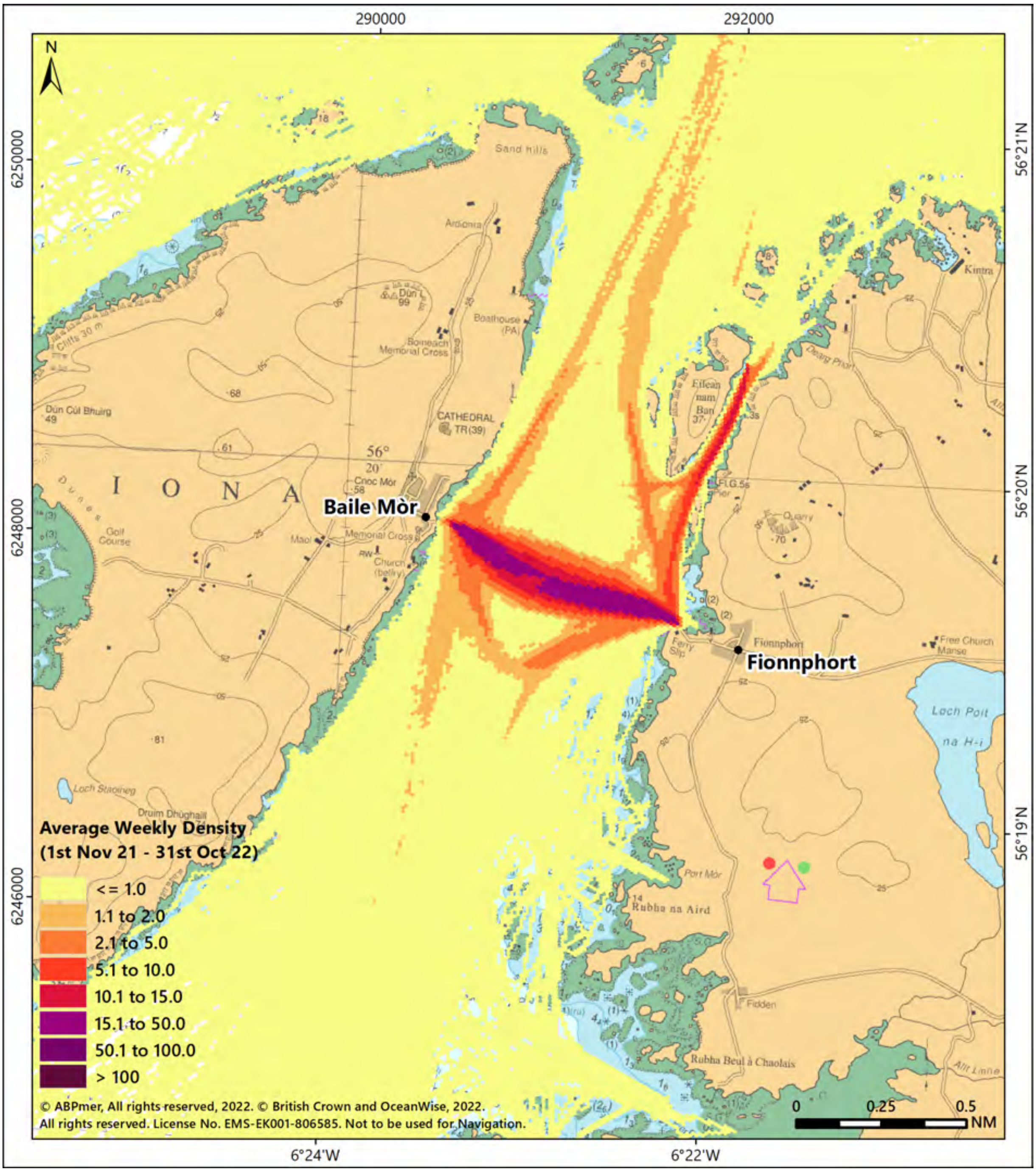

Figure 28. Average Weekly Vessel Density (using AIS from 01 Nov 2021 to 31 Oct 2022)

5.10.1 Vessel composition analysis

Vessel density indicates areas and routes with the greatest number of vessel movement. Where two areas or routes of dense vessel traffic meet a greater amount of vessel interaction can be expected. Vessel interaction through volume of numbers or the nature of the traffic flow increases levels of risk and may result in slower transit times. Transects have been drawn to allow the vessel transits through specific parts of the study area to be quantified. The transects are shown in Figure 29.

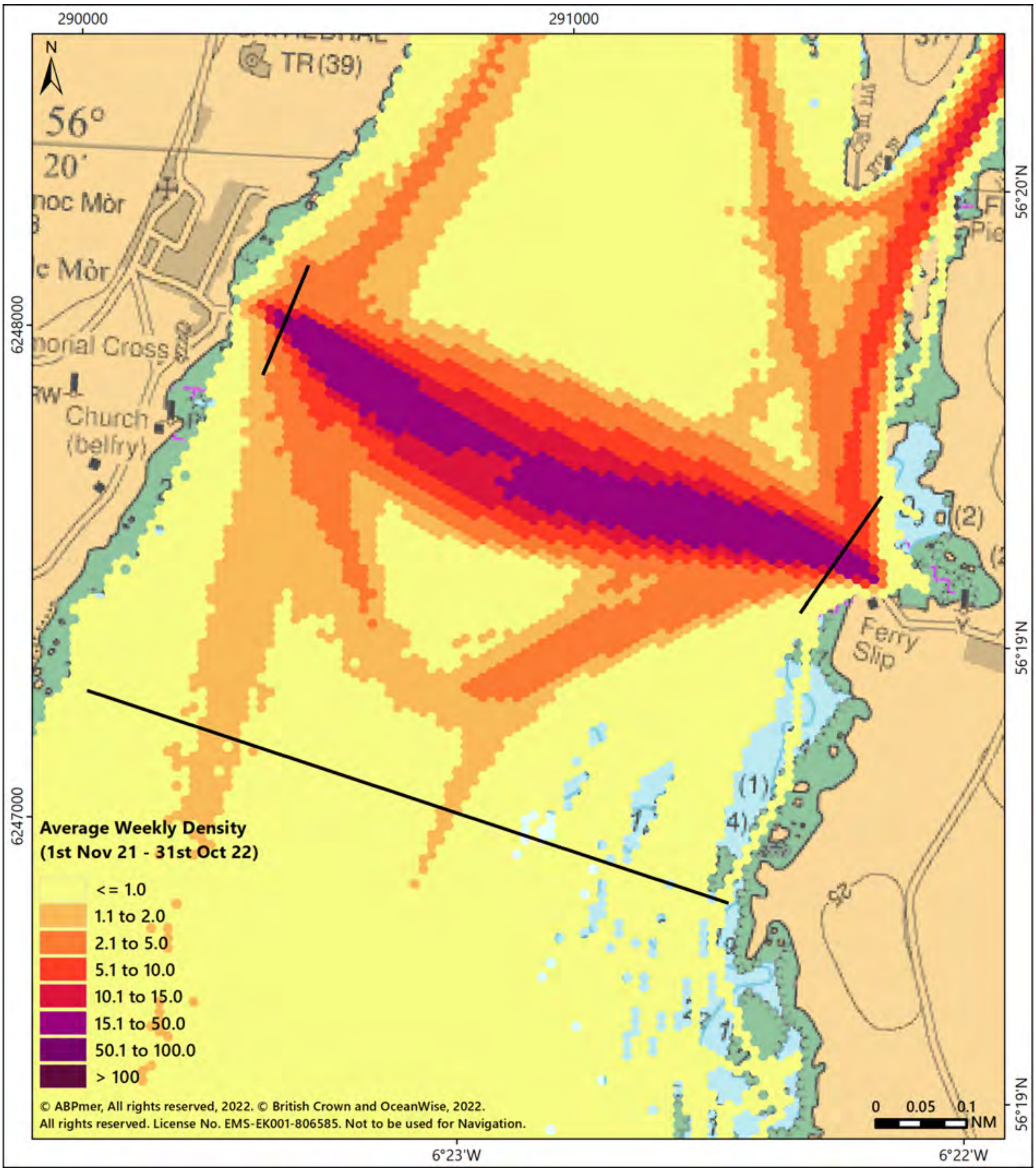

Figure 29. Transect Locations on Average Vessel Density

Table 1 to Table 3 detail the number of vessel transits per AIS group corresponding to the transect lines identified on Figure 29.

The transects are identifies as ‘Sound of Iona’ in Table 1, ‘Fionnphort’ in Table 2 and ‘Iona’ in Table 3 The data is representative of 365 days of AIS and percentage against each type of craft in the data record.

For the transect across the Sound of Iona there were fewer vessels traveling each month, however there was more variety in ship type. Table 1 identifies that the majority of vessel transits crossing the transect line in the Sound of Iona are recreational (56%). The next most predominant vessel type operating in that area were fishing (17%) and passenger (13%). The transect line across the Sound of Iona line was taken outside of the usual ferry route, passenger vessel transits will be associated with the ferry when it leaves the area for repair or refit and tour boat operators.

Table 1. Sound of Iona vessel transect

Ship type	Sound of Iona Transit Line Count (365 days)	Transit Count Percentage (%)
Non-Port Service Craft	17	1.8
Port Service Craft	59	6.4
Dredging or Underwater Operations	16	1.7
High Speed Craft	19	2.1
Passenger	120	13.0
Cargo	7	0.8
Fishing	165	17.8
Recreational	522	56.4
Total	**925**	**100**

There was a total of 4,718 vessels crossing the transect line across Fionnphort for the dataset. Of these 4,718 vessels 4,482 (95%) were passenger vessels, with 198 (4%) as fishing. A small percentage were made up of other vessel types. Table 2 identifies that nearly all movements in and out of Fionnphort recorded in the AIS dataset are the CFL ferry. It is likely that there were also movements from recreational boats, small fishing vessels and tour boat operators; but these vessels are not identified in the AIS record. From anecdotal information, it is known that vessel moorings are located in the area with both local and visiting craft making use of these year-round.

Table 2. Fionnphort vessel transect

Ship type	Sound of Iona Transit Line Count (365 days)	Transit Count Percentage (%)
Non-Port Service Craft	4	0.1
Port Service Craft	10	0.2
Dredging or Underwater Operations	4	0.1
High Speed Craft	1	0.0
Passenger	4,482	95.0
Fishing	198	4.2
Recreational	19	0.4
Total	**4,718**	**100**

There were 3,415 vessels crossing the transect line at Iona, Table 3 identifies that nearly all movements are passenger vessels (93%) with 110 (3%) as fishing vessels. However, from anecdotal information, it is known that vessel moorings are located in the area with both local and visiting craft making use of these year-round again.

Table 3. Iona vessel transect

Ship type	Sound of Iona Transit Line Count (365 days)	Transit Count Percentage (%)
Non-Port Service Craft	4	0.1
Port Service Craft	46	1.3
Dredging or Underwater Operations	4	0.1
High Speed Craft	28	0.8
Passenger	3,184	93.2
Cargo	1	0.0
Fishing	110	3.2
Recreational	38	1.1
Total	**3,415**	**100**

Table 4 to Table 6 detail the length of vessels by type crossed each of the transect lines in the study area.

Table 4. Vessel length comparison (Sound of Iona transect line)

Vessel Length	Number of Vessels								
	Non-Port Service Craft	Port Service Craft	Dredging or Underwater	High Speed Craft	Passenger	Cargo	Fishing	Recreational	All Ship Types
0-9	7	35	9	16	2		69	88	226
10-19	2	13	6	1	52	2	96	392	564
20-29	6	11	1	2	18	4		31	73
30-39	-	-	-	-	44	1	-	6	51
40-49	-	-	-	-	1	-	-	4	5
50-59	2	-	-	-	-	-	-	-	2
60-69	-	-	-	-	2	-	-	-	2
70-79	-	-	-	-	1	-	-	-	1
150-160	-	-	-	-	-	-	-	1	1
Total	**17**	**59**	**16**	**19**	**120**	**7**	**165**	**522**	**925**

Table 5. Vessel length comparison (Fionnphort transect line)

Vessel Length	Number of Vessels							
	Non-Port Service Craft	Port Service Craft	Dredging or Underwater	High Speed Craft	Passenger	Fishing	Recreational	All Ship Types
0-9	4	-	3	-	-	56	14	77
10-19	-	1	1	-	436	142	5	585
20-29	-	9	-	1	-	-	-	10
30-39	-	-	-	-	4,044	-	-	4,044
40-49	-	-	-	-	1	-	-	1
70-79	-	-	-	-	1	-	-	1
Total	**4**	**10**	**4**	**1**	**4,482**	**198**	**19**	**4,718**

Table 6. Vessel length comparison (Iona transect line)

Vessel Length	Number of Vessels								
	Non-Port Service Craft	Port Service Craft	Dredging or Underwater	High Speed Craft	Passenger	Cargo	Fishing	Recreational	All Ship Types
0-9	3	35	-	27	2	-	110	29	206
10-19	1	11	4	1	361	-	-	9	387
30-39	-	-	-	-	2,821	1	-	-	2,822
Total	**4**	**46**	**4**	**28**	**3,184**	**1**	**110**	**38**	**3,415**

6 Marine Works

6.1 Project details

The marine works for the project consists of a new rock armour breakwater and a capital dredge, see Figure 30.

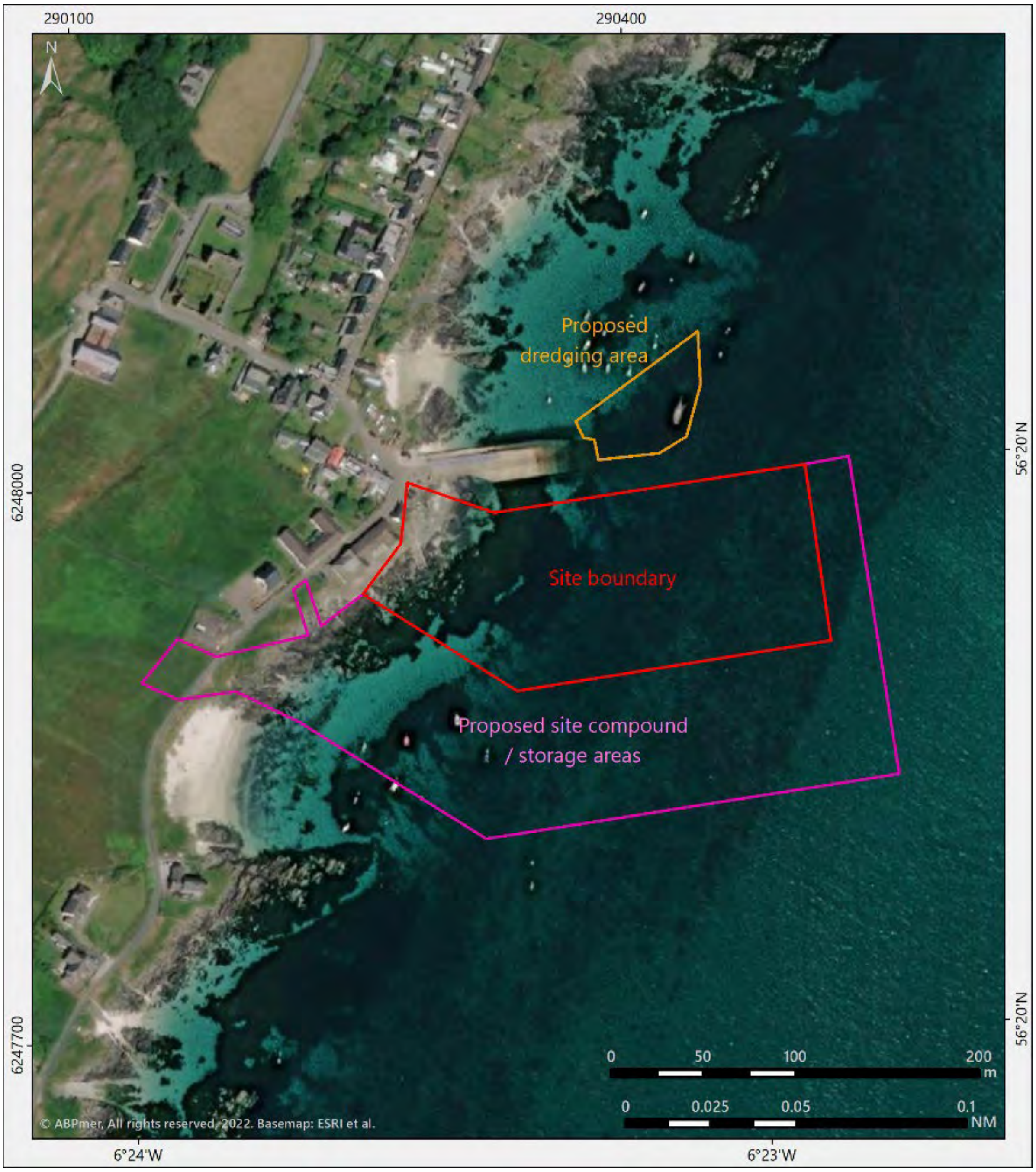

Figure 30. Iona Breakwater and dredge area

The following sections provide a description of each component of the works, as relevant to marine safety and navigation.

The Breakwater: the breakwater will be comprised a rock armour structure with a proposed 2:1 slope on outer face (non-slipway side) and 1:1.5 on the inner face (slipway side). The crest length will be *circa* 185 m and a crest level of 7.1 m above chart datum. The breakwater will be located approximately 70 m south of the existing slipway in Iona. The function of the breakwater is primarily to provide defence from waves propagating from a southerly direction, the structure will not provide protection from the waves propagating from northerly or easterly directions. The breakwater will result in an overall reduction of wave heights at the structure. The overall footprint of the breakwater is approximately 7,000 m^2. The rock armour breakwater will be constructed of clean quarried rock. The estimated volume of rock armour required for the proposed breakwater is 43,000 m^3.

The capital dredge: in order to accommodate the new navigation channel requirements, some dredging works will be required. The approximate dredge area is 2,017 m^2 manoeuvring depth for the ferry to safely access and egress the berth. The approximate dredge volume is 1,225 m^3. It is proposed that this is carried out by a backhoe dredge with the material deposited at Portnahaven disposal site, as shown on Figure 2.

6.2 Construction phase

During construction, site welfare facilities and site compound is expected to be established on a barge. This is where all works will be undertaken from, however there will likely be a small compound on shore which could be established at the car park adjacent to the pier (occupying maximum 2 spaces). The materials are expected to be transported to site by barge and installed from a barge fully equipped with crane and grab. Transport by road will be minimal. The duration of the works is expected to be 52 weeks.

The dredging plant will be mobilised to dredge one pocket at the site. One vessel is envisaged for this activity, and it would be expected to undertake multiple movements from the dredge site to the disposal site. As part of the dredging along the ferry route, the dredging operations will either be overnight or arranged with CFL to eliminate (as far as possible) any impact to the ferry service.

The sea level formation for rock armour installation will be undertaken by a diving team who will be accommodated on a barge. Rock armour for breakwaters delivered to site by barge and installation on the south faces of the breakwater will occur by crane grab off the barge (there is no anticipation of rock storage as it will be installed upon delivery to site). If a barge with a capacity of around 2,700 t were used for delivering rock armour to site, it would be expected to involve in the region 40-50 movements. This will be unloaded from the south face. The number of vessels may change in accordance with the successful contractor's proposals. The proposed breakwater at Iona is approximately 40 m from both ferries / tourism / fishing slipways, therefore rock armour activities will not encroach on the movement of ferries or other vessels.

Following this a security gate will be installed and all work will be tested and commissioned. Then the contractor will be demobilised.

6.3 Operational phase

The breakwater will be incorporated into Argyll and Bute Council's marine facility portfolio and be monitored as part of the Council's engineering and Port Marine Safety Code assurance programme. This includes monitoring and maintenance of breakwater and lighting, lifesaving equipment and AtoN. The ferry service will continue to operate (in its current form) with updated passage plan information and procedures. The approach area will be subject to period bathymetric survey to monitor the depth of water as part of Argyll and Bute Council's survey programme.

7 Hazard Workshop

In order to provide an NRA of navigational risk during the construction and operational phases of the proposed breakwater, a hazard workshop with maritime community stakeholders was undertaken. The hazard identification workshop was held on 09 September 2021 over Microsoft Teams. During the workshop, a presentation was given of the available baseline data and exercises were carried out to identify potential hazards associated with the proposed scheme.

The aim of the workshop was to identify navigational safety concerns relative to the study's scope. In addition, attendees at the workshop provided anecdotal information regarding marine use of the study area, which enhanced the level of detail collected through the navigation baseline activities. The output from the workshop was documented and shared with attendees. A total of 16 hazard scenarios were identified for the construction phase and 4 hazard scenarios for the operational phase.

7.1 Attendance

Stakeholder attendees at the hazard workshops are shown in Table 7. This list was drawn from known port users, maritime stakeholders, project officers and those that were identified through local consultation. This list is not exhaustive but is representative of those with interests in the area. Other invitees included individual local fisherman, the Scottish Canoe Association, the Royal Yachting Association (RYA) and the RNLI, who were unable to attend.

Table 7. Hazard Workshop Attendees

Attendee	Organisation
Scott Reid	Argyll and Bute Council
Elsa Simoes	Argyll and Bute Council
Jamie Salmon	Argyll and Bute Council
James Hamilton	RPS
Helen Croxson	MCA
Sam Chudley	MCA
Peter Douglas	NLB
David McHardie	Caledonian Maritime Assets Ltd
Alastair Mackie	Fionnphort Fishing Vessel Owner
Mark Jardine	Iona Tour Boat
Sophie Butler	ABPmer
Monty Smedley	ABPmer

8 Navigational Risk Assessment

This NRA has been carried out to determine the navigational risks for vessels, associated with the proposed development and operation of the Iona Breakwater. To assess navigational risk, the specifics of the scheme have been considered in relation to the potential impacts during the construction and operational phases of the development.

- **Construction:** construction of the breakwater and capital dredging.
- **Operation:** changes to vessel movement patterns, port and facility maintenance.

The process for carrying out an NRA follows the process identified in the PMSC's Guide to Good Practice (DfT, 2018). The process also includes the relevant process for the size and scale of the marine works within the methodology from the MCA (2021b); Methodology for Assessing the Marine Navigational Safety and Emergency Response Risks of Offshore Renewable Energy Installations (OREI).

1. Identification of hazard definitions;
2. Listing of potential hazard scenarios (i.e. descriptions of hazard and outcome);
3. Identification of causes that may lead to one of the described hazard scenarios (i.e. an accident or incident outcome);
4. Consideration of existing (embedded) mitigation measures, which either control or address the outcome of an accident or incident; and
5. Additional (future) risk controls, which are not currently in place, but could be used to further reduce or eliminate risk.

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

8.1 Hazard definitions

The first step in the NRA process is the consideration of potential hazards resulting from the proposed scheme. Table 8 provides hazard category definitions, taken from the MCA; 'Methodology for Assessing the Marine Navigational Safety and Emergency Response Risks of OREI', (MCA, 2021b).

Six hazard categories have been scoped out of this NRA. These are shown in Table 9 along with the reason. The rationale considers the construction methodology as well as the operational requirements for the proposed development, and the potential outcomes, in terms of navigational hazards.

Table 8. Hazard category definitions

Category	Description
Accidents to personnel	Accidents to personnel are defined as those accidents which cause harm to any person on board the vessel e.g. crew, passengers, stevedores; which do not arise as a result of one of the other accident categories. Essentially, it refers to accidents to individuals, though this does not preclude multiple human casualties as a result of the same hazard, and typically includes harm caused by the movement of the vessel when underway, slips, trips, falls, electrocution and confined space accidents, food poisoning incidents, etc.
Accidents to the General Public	Accidents to personnel are defined as those accidents which lead to injury, death or loss of property amongst the population ashore resulting from one of the other ship accident categories.
Allision	Defined as a violent contact between a vessel and a fixed structure.
Capsizing	The overturning of a vessel after attaining negative stability.
Capsizing	The overturning of a vessel after attaining negative stability.
Collision	Collision is defined as a vessel striking, or being struck by, another vessel, regardless of whether either vessel is under way, anchored or moored; but excludes hitting underwater wrecks.
Contact	Contact is defined as a vessel striking, or being struck by, an external object that is not another vessel or the sea bottom. Sometimes referred to as impact.
Explosion	An explosion is defined as an uncontrolled release of energy, which causes a pressure discontinuity or blast wave.
Fire	Fire is defined as the uncontrolled process of combustion, characterised by heat or smoke or flame or any combination of these.
Flooding	Flooding is defined as sea water, or water ballast, entering a space, from which it should be excluded, in such a quantity that there is a possibility of loss of stability leading to capsizing or sinking of the vessel.
Foundering	To sink below the surface of the water.
Grounding	Grounding is defined as the ship coming to rest on, or riding across, underwater features or objects, but where the vessel can be freed from the obstruction by lightning and/or assistance from another vessel (e.g. tug) or by floating off on the next tide.
Hazardous substances accidents	Hazardous substance accidents are defined as any substance which - if generated as a result of a fire, accidental release, human error, failure of process equipment, loss of containment, or overheating of electrical equipment - can cause impairment of the health and/or functioning of people or damage to the vessel. These materials may be toxic or flammable gases, vapours, liquids, dusts or solid substances.
Loss of hull integrity	Loss of hull integrity is defined as the consequence of certain initiating events that result in damage to the external hull, or to internal structure and sub-division, such that any compartment or space within the hull is opened to the sea or to any other compartment or space (where it is not designed to be).
Machinery related accidents	Machinery related accidents are defined as any failure of equipment, plant and associated systems which prevents, or could prevent if circumstances dictate, the ship from manoeuvring or being propelled or controlling its stability.

Category	Description
Payload related accidents	Payload related accidents include loss of stability due to cargo shifting and damage to the vessel's structure resulting from the method employed for loading or discharging the cargo. This category does not include incidents which can be categorised as Hazardous substance, Fires, Explosions, Loss of hull integrity, Flooding accidents etc.
Stranding	Stranding is defined as being a greater hazard than grounding and is defined as the ship becoming fixed on an underwater feature or object such that the vessel cannot readily be moved by lightening, floating off, or with assistance from other vessels (e.g. tugs).

Table 9. Hazard categories scoped out

Scoped Out Hazard Category	Rationale
Accidents to the general public	The site will not be open to the general public shoreside during the works. Water access is considered by its hazard category.
Capsizing	The risk of capsize to project craft has been considered as part of Payload related accidents.
Contact	Contact has been considered as part of allision.
Foundering	Foundering is not considered a likely hazard scenario in its own right and has been considered as part of grounding.
Loss of hull integrity	The construction phase does not have the potential to cause a vessel to lose hull integrity. This may occur from allision, collisions or grounding, which are considered separately.
Stranding	Stranding is not considered a likely hazard scenario in its own right and has been considered as a potential consequence of grounding.

8.2 Hazard scenarios

From the hazard categories scoped into the NRA, the study team at ABPmer has identified the following specific hazard scenarios which relate to either the scheme construction (Table 10) or the operational (Table 11) phases. In total, 19 hazard scenarios are identified in the NRA, 16 in the construction phase and 4 in the operational phase.

Table 10. Construction phase hazard scenarios

Assessment Number	Hazard Category	Hazard Scenario Title
1	Accidents to personnel	Man overboard during dredge/construction works
2	Accidents to personnel	Diving operations associated with the marine works
3	Allision	Dredge/construction plant with marine works during construction phase
4	Allision	Recreational or fishing vessel allision with marine works
5	Allision	Ferry or tour boat allision with marine works
6	Collision	Dredge/construction plant collision with recreational/fishing vessel
7	Collision	Dredge/construction plant collision with ferry/tour boat
8	Collision	Tug and tow collision with recreational/fishing vessel
9	Collision	Tug and tow collision with ferry/tour boat
10	Fire/Explosion	Dredge/construction plant on-board fire
11	Flooding	Dredger flooding whilst engaged in operations
12	Grounding	Dredger grounding whilst engaged in operations
13	Hazardous substance accidents	Accidental spill during marine works
14	Machinery related accidents	Heavy lift failure or failure of lifting gear
15	Payload related accidents	Incorrect payload distribution/loading affects vessel stability
16	Other	Small non-powered craft displaced by marine works

Table 11. Operational phase hazard scenarios

Assessment Number	Hazard Category	Hazard Scenario Title
1	Allision	Ferry or tour boat with the breakwater
2	Allision	Recreational or fishing vessel allision with the breakwater
3	Grounding	Any vessel
4	Other	Small non-powered craft displaced by breakwater

The hazard scenarios identified in Table 10 and Table 11 have been considered according to their 'Most Likely' and 'Worst Credible' outcomes. This provides the option to consider very serious outcomes, which could credibly occur, along with outcomes that are less serious, but could occur on a more frequent basis. The full working and outcome description of each scenario, presented as a full NRA, is provided in table format in Appendix B.

8.2.1 Hazard scenario causes

Each hazard scenario was considered to determine its possible cause(s). Table 12 and Table 13 give a frequency (count) of the causes identified during the assessment process for the construction and operational phases of the project.

Table 12. Cause frequency for the construction phase

Cause	Frequency
Human error/fatigue - Vessel Personnel	13
Vessel breakdown or malfunction	12
Adverse weather conditions	10
Restricted visibility	10
Inadequate procedures in place onboard vessel	10
Inadequate training/competence - Personnel	7
Human error/fatigue - Construction personnel	7
Reduction in safe navigable space	6
Unplanned interaction with recreational/fishing craft	6
Communication failure - Personnel	6
Failure to follow passage plan	6
Incorrect assessment of tidal flow	5
Inadequate bridge resource management	5
Communication failure - Operational/procedural	5
Failure to comply with safe systems of work	5
Notice to Mariners failure to observe	5
Manoeuvre misjudged	4
Inadequate marine procedures - Project	4
AIS failure	4
Limited area for manoeuvring	3
Excessive vessel speed	3
Human error/fatigue - Marine personnel	3
Towing equipment failure	3
Inadequate maintenance/inspection	3
Unplanned interaction with ferry/tour boat	3
Failure of Aid to Navigation (out of position/unlit)	2
Loss of watertight integrity	2
Interaction with passing vessel	2
Navigation equipment failure	2
Scheduling conflicts	2
Increased vessel use	1
Human error	1
Competence	1
Fire/Explosion	1
Vessel has unreported defect	1
Vessel Ramps or Hatches not secure	1
Port Equipment (including craft) mechanical breakdown/system malfunction	1
Equipment failure (bridge)	1

The most frequently identified causes for the construction phase are 'Human error/fatigue – Vessel Personnel' with a frequency of 13, 'Vessel breakdown or malfunction' with a frequency of 12, 'Inadequate procedures in place onboard vessel', 'Adverse weather conditions' and 'Restricted visibility' with a frequency of 10. Since there is dredging and a breakwater constructed in an area which has vessels passing through it, numerous hazards have causes which are attributed to these vessels. There will be periods were non-construction vessel movements affect the construction, such as dredging along the ferry route. Due to the location of the site, it is particularly exposed to weather fronts from certain directions. This means there will be periods where wind direction and wave height may affect the construction.

Table 13. Cause frequency for the operational phase

Cause	Frequency
Reduction in safe navigable space	4
Limited area for manoeuvring	4
Human error/fatigue - Vessel Personnel	3
Adverse weather conditions	3
Restricted visibility	3
Unplanned interaction with recreational/fishing craft	3
Incorrect assessment of tidal flow	3
Manoeuvre misjudged	3
Increased vessel use	3
Vessel breakdown or malfunction	2
Inadequate procedures in place onboard vessel	2
Inadequate training/competence - Personnel	2
Inadequate bridge resource management	2
Excessive vessel speed	2
Failure of Aid to Navigation (out of position/unlit)	2
Human error	2
Competence	2
Human error/fatigue - Construction personnel	1
Communication failure - Personnel	1
Failure to follow passage plan	1
Failure to observe standing notices	1
Incapacitated master (drinks/drugs)	1
Inadequate surveying	1

The most commonly identified causes both have a frequency of four. They are: 'Limited area for manoeuvring' and 'Reduction in safe navigable space'. These causes are closely followed in frequency by 'Human error/fatigue - Vessel Personnel', 'Unplanned interaction with recreational/fishing craft', 'Adverse weather conditions', 'Restricted visibility', 'Increased vessel use', 'Incorrect assessment of tidal flow', 'Manoeuvre misjudged' which each have a frequency of 3. The most frequently identified causes for the operational phase are similar to those identified for the construction phase, with the addition of the site causing a reduction of safe navigable space. The next stage of the process considers these causes in the context of existing controls, which might be applicable to prevent the hazard scenario from occurring.

8.3 Existing (embedded) risk controls

Each hazard scenario has been considered in light of embedded risk controls. It should be noted that embedded risk controls, in the context of marine safety, relate to processes, practices and available safety resources that are currently implemented and items identified as part of the project scheme. For example, these might include international regulations (such as the International Regulations for Preventing Collisions at Sea (COLREGS) (IMO, 1972)), or provision of emergency services (such as ambulances). In addition, any controls planned as part of the scheme have been considered as embedded within the scheme design.

Table 14 and Table 15 present the embedded risk controls with a frequency count of the number of assessments to which they apply for the construction and operational phases respectively. Following construction of the Marine Works certain controls (which are already implemented) will be updated to include for new operating instructions. These include controls such as the 'Marine Safety Management System' and 'Passage Planning' for the ferry.

Table 14 Embedded risk controls for the construction phase

Controls	Frequency
Marine Safety Management System	16
Vessel's emergency response procedures	8
Contractor risk assessment method statement (RAMS)	8
Emergency services equipment - shore side	7
Standing Orders/SOPs	4
Oil spill contingency plans	3
Communications equipment	3
Safe systems of work (H&S)	3
Passage planning	2
Tier 2 contractor	2
Availability of latest hydrographic information	1
Visual observation (clear line of sight)	1
Weather forecasting	1
Vessel maintenance	1
Vessel inspection/survey	1

Table 15 Embedded risk controls for the operation phase

Controls	Frequency
Marine Safety Management System	4
Oil spill contingency plans	3
Tier 2 contractor	3
Vessel's emergency response procedures	2
Emergency services equipment - shore side	2
Passage planning	2
Weather forecasting	2
Aids to navigation, Provision and maintenance of	2
Communications equipment	1
Dredging programme	1

The assessment of risk is based upon the descriptions of the 'Most Likely' and 'Worst Credible' to determine the outcome in respect of effect to people, property, the environment and port business. This approach follows the best practice guidance from the PMSC 'Guide to Good Practice' (DfT, 2018). In making the assessment, the outcome from each scenario using the receptors of 'people, property, environment and port' has been evaluated to give a baseline risk with **no mitigation** measures in place.

8.3.1 Risk evaluation: embedded

After determining which controls are applicable to each hazard scenario, an embedded risk score has been calculated by determining the reduction in likelihood and consequence for each risk control should it be implemented; these reductions were then applied to the frequency and consequence of the scenario to give the overall risk score. Table 16 and
Table 17 show the hazard scenarios ranked by current risk after embedded risk controls have been considered.

Table 16. Ranked hazard scenarios for the construction phase

Hazard Category	Hazard Scenario	Baseline Risk	Current Risk
Allision	Ferry or tour boat allision with marine works	Hig	Sig
Flooding	Dredger flooding whilst engaged in operations	Hig	Sig
Allision	Dredge/construction plant impact with marine works during construction phase	Sig	Sig
Allision	Recreational or fishing vessel allision with marine works	Sig	Sig
Collision	Dredge/construction plant collision with recreational/fishing vessel	Sig	Sig
Collision	Tug and tow collision with recreational/fishing vessel	Sig	Sig
Collision	Tug and tow collision with ferry/tour boat	Sig	Sig
Hazardous substance accidents	Accidental spill during marine works	Sig	Sig
Machinery related accidents	Heavy lift failure, or failure of lifting gear	Sig	Sig
Payload related accidents	Incorrect payload distribution/ loading affects vessel stability	Sig	Mod
Fire/Explosion	Dredge/construction plant on-board fire	Sig	Mod
Other	Small non-powered craft displaced by marine works	Sig	Mod
Accidents to personnel	Man overboard during dredge/construction works	Mod	Low
Accidents to personnel	Diving operations associated with the marine works	Mod	Low
Collision	Dredge/construction plant collision with ferry/tour boat	Low	Low
Grounding	Dredger grounding whilst engaged in operations	Low	Low

Table 17. Ranked hazard scenarios for the operational phase

Hazard Category	Hazard Scenario	Baseline Risk	Current Risk
Allision	Ferry or tour boat with the breakwater	Hig	Hig
Allision	Recreational or fishing vessel allision with the breakwater.	Sig	Mod
Other	Small non-powered craft, displaced by breakwater	Sig	Mod
Grounding	Any vessel	Sig	Mod

The risk scores associated with each of the 20 hazard scenarios has been set on a scale of no risk to Very High Risk. The classification of each score is given in Table 18.

8.4 Tolerability

In determining whether the predicted level of risk is tolerable and acceptable, the following questions are considered:

- Is the risk below any unacceptable limit that has been established?
- If so, has it also been reduced to as low as reasonably practicable (ALARP)?

The risk is tolerable and acceptable if the answer to both these questions is 'Yes'. A&BC, as the marine asset owner and operator consider that any final risk outcome in the High or Very High band, is intolerable. Following which, all hazard scenarios have risk reduced to a point concluded to be ALARP. Table 18 identifies the score outcome used in this NRA.

Table 18. Classification of hazard scenario outcome

Classification	Outcome
Very High Risk	VH
High Risk	Hig
Significant Risk	Sig
Moderate Risk	Mod
Low Risk	Low
Negligible Risk	Neg
No Risk	Non

8.5 Additional (future) risk controls

Additional controls have been identified to ensure that risk levels are reduced to a level which is considered to be ALARP (see Section 1.4.3 for a description of ALARP). These additional controls are safety recommendations which were then assigned a likelihood and consequence reduction to allow the calculation of a Future risk score. The identified measures, if fully adopted, should be incorporated into Argyll and Bute Council's operational plans for establishing and running the proposed breakwater.

Table 19 details the additional controls which were identified as recommendations for potential mitigation for the breakwater construction phase along with the frequency in which they were applied to the hazard scenarios.

Table 20 details the additional controls which were identified as recommendations for potential mitigation for the breakwater operational phase along with the frequency in which they were applied to the hazard scenarios.

Table 19. Additional controls for the construction phase

Control	Frequency
Marine liaison officer	15
AIS/Radar coverage	7
Notices to mariners	7
Weather forecasting	4
Aids to navigation, Provision and maintenance of	4
Communications - Stakeholder	4
Availability of pollution response equipment	4
Promulgation of information	4
Operational weather limits	4
Safety boat	3
Passage planning	2
Operational planning	1
Loading/unloading plan	1

Table 20. Additional controls for the operational phase

Control	Frequency
Review of available powers	4
Update ALRS and Sailing Directions	3
Passage planning	2
Shore side facility maintenance programme	2
Hydrographic surveying program	1
Promulgation of information	1

8.6 Risk evaluation future

Following the application of the additional (future) risk controls, the outcome of each hazard scenario in respect of the assessed future risk has been determined. The future risk outcome takes into account the likelihood reduction and consequence reduction from each proposed risk control. Table 21 and Table 22 present the future risk level for the hazard scenarios after the additional controls have been applied.

Table 21. Ranked hazard scenarios for the construction phase

Hazard Category	Hazard Scenario	Baseline Risk	Current Risk	Future Risk
Flooding	Dredger flooding whilst engaged in operations	Hig	Sig	Sig
Collision	Tug and tow collision with ferry/tour boat	Sig	Sig	Sig
Allision	Ferry or tour boat allision with marine works	Hig	Sig	Mod
Allision	Dredge/construction plant impact with marine works during construction phase	Sig	Sig	Mod
Allision	Recreational or fishing vessel allision with marine works	Sig	Sig	Mod
Collision	Dredge/construction plant collision with recreational/fishing vessel	Sig	Sig	Mod
Collision	Tug and tow collision with recreational/fishing vessel	Sig	Sig	Mod
Hazardous substance accidents	Accidental spill during marine works	Sig	Sig	Mod
Machinery related accidents	Heavy lift failure, or failure of lifting gear	Sig	Sig	Mod
Payload related accidents	Incorrect payload distribution/loading affects vessel stability	Sig	Mod	Mod
Fire/Explosion	Dredge/construction plant on-board fire	Sig	Mod	Mod
Other	Small non-powered craft displaced by marine works	Sig	Mod	Mod
Accidents to personnel	Man overboard during dredge/construction works	Mod	Low	Low
Accidents to personnel	Diving operations associated with the marine works	Mod	Low	Low
Collision	Dredge/construction plant collision with ferry/tour boat	Low	Low	Low
Grounding	Dredger grounding whilst engaged in operations	Low	Low	Low

Table 22. Ranked hazard scenarios for the operational phase

Hazard Category	Hazard Scenario	Baseline Risk	Current Risk	Future Risk
Allision	Ferry or tour boat with the breakwater	Hig	Hig	Mod
Other	Small non-powered craft, displaced by breakwater	Sig	Mod	Mod
Allision	Recreational or fishing vessel allision with the breakwater.	Sig	Mod	Low
Grounding	Any vessel	Sig	Mod	Low

9 NRA Discussion

This section expands upon the assessments and comments on future risk controls, as part of the existing harbour operation. Section 9.1 provides a commentary on construction hazard scenarios; Section 9.1.1 addresses the operational phase of the scheme.

9.1 Construction hazard scenarios

The NRAs for the construction stage of the project which have an assessed outcome of significant risk (or above) when currently available controls are applied have been taken forward into this section for further consideration. These hazard scenarios are listed in Table 23.

Table 23. Construction NRAs with significant or higher current risk

Hazard Category	Hazard Scenario	Current Risk	Future Risk
Flooding	Dredger flooding whilst engaged in operations	Sig	Sig
Collision	Tug and tow collision with ferry/tour boat	Sig	Sig
Allision	Ferry or tour boat allision with marine works	Sig	Mod
Allision	Dredge/construction plant impact with marine works during construction phase	Sig	Mod
Allision	Recreational or fishing vessel allision with marine works	Sig	Mod
Collision	Dredge/construction plant collision with recreational/fishing vessel	Sig	Mod
Collision	Tug and tow collision with recreational/fishing vessel	Sig	Mod
Hazardous substance accidents	Accidental spill during marine works	Sig	Mod
Machinery related accidents	Heavy lift failure, or failure of lifting gear	Sig	Mod

9.1.1 Flooding – Dredger flooding whilst engaged in operations

During the construction phase dredge and marine works, there is an increased risk of dredge vessels having an ingress of water during dredge operations through a weld failure, sea value defect or dredge cargo loading error with the vessel close inshore, in complex tidal conditions. The outcome would have a small negative magnitude as the potential impact will be localised to the extent of the marine construction area and will be present for the construction phase only. The hazard scenario has the potential to occur throughout the construction phase and would have a high impact on safety with limited ability to adapt to the situation, hence the sensitivity is high. Therefore, the dredger flooding has an overall assessment of minor adverse.

The following mitigation measure would need to be introduced by Argyll and Bute Council to reduce the risk to a level that could be considered ALARP:

- Marine liaison officer – to coordinate emergency response with shore side resources.

Following the implementation of this measure neither the sensitivity nor the magnitude of this assessment will change and therefore it will still be considered minor adverse.

9.1.2 Collision – Tug and tow collision with ferry/tour boat

A tug and tow collision with a ferry/tour boat carries a risk when the ferry/tour boat is travelling to and from the current slipway or pier. Collision risk is increased during periods of high vessel traffic, and when adverse weather may negatively affect vessel manoeuvrability. The collision has the potential to result in damage which may lead to a pollution event (e.g. fuel spill).

This assessment has a medium level of sensitivity as vessels have some ability to adapt to the situation through application of their engines, anchors or adjust moorings. In addition, it is likely the tug and tows will be moving at slow speed to transport material short distances between the barge and the marine works. The potential effect from a collision will be localised to the immediate extent of the marine construction area. The impact has potential to occur throughout the construction phase when these vessels are manoeuvring thus it has a magnitude of large negative. Therefore, the collision risk has an overall assessment of moderate adverse.

The following mitigation measures would need to be introduced by Argyll and Bute Council to reduce the risk to a level that could be considered ALARP:

- AIS coverage – all dredge/construction vessels, including barges to carry AIS (A or B).
- Notices to mariners – issued on the Council website containing details about construction activities.
- Marine liaison officer – to provide safety information to vessels navigating in the area and to local authorities.
- Safety lighting – Appropriate illumination of the marine works to be provided, without affecting mariners' night vision (BSI, Road Lighting, BS:5489-1 2020).

Following the implementation of these measures, specifically the issuing of notices to mariners and AIS coverage, the impact reduces to medium as incidents and accidents are less likely. Therefore, the scenario is assessed as moderate to minor adverse.

9.1.3 Allision – Ferry or tour boat allision with marine works

Ferry and tour boats transiting in proximity to the marine works have the potential to make heavy contact (allision) with the works. Allision risk will be increased during times of adverse weather when wind activity and wave action has the potential to adversely affect vessel manoeuvring and in periods of reduced visibility where it will be difficult to see breakwater. The risk will also be increased in periods of high vessel movements as this will decrease the available space for manoeuvring. Any contact has the potential to result in some damage which may lead to a pollution event (e.g. fuel or oil spill) and due to passengers being often onboard the vessel there is a risk of multiple injuries and associated negative publicity.

This potential effect would have a medium level of sensitivity as vessels have some ability to adapt to the situation through the application of their engines to manoeuvre or use of anchors to avoid/ reduce the impact of an allision. These vessels will also have SOPs in place which would provide a process to follow for crew and passengers if a marine incident occurs, this could potentially reduce the severity of an incident. The potential effect from an allision will be localised to the immediate extent of the marine construction area. The impact has the potential to occur throughout the construction phase and therefore has a medium negative magnitude. Therefore, the overall outcome is moderate to minor adverse.

The following mitigation measures would need to be introduced by Argyll and Bute Council to reduce the risk to a level that could be considered ALARP:

- Notices to mariners – issued on the Council website containing details about construction activities.
- Aids to navigation, Provision and maintenance of – illumination of marine works at night.
- Marine liaison officer – central point of contact to coordinate activities.
- Availability of pollution response equipment – contractor to have tier 1 pollution equipment
- Promulgation of information – information on activities shared with local communities.
- Safety lighting – Appropriate illumination of the marine works to be provided, without affecting mariners' night vision (BSI, Road Lighting, BS:5489-1, 2020).

Following the implementation of these measures, specifically the appointment of a marine liaison officer, notices to mariners and the illumination of marine works at night, the magnitude is reduced to small negative as likelihood of an allision is reduced. Therefore, the scenario is assessed as minor adverse.

9.1.4 Allision – Dredge/construction plant impact with marine works during construction phase

Dredge/construction plant used during the marine works has the potential to make heavy contact (allision) with the works. These vessels include jack-up platforms, barges, tugs and tows, dredging plant and workboat support craft. It should be noted that construction activities carried out from platforms held in place by spud support legs are not subject to allision when the platform is elevated. However, when being manoeuvred into position there is a risk of contact between the vessel and structures within the marine construction area. Allision risk increases during times of adverse weather when wind activity and wave action has the potential to adversely affect vessel manoeuvring. Any contact has the potential to result in some damage which may lead to a pollution event (e.g. fuel or oil spill).

This potential effect would have a high level of sensitivity as the vessels have some ability to adapt to the situation through the application of their engines, anchors or adjusting moorings. In addition, it is likely that dredge and construction vessels would be moving at a slow speed whilst working making any allision a controlled outcome if avoidance action is taken. The potential effect from an allision will be localised to the immediate extent of the marine construction area. The impact has the potential to occur throughout the construction phase whilst vessels are manoeuvring leading to a magnitude of medium thus this scenario has an overall outcome of major to moderate adverse.

The following mitigation measures would need to be introduced by Argyll and Bute Council to reduce the risk to a level that could be considered ALARP:

- AIS coverage – all construction craft to carry AIS to reduce the severity of the hazard if it were to occur.
- Aids to navigation, Provision and maintenance of – illumination of marine works at night.
- Marine liaison officer – central point of contact to coordinate activities.
- Weather forecasting – monitored by construction personnel with weather limits for activities identified.

- Operational weather limits – Maximum wind/wave limits for construction activities.
- Safety lighting – Appropriate illumination of the marine works to be provided, without affecting mariners' night vision (BSI, Road Lighting, BS:5489-1, 2020).

Following the implementation of these measures, specifically the appointment of a marine liaison officer, operational weather limits and the illumination of marine works at night, the sensitivity is reduced to low. Therefore, the scenario is assessed as minor adverse.

9.1.5 Allision – Recreational or fishing vessel allision with marine works

Recreational and fishing vessels transiting proximate to the marine works have the potential make heavy contact (allision) with the works during construction. Allision risk will be increased during times of adverse weather when wind activity and wave action has the potential to adversely affect vessel manoeuvring and in periods of reduced visibility where it will be difficult to see breakwater. The risk will also be increased in periods of high vessel movements as this will decrease the available space for manoeuvring. Any contact has the potential to result in some damage which may lead to a pollution event (e.g. fuel or oil spill).

This potential effect would have a high level of sensitivity as the vessels have some ability to adapt to the situation through the application of their engines to manoeuvre or use of anchors to avoid/ reduce the impact of an allision. The potential effect from an allision will be localised to the immediate extent of the marine construction area. The impact has the potential to occur throughout the construction phase, with accidents occurring often, leading to a medium negative magnitude. Therefore, the overall outcome is major to moderate adverse.

The following mitigation measures would need to be introduced by Argyll and Bute Council to reduce the risk to a level that could be considered ALARP:

- Notices to mariners – issued on the Council website containing details about construction activities.
- Aids to navigation, Provision and maintenance of – illumination of marine works at night.
- Marine liaison officer – central point of contact to coordinate activities.
- Availability of pollution response equipment – contractor to have tier 1 pollution equipment.
- Promulgation of information – information on activities shared with local communities.
- Communications – Stakeholder – stakeholders should be informed of the need to move buoyed areas during construction and advised of other suitable locations.
- Safety lighting – Appropriate illumination of the marine works to be provided, without affecting mariners' night vision (BSI, Road Lighting, BS:5489-1, 2020).

Following the implementation of these measures, specifically the appointment of a marine liaison officer, notices to mariners and the illumination of marine works at night, the magnitude is reduced to small negative. Therefore, the scenario is assessed as minor adverse.

9.1.6 Collision – Dredge/construction plant collision with recreational/fishing vessel

Dredge/construction plant used during the marine works have the potential to collide with recreational and fishing vessels transiting past the works or accessing moorings at Iona. The dredge and construction vessels include jack-up platforms, barges, dredging plant and workboat support craft. Tugs and tows are considered under a separate assessment see Section 9.1.7. Collision risk will be increased during times of adverse weather when wind activity and wave action has the potential to adversely affect vessel manoeuvring or when there is high vessel activity in the area. Any collision has the potential to result in damage which may lead to a pollution event (e.g. fuel or oil spill).

This potential effect would have a high level of sensitivity as the is a high level of safety impact for shipping and navigation receptors, despite vessels also have some ability to adapt to the situation through the application of their engines, anchors or adjusting moorings. It is likely that dredge and construction vessels would be moving at a slow speed whilst working making any potential collision more avoidable and have a smaller impact. The potential effect from a collision will be localised to the immediate extent of the marine construction area. The impact has the potential to occur throughout the construction phase whilst vessels are manoeuvring leading to an assessed magnitude of medium. Therefore, the assessment of significance is moderate to minor adverse.

The following mitigation measures would need to be introduced by Argyll and Bute Council to reduce the risk to a level that could be considered ALARP:

- AIS coverage – all dredge/construction vessels, including barges to carry AIS (A or B).
- Notices to mariners – issued on the Council website containing details about construction activities.
- Promulgation of information – information on activities shared with local communities.
- Safety boat – available and manned during construction activities.
- Marine liaison officer – to provide safety information to vessels navigating in the area and to local authorities.
- Communications – Stakeholder – stakeholders should be informed of the need to move buoyed areas during construction and advised of other suitable locations.
- Safety lighting – Appropriate illumination of the marine works to be provided, without affecting mariners' night vision (BSI, Road Lighting, BS:5489-1, 2020).

Following the implementation of these measures, specifically the appointment of a marine liaison officer, the publicising of the notices to mariners and AIS coverage, then the magnitude is reduced to small. Therefore, the scenario is assessed as minor adverse.

9.1.7 Collision – Tug and tow collision with recreational/fishing vessel

A tug and tow moving material to the construction side or departing for sea may come into contact and collide with a recreational or fishing vessel. Collision risk is increased during periods of high vessel traffic, and when adverse weather may adversely affect either vessels ability to manoeuvre. The collision has the potential to result in damage which may lead to a pollution event (e.g. fuel spill).

The potential effect would have high level of sensitivity as there is a high level of safety impact and the vessels will also have some ability to adapt to the situation through application of their engines, anchors or adjust moorings. It is likely the tug and tow vessels will be moving at slow speed to transport material short distances between the barge and the marine works. The potential effect from the collision will be localised to the immediate extent of the marine construction area. The magnitude of effect is considered to be medium due to the frequency of tug and tow movements during the works. Hence the overall significance is moderate adverse.

The following mitigation measure would need to be introduced by Argyll and Bute Council to reduce the risk to a level that could be considered ALARP:

- AIS coverage – all dredge/construction vessels, including barges to carry AIS (A or B).
- Communications – Stakeholder – stakeholders should be informed of the need to move buoyed areas during construction and advised of other suitable locations.

- Safety lighting – Appropriate illumination of the marine works to be provided, without affecting mariners' night vision (BSI, Road Lighting, BS:5489-1, 2020).

Following the implementation of this measure the risk would be reduced but remains within the classification of moderate adverse. This is reflective of the fact that once a tug and tow has left the immediate vicinity of the works, vessels will navigate in the usual way, following international rules such as COLREGS. The ability of the project scheme to implement additional controls is limited past the requirement to use AIS for identification.

9.1.8 Hazardous substance accidents – Accidental spill during marine works

During the marine works there is an increased risk of accidental spillage of oil, fuel and chemical pollutants from the dredge plant, construction vessel activity and marine construction works. This may result in a reduction in water quality. The prevailing weather conditions during any marine pollution event will dictate the path and extent of surface water sheens.

The impact has the potential to occur infrequently throughout the period; and the volume of a spill is likely to be small scale due to the volume which could be spilled at any one time through construction activity. It should be noted that Argyll and Bute Council have oil spill contingency plans in place, which include a Tier 2 response contractor. These factors lead to an assessment of the magnitude of a spill as small and a sensitivity as high. Therefore, the overall assessment being minor adverse.

The following mitigation measures would need to be introduced by Argyll and Bute Council to reduce the risk to a level that can be considered ALARP:

- Availability of pollution response equipment – contractor to have tier 1 pollution equipment.
- Marine liaison officer – coordinating activities for the construction.
- Safety lighting – Appropriate illumination of the marine works to be provided, without affecting mariners' night vision (BSI, Road Lighting, BS:5489-1, 2020).

Following the implementation of these measures, specifically the availability of pollution response equipment, the future risk is assessed to remain as minor adverse.

9.1.9 Machinery related accidents – Heavy lift failure, or failure of lifting gear

During the marine works there is a risk of lifting gear failure whilst a load is slung or a heavy load is transferred between vessels, a vessel and the marine works or rock is placed along the breakwater. The nature of the loads during the construction phase of the marine works means that should a failure occur and the load be dropped onto a vessel, it would lead to major damage for the vessel and possible fatalities. The prevailing weather conditions will be the main factor leading to this impact occurring; especially high wind conditions affecting cranes, and large swell causing movement of vessels.

The potential effect would have a high level of impact for vessels and crew, with limited ability to adapt to a quickly developing incident. The sensitive is therefore assessed as high. The potential effect would be localised to the extent of the incident within the study area and will be present for the construction phase only. The impact has the potential to occur infrequently throughout the period of the construction, which leads to 'small negative magnitude and an overall outcome of minor adverse.

The following mitigation measures would need to be introduced by Argyll and Bute Council to reduce the risk to a level that can be considered ALARP:

- Weather forecasting – monitoring of weather conditions.

- Operational weather limits – maximum wind/wave limits for construction activities.
- Marine liaison officer – coordinating activities for the construction.
- Safety lighting – Appropriate illumination of the marine works to be provided, without affecting mariners' night vision (BSI, Road Lighting, BS:5489-1, 2020).

Following the implementation of these measures, specifically the implementation of operational weather limits, the future risk is assessed to remain as minor adverse.

9.2 Operation hazard scenarios

The NRAs for the operational stage of the project which have an assessed outcome of significant risk (or above) when currently available controls are applied have been taken forward into this section for further consideration. These hazard scenarios are listed in Table 24.

Table 24. Operation NRAs with significant or higher current risk

Hazard Category	Hazard Scenario	Current Risk	Future Risk
Allision	Ferry or tour boat with the breakwater	Hig	Mod

9.2.1 Allision – Ferry or tour boat with the breakwater

Any allision has the potential to cause damage to a vessel which may lead to a pollution event and cause injuries to personnel. This risk will diminish with time as crew become familiar with the new breakwater locations and the effects of wind and tidal flow at this location. The passage of the ferry would be altered by the proposed marine works as the presence of the breakwaters would require the ferry and tour boats to transit around the new structure, thereby altering the approach/departure route compared to that used presently.

This potential effect would have a medium level of sensitivity due safety impacts for the vessel from an allision. It is likely that any allision would be at low speed given that vessels are arriving or departing the port on the approach to the berth; meaning that there is time to react to an allision situation by use of the vessel's engines, rudder and bow thruster (if fitted). In addition, the potential impact is localised to the area of the marine facilities but can occur throughout the operational phase leading to a magnitude of medium and an overall ranking of moderate to minor adverse.

The following mitigation measures would need to be introduced by Argyll and Bute Council to reduce the risk to a level that can be considered ALARP:

- Passage planning – update to CalMac passage plan.
- Update the Admiralty List of Radio Signals (ALRS) volume 6, and Sailing Directions – updates to include new structures.
- Review of available powers – Argyll and Bute Council should review their powers in relation to operating the port facility at Iona to determine whether further powers are required to ensure navigational safety.
- Shore side facility maintenance programme – schedule of maintenance including AtoN.

Following the implementation of these measures, specifically the review of available powers and the updates to the marine safety management system the overall ranking will be reduced to minor adverse.

10 Mitigation Measures Summary

The following sections consolidates the list of additional (future) risk controls identified in Sections 9.1 and 9.2. The context of the description is drawn from the assessments in Appendix B.

- Marine liaison officer – the marine liaison officer provides a point of contact for the marine works, will provide safety information to vessels navigating in the area and coordinate with local authorities during emergency situations. This is just to provide a central point of contact.
- AIS coverage – all dredge/construction vessels, including barges to carry AIS (A or B).
- Notices to mariners – issued by Argyll and Bute Council containing details about the construction works. These should be issued prior to any works (or any related activities such as diving or towage movements).
- Availability of pollution response equipment – pollution response equipment should be available and carried by the contractors for use at Iona. The equipment should be appropriate for the type and scale of pollution that may occur.
- Weather forecasting – a weather forecasting service should be regularly monitored to indicate any periods of upcoming adverse weather conditions. Appropriate actions should then be taken to mitigate any potential situations that may arise. These actions should be documented in the safety management system with the specific weather conditions which necessitates the actions.
- Operational weather limits – including maximum wave and wind limits for construction activities should be detailed in the contractors 'Risk Assessment Method Statement'.
- Promulgation of information – information on the project and upcoming operations with associated vessel movements should be provided to local stakeholders. This should include details of the marine works and breakwater being given to the Scottish Canoe Association to distribute to their members. A website page (potentially on the Council's website) for the project, providing information and a method to contact the project would allow any vessels in the area to obtain information.
- Aids to navigation, Provision and maintenance of – aids to navigation should be provided after consultation and approval of the NLB. Marine works to be illuminated at night. The aids to navigation must be maintained to provide the availability of the aids to navigation required by the NLB with any out of service periods reported via the LATON system.
- Safety boat – the safety boat should be appropriate for the wind and wave conditions in the area. It should be available on site and manned during construction operations in order to provide quick assistance if any incident was to occur.
- Passage planning – CFL should update their passage plan, both during the works and on completion of the works to recognise the altered route.
- Operational planning – capital dredging should be scheduled, as far as possible, to avoid disruption to ferry operations.
- Review of available powers – Argyll and Bute Council should review their powers in relation to operating the port facility at Iona to determine whether further powers are required to ensure navigational safety
- Update ALRS and Sailing Directions – updates to include new structures after completion of the marine works.
- Shore side facility maintenance programme – to schedule the maintenance of the site, including the AtoN.
- Communications – Stakeholder – stakeholders should be informed of the need to move buoyed areas during construction and advised of other suitable locations.

- Safety – Lighting - it is important that any marine works at night or at times of reduced visibility are sufficiently illuminated in accordance with the Health and Safety Executive (HSE) Approved Code of Practice (ACOP) 'Safety in Docks' (HSE, 2014). The guidance on illumination levels is drawn from the 'Safety and Health in Ports' code of practice published by the International Labour Organization, this states that: *"On access routes for people, plant and vehicles and in lorry parks and similar areas, the minimum level of illumination should not be less than 10 lux. In operational areas where people and vehicles or plant work together, the minimum level of illumination should not be less than 50 lux"*. (ILO 2016). This level of illumination must be balanced alongside the requires from the British Standard Institute (BSI) publication 'Design of Road Lighting' BS:5489-1, 2020.

A further three additional mitigation measures were listed in risk assessments that were not brought forward as having a 'Significant' or higher current risk but should be considered as part of the overall scheme mitigation as they contribute to lowering risk overall, and form part of the 'ALARP' conclusion.

- Hydrographic surveying program – data to be provided to UKHO for use in navigational charts.
- Loading/unloading plan – during the construction phase, a loading/unloading plan should be created detailing the location and order in which equipment will be loaded/unloaded on the construction barge. This should take vessel stability and crane location into account to prevent list or loll.
- Operation planning – the dredging should be scheduled to deconflict with the ferry schedule.

11 Summary

In total, this NRA has identified 20 hazard scenarios which have been assessed. A total of 16 hazard scenarios were identified for the construction phase and 4 hazard scenarios for the operational phase. Consultation has been conducted with stakeholders to draw out local user opinion. To inform the consultees, information defining the baseline navigational environment has been used, including a traffic assessment from one year of AIS data collected between 01 November 2021 to 31 October 2022.

The initial assessment identified 10 assessments with a current risk score outcome of significant or higher. Following the NRA process, 17 mitigation measures were identified, split between the Construction and Operational phases of the proposed development. After implementation of appropriate mitigation, marine risk to navigational receptors was reduced to a level of 'as low as reasonably practicable' as required by the Port Marine Safety Code (DfT, 2016) through the adoption of future mitigation controls.

12 References

A&BC, 2023. 'Marine Safety Management System' Argyll and Bute Council, Version 12, June 2023.

ABPmer SEASTATES: www.seastates.net

BS 5489-1:2020 Design of road lighting - Lighting of roads and public amenity areas. Code of practice, British Standards Institution, 31 May 2020.

DfT, 2016. 'Port Marine Safety Code (PMSC)'. Department for Transport, November 2016.

DfT, 2018. A Guide to Good Practice on Port Marine Operations, Department for Transport, February 2018.

Health and Safety Executive (HSE), 2014. Approved Code of Practice (ACOP), Safety In Docks, L148. https://www.hse.gov.uk/pubns/books/l148.htm

International Labour Organization (ILO), 2016. Safety and health in ports (Revised 2016) https://www.ilo.org/sector/activities/sectoral-meetings/WCMS_546257/lang--en/index.htm

IMO, 1972. The International Regulations for Preventing Collisions at Sea (COLREGS). International Maritime Organisation, 1972

IMO 2018. Revised Guidelines for Formal Safety Assessment (FSA) for use in the IMO rule making process. International Maritime Organization

MCA, 2021a. 'MGN 654 (M+F) Safety of Navigation: Offshore Renewable Energy Installations (OREIs) - Guidance on UK Navigational Practice, Safety and Emergency Response'

MCA, 2021b. 'Methodology for Assessing the Marine Navigational Safety and Emergency Response Risks of Offshore Renewable Energy Installations (OREI). Maritime and Coastguard Agency', April 2021.

RPS, 2021. 'FIONNPHORT Breakwater Project Environmental Scoping Report' RPS Group, July 2021

UK Government, 2011. 'The UK Marine Policy Statement, March (2011).

13 Abbreviations/Acronyms

A&BC	Argyll and Bute Council
A&B	Argyll and Bute
AtoN	Aids to Navigation
ACOP	Approved Code of Practice
AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
ALRS	Admiralty List of Radio Signals
BS	British Standard
BSI	British Standard Institute
CFL	CalMac Ferries Ltd
CMAL	Caledonian Maritime Assets Limited
COLREGS	International Regulations for Preventing Collisions at Sea
DfT	Department for Transport
FSA	Formal Safety Assessment
GLA	General Lighthouse Authority
GT	Gross Tonnage
H&S	Health & Safety
HM	Her Majesty's
Hig	High Risk
HSE	Health and Safety Executive
HW	High Water
ID	Identity
ILO	International Labour Organization
IMO	International Maritime Organization
LATON	Local Aids to Navigation
LOA	Length Overall
Low	Low Risk
lux	Unit of Illuminance
M+F	Merchant + Fishing
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MGN	Marine Guidance Note
MoB	Man Overboard
Mod	Moderate Risk
MSMS	Marine Safety Management Systems
MV	Motor Vessel
Neg	Negligible Risk
NLB	Northern Lighthouse Board
Non	No Risk
NRA	Navigational Risk Assessment
OREI	Offshore Renewable Energy Installation
PMSC	Port Marine Safety Code
RAMS	Risk Assessment Method Statement
RHIBs	Rigid Hull Inflatable Boats
RNLI	Royal National Lifeboat Institution
RPS	RPS Group
RYA	Royal Yachting Association

SHA	Statutory Harbour Authority
Sig	Significant Risk
SMS	Safety Management System
SOLAS	Safety of Life at Sea
SOP	Standard Operating Procedure
UK	United Kingdom
UKHO	UK Hydrographic Office
UNCLOS	United Nations Convention on the Law of the Sea
VH	Very High Risk

Cardinal points/directions are used unless otherwise stated.

SI units are used unless otherwise stated.

Appendices





Innovative Thinking - Sustainable Solutions

ABP mer

A Wave Model Output

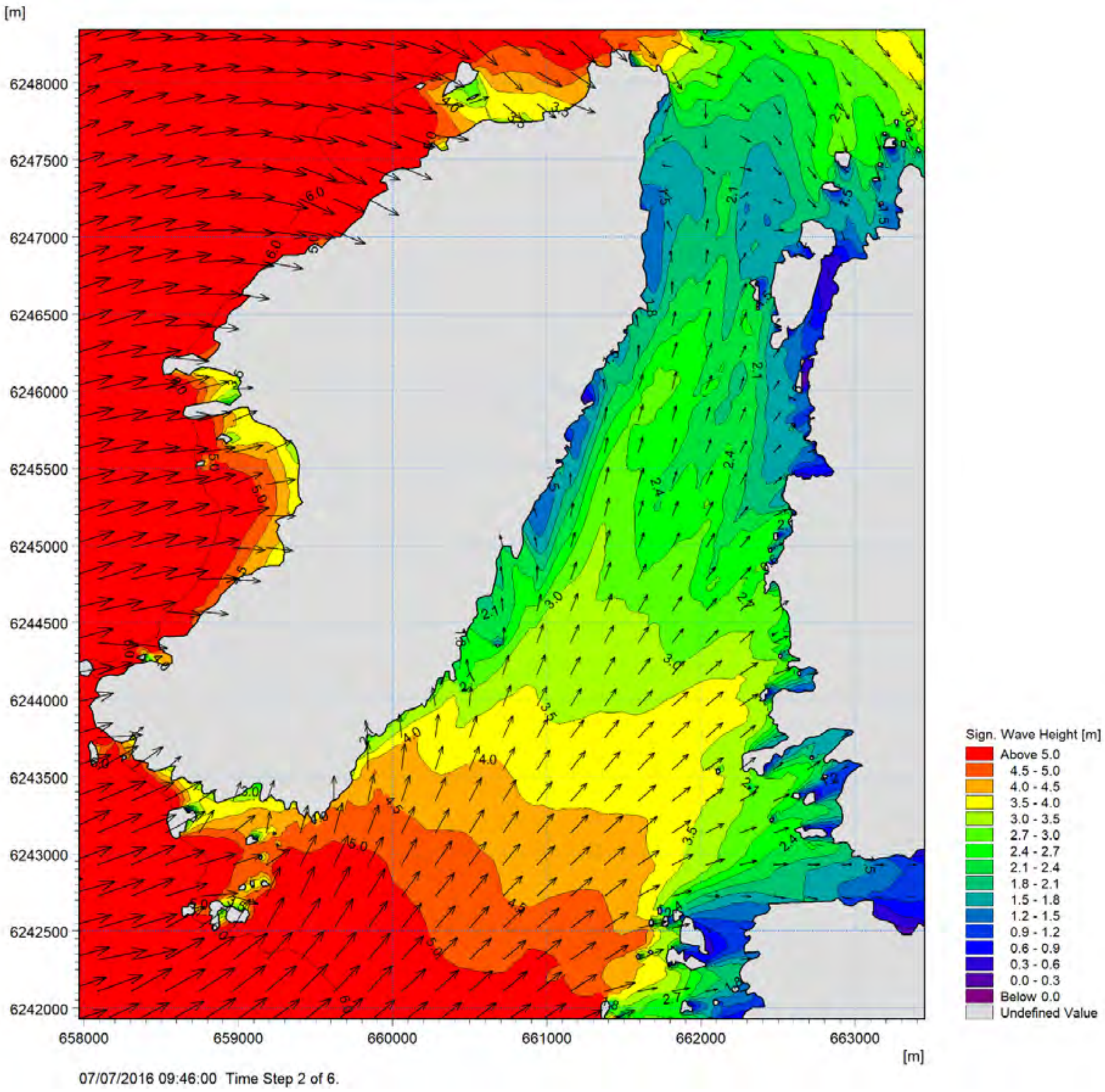

Figure A1. **Significant wave height and mean wave direction – 1 in 1 year return period storm from 240º at HW**

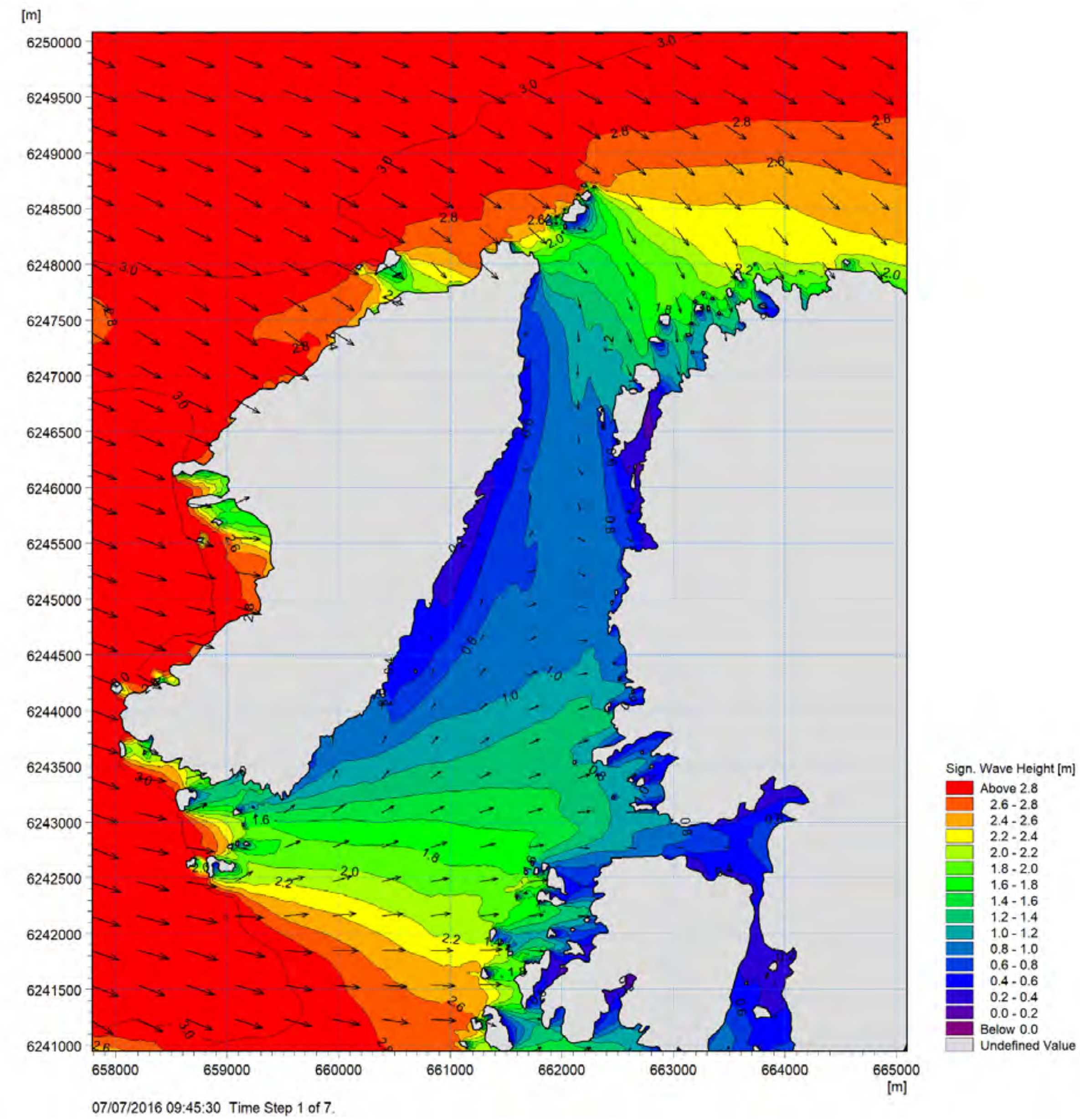

Figure A2. Significant wave height and mean wave direction – 1 in 1 year return period storm from 315° at HW

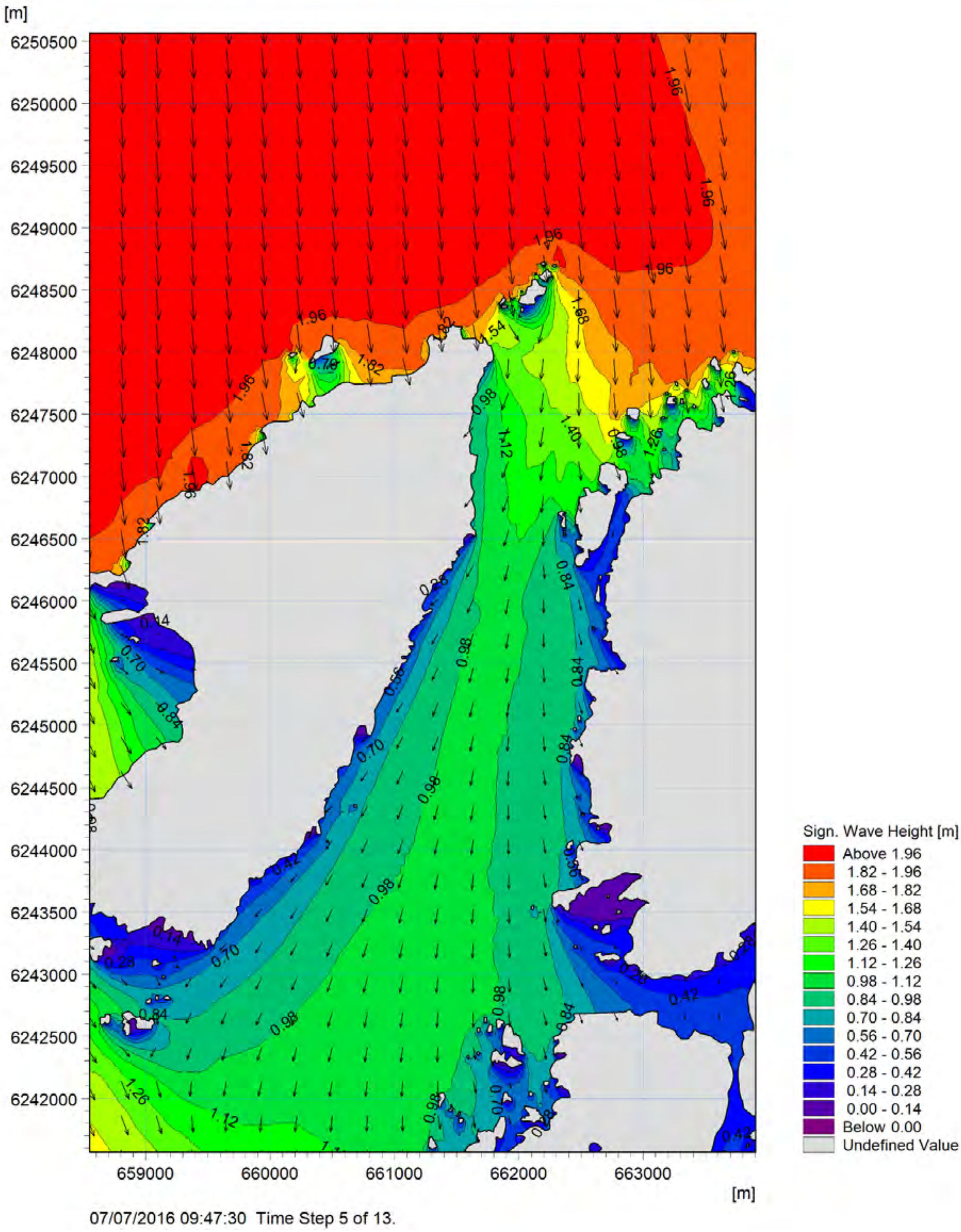

Figure A3. Significant wave height and mean wave direction – 1 in 1 year return period storm from 000° at HW

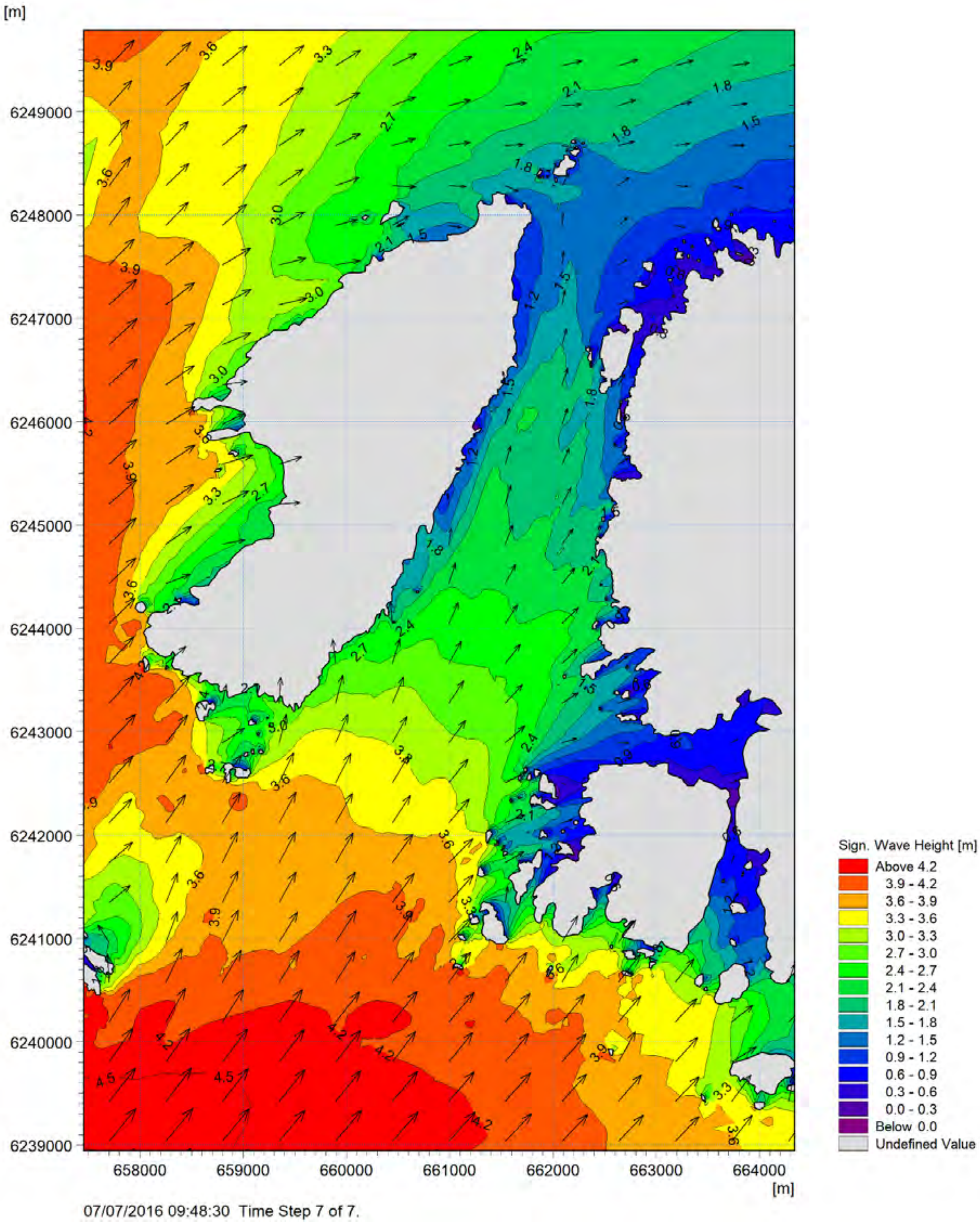

Figure A4. **Significant wave height and mean wave direction – 1 in 1 year return period storm from 210° at HW**

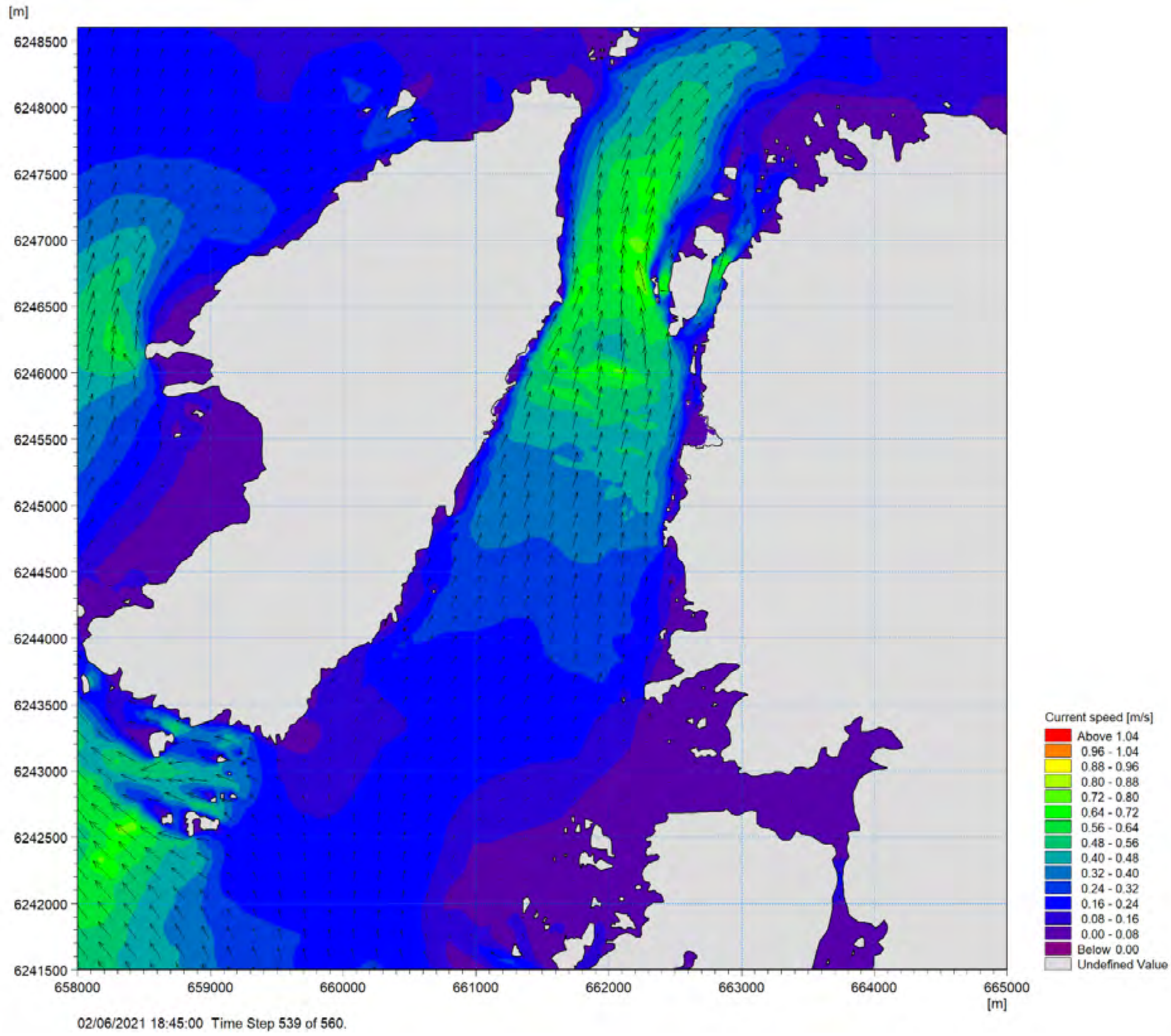

Figure A5. Typical neap tidal flood (north going) current flow through the Sound of Iona

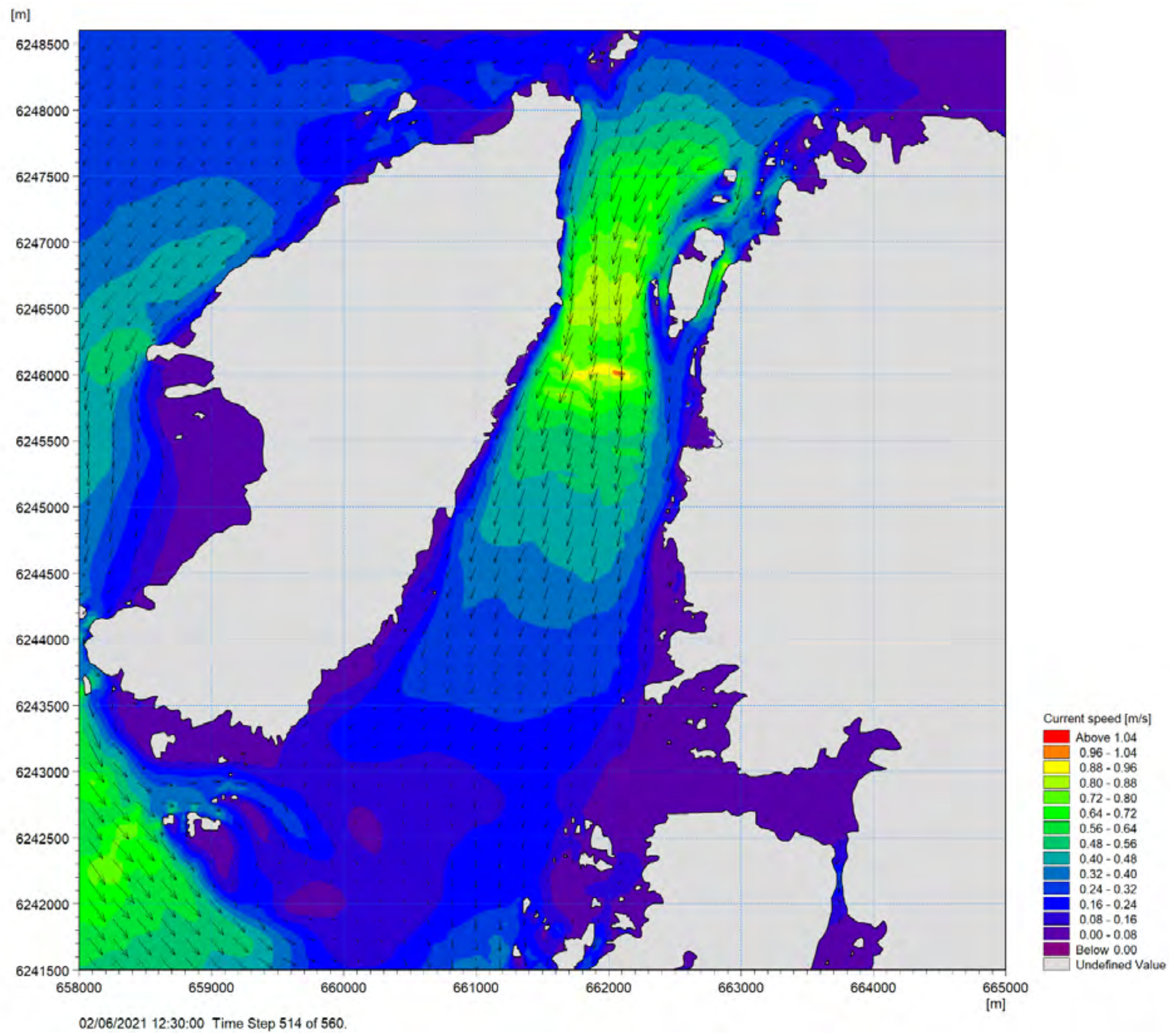

Figure A6. **Typical neap tidal ebb (south going) flow through the Sound of Iona**

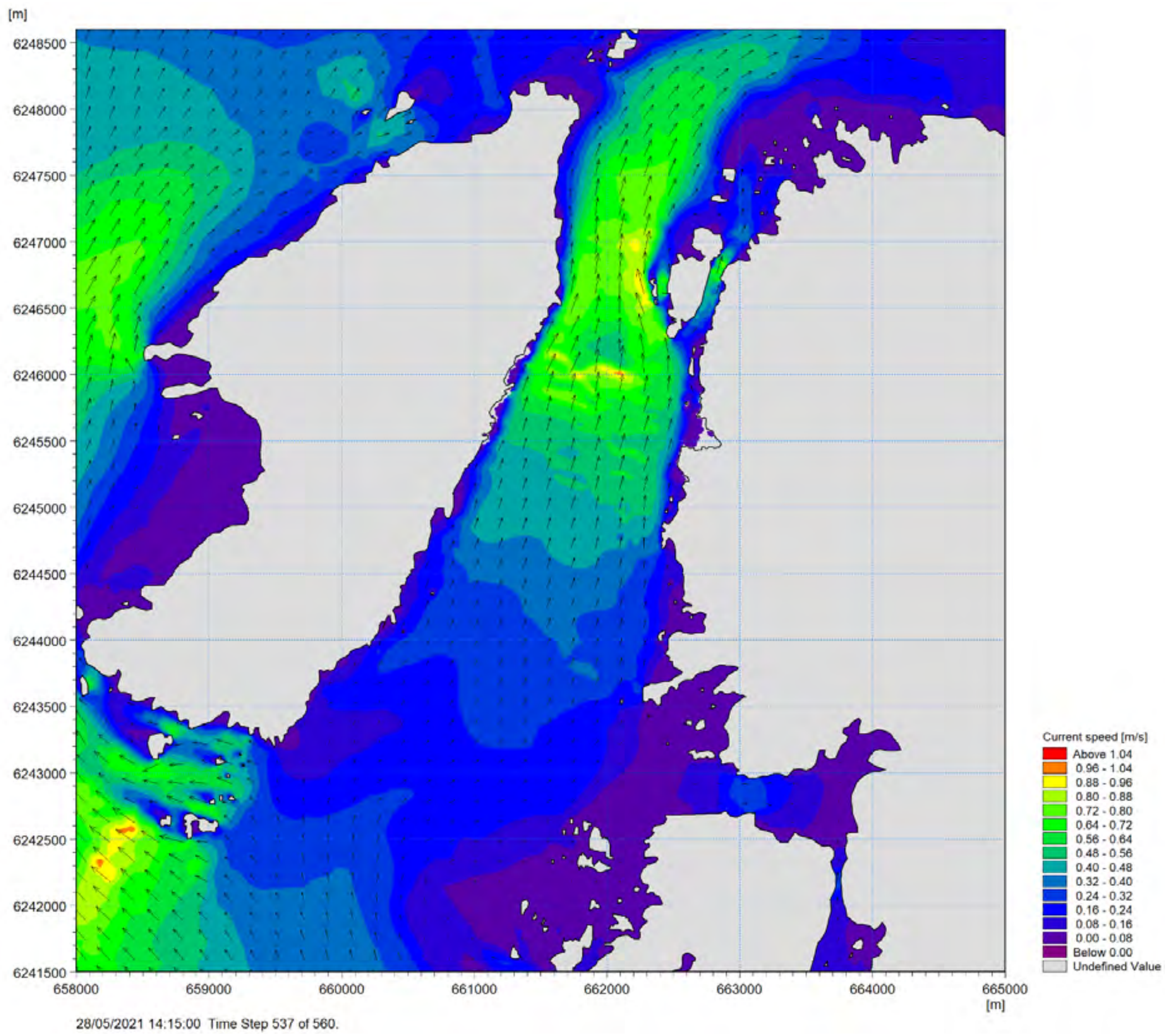

Figure A7. Typical spring tidal flood (north going) flow through the Sound of Iona

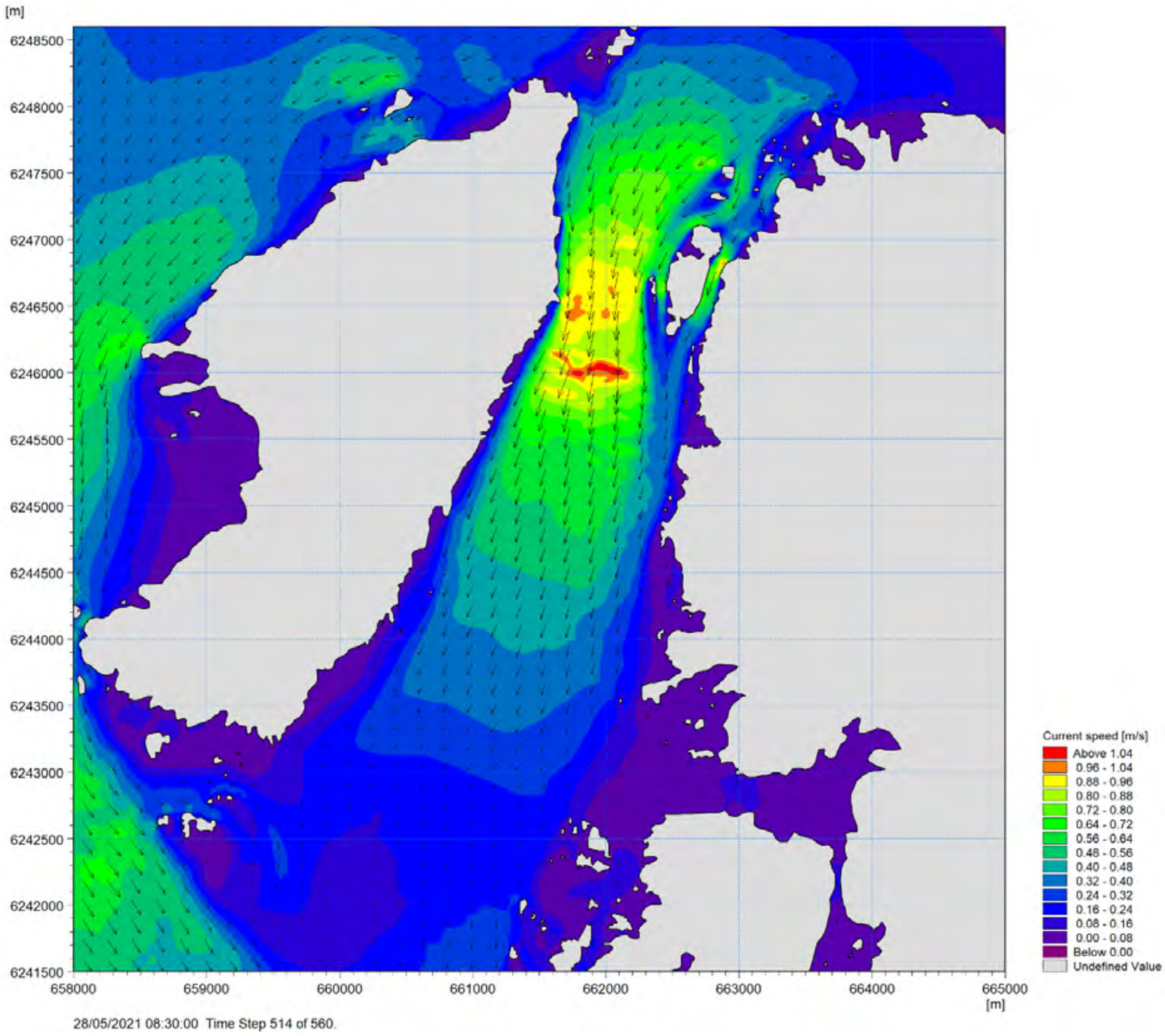

Figure A8. Typical spring tide ebb (south going) flow through the Sound of Iona

B Marine Risk Assessments

B.1 Construction phase

Assessment Number	Hazard Category	Hazard Scenario Title	Worst Credible Scenario	Years between worst occurrence	Consequence: People	Consequence: Property	Consequence: Planet	Consequence: Port	Most Likely Scenario	Years between likely occurrence	Consequence: People	Consequence: Property	Consequence: Planet	Consequence: Port	Inherent Risk	Inherent Risk	Cause ID	Causes
1	Accidents to personnel	Man overboard during dredge/construction works	Man overboard (MoB) during the dredge/construction works, MoB hits head on the vessel leading to drowning. No pollution, minor delay to construction works.	25	3	0	0	3	MoB recovered to shore and treated for cold water immersion. No pollution, minor delay to construction works.	5	1	0	0	1	4.43	Mod	1	Human error/fatigue - Vessel Personnel
																	3	Human error/fatigue - Construction personnel
																	7	Inadequate procedures in place onboard vessel
																	25	Communication failure - Personnel
																	26	Adverse weather conditions
																	37	Failure to comply with safe systems of work
																	59	Inadequate marine procedures - Project
																	76	Inadequate training/competence - Personnel

Control ID	Embedded Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Current Risk	Current Risk	Control ID	Further Applicable Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Final Risk	Final Risk
26	Communications equipment	To request shore assistance	5%	0%	3.98	Low	9	Safety lighting	Appropriate illumination of the marine works to be provided, without affecting mariners' night vision (BSI, Road Lighting, BS:5489-1, 2020)	5%	0%	2.70	Low
44	Safe systems of work (H&S)	Specific to each of the construction activities	15%	0%			28	AIS/Radar coverage	All construction craft to carry AIS	0%	5%		
62	Emergency services equipment - shore side	Ambulance services	0%	10%			116	Weather forecasting	Monitored by construction personnel with weather limits for activities identified	10%	0%		
70	Marine Safety Management System	Argyll and Bute Council has a MSMS to cover the requirements of the PMSC	5%	0%			117	Operational weather limits	Maximum wind/wave limits for construction activities	15%	0%		
116	Weather forecasting	Monitored to indicate periods of adverse weather conditions	5%	0%			135	Safety boat	Available on site and appropriate for the wind and wave conditions in the area	0%	20%		
130	Vessel's emergency response procedures	Actions to be taken in a MoB emergency	5%	0%			136	Marine liaison officer	Central point of contact to coordinate activities	10%	5%		
140	Contractor risk assessment method statement (RAMS)	to be approved by the client before construction begins	15%	0%									

Assessment Number	Hazard Category	Hazard Scenario Title	Worst Credible Scenario	Years between worst occurrence	Consequence: People	Consequence: Property	Consequence: Planet	Consequence: Port	Most Likely Scenario	Years between likely occurrence	Consequence: People	Consequence: Property	Consequence: Planet	Consequence: Port	Inherent Risk	Inherent Risk	Cause ID	Causes
2	Accidents to personnel	Diving operations associated with the marine works	Dredge/construction vessel unaware of divers in the water. Diver caught in propellers or umbilical severed, loss of life, operations cease, national adverse publicity.	50	3	1	0	4	Dredge/Construction vessel approaches diving area and does not see 'A' flag. Vessel is warned of underwater operations and alters course. Divers taken out of water, disruption to activities.	5	0	0	0	1	4.99	Mod	1	Human error/fatigue - Vessel Personnel
																	3	Human error/fatigue - Construction personnel
																	6	Inadequate bridge resource management
																	23	Communication failure - Operational/procedural
																	28	Restricted visibility
																	37	Failure to comply with safe systems of work
																	59	Inadequate marine procedures - Project
																	87	Notice to Mariners failure to observe

Control ID	Embedded Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Current Risk	Current Risk	Control ID	Further Applicable Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Final Risk	Final Risk
26	Communications equipment	To warn vessels of ongoing diving operations	10%	0%	3.94	Low	9	Safety lighting	Appropriate illumination of the marine works to be provided, without affecting mariners' night vision (BSI, Road Lighting, BS:5489-1, 2020)	5%	0%	3.33	Low
44	Safe systems of work (H&S)	Required for permit/permission to work process	15%	0%			28	AIS/Radar coverage	All construction craft to carry AIS	10%	0%		
70	Marine Safety Management System	Argyll and Bute Council has a MSMS to cover the requirements of the PMSC	5%	0%			41	Notices to mariners	Issued on the Council website prior to diving operations	10%	0%		
97	Visual observation (clear line of sight)	Identification of 'A' flag	10%	0%			135	Safety boat	Available and manned during diving operations	20%	5%		
140	Contractor risk assessment method statement (RAMS)	to be approved by the client before construction begins	15%	0%			136	Marine liaison officer	Central point of contact to coordinate activities	10%	0%		

Assessment Number	Hazard Category	Hazard Scenario Title	Worst Credible Scenario	Years between worst occurrence	Consequence People	Consequence Property	Consequence Planet	Consequence Port	Most Likely Scenario	Years between likely occurrence	Consequence People	Consequence Property	Consequence Planet	Consequence Port	Inherent Risk	Inherent Risk	Cause ID	Causes
3	Allision	Dredge/construction plant impact with marine works during construction phase	Dredge/construction vessel slow speed impact with structures during the marine works dredge/construction phase, leading to minor damage to vessel, serious injury to crew, minor pollution (Tier 1). Delay to marine works.	25	2	4	2	2	Slow speed impact results in no damage to vessel hull, minor injury to crew, no pollution. Minor delay to marine works.	1	0	0	0	1	5.00	Sig	3	Human error/fatigue - Construction personnel
																	11	Vessel breakdown or malfunction
																	16	Unplanned interaction with recreational/fishing craft
																	20	Towing equipment failure
																	26	Adverse weather conditions
																	28	Restricted visibility
																	61	Incorrect assessment of tidal flow
																	110	Reduction in safe navigable space
																	112	Unplanned interaction with ferry/tour boat
																	113	Manoeuvre misjudged

Control ID	Embedded Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Current Risk	Current Risk	Control ID	Further Applicable Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Final Risk	Final Risk
21	Oil spill contingency plans	Covers all A&B Council facilities	0%	5%	5.00	Sig	9	Safety lighting	Appropriate illumination of the marine works to be provided, without affecting mariners' night vision (BSI, Road Lighting, BS:5489-1, 2020)	5%	0%	4.41	Mod
24	Tier 2 contractor	Provides personnel and equipment during oil spill response	0%	10%			28	AIS/Radar coverage	All construction craft to carry AIS	10%	0%		
70	Marine Safety Management System	Argyll and Bute Council has a MSMS to cover the requirements of the PMSC	5%	0%			57	Aids to navigation, Provision and maintenance of	Illumination of marine works at night	10%	0%		
130	Vessel's emergency response procedures	Actions to be taken in a contact/allision emergency	0%	5%			116	Weather forecasting	Monitored by construction personnel with weather limits for activities identified	10%	0%		
140	Contractor risk assessment method statement (RAMS)	Details the methods used to complete the construction	10%	0%			117	Operational weather limits	Maximum wind/wave limits for construction activities	10%	0%		

Assessment Number	Hazard Category	Hazard Scenario Title	Worst Credible Scenario	Years between worst occurrence	Consequence People	Consequence Property	Consequence Planet	Consequence Port	Most Likely Scenario	Years between likely occurrence	Consequence People	Consequence Property	Consequence Planet	Consequence Port	Inherent Risk	Inherent Risk	Cause ID	Causes
4	Allision	Recreational or fishing vessel allision with marine works	Recreational or fishing vessel transiting past the marine works allides with temporary or part build structures. Impact causes vessel to be holed leading to flooding and the vessel sinking, multiple fatalities, delay to the construction programme, national adverse publicity, limited pollution (Tier 1).	25	4	3	2	4	Slow speed impact causes vessel damage, leading to minor injury to crew, no delay to construction programme, no pollution.	1	1	1	0	1	5.95	Sig	1	Human error/fatigue - Vessel Personnel
																	11	Vessel breakdown or malfunction
																	16	Unplanned interaction with recreational/fishing craft
																	26	Adverse weather conditions
																	28	Restricted visibility
																	34	Limited area for manoeuvring
																	36	Failure of Aid to Navigation (out of position/unlit)
																	61	Incorrect assessment of tidal flow
																	87	Notice to Mariners failure to observe
																	105	Navigation equipment failure
																	110	Reduction in safe navigable space
																	112	Unplanned interaction with ferry/tour boat
																	113	Manoeuvre misjudged

Control ID	Embedded Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Current Risk	Current Risk	Control ID	Further Applicable Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Final Risk	Final Risk
70	Marine Safety Management System	Argyll and Bute Council has a MSMS to cover the requirements of the PMSC	5%	0%	5.91	Sig	4	Communications - Stakeholder	Covering the moving of buoyed areas	5%	0%	4.86	Mod
							9	Safety lighting	Appropriate illumination of the marine works to be provided, without affecting mariners' night vision (BSI, Road Lighting, BS:5489-1, 2020)	5%	0%		
							36	Availability of pollution response equipment	Contractor to have tier 1 pollution equipment	0%	5%		
							41	Notices to mariners	Issued on the Council website containing details about construction activities	10%	0%		
							48	Promulgation of information	Information on activities shared with local communities	10%	0%		
							57	Aids to navigation, Provision and maintenance of	Illumination of marine works at night	10%	0%		
							136	Marine liaison officer	Central point of contact to coordinate activities	5%	5%		

Assessment Number	Hazard Category	Hazard Scenario Title	Worst Credible Scenario	Years between worst occurrence	Consequence People	Consequence Property	Consequence Planet	Consequence Port	Most Likely Scenario	Years between likely occurrence	Consequence People	Consequence Property	Consequence Planet	Consequence Port	Inherent Risk	Inherent Risk	Cause ID	Causes
5	Allision	Ferry or tour boat allision with marine works	Ferry or Tour Boat transiting past the marine works allides with temporary or part build structures. Impact causes vessel to be holed leading to flooding, multiple fatalities, operations cease during investigation and recovery, pollution (Tier 2), international adverse publicity.	50	4	3	3	4	Slow speed impact causes minor vessel damage, leading to minor injury to crew/passengers, no delay to construction programme, no pollution, adverse publicity from passengers.	10	1	1	0	2	7.05	Hig	1	Human error/fatigue - Vessel Personnel
																	6	Inadequate bridge resource management
																	11	Vessel breakdown or malfunction
																	16	Unplanned interaction with recreational/fishing craft
																	26	Adverse weather conditions
																	28	Restricted visibility
																	36	Failure of Aid to Navigation (out of position/unlit)
																	61	Incorrect assessment of tidal flow
																	72	Failure to follow passage plan
																	103	Excessive vessel speed
																	110	Reduction in safe navigable space
																	111	Scheduling conflicts
																	113	Manoeuvre misjudged

Control ID	Embedded Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Current Risk	Current Risk	Control ID	Further Applicable Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Final Risk	Final Risk
21	Oil spill contingency plans		0%	5%			9	Safety lighting	Appropriate illumination of the marine works to be provided, without affecting mariners' night vision (BSI, Road Lighting, BS:5489-1, 2020)	5%	0%		
26	Communications equipment		0%	5%			10	Passage planning	CFL ferry to update passage planning based on the works	5%	0%		
70	Marine Safety Management System	Argyll and Bute Council has a MSMS to cover the requirements of the PMSC	5%	0%	5.69	Sig	36	Availability of pollution response equipment	Contractor to have tier 1 pollution equipment	0%	10%	4.63	Mod
95	Standing Orders/SOPs		5%	0%			41	Notices to mariners	Issued on the Council website containing details about construction activities	5%	0%		
130	Vessel's emergency response procedures		0%	5%			57	Aids to navigation, Provision and maintenance of	Illumination of marine works at night	10%	0%		
							136	Marine liaison officer	Central point of contact to coordinate activities and provide safety information	0%	5%		

Assessment Number	Hazard Category	Hazard Scenario Title	Worst Credible Scenario	Years between worst occurrence	Consequence People	Consequence Property	Consequence Planet	Consequence Port	Most Likely Scenario	Years between likely occurrence	Consequence People	Consequence Property	Consequence Planet	Consequence Port	Inherent Risk	Inherent Risk	Cause ID	Causes
6	Collision	Dredge/construction plant collision with recreational/fishing vessel	Collision of a recreational/fishing craft with a dredge/construction vessel. Vessels do not identify each other and do not take avoiding action. Recreational/fishing vessel holed and sinks, multiple fatalities, small scale pollution (Tier 1), construction activities cease until investigation and recovery of vessel complete.	25	4	4	2	4	Vessels take avoiding action resulting in minor collision. Recreational/fishing vessel receives minor damage, no damage to dredge/construction plant, minor injuries, no pollution. No delay to construction activities.	10	1	1	0	0	5.31	Sig	1	Human error/fatigue - Vessel Personnel
																	3	Human error/fatigue - Construction personnel
																	6	Inadequate bridge resource management
																	7	Inadequate procedures in place onboard vessel
																	11	Vessel breakdown or malfunction
																	16	Unplanned interaction with recreational/fishing craft
																	25	Communication failure - Personnel
																	26	Adverse weather conditions
																	28	Restricted visibility
																	72	Failure to follow passage plan
																	76	Inadequate training/competence - Personnel
																	82	AIS failure
																	87	Notice to Mariners failure to observe
																	103	Excessive vessel speed
																	105	Navigation equipment failure
																	110	Reduction in safe navigable space

Control ID	Embedded Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Current Risk	Current Risk	Control ID	Further Applicable Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Final Risk	Final Risk
62	Emergency services equipment - shore side	Ambulance services	0%	5%	5.31	Sig	4	Communications - Stakeholder	Covering the moving of buoyed areas	5%	0%	4.02	Mod
70	Marine Safety Management System	Argyll and Bute Council has a MSMS to cover the requirements of the PMSC	5%	0%			9	Safety lighting	Appropriate illumination of the marine works to be provided, without affecting mariners' night vision (BSI, Road Lighting, BS:5489-1, 2020)	5%	0%		
130	Vessel's emergency response procedures	Actions to be taken following a collision	0%	5%			28	AIS/Radar coverage	All dredge/construction vessels, including barges to carry AIS	10%	0%		
140	Contractor risk assessment method statement (RAMS)	Details the risks and mitigations for specific construction activities	10%	0%			41	Notices to mariners	Issued on the Council website containing details about construction activities	10%	0%		
							48	Promulgation of information	Information on activities shared with local communities	10%	0%		
							135	Safety boat	Available and manned during construction activities	0%	10%		
							136	Marine liaison officer	Central point of contact to coordinate activities and provide safety information	10%	5%		

Assessment Number	Hazard Category	Hazard Scenario Title	Worst Credible Scenario	Years between worst occurrence	Consequence People	Consequence Property	Consequence Planet	Consequence Port	Most Likely Scenario	Years between likely occurrence	Consequence People	Consequence Property	Consequence Planet	Consequence Port	Inherent Risk	Inherent Risk	Cause ID	Causes
7	Collision	Dredge/construction plant collision with ferry/tour boat	Collision of a ferry/tour boat with a dredge/construction vessel when manoeuvring. Damage to both vessels requires survey and repair, minor injuries from impact, no pollution, delays to construction activities.	25	1	3	0	2	Minor collision at slow speed during manoeuvring results in minor damage to vessels. No injuries, no pollution, no delay to activities.	5	0	1	0	0	3.97	Low	1	Human error/fatigue - Vessel Personnel
																	3	Human error/fatigue - Construction personnel
																	6	Inadequate bridge resource management
																	7	Inadequate procedures in place onboard vessel
																	11	Vessel breakdown or malfunction
																	23	Communication failure - Operational/procedural
																	26	Adverse weather conditions
																	28	Restricted visibility
																	34	Limited area for manoeuvring
																	61	Incorrect assessment of tidal flow
																	68	Interaction with passing vessel
																	72	Failure to follow passage plan
																	82	AIS failure
																	87	Notice to Mariners failure to observe
																	103	Excessive vessel speed
																	107	Equipment failure (bridge)
																	110	Reduction in safe navigable space
																	111	Scheduling conflicts
																	113	Manoeuvre misjudged

Control ID	Embedded Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Current Risk	Current Risk	Control ID	Further Applicable Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Final Risk	Final Risk
62	Emergency services equipment - shore side	Ambulance services	5%	0%	3.82	Low	1	Operational planning	Dredging scheduled to avoid ferry timings	5%	0%	3.23	Low
70	Marine Safety Management System	Argyll and Bute Council has a MSMS to cover the requirements of the PMSC	5%	0%			9	Safety lighting	Appropriate illumination of the marine works to be provided, without affecting mariners' night vision (BSI, Road Lighting, BS:5489-1, 2020)	5%	0%		
130	Vessel's emergency response procedures	Actions to be taken after a collision	0%	5%			10	Passage planning	CFL ferry to update passage planning based on the works	5%	0%		
140	Contractor risk assessment method statement (RAMS)	Details the risks and mitigations for specific construction activities	10%	0%			28	AIS/Radar coverage	All dredge/construction vessels, including barges to carry AIS (A or B).	10%	0%		
							41	Notices to mariners	Issued on the Council website containing details about construction activities	10%	0%		
							48	Promulgation of information	Information on activities shared with local communities	10%	0%		
							136	Marine liaison officer	To provide safety information to vessels navigating in the area and to local authorities	10%	5%		

Assessment Number	Hazard Category	Hazard Scenario Title	Worst Credible Scenario	Years between worst occurrence	Consequence People	Consequence Property	Consequence Planet	Consequence Port	Most Likely Scenario	Years between likely occurrence	Consequence People	Consequence Property	Consequence Planet	Consequence Port	Inherent Risk	Inherent Risk	Cause ID	Causes
8	Collision	Tug and tow collision with recreational/fishing vessel	Tug and tow (transporting material by barge) on transit in the Sound of Iona collision with recreational/fishing vessel. Recreational/fishing vessel holed and sinks in deep water. Multiple fatalities, pollution (Tier 2). Disruption to marine works meaning temporary suspension of operations.	50	4	4	3	4	Vessels make contact whilst taking avoiding action, glancing blow resulting in minor damage to both vessels. Vessels proceed to nearest suitable berth to assess damage. Minor injury to crew, no pollution, minor disruption to operations.	10	1	1	0	1	5.89	Sig	1	Human error/fatigue - Vessel Personnel
																	7	Inadequate procedures in place onboard vessel
																	11	Vessel breakdown or malfunction
																	20	Towing equipment failure
																	23	Communication failure - Operational/procedural
																	26	Adverse weather conditions
																	28	Restricted visibility
																	72	Failure to follow passage plan
																	76	Inadequate training/competence - Personnel
																	82	AIS failure

Control ID	Embedded Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Current Risk	Current Risk	Control ID	Further Applicable Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Final Risk	Final Risk
10	Passage planning	Required by the SOLAS convention	10%	0%	5.16	Sig	4	Communications - Stakeholder	Covering the moving of buoyed areas	5%	0%	4.83	Mod
62	Emergency services equipment - shore side	Ambulance services	0%	5%			9	Safety lighting	Appropriate illumination of the marine works to be provided, without affecting mariners' night vision (BSI, Road Lighting, BS:5489-1, 2020)	5%	0%		
70	Marine Safety Management System	Argyll and Bute Council has a MSMS to cover the requirements of the PMSC	5%	0%			28	AIS/Radar coverage	All dredge/construction vessels, including barges to carry AIS (A or B).	10%	0%		
130	Vessel's emergency response procedures	Actions to be taken after a collision	0%	5%									

Assessment Number	Hazard Category	Hazard Scenario Title	Worst Credible Scenario	Years between worst occurrence	Consequence People	Consequence Property	Consequence Planet	Consequence Port	Most Likely Scenario	Years between likely occurrence	Consequence People	Consequence Property	Consequence Planet	Consequence Port	Inherent Risk	Inherent Risk	Cause ID	Causes
9	Collision	Tug and tow collision with ferry/tour boat	Tug and tow (transporting material by barge) on transit in the Sound of Iona collision with ferry/tour boat. Ferry/tour boat (carrying passengers) holed and sinks in deep water. Loss of life, pollution (Tier 2). Disruption to marine works meaning temporary suspension of operations, and international adverse publicity.	50	4	4	3	4	Collision occurs in deep water within Sound of Iona. Vessels make contact whilst taking avoiding action, glancing blow resulting in minor damage to both vessels. Vessels proceed to nearest suitable berth to assess damage. Minor injury to crew/passengers, no pollution, no disruption to operations.	10	1	1	0	2	5.87	Sig	1	Human error/fatigue - Vessel Personnel
																	6	Inadequate bridge resource management
																	7	Inadequate procedures in place onboard vessel
																	11	Vessel breakdown or malfunction
																	16	Unplanned interaction with recreational/fishing craft
																	20	Towing equipment failure
																	23	Communication failure - Operational/procedural
																	25	Communication failure - Personnel
																	26	Adverse weather conditions
																	28	Restricted visibility
																	68	Interaction with passing vessel
																	72	Failure to follow passage plan
																	76	Inadequate training/competence - Personnel
																	82	AIS failure
																	112	Unplanned interaction with ferry/tour boat

Control ID	Embedded Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Current Risk	Current Risk	Control ID	Further Applicable Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Final Risk	Final Risk
10	Passage planning	Required by the SOLAS convention	10%	0%	5.78	Sig	9	Safety lighting	Appropriate illumination of the marine works to be provided, without affecting mariners' night vision (BSI, Road Lighting, BS:5489-1, 2020)	5%	0%	5.18	Sig
70	Marine Safety Management System	Argyll and Bute Council has a MSMS to cover the requirements of the PMSC	5%	0%			28	AIS/Radar coverage	All dredge/construction vessels, including barges to carry AIS (A or B).	20%	0%		
							41	Notices to mariners	Issued on the Council website containing details about construction activities	10%	0%		
							136	Marine liaison officer	To provide safety information to vessels navigating in the area and to local authorities	5%	0%		

Assessment Number	Hazard Category	Hazard Scenario Title	Worst Credible Scenario	Years between worst occurrence	Consequence People	Consequence Property	Consequence Planet	Consequence Port	Most Likely Scenario	Years between likely occurrence	Consequence People	Consequence Property	Consequence Planet	Consequence Port	Inherent Risk	Inherent Risk	Cause ID	Causes
10	Fire/Explosion	Dredge/construction plant on-board fire	Fire on-board the dredge/construction vessel. Fire makes the vessel inoperative, multiple fatalities, minor pollution (Tier 1) from fire fighting products and run off, vessel laid up or removed from service. Disruption to the marine works.	50	4	4	2	3	Fire is contained by ship's crew, resulting in localised damage to vessel on-board equipment. Minor injury, no pollution, vessel operational capability unaffected. Minor disruption to the marine works.	10	1	1	0	0	5.32	Sig	3	Human error/fatigue - Construction personnel
																	7	Inadequate procedures in place onboard vessel
																	8	Fire/Explosion
																	11	Vessel breakdown or malfunction

Control ID	Embedded Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Current Risk	Current Risk	Control ID	Further Applicable Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Final Risk	Final Risk
62	Emergency services equipment - shore side	Fire and ambulance services	0%	10%	4.72	Mod	9	Safety lighting	Appropriate illumination of the marine works to be provided, without affecting mariners' night vision (BSI, Road Lighting, BS:5489-1, 2020)	5%	0%	4.42	Mod
70	Marine Safety Management System	Argyll and Bute Council has a MSMS to cover the requirements of the PMSC	5%	0%			136	Marine liaison officer	To coordinate emergency response with shore side resources	0%	5%		
95	Standing Orders/SOPs	Vessel's procedures for undertaking operations	10%	0%									
130	Vessel's emergency response procedures	Actions to be taken for a fire	0%	10%									
140	Contractor risk assessment method statement (RAMS)	Details the risks and mitigations for specific construction activities	5%	0%									

Assessment Number	Hazard Category	Hazard Scenario Title	Worst Credible Scenario	Years between worst occurrence	Consequence: People	Consequence: Property	Consequence: Planet	Consequence: Port	Most Likely Scenario	Years between likely occurrence	Consequence: People	Consequence: Property	Consequence: Planet	Consequence: Port	Inherent Risk	Inherent Risk	Cause ID	Causes
11	Flooding	Dredger flooding whilst engaged in operations	Ingress of water due to weld failure, sea valve failure, hatches/ramps not secure, affects vessel stability leading to vessel sinking. Loss of life, pollution (Tier 2), navigation hazard disrupting operations, major adverse publicity.	50	4	4	3	4	Ingress of water controlled before vessel stability affected. Operations delayed until investigation/repairs completed.	10	0	2	0	2	6.28	Hig	1	Human error/fatigue - Vessel Personnel
																	7	Inadequate procedures in place onboard vessel
																	9	Loss of watertight integrity
																	11	Vessel breakdown or malfunction
																	25	Communication failure - Personnel
																	57	Vessel Ramps or Hatches not secure
																	75	Inadequate maintenance/inspection

Control ID	Embedded Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Current Risk	Current Risk	Control ID	Further Applicable Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Final Risk	Final Risk
70	Marine Safety Management System	Argyll and Bute Council has a MSMS to cover the requirements of the PMSC	5%	0%	5.66	Sig	136	Marine liaison officer	To coordinate emergency response with shore side resources	0%	5%	5.44	Sig
95	Standing Orders/SOPs	Standard vessel operating procedures	5%	5%									
118	Vessel maintenance	Maintenance schedule part of the vessel SMS	15%	10%									
119	Vessel inspection/survey	Port and flag state inspections and survey by classification society	15%	10%									

Assessment Number	Hazard Category	Hazard Scenario Title	Worst Credible Scenario	Years between worst occurrence	Consequence: People	Consequence: Property	Consequence: Planet	Consequence: Port	Most Likely Scenario	Years between likely occurrence	Consequence: People	Consequence: Property	Consequence: Planet	Consequence: Port	Inherent Risk	Inherent Risk	Cause ID	Causes
12	Grounding	Dredger grounding whilst engaged in operations	Dredger grounds whilst dredging. Drag head and pipe damaged, hull holed causing ingress of water, pollution (Tier 2), disruption to marine works and adverse publicity.	25	0	2	0	3	Dredger grounds, minor damage to drag head and pipe, plus damage to vessel hull from contact with the seabed. Vessel requires hull survey causing delay to marine works.	5	0	1	0	1	3.89	Low	1	Human error/fatigue - Vessel Personnel
																	7	Inadequate procedures in place onboard vessel
																	9	Loss of watertight integrity
																	11	Vessel breakdown or malfunction
																	14	Vessel has unreported defect
																	25	Communication failure - Personnel
																	61	Incorrect assessment of tidal flow

Control ID	Embedded Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Current Risk	Current Risk	Control ID	Further Applicable Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Final Risk	Final Risk
31	Availability of latest hydrographic information	Survey provided in advance of the dredge	10%	0%	3.89	Low	9	Safety lighting	Appropriate illumination of the marine works to be provided, without affecting mariners' night vision (BSI, Road Lighting, BS:5489-1, 2020)	5%	0%	3.70	Low
70	Marine Safety Management System	Argyll and Bute Council has a MSMS to cover the requirements of the PMSC	5%	0%			116	Weather forecasting	Monitoring of weather conditions	5%	0%		
95	Standing Orders/SOPs	Vessels procedures for carrying out operations	5%	0%			117	Operational weather limits	Maximum wind/wave limits for construction activities	10%	0%		
130	Vessel's emergency response procedures	Actions taken following a grounding	0%	5%			136	Marine liaison officer	Coordinating activities for the construction	5%	0%		

Assessment Number	Hazard Category	Hazard Scenario Title	Worst Credible Scenario	Years between worst occurrence	Consequence People	Consequence Property	Consequence Planet	Consequence Port	Most Likely Scenario	Years between likely occurrence	Consequence People	Consequence Property	Consequence Planet	Consequence Port	Inherent Risk	Inherent Risk	Cause ID	Causes
13	Hazardous substance accidents	Accidental spill during marine works	Pollution from marine incident or accidental spill during construction phase leading to Tier 2 response. For example split hose or pipe on construction craft. No effect to other nearby vessels.	5	0	0	3	3	Pollution from accidental spill during construction phase leading to Tier 1 response. For example, from refuelling machinery on marine plant such as generators, compressors or cranes. Contractors pollution response equipment deployed. No effect to other nearby vessels.	1	0	0	2	1	5.35	Sig	1	Human error/fatigue - Vessel Personnel
																	5	Human error/fatigue - Marine personnel
																	7	Inadequate procedures in place onboard vessel
																	11	Vessel breakdown or malfunction
																	25	Communication failure - Personnel
																	37	Failure to comply with safe systems of work
																	59	Inadequate marine procedures - Project
																	75	Inadequate maintenance/inspection
																	76	Inadequate training/competence - Personnel

Control ID	Embedded Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Current Risk	Current Risk	Control ID	Further Applicable Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Final Risk	Final Risk
21	Oil spill contingency plans	Covers all A&B Council facilities	0%	5%	5.35	Sig	9	Safety lighting	Appropriate illumination of the marine works to be provided, without affecting mariners' night vision (BSI, Road Lighting, BS:5489-1, 2020)	5%	0%	4.70	Mod
24	Tier 2 contractor	Provides personnel and equipment during oil spill response	0%	10%			36	Availability of pollution response equipment	Contractor to have tier 1 pollution equipment	0%	15%		
70	Marine Safety Management System	Argyll and Bute Council has a MSMS to cover the requirements of the PMSC	5%	0%			136	Marine liaison officer	Coordinating activities for the construction	0%	5%		

Assessment Number	Hazard Category	Hazard Scenario Title	Worst Credible Scenario	Years between worst occurrence	Consequence People	Consequence Property	Consequence Planet	Consequence Port	Most Likely Scenario	Years between likely occurrence	Consequence People	Consequence Property	Consequence Planet	Consequence Port	Inherent Risk	Inherent Risk	Cause ID	Causes
14	Machinery related accidents	Heavy lift failure, or failure of lifting gear	Failure during unloading of barge with load slung. Load released and lands on vessel deck causing major damage to either vessel or failure during transfer of heavy cargo from vessel to construction site. Single fatality, minor pollution (Tier 1), operations cease pending recovery and investigation.	25	3	3	2	4	Failure of lifting equipment causes automatic shutoff. Delay to operations while repairs are made.	1	0	0	0	1	5.88	Sig	1	Human error/fatigue - Vessel Personnel
																	5	Human error/fatigue - Marine personnel
																	7	Inadequate procedures in place onboard vessel
																	11	Vessel breakdown or malfunction
																	23	Communication failure - Operational/procedural
																	37	Failure to comply with safe systems of work
																	69	Port Equipment (inc. craft) mechanical breakdown/system malfunction
																	75	Inadequate maintenance/inspection

Control ID	Embedded Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Current Risk	Current Risk	Control ID	Further Applicable Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Final Risk	Final Risk
62	Emergency services equipment - shore side	Ambulance services	0%	5%	5.19	Sig	9	Safety lighting	Appropriate illumination of the marine works to be provided, without affecting mariners' night vision (BSI, Road Lighting, BS:5489-1, 2020)	5%	0%	4.88	Mod
70	Marine Safety Management System	Argyll and Bute Council has a MSMS to cover the requirements of the PMSC	5%	0%			116	Weather forecasting	Monitoring of weather conditions	5%	0%		
140	Contractor risk assessment method statement (RAMS)	Details the risks and mitigations for specific construction activities	10%	0%			117	Operational weather limits	Maximum wind/wave limits for construction activities	10%	0%		
							136	Marine liaison officer	Coordinating activities for the construction	5%	0%		

Assessment Number	Hazard Category	Hazard Scenario Title	Worst Credible Scenario	Years between worst occurrence	Consequence				Most Likely Scenario	Years between likely occurrence	Consequence				Inherent Risk	Inherent Risk	Cause ID	Causes
					People	Property	Planet	Port			People	Property	Planet	Port				
15	Payload related accidents	Incorrect payload distribution/loading affects vessel stability	Rock barge is loaded/unloaded incorrectly, causing instability and capsize of vessel. Loss of vessel, loss of life if barge manned, pollution (Tier 1), navigation hazard created by the sunk vessel, delays to marine construction programme.	25	3	3	2	3	Barge takes on list during unloading. Operations cease and barge unloaded causing delays.	1	0	0	0	1	5.49	Sig	1	Human error/fatigue - Vessel Personnel
																	5	Human error/fatigue - Marine personnel
																	26	Adverse weather conditions
																	37	Failure to comply with safe systems of work
																	59	Inadequate marine procedures - Project
																	76	Inadequate training/competence - Personnel

Control ID	Embedded Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Current Risk	Current Risk	Control ID	Further Applicable Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Final Risk	Final Risk
44	Safe systems of work (H&S)		10%	10%			9	Safety lighting	Appropriate illumination of the marine works to be provided, without affecting mariners' night vision (BSI, Road Lighting, BS:5489-1, 2020)	5%	0%		
62	Emergency services equipment - shore side		0%	10%	4.72	Mod	121	Loading/unloading plan	Detailing the order to load/unload and position of cargo to maintain stability	15%	0%	4.41	Mod
70	Marine Safety Management System	Argyll and Bute Council has a MSMS to cover the requirements of the PMSC	5%	0%			136	Marine liaison officer	Coordinating activities for the construction	5%	0%		
140	Contractor risk assessment method statement (RAMS)	Details the risks and mitigations for specific construction activities	10%	0%									

Assessment Number	Hazard Category	Hazard Scenario Title	Worst Credible Scenario	Years between worst occurrence	Consequence				Most Likely Scenario	Years between likely occurrence	Consequence				Inherent Risk	Inherent Risk	Cause ID	Causes
					People	Property	Planet	Port			People	Property	Planet	Port				
16	Other	Small non-powered craft, displaced by marine works	Displacement of small non-powered craft (e.g. kayaks, Paddleboards) which may be transiting past the word into deeper water due to the presence of marine works, loss of line-of-sight for smaller craft with larger craft in the area such as tour boats or the ferry leaving or entering the slipway area. Worst case scenario is the non-powered craft is operated solo. Non-powered craft capsizes, occupant is separated from the craft, vessel sinks or is lost, loss of life, no pollution. Adverse publicity.	25	4	1	0	4	Displacement of small non-powered craft (e.g. kayaks, Paddleboards) which may be transiting past the word into deeper water due to the presence of marine works, loss of line-of-sight for smaller craft with larger craft in the area such as tour boats or the ferry leaving or entering the slipway area. One or more members of the non-powered craft group capsize, occupants remain with their craft and are rescued by the emergency services or nearby commercial craft. Minor injury (hypothermia), local publicity. No pollution or property damage.	5	1	0	0	1	5.11	Sig	16	Unplanned interaction with recreational/fishing craft
																	3	Human error/fatigue - Construction personnel
																	26	Adverse weather conditions
																	28	Restricted visibility
																	28	Restricted visibility
																	33	Increased vessel use
																	34	Limited area for manoeuvring
																	72	Failure to follow passage plan
																	76	Inadequate training/competence - Personnel
																	80	Human error
																	86	Competence
																	87	Notice to Mariners failure to observe
																	110	Reduction in safe navigable space

Control ID	Embedded Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Current Risk	Current Risk	Control ID	Further Applicable Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Final Risk	Final Risk
70	Marine Safety Management System	Review the A&B Council MSMS to cover new operations at Iona	0%	5%			9	Safety lighting	Appropriate illumination of the marine works to be provided, without affecting mariners' night vision (BSI, Road Lighting, BS:5489-1, 2020)	5%	0%		
					4.73	Mod	41	Notices to mariners	Issued on the Council website containing details about construction activities	10%	0%	4.19	Mod
							48	Promulgation of information	Information on activities shared with local communities and the Scottish Canoe Association	10%	0%		
							57	Aids to navigation, Provision and maintenance of	Illumination of marine works at night	10%	0%		
							136	Marine liaison officer	Central point of contact to coordinate activities	5%	5%		

B.2 Operation phase

Assessment Number	Hazard Category	Hazard Scenario Title	Worst Credible Scenario	Years between worst occurrence	Consequence: People	Consequence: Property	Consequence: Planet	Consequence: Port	Most Likely Scenario	Years between likely occurrence	Consequence: People	Consequence: Property	Consequence: Planet	Consequence: Port	Inherent Risk	Inherent Risk	Cause ID	Causes
1	Allision	Ferry or tour boat with the breakwater	Ferry or tour boat makes heavy contact with the breakwater on approach. Hull punctured leading to extensive flooding and vessel sinking. Multiple fatalities, pollution (Tier 2), national adverse publicity. Operations cease until wreck can be recovered.	50	4	4	3	4	Ferry or tour boat makes contact with breakwater on approach at slow speed causing minor damage to vessel hull. Minor injuries to passengers and crew, no pollution, vessel out of service until survey and repairs made.	10	1	3	0	1	7.13	Hig	1	Human error/fatigue - Vessel Personnel
																	6	Inadequate bridge resource management
																	7	Inadequate procedures in place onboard vessel
																	11	Vessel breakdown or malfunction
																	16	Unplanned interaction with recreational/fishing craft
																	26	Adverse weather conditions
																	28	Restricted visibility
																	34	Limited area for manoeuvring
																	36	Failure of Aid to Navigation (out of position/unlit)
																	61	Incorrect assessment of tidal flow
																	72	Failure to follow passage plan
																	76	Inadequate training/competence - Personnel
																	103	Excessive vessel speed
																	110	Reduction in safe navigable space
																	113	Manoeuvre misjudged

Control ID	Embedded Controls: Control	Embedded Controls: Comment	Likelihood Reduction	Consequence Reduction	Current Risk	Current Risk	Control ID	Further Applicable Controls: Control	Further Applicable Controls: Comment	Likelihood Reduction	Consequence Reduction	Final Risk	Final Risk
10	Passage planning	Including all relevant information on the area	5%	0%	6.25	Hig	10	Passage planning	Update to CalMac passage plan	10%	0%	###	Sig
21	Oil spill contingency plans	Covers all A&B Council facilities	0%	5%			14	Update ALRS and Sailing Directions	Updates to include new structures	10%	0%		
24	Tier 2 contractor	Provides personnel and equipment during oil spill response	0%	10%			112	Review of available powers	To determine whether further powers are required to ensure navigational safety	10%	10%		
26	Communications equipment	Ability to request shoreside assistance	5%	5%			122	Shore side facility maintenance programme	Schedule of maintenance including AtoN	10%	0%		

Assessment Number	Hazard Category	Hazard Scenario Title	Worst Credible Scenario	Years between worst occurrence	Consequence: People	Consequence: Property	Consequence: Planet	Consequence: Port	Most Likely Scenario	Years between likely occurrence	Consequence: People	Consequence: Property	Consequence: Planet	Consequence: Port	Inherent Risk	Inherent Risk	Cause ID	Causes
2	Allision	Recreational or fishing vessel allision with the breakwater.	Recreational or fishing vessel makes heavy impact with the breakwater. Impact causes vessel to be holed leading to serious injury to crew, and significant damage to the vessel. Limited pollution (Tier 1), vessel stranded on breakwater resulting in delays to operations until vessel recovered.	50	2	2	2	3	Recreational or fishing vessel makes contact with the breakwater at slow speed causing vessel damage, leading to minor injury to crew, no pollution.	5	1	1	0	1	5.44	Sig	1	Human error/fatigue - Vessel Personnel
																	11	Vessel breakdown or malfunction
																	16	Unplanned interaction with recreational/fishing craft
																	26	Adverse weather conditions
																	28	Restricted visibility
																	31	Failure to observe standing notices
																	33	Increased vessel use
																	34	Limited area for manoeuvring
																	36	Failure of Aid to Navigation (out of position/unlit)
																	55	Incapacitated master (drinks/drugs)
																	61	Incorrect assessment of tidal flow
																	76	Inadequate training/competence - Personnel
																	103	Excessive vessel speed
																	110	Reduction in safe navigable space
																	113	Manoeuvre misjudged

Control ID	Embedded Controls: Control	Embedded Controls: Comment	Likelihood Reduction	Consequence Reduction	Current Risk	Current Risk	Control ID	Further Applicable Controls: Control	Further Applicable Controls: Comment	Likelihood Reduction	Consequence Reduction	Final Risk	Final Risk
21	Oil spill contingency plans	Covers all A&B Council facilities	0%	5%	4.27	Mod	14	Update ALRS and Sailing Directions	Updates to include new structures	10%	0%	###	Low
24	Tier 2 contractor	Provides personnel and equipment during oil spill response	0%	10%			112	Review of available powers	To determine whether further powers are required to ensure navigational safety	10%	10%		
57	Aids to navigation, Provision and maintenance of	AtoN have been proposed for the breakwater, to be confirmed by NLB	15%	0%			122	Shore side facility maintenance programme	Schedule of maintenance including AtoN	10%	0%		
62	Emergency services equipment - shore side	Ambulance service	0%	10%									
70	Marine Safety Management System	Review the A&B Council MSMS to cover new operations at Iona	0%	5%									
116	Weather forecasting	Advance warning gained from available internet resources and metocean forecasts	5%	0%									

Assessment Number	Hazard Category	Hazard Scenario Title	Worst Credible Scenario	Years between worst occurrence	Consequence: People	Consequence: Property	Consequence: Planet	Consequence: Port	Most Likely Scenario	Years between likely occurrence	Consequence: People	Consequence: Property	Consequence: Planet	Consequence: Port	Inherent Risk	Inherent Risk	Cause ID	Causes
3	Grounding	Any vessel	Vessel grounds on materials dropped during the construction of the breakwater. Rock penetrates the hull resulting in flooding, vessel requires survey and repair, potential for minor pollution (Tier 1).	25	0	2	2	3	Breakwater construction, dredge works and changes to localised flow patterns lead to depth changes post-construction (scour, deposit, accidental material left from construction works). Grounding of a vessel on accumulated sediment, delay to operations as vessels requires checks for damage.	5	0	1	0	1	5.20	Sig	1	Human error/fatigue - Vessel Personnel
																	3	Human error/fatigue - Construction personnel
																	6	Inadequate bridge resource management
																	7	Inadequate procedures in place onboard vessel
																	25	Communication failure - Personnel
																	26	Adverse weather conditions
																	33	Increased vessel use
																	34	Limited area for manoeuvring
																	61	Incorrect assessment of tidal flow
																	80	Human error
																	86	Competence
																	104	Inadequate surveying
																	110	Reduction in safe navigable space
																	113	Manoeuvre misjudged

Control ID	Embedded Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Current Risk	Current Risk	Control ID	Further Applicable Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Final Risk	Final Risk
10	Passage planning	Including all relevant information on the area and contingency planning for ferry/tour boats	10%	0%	4.20	Mod	10	Passage planning	Update to CalMac passage plan	5%	0%	###	Low
11	Dredging programme	To be influenced by hydrographic survey	10%	5%			17	Hydrographic surveying program	Data to be provided to the UKHO for use in navigational charts	10%	0%		
21	Oil spill contingency plans	Covers all A&B Council facilities	0%	5%			112	Review of available powers	To determine whether further powers are required to ensure navigational safety	10%	10%		
24	Tier 2 contractor	Provides personnel and equipment during oil spill response	0%	10%									
70	Marine Safety Management System	Review the A&B Council MSMS to cover new operations at Iona	0%	5%									
130	Vessel's emergency response procedures	Actions to be taken during a grounding emergency	0%	10%									

Assessment Number	Hazard Category	Hazard Scenario Title	Worst Credible Scenario	Years between worst occurrence	Consequence: People	Consequence: Property	Consequence: Planet	Consequence: Port	Most Likely Scenario	Years between likely occurrence	Consequence: People	Consequence: Property	Consequence: Planet	Consequence: Port	Inherent Risk	Inherent Risk	Cause ID	Causes
4	Other	Small non-powered craft, displaced by breakwater	Displacement of small non-powered craft (e.g. kayaks, Paddleboards) into deeper water due to Breakwater presence, loss of line-of-sight for non-powered craft with larger craft moving in the area due to the Breakwater size. Capsize of non-powered craft, loss of life, no pollution. Adverse publicity.	25	4	1	0	4	Displacement of small non-powered craft (e.g. kayaks, Paddleboards) into deeper water due to Breakwater presence, loss of line-of-sight for non-powered craft with larger craft moving in the area due to the Breakwater size. Capsize of non-powered craft, minor injury (hypothermia), rescued by emergency services or local craft. No pollution, adverse publicity.	5	1	0	0	1	4.77	Mod	16	Unplanned interaction with recreational/fishing craft
																	28	Restricted visibility
																	33	Increased vessel use
																	34	Limited area for manoeuvring
																	80	Human error
																	86	Competence
																	110	Reduction in safe navigable space

Control ID	Embedded Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Current Risk	Current Risk	Control ID	Further Applicable Controls: Control	Comment	Likelihood Reduction	Consequence Reduction	Final Risk	Final Risk
70	Marine Safety Management System	Review the A&B Council MSMS to cover new operations at Iona	0%	5%	4.73	Mod	14	Update ALRS and Sailing Directions	Updates to include new structures	10%	0%	###	Mod
							48	Promulgation of information	Information on breakwater and lighting shared with local communities and the Scottish Canoe Association	10%	0%		
							112	Review of available powers	To determine whether further powers are required to ensure navigational safety	10%	10%		

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APPENDIX 7.1

Terrestrial Biodiversity Survey Results

7 TERRESTRIAL BIODIVERSITY SURVEY RESULTS

7.1 Introduction

7.1.1 Purpose and Scope of the Report

This report details the results of ecology surveys undertaken for the Proposed Development. The surveys were designed to assess the baseline conditions within the site boundary and surrounding area including habitats and protected species of conservation concern. The findings of these surveys will be used to inform the Proposed Development Ecological Impact Assessment.

7.1.2 Report Objectives

The main objectives of these surveys were to identify any areas:

- Which support notable or legally protected habitats;
- To identify the use of the proposed development area and zone of influence by protected species; and
- Which support significant numbers of qualifying species of nearby designated sites that may have connectivity to the habitats within the site.

7.2 Relevant Legislation

A summary of the legislation relevant to habitats and protected species, or those which may pose a potential constraint to the scheme as identified in this report, are provided in Appendix A and include:

- The Wildlife and Countryside Act 1981 (as amended);
- The Protection of Badgers Act 1992;
- Nature Conservation (Scotland) Act 2004 (as amended);
- The Wildlife and Natural Environment (Scotland) Act 2011;
- The UK Biodiversity Action Plan (UKBAP) 1994;
- Environmental Impact Assessment Directive 85/337/EEC (the EIA Directive);
- Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019);
- The Conservation (Natural Habitats &c.) Amendment (Scotland) Regulations 2012, relating to reserved matters in Scotland; and
- Scottish Planning Policy (2020).

7.3 Methodology

7.3.1 Desk Study

A desk study was undertaken to gather information on the potential value of the site and wider area for protected species (excluding avian interests which are dealt with in Chapter 9) and habitats through the following:

- A request was made to Argyll Biological Record Centre (ABReC) for records from the last 10 years relating to:
  - All other notable and protected species - 2km buffer;
  - Non-statutory sites (e.g, Scottish Wildlife Nature Reserves, Local Nature Conservation Sites (LNCS) - 2km buffer;
- NatureScot (NS) SiteLink website was consulted to identify the presence of any Sites designated for terrestrial biological features within 5km (e.g., Special Areas of Conservation (SAC), Sites of Special Scientific Interest (SSSI) and Local Nature Reserves (LNR);
- Scotland's environment web[1];
- JNCC website[2];
- Argyll and Bute Council open data website[3]; and
- Aerial imagery which was studied prior to the survey to inform any areas of high sensitivity which might require additional survey effort during the site visit.

7.3.2 Ecology

7.3.2.1 Preliminary Ecological Appraisal

A Preliminary Ecological Appraisal (PEA) Report was undertaken in accordance with CIEEM (2017). This comprised a desk study, Phase 1 Habitat survey and a preliminary protected species assessment within 100m of the footprint of the site as defined at the time of survey (Figure 7-2). The following species were screened out of the assessment due to the Proposed Development falling outside of the known distribution and/or the absence of suitable habitat: badger (*meles meles*), water vole (*Arvicola amphibious*), red squirrel (*Sciurus vulgaris*), pine marten (*Martes martes*), wildcat (*Felis sylvestris*) and great crested newt (*Triturus cristatus*).

[1] Map | Scotland's environment web

[2] https://jncc.gov.uk/our-work/list-of-spas/

[3] https://data-argyll-bute.opendata.arcgis.com/datasets/open-data-local-nature-conservation-site

Phase 1 Habitat Survey

An extended Phase 1 Habitat survey was carried out 7 July 2021. All habitats were mapped using the methodology described in the Joint Nature Conservation Committee's (JNCC) Handbook (JNCC, 2016). The survey also aimed to identify the presence of Invasive Non-Native Species (INNS) subject to legal control. The results of the Phase 1 Habitat survey can be found in Figure 7-3.

Botanical nomenclature in this report follows that of Stace (2010).

During the Phase 1 Habitat survey, habitats on site were assessed for their suitability to support legally protected or notable species that would be affected by, or need to be considered for, the scheme.

Any incidental sightings of individual species or field signs such as footprints, latrines or feeding remains discovered during the survey were noted as Target Notes (TNs) and are referenced as such (e.g., TNxx) throughout this report, with a detailed Target Note Record presented in Appendix B, which also includes all GPS locations.

<Redacted>

As part of the PEA, an assessment was made of the suitability of the habitats present to support roosting, foraging and commuting <Redacted> within the survey area. The assessment criteria as per the <Redacted> Conservation Trust (Collins, 2016) are detailed in Table 7.1.1.

Table 7.1.1: Bat Habitat Assessment Criteria

Suitability	Description of Roosting Habitats	Foraging and Commuting Habitats
Negligible	Negligible habitat features on site not likely to be used by roosting <Redacted>	Negligible habitat features on site not likely to be used by commuting or foraging <Redacted>
Low	A structure with one or more potential roost sites that could be used by individual <Redacted> opportunistically. However, these potential roost sites do not provide enough space, shelter, protection, appropriate conditions and/or suitable surrounding habitat to be used on a regular basis or by larger numbers of <Redacted> (i.e. unlikely to be suitable for maternity or hibernation). A tree of sufficient size and age to contain potential roost features but with none seen from the ground or features seen with only very limited roosting potential.	Habitat that could be used by small numbers of commuting <Redacted> such as gappy hedgerow or un-vegetated stream, but isolated, i.e. not very well connected to the surrounding landscape by other habitat. Suitable, but isolated habitat that could be used by small numbers of foraging <Redacted> such as a lone tree (not in a parkland situation) or a patch of scrub.
Moderate	A structure or tree with one or more potential roost sites that could be used by <Redacted> due to its size, shelter, protection, conditions and surrounding habitat but unlikely to support a roost of high conservation status (with respect to roost type only – the assessments in this table are made irrespective of species conservation status, which is established after presence is confirmed).	Continuous habitat connected to the wider landscape that could be used by <Redacted> commuting such as lines of trees and scrub or linked back gardens. Habitat that is connected to the wider landscape that could be used by <Redacted> for foraging such as trees, scrub, grassland or water.
High	A structure or tree with one or more potential roost sites that are obviously suitable for use by larger numbers of <Redacted> on a more regular basis and potentially for longer periods of time due to their size, shelter, protection, condition and surrounding habitat.	Continuous, high-quality habitat that is well connected to the wider landscape that is likely to be used regularly by commuting <Redacted> such as river valleys, streams, hedgerows, lines of trees and woodland edge. Site close to, and connected to, known roosts.

<Redacted>

All coastline, waterbodies, watercourses and minor ditches within the PEA survey area were assessed for their potential to support <Redacted> (where access permitted and where it was safe to do so).

Reptiles

Areas of suitable reptile habitat were identified within the assessment area as part of the PEA. Reptiles require dry habitats with areas of refugia and basking such as rock piles, crags, scree, and drystone walls. Any features such as these were assessed for their potential to support reptile species (e.g., common lizard (*Zootoca vivipara*)).

7.3.2.2 <Redacted> Survey

A dedicated <Redacted> survey was undertaken of the site footprint (as proposed at the time of survey) and a 200m buffer (Figure 7-2) concurrently with the PEA survey. All signs of <Redacted> were recorded. <Redacted> field signs are described in Bang & Dahlstrøm (2001) and include resting sites (e.g., <Redacted> <Redacted>, prints and feeding remains. Descriptions of these and other field evidence terms are summarised below:

- Shelters / <Redacted>: these are underground features where <Redacted> live. They can be tunnels within banksides, underneath root plates or boulder piles, and even man-made structures such as disused drains. <Redacted> are used by <Redacted> to rest up during the day and are the usual site of natal or breeding places. <Redacted> may use <Redacted> permanently or temporarily.
- <Redacted>: these are above ground resting sites. They may be partially sheltered, or fully exposed. <Redacted> may be regularly used, especially in reed beds and on in-stream islands. They have been known to be used as natal and breeding sites. <Redacted> can be very difficult to identify, sometimes consisting of no more than an area of flattened grass or earth and are best identified by the presence of other field signs (e.g., <Redacted>. Where rocks or rock armour are used as <Redacted>, these can be almost impossible to identify without observing the <Redacted> in-situ.
- Prints: <Redacted> have characteristic footprints that can be found in soft ground and muddy areas.
- <Redacted> <Redacted> faeces can be used to mark territories, often on in-stream boulders. They can be present within or outside the entrances of <Redacted> <Redacted> have a characteristic smell and often contain fish remains.
- Feeding signs: the remains of prey items may be found at preferred feeding stations. Remains of fish, crabs or skinned amphibians can indicate the presence of <Redacted>
- Paths: these are terrestrial routes that <Redacted> take when moving between resting-up sites and watercourses, or at high flow conditions when they will travel along bank sides in preference to swimming.
- Slides and play areas: slides are typically worn areas on steep slopes where <Redacted> slide on their bellies, often found between <Redacted> and watercourses. Play areas are used by juvenile <Redacted> in play and are often evident by trampled vegetation and the presence of slides. These are often positioned in sheltered areas adjacent to the natal <Redacted>

Any of these field signs are diagnostic of the presence of <Redacted> although <Redacted> are the most reliably identifiable evidence. Where resting sites are discovered, then an indication of their importance is recorded. This is done by evaluating <Redacted> freshness, prints and paths or niche availability and quality of the feature.

7.4 Results

7.4.1 Desk Study

7.4.1.1 Ecology

ABReC responded on 31 August 2021 stating that they could not produce full data reports at this time and granted permission for their data to be downloaded from NBN Atlas[4] in relation to this project. The website was accessed, and data collated on 1st September 2021, detailing protected and notable species (non-avian) within 2 km of the Proposed Development within the last 10 years (Table 7.1.2).

Table 7.1.2: ABReC Records of Protected and Notable Species Within 2km From the Last 10 Years

Common Name	Taxon Name	European Protected Species (Following EU Exit)	Wildlife and Countryside Act 1981 (as amended)	Argyll and Bute Local Biodiversity Action Plan
Mammal				
<Redacted>	<Redacted>	EPS (Habitats Directive)		Yes
West European hedgehog				
Reptile				
Common lizard	*Zootoca vivipara*		Schedule 5 (Section 9(5))	

Within 5km of the Proposed Development eight non-statutory designated sites relating to terrestrial ecology were identified, (Table 7.1.3 and Figure 7.1). No SAC's designated for <Redacted> were identified within 20km:

Table 7.1.3: Statutory and Non-Statutory Sites Designated for Terrestrial Biodiversity (Excluding Avian Interests).

Site	Designation	Distance from site	Features of interest
South East Iona	LNCS	1.4	No Information available
A Mhachair, Iona	LNCS	1.5	No Information available
Port Baul-Mhoir, Iona	LNCS	3.3	No Information available
Port an Fhir-Bheige, Iona	LNCS	2.8	No Information available
Kintra	LNCS	1.9	No Information available
Slugan Dubh	LNCS	2.3	No Information available
Fidden	LNCS	2.2	No Information available
Erraid Sound	LNCS	3.2	No Information available

No information was available on the NatureScot SiteLink website or from the local authority on the nature of the designations listed in the table above. Only the first four of these were located on Iona, with the remaining sites located on Mull.

No areas of ancient woodland were identified on Iona.

[4] https://scotland.nbnatlas.org/

7.4.2 Survey Results

7.4.2.1 Ecology

7.4.2.1.1 Phase 1 Habitat

A list of the habitats present within the site and survey boundary along with the total area they occupy is shown in Table 7.1.4. Individual habitat types are described in more detail below, with the dominant species listed.

The main habitat found within the site boundary comprised open sea. The habitats identified within the survey can be found in Figure 7.3. All habitats below the Mean High Water Springs (MHWS) line have been excluded from the calculations and are dealt with in Chapter 8 (Marine Biodiversity).

Table 7.1.4: Phase 1 Habitat Types

Phase 1 Habitat Type	Survey Area (ha)*	Area in Site Boundary and Temporary Work Area (ha)
Neutral grassland - semi-improved - B2.2	0.29	0.06
Improved grassland - B4	0.12	0.01
Swamp - F1	0.03	-
Intertidal – mud/sand – H1.1	0.06	-
Boulders/rocks above high tide mark – H4	0.16	0.06
Strandline vegetation – H5	0.05	-
Coastal grassland – H8.4	0.14	0.06
Cultivated/disturbed land – amenity grassland – J1.2	0.18	-
Buildings J3.6	0.22	-
Defunct hedge – species poor - J2.2.2	N/A	-
Fence – J2.4	N/A	-
Wall – J2.5	N/A	-
Other habitat - J5 (pier, hardstanding)	0.25	0.03
Road/track	0.20	0.02
Total	**1.70**	**0.24**

* Survey Area includes those habitats mapped during the Phase 1 Habitat survey as well as a small section of the temporary working area which was mapped from aerial photography.
$ All habitats below the Mean High Water Springs (MHWS) line have been mapped as 'sea'

Semi-improved Neutral Grassland (B2.2)

The majority of the habitat within the survey area comprises semi-improved neutral grassland dominated by Yorkshire fog (*Holcus lanatus*) (TN 4). The area comprises a very species rich community including abundant creeping buttercup (*Ranunculus repens*), hogweed (*Heracleum sphondylium*) and white clover (*Trifolium repens*). Other species include crested dog's tail (*Cynosurus cristatus*), broad-leaved dock (*Rumex obtusifolius*) and common eyebright (*Euphrasia nemorosa*) with occasional yellow rattle (*Rhinanthus minor*), red clover (*Trifolium pratense*) and ragged robin (*Lychnis flos-cuculi).* Patches of soft rush (*Juncus effusus*) and yellow iris (*Iris pseudacorus*) present. Common spottedorchid (*Dactylorhiza fuchsia*) and Northern marsh-orchid (*Dactylorhiza purpurella*) were rare. There were no signs of grazing with ground cover reaching up to 1m tall.

The semi-improved neutral grassland in the surrounding survey area has the same typical species composition though is slightly more improved due to more intensive management (e.g., mowing).

Improved Grassland (B4)

Small pockets of improved grassland surrounded the buildings at Baile Mor village, which were dominated by perennial rye-grass (*Lolium perenne*), with abundant daisy (*Bellis perennis*), crested dog's tail and common nettle (*Urtica dioica*) and frequent white clover and field horsetail (*Equisetum arvense*).

Swamp (F1)

An area of swamp was found at the south-western corner of the main field which surrounded a drainage ditch (TN 5). It was dominated by common reed (*Phragmites australis*), with frequent yellow iris and occasional meadowsweet (*Filipendula ulmaria*). Access through the reed was too difficult therefore the survey was done from out with the habitat. The area appeared unmanaged.

Intertidal – Sand (H1.1)

An area of bare sand was present along the intertidal zone which was exposed only during low tide (TN7).

Boulders/Rock Above High Tide Mark (H4)

There is an area of boulders and rocks above the high tide mark (TN 8), that runs along the length of the survey area from north to south adjacent to the sea. These have occasional thrift (*Armeria maritima*) growing on them, as well as lichen species *Xanthoria parietina* and *Ramalina spp*.

Strandline Vegetation (H5)

A thin strip of strandline vegetation was found along the boundary of the survey area at the northern end. This was dominated by curly dock (*Rumex crispus*) with frequent sea plantain (*Plantago maritima*) and occasional thrift and silverweed (*Potentilla anserina*). The substrate was rock and shingle.

Coastal Grassland (H8.4)

Within the survey area there was a strip of coastal grassland adjacent to the coast (TN 1). The grassland is dominated by red fescue (*Festuca rubra*) with: abundant white clover, field horsetail and silverweed; and frequent meadow buttercup, yellow iris and creeping thistle (*Cirsium arvense*). Thrift and lady's bedstraw (*Galium verum*) were occasional with meadowsweet and sea plantain rarely found. A thin strip of common reed surrounded a ditch at the south-western edge of this area (TN 3) and a small patch of dense bramble (*Rubus fruticosus*) was located at TN 2. The grassland which is at the side of the road appeared unmanaged.

Amenity Grassland (J1.2)

Small pockets of mown lawns were found around some of the buildings and houses at Baile Mor village. Some were inaccessible such as gardens, but those that were accessible included vegetation such as daisy, ribwort plantain (*Plantago lanceolata*), red clover and common dandelion (*Taraxacum officinale*).

Buildings (J3.6)

Several buildings were located within the survey boundary which form part of Baile Mor village ranging from small modern buildings to larger older buildings.

Ditch (J2.6)

A drainage ditch was found at NM 28470, 23930, close to TN5. This went through the area of swamp and across the road and out to sea. Most of it was inaccessible, however from the area that was accessible outside the survey boundary, common reed was found to be dominant, with abundant marsh marigold (*Caltha palustris*) and meadow buttercup (*Ranunculus acris*) and frequent yellow iris.

Hedge (J2.2.2)

A defunct species poor hedge surrounded one of the gardens in the village which was mostly composed of introduced species and dominated by Buddleia (*Buddleja spp.*).

Other Habitat (J5)

Other habitat within the survey area included the pier at Baile Mor and the road that goes through the village, as well as a small car park adjacent to the fire station.

Invasive Non-Native Species

A mink, an INNS, was observed at NM 28779, 24287 on the 16th June 2021 during another survey at the site. No other signs of INNS were observed during this survey.

7.4.2.1.2 Protected/Notable Species

During the survey, no signs of protected species were recorded. The habitats as described above have been assessed for their potential to support protected species.

<Redacted>

The coastal habitats present offer good commuting potential for <Redacted> though there is limited connectivity within the survey area to inland freshwater foraging habitats. Due to the high levels of disturbance associated with the presence of a ferry terminal and the local village it is unlikely that the habitats in the survey area are used as refugia by <Redacted>

During the <Redacted> survey undertaken on 16th June 2021, no field signs of <Redacted> were recorded.

<Redacted>

The Proposed Development offers negligible foraging or commuting habitat for <Redacted> due its marine situation. The terrestrial habitats in the survey buffer to the west offer low foraging and commuting habitat for <Redacted> species, due to the exposed nature and lack of woodland and watercourses. The semi-improved neutral grassland (TN4), coastal grassland (TN1), swamp habitat (TN5) and gardens offer foraging potential however the foraging opportunities in the wider area are also relatively limited with generally poor connectivity.

During the PEA survey undertaken on 16th of June 2021, two trees were found within the survey area, neither of which had potential <Redacted> roost features. The buildings in Baile Mòr village within the survey buffer could offer moderate potential for roosting <Redacted> species utilising the area.

Therefore, the site has been assessed as having negligible potential for foraging, commuting and roosting <Redacted> species, with the terrestrial habitats to the west offering moderate potential for roosting <Redacted> and low potential for foraging and commuting.

Reptiles

The site offers no suitable habitat for reptiles. The survey buffer to the west has been assessed as having the potential to support common lizard (*Zootoca vivipara*) and slow worms (*Anguis fragilis*). This is due to the presence of the field of semi-improved neutral grassland at TN 4 and the area of coastal grassland at TN1. The desk study only identified the presence of common lizards on Iona.

7.5 References

- Bang, P & Dahlstrøm, P (2001). Animal Tracks and Signs. Oxford University Press, Oxford.
- CIEEM (2017) Guidelines for Preliminary Ecological Appraisal: 2nd Edition. Chartered Institute of Ecology and Environmental Management, Winchester.

- Collins, J. (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). The Bat Conservation Trust, London.
- Joint Nature Conservation Committee (2010) Phase 1 Habitat Survey: A technique for environmental audit.
- Stace C. A (2016), New Flora of the British Isles, 3rd Edition, Cambridge University Press.

Appendix A Legislation

European Protected Species

European Protected Species are defined under the European Commission (EC) Habitats and Species Directive 92/43/EEC and include species such as <Redacted> and all species of <Redacted> The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) translates this European legislation into UK law. This was updated to the Conservation of Habitats and Species (Amendment) (EU Exit) regulations 2019 following the UK's exit from the European Union.

This legislation makes it an offence to deliberately or recklessly kill, injure or disturb European Protected Species. Their places of shelter are fully protected, and it is an offence to damage, destroy or obstruct access to or otherwise deny the animal use of a breeding site or resting site, whether deliberately or not. It is also an offence to disturb in a manner that is, or in circumstances which are likely to significantly affect the local distribution or abundance of the species, disturb in a manner or circumstances which are likely to impair its ability to survive, breed or reproduce, or rear or otherwise care for its young. Any activity which is likely to affect such a species requires prior consultation with the relevant statutory nature conservation organisation. In Scotland, this means that NatureScot should be consulted.

A licence from NatureScot is required in cases of potential disturbance of European Protected Species or damage or destruction of a resting site as a result of work activities. Under Regulation 44 2(e) of the Conservation (Natural Habitats etc.) Regulations 1994 licences may be granted for:

- preserving public health or public safety or other imperative reasons of overriding public interest including those of a social or economic nature and beneficial consequences of primary importance for the environment.

Importantly, under Section 3 of Regulation 44, in order for a licence application to be successful, two tests must be satisfied, namely:

- there is no satisfactory alternative (including retaining the status quo); and
- the action authorised will not be detrimental to the maintenance of the population of the species concerned at a favourable conservation status in its natural range.

The Wildlife and Countryside Act 1981 (as amended)

The Wildlife and Countryside Act 1981 provides protection to a range of species and habitats. The Nature Conservation (Scotland) Act 2004 and Wildlife and Natural Environment (Scotland) Act 2011 amend the Wildlife and Countryside Act in Scotland.

Section 9 of the Act provides protection to certain animal species. Enhanced protection is provided for species listed in Schedule 5, which includes water voles and red squirrels. It is an offence to intentionally or recklessly kill, injure or take animals listed in Schedule 5, with the exception of water voles, which are protected in respect of Section 9(4) only, meaning that water vole habitat is protected, although the animals themselves are not. It is also an offence to recklessly damage, destroy or obstruct access to any place used for shelter or breeding by species listed under Schedule 5. Any works which may potentially cause disturbance to such a species requires prior consultation with NatureScot.

The Wildlife and Countryside Act 1981 (as amended) also protects against the spread of invasive non-native plant and animal species (INNS). Specifically, in relation to plants, it is an offence under this legislation to plant or otherwise cause a plant to grow in the wild at a place outwith its native range and includes species such as Japanese knotweed (*Fallopia japonica*), giant hogweed (*Heracleum mantegazzianum*) and rhododendron (*Rhododendron ponticum* and hybrids).

In addition to the above, all wild birds, their nests and their eggs are protected under the Wildlife and Countryside Act 1981 (as amended). This legislation makes it an offence to intentionally or recklessly:

- kill, injure or take any wild bird (excluding certain specified game and other licence-controlled species);
- take, damage, destroy or otherwise interfere with the nest of any wild bird while it is in use or being built;
- obstruct or prevent any wild bird from using its nest; or
- take or destroy the egg of any wild bird.

In addition, there are some rare breeding species, such as <Redacted> barn owl or kingfisher, which are listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended), which receive extra protection, making it an offence to intentionally or recklessly:

- disturb any species listed under Schedule 1 of the Act whilst at the nest site, or while building a nest;
- disturb the dependent young of any species listed under Schedule 1;
- disturb any species listed under Schedule 1 which leks while it is doing so;
- harass any wild bird included in Schedule 1A; or
- take, damage, destroy or otherwise interfere with any nest habitually used by any wild bird included in Schedule A1, even when that nest is not in use.

Appendix B Target Notes

Target Note Reference	Easting	Northing	Note
1	128519	723906	Area of coastal grassland - H8.4
2	128521	723922	Small patch of bramble - dense
3	128501	723903	Thin strip of common reed surrounding drain
4	128499	723981	Area of semi-improved neutral grassland
5	128490	723936	Area of swamp dominated by common reed
6	128654	724003	Built-up area including the Iona Pier and road
7	128615	724103	Thin strip of strandline vegetation
8	128611	724084	Boulders / rocks above high tide mark
9	128595	724052	Sandy bay with rocky outcrops.
10	128578	724026	Area of grassland (B2.2) that is used for storing boats and other fishing equipment.
11	128575	723945	Area of hardstanding outside a closed cafe.
12	128493	723913	Other - J5 - hardstanding

APPENDIX 7.2

<Redacted> **Species Protection Plan**

7 <Redacted> SPECIES PROTECTION PLAN

7.1 Introduction

This <Redacted> Protection Plan <Redacted> has been prepared to manage and protect <Redacted> during the construction phase of the Iona Breakwater Project. Figure 7-1 shows the site location and the survey areas used in the assessment of the Proposed Development.

The scope of the survey was informed by the suitable habitats found within the Site and surrounding area.

7.1.1 Designated Sites

During the Screening process, all links to Special Areas of Conservation (SACs) designated for <Redacted> <Redacted> were screened out, as such there are no risks associated with connections to SACs.

7.2 <Redacted> Survey Results

7.2.1 Field Survey

The coastal habitats present offer good commuting and potential for <Redacted> though there is limited connectivity within the survey area to inland freshwater foraging habitats. Due to the high levels of disturbance associated with the presence of a ferry terminal and the local village it is unlikely that the habitats in the survey area are used as refugia by <Redacted>

During the <Redacted> survey undertaken on 16th June 2021, no field signs of <Redacted> were recorded. Survey methods are described in detail Technical Appendix 7.1.

7.2.2 Desk Study

Historic biological records from Argyll and Bute Records Centre pertaining to <Redacted> were confirmed within 2km from the Project area within the last ten years.

7.3 Species Protection Protocol

The measures outlined in this report have been developed to mitigate against the potential effects on <Redacted>

7.3.1 Pre-Construction Surveys

In advance of construction works commencing, a walkover of the Site Boundary and Temporary Working Area plus a minimum of 200m buffer should be undertaken to identify any change in the baseline conditions presented in Appendix 7.1.

7.3.2 Construction Specific Protection

The following guidelines should be complied with throughout the construction phase of breakwater to ensure impacts to <Redacted> and their habitats are limited:

- An Ecological Clerk of Works (ECoW) should be present on site to oversee enabling works and construction including dredging works; and contribute to all relevant construction method. They should be a suitably experienced individual, whose role would ensure works are carried out in accordance with the Construction Environmental Management Plan (CEMP) produced for the development, ensuring compliance with international and national legislation and planning conditions. Once works are underway, the ECoW would work full time on site providing ecological and pollution control advice and supervision for all relevant mitigation measures;
- No work should be carried out within 30m of any <Redacted> shelter or 200m of any breeding <Redacted> except under license from NatureScot. Should a licence be required for any works, the ECoW will be responsible for ensuring compliance with any licensing conditions;
- No works resulting in large scale noise or vibration such as pile driving or blasting should be undertaken within 100m of any <Redacted> shelter, unless under license from NatureScot;
- Ensure all rubbish and materials will be collected and removed from site on a regular basis to prevent trapping or injury of any wildlife;
- Any excavations, including trenches and trial pits more than 0.5 m deep will be covered in the evening to prevent animals falling in. Where pits and trenches cannot be closed or filled on a nightly basis, ensure that a plank is placed into the excavation so an animal can use this as a means of escape if necessary;
- Any open pipes, whether installed or being stored, should be closed to prevent any animals entering and becoming trapped;
- In the unlikely event of discovering any evidence suggesting <Redacted> presence within the footprint of the works, work must stop immediately and the ECoW should be contacted for advice on how to proceed;
- Night working should be avoided wherever possible. Where this is not possible, lighting should be focussed on the works area(s) and directed away from water and areas of potential <Redacted> foraging. Lighting should be kept to an absolute minimum within 100m from any identified <Redacted> shelter;
- Toolbox talks on <Redacted> should be given to all construction staff on site and an emergency procedure protocol given to contractors in the event of encountering an <Redacted> or discovering a new shelter; and
- If <Redacted> or new shelters are recorded during construction, all of the following emergency procedure must be adhered to:

- All works, in the vicinity of the <Redacted> are to stop immediately and the ECoW contacted;
- The ECoW will review the situation and install the relevant exclusion zone and timings;
- Should micrositing of works outwith exclusion zones applied to new shelters not be possible, an application to NatureScot will be required;
- Consultation with NatureScot will be undertaken, if required;
- Mitigation measures additional to those already in place may be required;
- Incident, outcomes and recommendations will be recorded; and
- Works will only recommence following advice from the ECoW.

In the unlikely event of an <Redacted> being injured or killed, or shelters damaged, the ECoW will be contacted immediately. They will attend the site and make a written and photographic record. This will record the time, location, personnel involved, and the details of the incident. This information will be supplied within 24 hours to NatureScot and the developer.

7.4 Post Construction Monitoring

Rock armour will be used in the construction of the breakwaters. In time, these blocks will be colonised by marine life to offer suitable foraging habitat for <Redacted> The defect period of this is anticipated to be 104 weeks, during which time monitoring of the breakwater will occur and any movement recorded and reported. After this, the breakwater will be inspected as part of the ongoing seabed bathymetric surveys regime. Systematic surveying of the UK's coastal waters is administered by the Maritime and Coastal Agency (MCA) under the Civil Hydrology Programme[5].

[5] [The Civil Hydrography Programme - https://www.gov.uk/guidance/the-civil-hydrography-programme](https://www.gov.uk/guidance/the-civil-hydrography-programme)

FIGURES

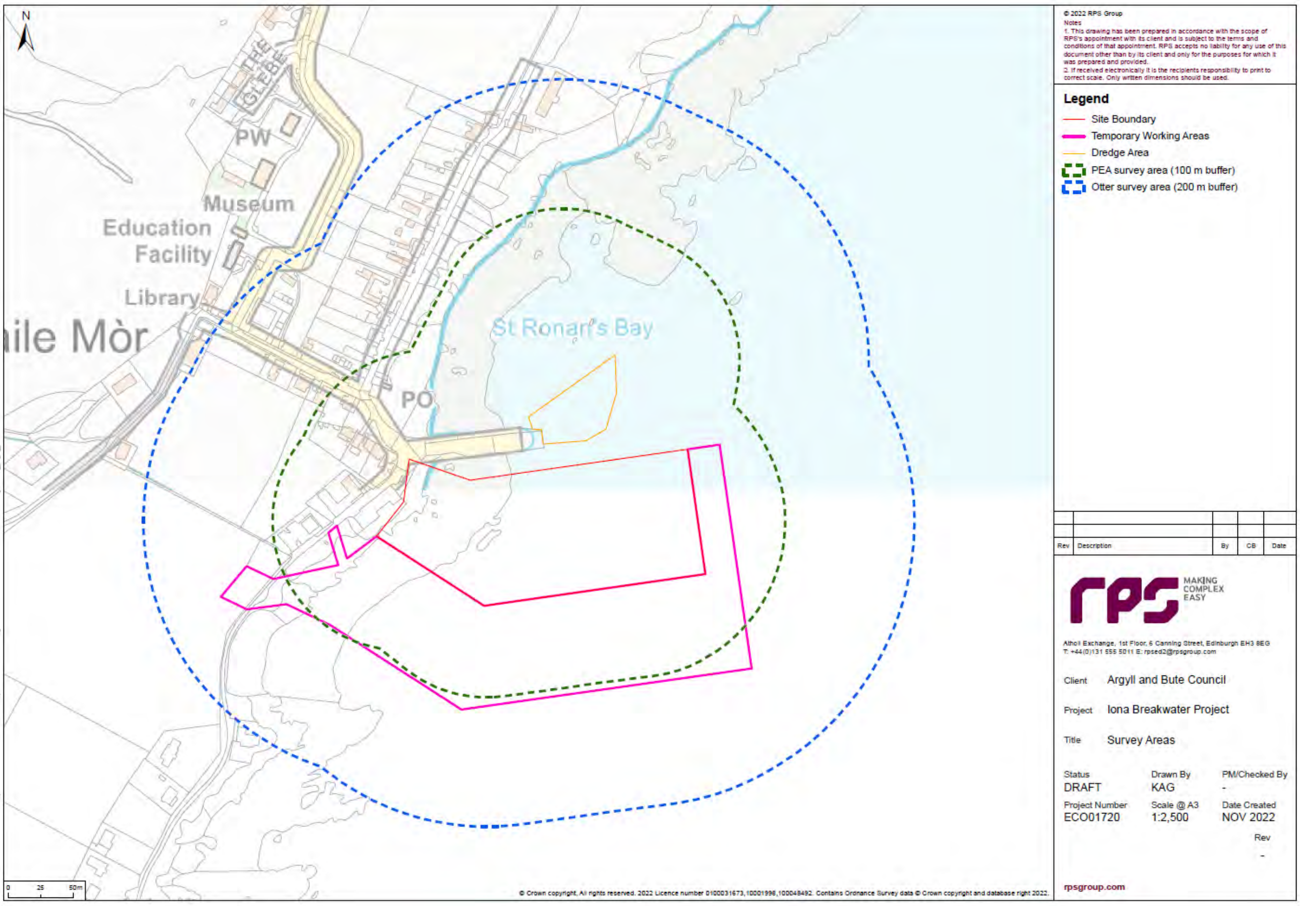

Figure 7-1: Survey Areas

APPENDIX 8.1

Seabed Sediment Analysis

Seabed Sediment Analysis

Metals		Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	dibutyltin (DBT)	tributyltin (TBT)
Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg DW	mg/kg DW
Detection Limit		0.5	0.04	0.5	0.5	0.5	0.01	0.5	2	0.001	0.001
Cefas AL1 (mg/kg)		20	0.4	40	40	50	0.3	20	130	0.1	0.1
Cefas AL2(mg/kg)		100	5	400	400	500	3	200	800	1	1
Canadian TEL(mg/kg)		7.2	0.7	52.3	18.7	30.2	0.13	15.9	124		
Canadian PEL(mg/kg)		41.6	4.2	160	108	112	0.7		271		
Sample ID	Sample Location										
MAR00820.007	BHI1 ES101 0.00-0.15m	1.3	0.14	4.5	4.4	2.7	0.06	4.6	4.7	<0.005	<0.005
MAR00820.008	BHI1 ES102 0.20-0.70m	1.2	0.2	5.2	4.5	4.4	0.04	5.2	11.8	<0.005	0.007
MAR00820.009	BHI2 ES101 0.00-0.15m	1.2	0.14	4.9	5.2	2.9	0.02	5.3	9.4	<0.005	<0.005
MAR00820.010	BHI2 ES102 0.15-0.45m	2	0.18	8.9	13.1	3.5	0.02	13.4	18.4	<0.005	<0.005
MAR00820.011	BHI3 ES101 0.00-0.15m	1.3	0.14	7.6	6.2	2.6	0.02	6.3	10.4	<0.005	<0.005
MAR00820.012	BHI3 ES102 0.15-0.40m	0.9	0.15	7.9	4.9	3.1	0.03	6.1	12.8	<0.005	<0.005
MAR00820.013	BHI3 ES103 0.40-0.65m	1.1	0.17	7.4	5	4.2	0.03	5.8	11.2	<0.005	0.008

Polyaromatic Hydrocarbons		Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthen	Benzo(ghi)perylene	Benzo(K)fluoranthen	Chrysene	Diben(ah)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-	Naphthalene	Phenanthrene	Pyrene	Total Hydrocarb
Units		ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	mg/kg	ug/kg
Detection Limit		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
Cefas AL1 (µg/kg)		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Canadian TEL (µg/kg)		6.71	5.87	46.9	74.8	88.8				108	6.22	113	21.2		34.6	86.7	153000	
Sample No.	Sample location																	
MAR00820.007	BHI1 ES101 0.00-0.15m	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	2660
MAR00820.008	BHI1 ES102 0.20-0.70m	<1	<1	<1	1.03	1.47	1.92	1.7	<1	1.44	<1	1.17	<1	1.46	<1	1.53	2.37	5720
MAR00820.009	BHI2 ES101 0.00-0.15m	<1	<1	1.52	1.5	<1	1.15	1.25	<1	1.83	<1	2.02	<1	<1	<1	1.37	2.6	3090
MAR00820.010	BHI2 ES102 0.15-0.45m	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.16	1510
MAR00820.011	BHI3 ES101 0.00-0.15m	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	2750
MAR00820.012	BHI3 ES102 0.15-0.40m	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1690
MAR00820.013	BHI3 ES103 0.40-0.65m	<1	<1	<1	<1	<1	1.21	<1	<1	<1	<1	1.16	<1	<1	<1	1.59	1.89	3040

PCB congener		PCB28	PCB52	PCB101	PCB118	PCB138	PCB153	PCB180	Sum of ICES7	alpha-Hexachlorcyclohexan	beta-Hexachlorcyclohexan	gamma-Hexachlorcyclohexan	Dieldrin	Hexachlorobenzene	p,p'-Dichorodiphenyldichlor	p,p'-Dichorodiphenyltrichl	p,p'-Dichorodiphenyldichlor
Units		ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Detection Limit		0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.56	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Cefas AL1 (mg/kg)									100				5				
Cefas AL2(mg/kg)									None								
Canadian TEL(mg/kg)									21.5								
Canadian PEL(mg/kg)									189								
MAR00820.007	BHI1 ES101 0.00-0.15m	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.56	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MAR00820.008	BHI1 ES102 0.20-0.70m	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.56	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MAR00820.009	BHI2 ES101 0.00-0.15m	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.56	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MAR00820.010	BHI2 ES102 0.15-0.45m	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.56	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MAR00820.011	BHI3 ES101 0.00-0.15m	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.56	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MAR00820.012	BHI3 ES102 0.15-0.40m	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.56	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MAR00820.013	BHI3 ES103 0.40-0.65m	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.56	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

APPENDIX 8.2

Intertidal Survey

Ocean Ecology

Marine Surveys, Analysis & Consultancy

Iona & Fionnphort Marine Access Improvement Project - Intertidal Habitat Assessment

REF: OEL_RPSION0221_INT

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Details

Version	Date	Description	Author(s)	Reviewed By
V01	30/09/2021	Draft	Elena Lo Giudice Cappelli, Samuel Holmes	Ross Griffin

Updates

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Abbreviations

BSH	Broadscale Habitat
CAA	Civil Aviation Authority
DEM	Digital Elevation Model
EIA	Environmental Impact Assessment
EMODnet	European Marine Observation and Data Network
EUNIS	European Nature Information System
GPS	Global Positioning System
GSD	Ground-Sampling Distance
INNS	Invasive Non-Native Species
JNCC	Joint Nature Conservation Committee
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MNCR	Marine Nature Conservation Review
NMPi	National Marine Plan Interactive
OEL	Ocean Ecology Limited
PfCO	Permission for Commercial Operations
PMF	Primary Marine Feature
RPQs	Remote Pilot Qualification
SAC	Special Area of Conservation
UAV	Unmanned Aerial Vehicle

1. Non-Technical Summary

This report presents the findings of two intertidal surveys conducted at Iona and Fionnphort for the Marine Access Improvement Project. The key aim was to characterise and map the key benthic habitats present across the foreshore to inform the drafting of an Environmental Impact Assessment (EIA).

The surveys took place at Iona and Fionnphort between the 22nd and 24th of August 2021 and involved the collection of Unmanned Aerial Vehicle (UAV) imagery accompanied by quadrat sampling to gather detailed information on the benthic communities present for subsequent biotope mapping purposes. A full suite of images and quadrats were collected across the full extent of the intertidal foreshore at each site between Mean Low Water Springs (MLWS) and Mean High Water Springs (MHWS).

An intricate landscape was encountered across the Fionnphort survey area with a strandline of varying width (EUNIS A2.21) giving way to a large area of littoral sand (A2.2, A2.231, A2.241) in the upper shore and rocky biotopes (A1.113, A1.211 and A1.212) in the mid to lower shore. Fionnphort was also flanked by rock cliffs and ledges covered in lichens (B3.1) in some areas.

A typical zonation was observed at Iona; this included supralittoral rocks and cliffs covered in lichens and green seaweeds (B3.1 and B3.11) and upper shore zones characterised by rocky habitats and biotopes supporting a number of marine invertebrate taxa and fucoids (A1.1131, A1.2141 and A1.211). The lower shore was characterised by fine sand (A2.22) with areas dominated by polychaete species (A2.24) with patches of rocks and sediments covered in kelp (*Laminaria digitata*) (A3.21 and A5.52).

Both survey areas fall within the boundaries of the Inner Hebrides and the Minches Marine SAC in their component below the MHWS mark. This site is not however designated to protect benthic features meaning that the EUNIS rock classifications meeting the qualifying criteria for Annex I bed rock reef habitat are not afforded protection under the Habitats Directive. Nevertheless, EUNIS classifications B3.1 and B3.11 are included under 'Supralittoral Rock: Cliff and Slopes' on the list of Section 2(4) Habitat of Principal Importance under the Nature Conservation (Scotland) Act 2004. Similarly, EUNIS classification A1.1133 and A1.2142 are listed as 'Littoral Rock: Intertidal Underboulder Communities'.

There were no observations of Priority Marine Features (PMFs) such as intertidal seagrass beds; however, seagrass debris were recorded at two locations in Fionnphort. Similarly, no maerl or kelp beds, two other PMFs with the potential of occur in or close to the survey areas, were recorded across the survey areas; however, kelp habitats were observed in the shallow subtidal areas at low water potentially forming kelp beds, into the infralittoral zone representative of EUNIS classifications A3.21 and A5.52 and the PMFs 'Kelp beds' and 'Kelp and seaweed communities on sublittoral sediment'. These habitas were investigated during the subtidal survey conducted concurrently to the intertidal surveys and reported separately.

2. Introduction

2.1. Project Overview

Argyll and Bute Council appointed RPS to carry out an expert review of all works undertaken to date and draft a detailed Environmental Impact Assessment (EIA) to support a marine access improvement project at Iona and Fionnphort, two sites in the Sound of Iona.

Iona is a small island located west of Mull, on the west coast of Scotland. A ferry service connects Iona to Fionnphort located in the southwest of Mull. Current facilities at both ports need upgrading and improving as difficulties have been identified in their use by all parties operating from each port (e.g., inter-island ferry, fishery and leisure boats). Several feasibility studies (Simoes & Salmon 2020a b) have been carried out over the years to propose different options for the Iona and Fionnphort marine access improvement works with the selected projects consisting of a new rock armour breakwater, berthing piles and dredging in Iona and of a new rock armour breakwater, overnight berthing facilities and dredging in Fionnphort (ByrneLooby 2019).

2.2. Project Background

RPS commissioned Ocean Ecology Limited (OEL) to conduct intertidal Unmanned Aerial Vehicle (UAV) and Phase I and II walkover surveys at both Iona and Fionnphort to inform the drafting of the EIA. The surveys involved the collection of UAV imagery and a Phase I and II walkover survey to characterise and map the soft-and-hard substrates and associated benthic communities of the two sites located within the Sound of Iona. Fionnphort is to the east of the survey area on the Isle of Mull (Figure 1) while Iona is to the west within St Ronan's Way on the Isle of Iona (Figure 1). Both sites are located at the pre-existing inter-island ferry terminals for the Fionnphort to Iona ferry service. The survey area is shallow with water depths up to 6m and drying heights in intertidal areas of 2m. The key objective was to map the distribution and extent of individual or groups of broadscale habitats, biotopes, biotope complexes and life forms present with a focus on confirming the presence/absence of any habitats and/or features of conservation interest across the Sound of Iona (e.g., Primary Marine Features (PMFs) such as seagrass beds).

This report provides a summary of the survey methodologies employed and detailed mapping of the habitats encountered during the survey. Habitats were determined through detailed interpretation of the UAV imagery and walkover data allowing for the determination of European nature Information System (EUNIS) habitats and biotopes (where possible) and subsequent creation of full coverage habitat/biotope mapping across the survey areas.

2.3. Current Understanding

Nature Scot (previously Scottish Natural Heritage) identified a number of benthic habitats and marine species as PMFs (Tyler-Walters et al. 2016). Several of these important and sensitive habitats are known to occur around the West coast of Scotland (Fuller 1999, NatureScot 2021) and have the potential to occur within or near the survey area.

Existing habitat mapping obtained from the European Marine Observation and Data Network (EMODnet) and the Scottish National Marine Plan Interactive (NMPi) suggests the habitats present within the survey areas primarily consist of intertidal sandy shores with moderate-high energy intertidal rock with the potential of representing PMFs including biogenic habitats like seagrass beds known to occur north of the survey area in Fionnphort (Figure 1). Other PMFs that have been recorded on both Isles (Mull and Iona) include kelp and maerl beds which could potentially occur within the survey area.

The Sound of Iona lies within the boundaries of the Inner Hebrides and the Minches Special Area of Conservation (SAC) designated to protect harbour porpoises (*Phocena phocena*) as per Annex II of the Habitat Directive (The Council Directive 92/43/EEC).

2.3.1. Seagrass Beds

Seagrasses (also known as eelgrass) are marine flowering plants found in shallow coastal areas down to approximately 10m, often growing in dense beds or meadows. The plants can be annual or perennial and stabilise the sediment, creating productive habitats that provide shelter and food for a wide variety of plants and animals (including other species of conservation importance and commercially valued fish species), as well as being important for carbon sequestration.

Seagrass 'beds' formed by the genus *Zostera* are generally classed as having plant densities that provide at least 5% cover (OSPAR 2009). Typically, *Zostera* spp. plant densities provide greater than 30% cover and in favourable conditions, extensive beds may form with up to 95% cover (Lancaster et al. 2014). A minimum area of 5 m x 5 m with at least 5% cover of *Zostera* spp. is required to qualify as a seagrass bed.

Zostera spp. beds are usually found in sands and muds from the upper shore down to 10m, in areas at least moderately sheltered from wave action such as sea lochs, inlets, bays, sounds, channels and lagoons. *Z. marina* is predominantly subtidal, whilst the narrow-leaved variant, *Z. marina var. angustifolia*, can occur in the shallow subtidal and intertidally on the mid to lower shore. Meadows of seagrass formed by either or both species are protected in Scotland through designations as the PMF broad habitat 'Seagrass Beds' (Tyler-Walters et al. 2016), through inclusion on the OSPAR list of threatened and/or declining species and habitats and as a Section 2(4) Habitat of Principal Importance under the Nature Conservation (Scotland) Act 2004.

A consultation relating to the distribution of PMFs across Scotland reported the presence of *Z. marina var. angustifolia* beds to the north of the Fionnphort survey area whilst a single record from Seagrass Spotter[1] reports the presence of a notable *Z. marina* bed in the shallow subtidal with the potential to extend into the intertidal zone (Figure 1).

2.3.2. Maerl Beds

Maerl is a collective term for several species of red seaweed, with hard, chalky skeletons that grow as unattached rounded nodules or short, branched shapes on the seabed. As a result, maerl can form large beds, where layers of dead maerl build up with a thin layer of pink, living maerl on the top. These beds are a priority habitat under Section 2(4) of the Nature Conservation (Scotland) Act 2004 as they form an important habitat for many different types of marine life, which live amongst or are attached to the surface of maerl, or burrow in the coarse gravel of dead maerl beneath the top living layer. Maerl beds can be of importance to sustainable fisheries, providing nursery grounds for commercial species of fish and shellfish.

Due to the fragility of maerl, the beds are easily damaged and have probably declined substantially in some areas. Pressures on maerl beds include scallop dredging, bottom trawling, aquaculture, and pollution. Maerl beds are very slow to develop and are unlikely to return if removed or lost. As such, they should be treated as a non-renewable resource.

Maerl beds are granted protection under the EC Directive on the Conservation of Natural Habitats and Wild Fauna and Flora (92/43/ECC), through inclusion on the OSPAR list of threatened and/or declining species and habitats and as the PMF broad habitat 'Maerl Beds' (Tyler-Walters et al. 2016). There are no known existing records of maerl within the Sound of Iona.

2.3.3. Kelp Beds

Beds of the kelps such as *Laminaria hyperborea* and *Laminaria digitata* form forests and parks in rocky coastal areas, under a variety of wave and tidal conditions. The kelp provides a canopy under which a wide range of animals and other seaweeds thrive. A rich diversity of red seaweeds grows among the kelp and on the kelp stipes, while depending on conditions, sea mats and sea firs may colonise the fronds. The rocks below the kelp are often encrusted with coralline algae or support cushion forming fauna, such as sea anemones, sponges and sea squirts. Small crustaceans and worms live among the kelp holdfasts, while sea urchins and sea snails graze on the seaweeds, and fish find shelter from predators among the fronds.

Kelp beds occur in shallow waters (to a maximum of 20-30m), on bedrock and boulders in a range of wave exposure regimes and tidal conditions and are protected in Scotland through designation as the PMF broad habitat 'Kelp beds'. There are no existing records of the PMF broad habitat 'Kelp Beds' within the Sound of Iona however this is likely due to the lack of sampling rather than true absence given the rocky subtidal habitats known to occur across the area.

[1] https://seagrassspotter.org/sighting/271

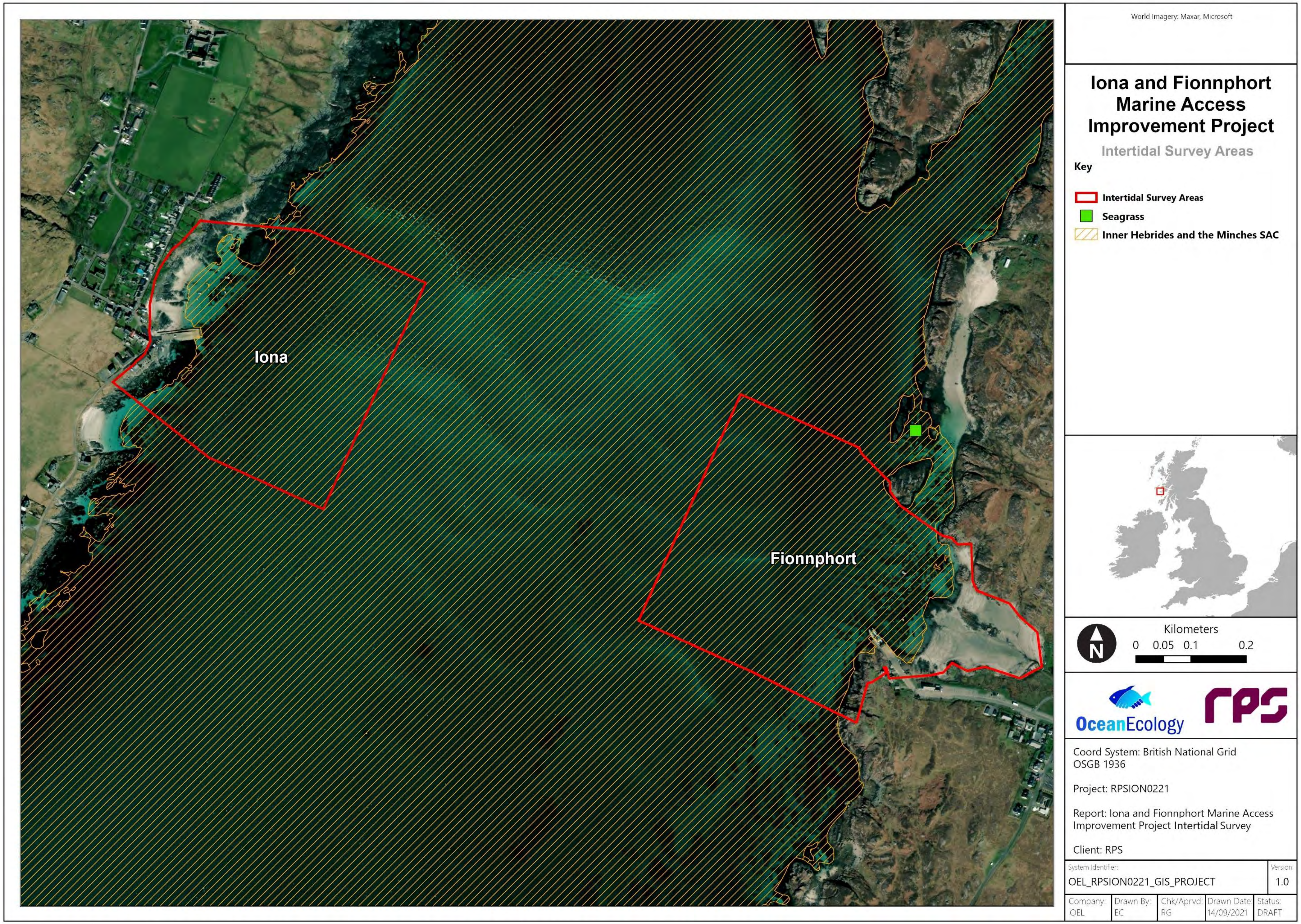

Figure 1 Location of the intertidal survey areas in Fionnphort and Iona within the Inner Hebrides and The Minches SAC. Note the existing seagrass bed record north of the Fionnphort site.

3. Methods

3.1. Survey Design

The intertidal surveys covered the area extending from Mean Low Water Springs (MLWS) to Mean High Water Springs (MHWS) at each location. An UAV survey was undertaken to collect high-resolution imagery across the survey areas at low water. Additionally, a total of 178 quadrat locations (92 at Fionnphort and 86 at Iona) were selected across the survey areas to supplement ground truth the UAV imagery and inform the subsequent habitat / biotope mapping.

3.2. Survey Methods

3.2.1. Walkover Survey

The Phase I and II intertidal walkover surveys were undertaken during low tide periods using ESRI ArcCollector on a tablet device equipped with a Bad Elf GPS & GLONASS providing 2.5 m positional accuracy. The surveys were undertaken in consideration of guidance in the Marine Monitoring Handbook (Davies et al. 2001), CCW Handbook for Marine Intertidal Phase I Survey and Mapping (Wyn et al. 2006) and latest guidance for characterising intertidal rocky shore and sediment habitats (NRW 2019, Wales 2019). EUNIS habitats and biotopes were identified in line with JNCC guidance on assigning benthic biotopes (Parry 2019). These were correlated to the Marine Habitat Classification for Britain and Ireland (MNCR) and, where possible, boundaries of habitats / biotopes were tracked as polygons in ESRI ArcCollector.

Representative examples of each habitat / biotope encountered were photographed whilst target notes were taken at any notable change in habitat / substrate and identified the presence of any notable features (e.g. intertidal rockpools) and habitats of conservation interest. These were accompanied by GPS fixes and close-up photographs of each feature, along with aspect photographs to the North, East, South and West from each sample location to capture wider site information. The presence of any Invasive Non-Native Species (INNS) was also to be noted and their location recorded. Other information recorded included general site conditions, sediment surface features (e.g. polychaetes casts), sediment type and characteristics, topography and evidence of any anthropogenic pressures.

3.2.2. UAV Mapping

The UAV mapping was carried out in consideration of JNCC guidance for use of UAVs in marine benthic monitoring (Crabb et al. 2019). All flights were conducted by OELs Qualified UAV Pilots (Remote Pilot Qualification (RPQs) under its Permission for Commercial Operations (PfCO) (CAA ID: 2654) granted by the Civil Aviation Authority (CAA). The UAV used was a DJI Phantom 4 multi-rotor quadcopter. The flight(s) were pre-planned using in Drone Deploy software at a flight height of 60 m to achieve a target orthomosaic Ground-Sampling Distance (GSD) of 2-3 cm/px with an accuracy[2] of between 2-3m.

3.3. Analysis

3.3.1. UAV Imagery Analysis

Following initial screening to remove any erroneous images, all images collected during the UAV mapping flights underwent Terain (2D) processing in the Drone Deploy software and were 'stitched' together to generate orthomosaic and Digital Elevation Model (DEM) outputs[3] for both intertidal survey areas. Achieved image resolution across both sites was 12 mega pixels with an average orthomosaic image density of 12 images per pixel. A detailed processing and output quality report for each intertidal survey area is provied in Appendix II.

The outputs were then used as base maps in GIS to facilitate subsequent habitat / biotope mapping by visual interrogation and delineation of boundaries.

3.3.2. EUNIS Classification Mapping

EUNIS habitats, biotope complexes and biotopes were identified in line with JNCC guidance on assigning benthic biotopes (Parry 2019) to allow for the production of a full coverage habitat/biotope map. All habitat / biotope determination was undertaken through consideration of the following:

- Existing habitat mapping (derived from EMODnet and NMPi)
- UAV imagery interpretation
- Review and interpretation of target field notes and quadrat imagery
- General site imagery

All habitat mapping was undertaken in ESRI ArcPro Version 2.8.1 by a habitat mapping specialist and reviewed by a secondary senior environmental scientist. Analysis of quadrat and site photos along with the UAV imagery allowed for polygons to be drawn around areas of a certain habitat/ biotope.

Confidence scores were assigned to all polygons to give an indication of their accuracy. Values ranged from 1 (one data source) to 2 (two data sources) depending on the following:

- Whether target filed notes and quadrats were available within the polygon
- Whether UAV imagery confirmed/suggested the presence of the same habitat / biotope within a polygon

[2] Measured as Root Mean Square Errors (RMSE).

[3] Note that Ground Control Points (GCPs) were not used to georeference the DEM outputs using real-time kinematic (RTK) GPS coordinates. As such the real-world position of the DEM output are presented subject to error associated with the drone's GPS accuracy whilst the elevation data is presented relative to the take-off position of the drone rather than absolute elevation (i.e. Mean Sea Level - MSL). As such the DEM outputs were only used to broadly inform the habitat mapping and should not be used for construction planning and/or navigation purposes.

- Whether the boundaries of the habitat / biotope were clearly defined either by UAV imagery, target field notes or quadrats

Highest scores were given to polygons where all data sources identified the same habitat / biotope, with distinct boundaries. Lower scores were assigned to polygons where the boundaries were not obvious. In these cases, polygons were drawn based upon expert judgement, given the information available.

3.3.3. Feature of Interest

After assigning EUNIS habitats and biotopes to the survey area based on UAV imagery analysis and walk over data (quadrats and target notes), an assessment of the presence of PMFs and other designated or protected habitats was carried out, and where appropriate, the extent of these features was calculated.

4. Results

4.1. Survey Progress

The UAV and intertidal walkover surveys were undertaken at Fionnphort and Iona during low tide periods between the 22nd and 24th of August 2021. Table 1 provides a summary of the sampling and information collected during the surveys.

Table 1 Summary of sampling undertaken and information collected during the intertidal surveys.

Sampling	Fionnphort	Iona
Quadrats	92	86
Target Notes	92	86
UAV imagery	860 images	385 images

4.2. UAV Survey

UAV mapping was undertaken at Fionnphort and Iona around low water on 22 August 2021. An 42:08 minute flight was undertaken at Fionnphort and a 21:06 minute flight at Iona. Flight height was maintained at 60 m for the Fionnphort flight and 75 m for the Iona flight. Weather conditions (e.g. wind / precipitation) remained favourable for data collection throughout.

The UAV flight of Fionnphort successfully captured 860 high-resolution nadir images across a coverage area of 0.98 km^2 to produce a high resolution orthomosaic model (GSD = 2.60cm/px) and DEM (GSD = 10.41cm/px) (Figure 2) with average RSME accuracy level of 2.31m. The UAV survey of Iona successfully captured 385 high-resolution nadir images across a coverage area of 0.34 km^2 to produce a high resolution orthomosaic model (GSD= 3.29 cm/px) and DEM (GSD = 13.17cm/px) (Figure 3) with average RSME accuracy level of 2.16m. Example aerial images are provided in Plate 1. The full orthomosaic, DEM and 3D model outputs are provided as Appendix II along with processing reports.

Plate 1 Example site UAV imagery at Fionnphort (left) and Iona (right).

Figure 2 UAV orthomosaic (top) and Digital Elevation Model (DEM) (bottom) generated from the UAV imagery collected during the intertidal survey of the Fionnphort survey area.

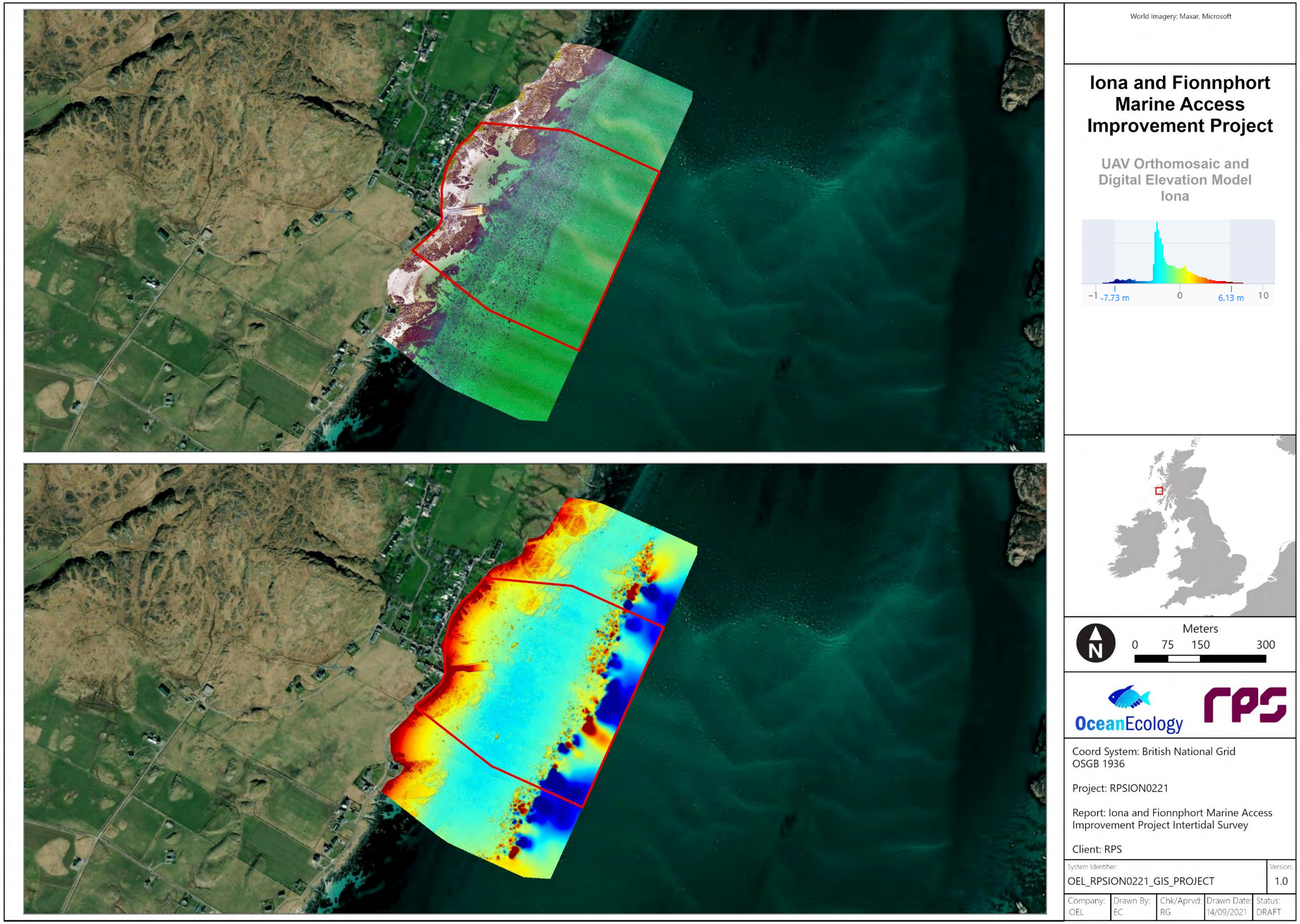

Figure 3 UAV orthomosaic (top) and Digital Elevation Model (DEM) (bottom) generated from the UAV imagery collected during the intertidal survey of Iona survey area.

4.3. Phase I Sampling

In total, target notes and quadrats were taken at 178 locations (92 at Fionnphort and 86 at Iona) to provide localised information on habitats and features of interest present across the intertidal areas and assign EUNIS classifications *in situ* to assist in ground truthing of UAV aerial imagery (Figure 4 and Plate 2).

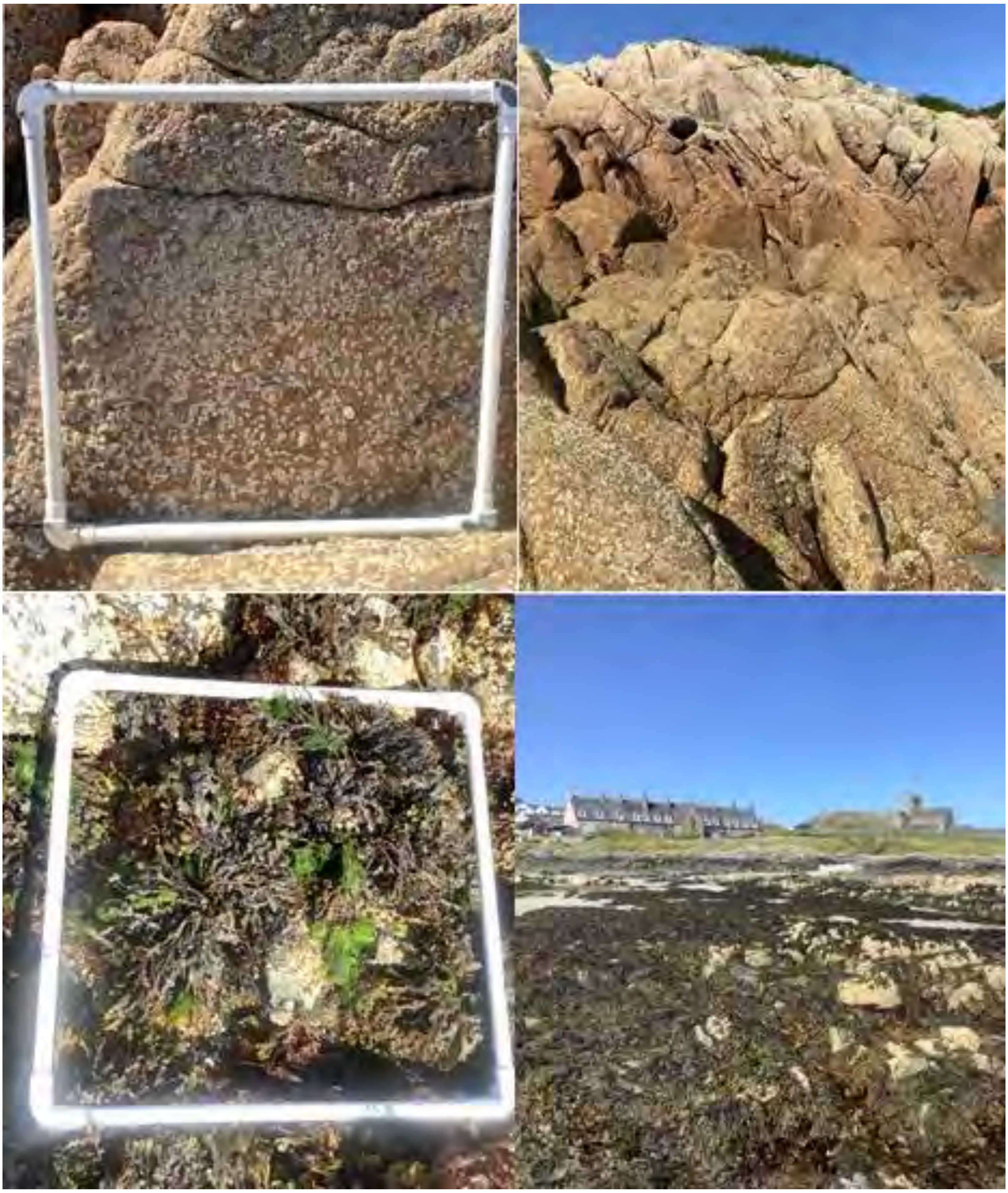

Plate 2 Top left: Quadrat at Fionnphort. Top Right: High energy rocky sore at Fionnphort (Object ID 73). Bottom left: Quadrat at Iona, Bottom right: High energy rocky shore covered in seaweeds at Iona (Object ID 18)

Figure 4 Location of target notes and quadrats collected across the Fionnphort (top) and Iona (bottom) survey areas.

4.4. Habitat / Biotope Mapping

4.4.1. Fionnphort

There was a total of 15 unique biotopes (EUNIS level 5 or above) from the 10 Broad Scale Habitats (BSH) (Table 2) observed across the Fionnphort survey area as mapped in Figure 5. The designation status of each is set out in Table 2 and discussed further in Section 5.

The upper shore was characterised by a wide strandline (A2.21) narrowing towards the north followed by a wide area of littoral sand and muddy sand (A2.2) grading into rocky habitats closer to the MLWS mark (A1.1, A1.2 and A1.3). The flanks of the survey area were bordered by rock cliffs and ledges covered in lichens (B3.11) in some areas. The portion of the survey area south of the existing slipway was dominated by a range or rocky habitats and biotopes (Table 2, Figure 5 and Plate 3).

A north to south zonation as well as a seaward gradient characterised the Fionnphort survey area. High to moderate energy rocky habitats (A1.1 and A1.2) were encountered at the north and south ends of the survey area grading from rocks dominated by mussel and/or barnacle (A1.1131) to rocks dominated by *Pelevetia caniculata* (A1.211), *F. spiralis* (A1.212) *F. serratus* (A1.214). The central portion of the Fionnphort survey area was characterised by sand and muddy sand (A2.22) in the upper shore grading into sand supporting polychaetes (A2.231) as well as *Macoma balthica* and *Arenicola marina* (A2.241) in the mid to lower shore. Patches of rock habitats of varying exposures as well as intertidal mixed sediments (A2.43) were scattered across the central portion of the survey area, including low energy rock habitats covered by *P. caniculata* (A1.311) and *F. spiralis* (A1.312).

A summary of EUNIS classifications recorded during the walkover survey is provided in Appendix I while the full set of intertidal photographs collected across the Fionnphort survey area provided as Appendix III. The EUNIS classification presented in Figure 5 is provided as Appendix IV in shapefile (.shp) format.

Table 2 Key EUNIS classifications recorded across the Fionnphort survey area.

EUNIS BSH	EUNIS Code	EUNIS Description	Designation Status
A1.1 - High energy littoral rock	A1.1131	*Semibalanus balanoides, Patella vulgata* and *Littorina* spp. on exposed to moderately exposed or vertical sheltered eulittoral rock	
	A1.1133	*Semibalanus balanoides* and *Littorina* spp. on exposed to moderately exposed eulittoral boulders and cobbles	'Littoral Rock: Intertidal boulder communities' Habitat of Principle Importance (Nature Conservation (Scotland) Act 2004)
	A1.12	Robust fucoid and/or red seaweed communities	
A1.2 - Moderate energy littoral rock	A1.211	*Pelvetia canaliculata* and barnacles on moderately exposed littoral fringe rock	
	A1.212	*Fucus spiralis* on full salinity exposed to moderately exposed upper eulittoral rock	
	A1.214	*Fucus serratus* on moderately exposed lower eulittoral rock	
	A1.2142	*Fucus serratus* and under-boulder fauna on exposed to moderately exposed lower eulittoral boulders	'Littoral Rock: Intertidal boulder communities' Habitat of Principle Importance (Nature Conservation (Scotland) Act 2004)
A1.3 - Low energy littoral rock	A1.31	Fucoids on sheltered marine shores	
	A1.311	*Pelvetia canaliculata* on sheltered littoral fringe rock	
	A1.312	*Fucus spiralis* on sheltered upper eulittoral rock	
A1.4 – Features of littoral rock	A1.45	Ephemeral green or red seaweeds (freshwater or sand-influenced) on non-mobile substrata	
A2.1 – Littoral Coarse sediment	A2.11	Shingle (pebble) and gravel shores	
A2.2 – Littoral sand and muddy sand	A2.21	Strandline	
	A2.231	Polychaetes in littoral fine sand	
	A2.241	*Macoma balthica* and *Arenicola marina* in muddy sand shores	
A2.4 - Littoral mixed sediment	A2.43	Species-poor mixed sediment shores	
B3 - Rock cliffs, ledges and shores, including the supralittoral	B3.11	Lichens or small green algae on supralittoral and littoral fringe rock	'Supralittoral rock' Habitat of Principle Importance (Nature Conservation (Scotland) Act 2004)
J4.5	-	Hard-surfaced areas of ports	

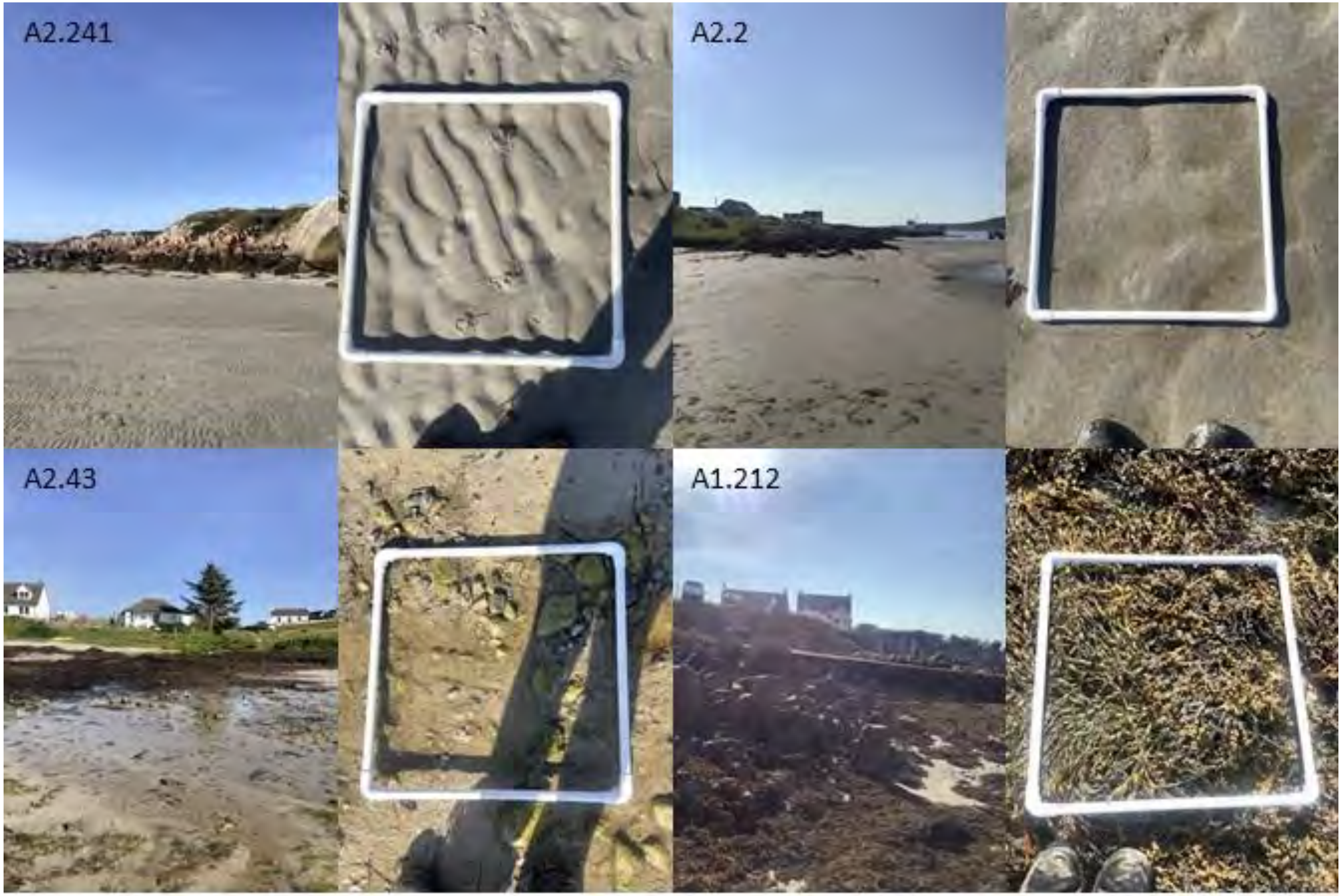

Plate 3 Example images of the main habitats/biotopes encountered across the Fionnphort survey area.

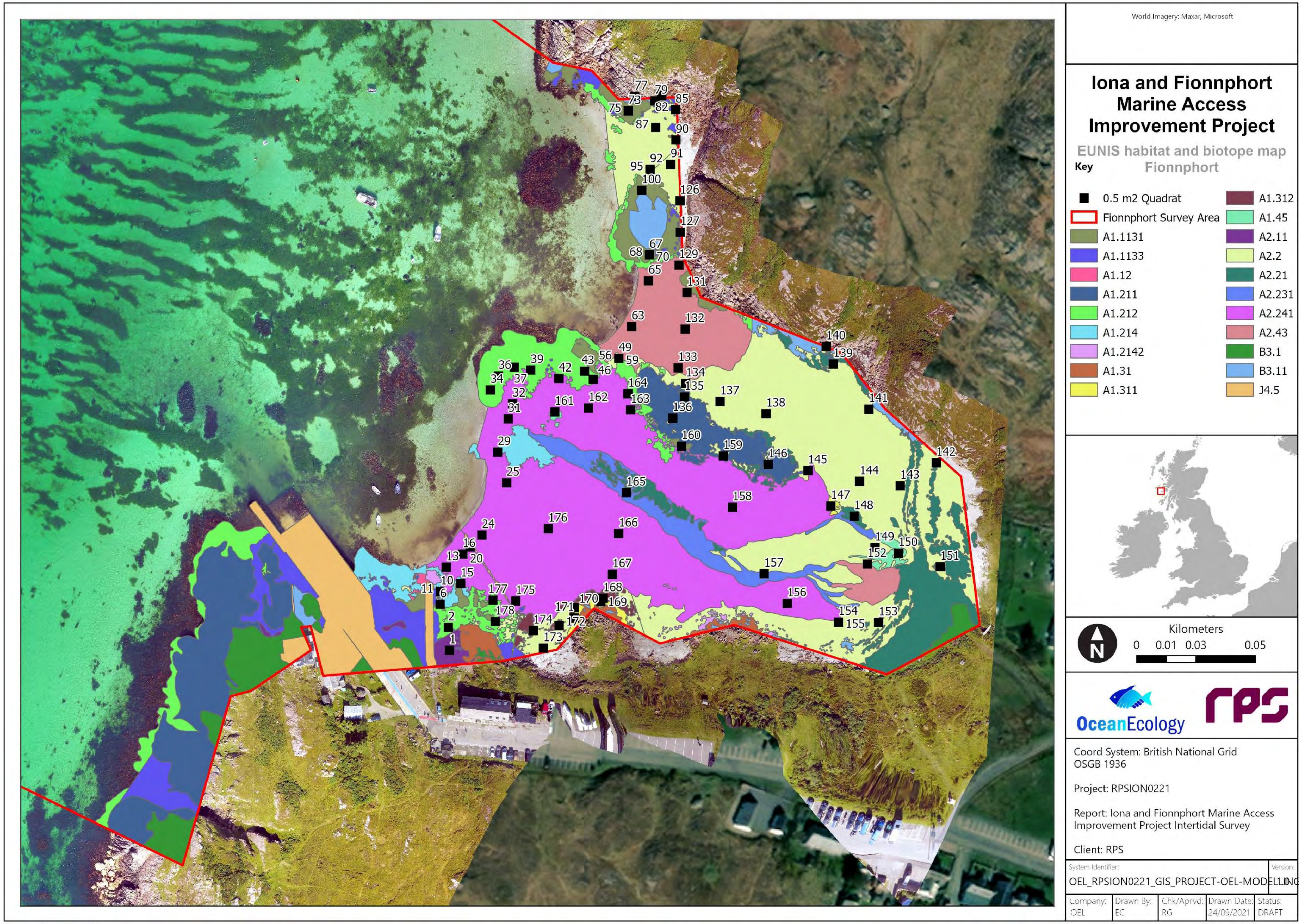

Figure 5 EUNIS habitat and biotope mapping with sampling locations visited during the intertidal survey of the Fionnphort survey area overlain on the orthomosaic derived from UAV imagery.

4.4.2. Iona

There was a total of 18 unique biotopes (EUNIS level 5 or above) from the 13 BSH (Table 3) observed across the Iona survey area as mapped in Figure 6. The designation status of each is set out in Table 3 and discussed further in Section 5.

The majority of the Iona survey area was characterised by high to moderate energy littoral rock habitats (A1.1 and A1.2) and sand and muddy sand (A2.2). The portion of the survey area closer to land was fringed by supralittoral and littoral fringe rock covered in lichens or small green algae (B3.11); while moving down the shore, the middle shore was interspersed with rocky habitats of different exposures (e.g., A1.2 and A1.3), littoral sand and mixed sediments (A2.4), with the lower and extreme lower shores dominated by sand and including patches of both rocks and sediments covered kelp and seaweed communities (A3.21 and A5.52). Barren littoral shingle (A2.111) was patchy in extent and mostly localised in the upper shore of the northern reaches of the survey area and just south of the existing slipway (Table 3, Figure 6 and Plate 4).

A clear zonation characterised the portion of the Iona survey area north of the existing slipway where lichens or green algae occurred on supralittoral and littoral fringe rock (B3.11) giving way in the upper to middle shore to exposed bedrock and large boulders representative of biotopes A1.1131 and A1.1133 with fucoids present in the fissures and crevices of the bedrock (A1.1132). The middle to lower shore comprised of sand (A2.2) with a mosaic of rocky habitats covered in fucoids, including *F. serratus* (A1.2141 and A1.2142), *Pelvetia caniculata* (A1.211) and *Himanthalia elongata* (A1.123), most frequent in the northern reaches of the survey area. The low and extremely low shore was dominated by sand with patches covered in kelp (*L. digitata*) and seaweeds (A5.52) in the central part, while kelp on rock (A3.21) was present to the north (Figure 6). South of the existing slipway, the survey area was mostly dominated by rock habitats, yet showing a similar zonation as that observed north of the pier, with the notable difference that a much wider area of rock covered by fucoids was present extending to the mid and lower shore (A1.2141) while sand was more confined.

A summary of EUNIS classifications recorded during the walkover survey is provided in Appendix I while the full set of intertidal photographs collected across the Iona survey are provided as Appendix III. The EUNIS classification presented in Figure 6 is provided as Appendix IV in shapefile (.shp) format.

Table 3 Key EUNIS classifications recorded at Iona.

EUNIS BSH	EUNIS Code	EUNIS Description	Designation Status
A1.1 - High energy littoral rock	A1.1131	*Semibalanus balanoides, Patella vulgata* and *Littorina* spp. on exposed to moderately exposed or vertical sheltered eulittoral rock	
	A1.1132	*Semibalanus balanoides, Fucus vesiculosus* and red seaweeds on exposed to moderately exposed eulittoral rock	
	A1.1133	*Semibalanus balanoides* and *Littorina* spp. on exposed to moderately exposed eulittoral boulders and cobbles	'Littoral Rock: Intertidal boulder communities' Habitat of Principle Importance (Nature Conservation (Scotland) Act 2004)
	A1.123	*Himanthalia elongata* and red seaweeds on exposed lower eulittoral rock	
A1.2 - Moderate energy littoral rock	A1.211	*Pelvetia canaliculata* and barnacles on moderately exposed littoral fringe rock	
	A1.2141	*Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock	
	A1.2142	*Fucus serratus* and under-boulder fauna on exposed to moderately exposed lower eulittoral boulders	'Littoral Rock: Intertidal boulder communities' Habitat of Principle Importance (Nature Conservation (Scotland) Act 2004)
A1.3	-	Low energy littoral rock	
A1.4 – Features of littoral rock	A1.421	Green seaweeds (*Enteromorpha* spp. and *Cladophora* spp.) in shallow upper shore rockpools	
A2.1 – Littoral Coarse sediment	A2.111	Barren littoral shingle	
A2.2 – Littoral sand and muddy sand	A2.21	Strandline	
	A2.22	Barren or amphipod-dominated mobile sand shores	
	A2.24	Polychaete/bivalve-dominated muddy sand shores	
A2.4 – Littoral mixed sediment	A2.43	Species-poor mixed sediment shores	
A2.8 – Features of littoral sediment	A2.82	Ephemeral green or red seaweeds (freshwater or sand-influenced) on mobile substrata	
A3.2 - Atlantic and Mediterranean	A3.21	Kelp and red seaweeds (moderate energy infralittoral rock)	Potential PMF Kelp bed

EUNIS BSH	EUNIS Code	EUNIS Description	Designation Status
moderate energy infralittoral rock			
A5.5 - Sublittoral macrophyte-dominated sediment	A5.52	Kelp and seaweed communities on sublittoral sediment	Potential PMF Kelp and seaweed communities on sublittoral sediment
B3 - Rock cliffs, ledges and shores, including the supralittoral	B3.11	Lichens or small green algae on supralittoral and littoral fringe rock	'Supralittoral rock' Habitat of Principle Importance (Nature Conservation (Scotland) Act 2004)
I2.2	-	Small-scale ornamental and domestic garden areas	
J4.5	-	Hard-surfaced areas of ports	

Plate 4 Example images of the main habitats/biotopes encountered at Iona.

Figure 6 EUNIS habitat and biotope mapping with sampling locations visited during the intertidal survey of the Iona survey area overlain on the orthomosaic derived from UAV imagery.

4.5. Features of Interest

4.5.1. Habitats of Principle Importance

A number of habitats have been identified as being the most threatened and requiring conservation action under Section 2(4) of the Nature Conservation (Scotland) Act 2004. Habitats assigned to EUNIS classification B3.1 and B3.11 were deemed to be included under 'Supralittoral rock: Maritime Cliff and Slopes' on this list. Similarly, biotopes assigned EUNIS classification A1.1133 and A1.2142 were deemed to be representative of 'Littoral Rock: Intertidal boulder communities' under Section 2(4) of the Nature Conservation (Scotland) Act 2004.

4.5.2. Seagrass Bed (PMF)

Detached seagrass shoots were recorded at quadrat locations 16 and 133 either side of the wide area of sand in the central portion of the Fionnphort survey area (Plate 5 and Figure 5). These were not deemed to meet the criteria of seagrass beds and therefore were not mapped (Lancaster et al. 2014; OSPAR 2009). However, from review of the UAV imagery covering the shallow subtidal areas it was clear seagrass was present across large shallow subtidal portions of the survey area at both sites (Iona and Fionnphort) as mapped as part of the subtidal benthic survey reported separately.

Plate 5 Dettached seagrass shoots recorded at quadrat locations 16 and 133 within the Fionnphort survey area.

4.5.3. Kelp Beds and Kelp and seaweed communities on sublittoral sediment (PMFs)

Kelp was observed at quadrat location 33 (Plate 6) and noted at target point 12 both located in the northern reaches of the Iona survey area. Additionally, kelp was also recorded in a few UAV images as mapped in Figure 6. However, these observations alone were not enough to confidently define the boundaries and extent of these features (low confidence scores) potentially representative of kelp bed habitats (Table 2 and Table 3). Due to the subtidal nature of kelp habitats, the assessment of these features has been carried out in detail as part of the subtidal benthic assessment reported separately.

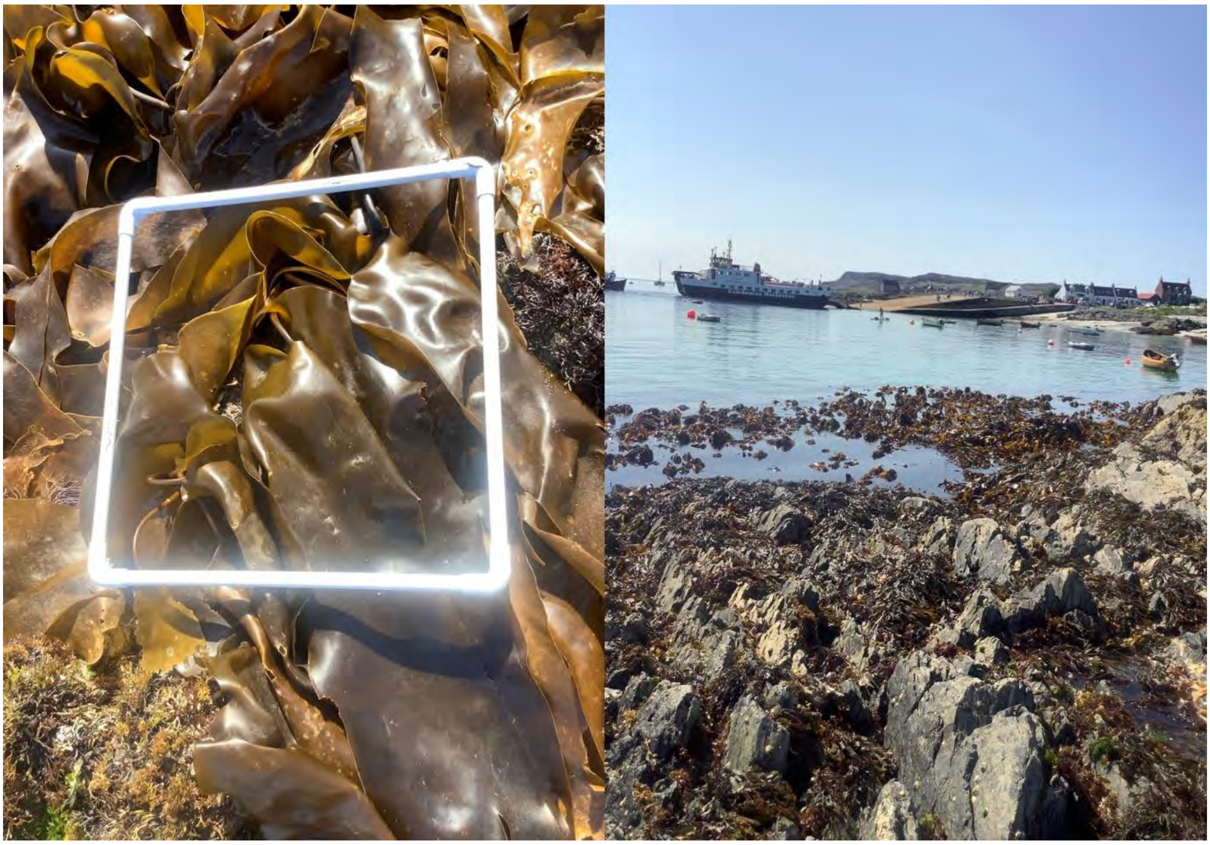

Plate 6 Kelp – *Laminaria digitata* Left: object ID 33. Right: target point 12 Southern aspect.

4.5.4. Annex I Habitats

Both survey areas were characterised by large areas of rocky habitats comprising a mosaic of exposed bedrock, boulders and cobbles; these were deemed to be representative of different biotopes spanning from high to low energy rock habitats with some supporting a variety of fucoids and other seaweeds.

Despite the EUNIS rock classifications assigned during these surveys in the mid to lower shore falling within the boundary of the Inner Hebrides and the Minches Marine SAC, the site is not designated to protected benthic features meaning that the EUNIS rock classifications meeting the qualifying criteria for Annex I bed rock reef habitat are not afforded protection under the Habitats Directive. No specific guidelines exist to determine whether intertidal rocky biotopes correspond to Annex I reefs, however the Marine Habitat Classification for Britain and Ireland (JNCC 2015) states that 'intertidal areas are only included within this Annex I type where they are connected to subtidal reefs'. Based on the habitat mapping presented here not all of the intertidal rocky features extend from the intertidal zone into the subtidal zone, meaning that only some, if any, of these features can be deemed to qualify as Annex I reefs.

Similarly, some of the sandy habitats observed across both survey areas and falling within the boundary of the Inner Hebrides and the Minches SAC could be representative of the Annex I habitat 'mudflats and sandflats not covered by seawater at low tide'. However, as this is not a qualifying feature of the Inner Hebrides and Minches SAC, they are not afford protected by this designation.

4.5.5. Other feature of Interest

No INNS or maerl (dead or alive) were recorded across the two survey areas.

5. Discussion

This report presents the findings and habitat mapping outputs of the intertidal surveys conducted across the Iona and Fionnphort survey areas as part of the intertidal habitat assessment for the Marine Access Improvement Project. The surveys involved the collection of UAV aerial imagery accompanied by an intertidal walkover survey where target field notes and quadrat data were obtained. The key objective was to map the distribution and extent of individual or groups of BSH, biotopes, biotope complexes and life forms present with a focus on confirming the presence/absence of any habitats and/or features of conservation interest across the two sites (e.g. seagrass beds).

An intricate complex of habitats and biotopes characterised the Fionnphort survey area. The flanks of this survey area were bordered by supralittoral rock and ledges above the MHWS mark covered in lichens (EUNIS B3.11) in some areas encasing a wide area of littoral sand and muddy sand (A2.2) in the upper shore, and various rocky habitats and biotopes in the mid to lower shore as well as to the north and south ends of the survey area. These rocky habitats and biotopes included bedrock and large boulder covered in *S. balanoides*, *P. vulgata* and *Littorina* sp. (A1.113) and in *F. serratus* (A1.214).

A clear zonation was observed across the Iona survey area, the full range of which was more evident in the central and northern reaches of this site. This included lichens or small green algae on supralittoral and littoral fringe rock (B3.11) giving way in the upper to mid shore to exposed bedrock and large boulders representative of biotopes A1.1131 and A1.1133. The mid to lower shore comprised of a mosaic of rocky habitats supporting fucoids (e.g. A1.2141 and A1.123) and in the lower shore kelp (A3.21); while the lower shore was mostly dominated by sand (A2.22) with patches covered in *L. digitata* (A5.52) in the extremely low shore. Sediments were more prevalent in the central portion of the Iona survey area where shingle occurred in the upper shore, while mixed sediment occurring in patches across the mid shore supporting occasional rock pools (A1.421).

Both survey areas fall within the boundaries of the Inner Hebrides and the Minches Marine SAC in their component below the MHWS mark. This site is not however designated to protect benthic features meaning that the EUNIS rock classifications meeting the qualifying criteria for Annex I bed rock reef habitat are not afforded protection under the Habitats Directive. Nevertheless, EUNIS classifications B3.1 and B3.11 are included under 'Supralittoral Rock: Cliff and Slopes' on the list of Section 2(4) Habitat of Principal Importance under the Nature Conservation (Scotland) Act 2004. Similarly, EUNIS classification A1.1133 and A1.2142 are listed as 'Littoral Rock: Intertidal Underboulder Communities'.

Of the rock habitats identified across both survey areas, those assigned EUNIS classification B3 and B3.11, and A1.1133 and A1.2142 were included in the list of habitats of principal importance under Section 2(4) of the Nature Conservation (Scotland) Act 2004 as 'Supralittoral

Rock: Marine Cliffs and Slopes’ and ’Littoral Rock: Intertidal Underboulder Communities’, respectively.

Detached seagrass shoots, probably of *Zostera marina var. angustifolia*, were recorded at two locations on the lower shore within the Fionnphort survey area. This area was not deemed to represent a seagrass bed as the seagrass was not attached to the substrate. However, it should be noted that dense patches of *Z. marina var. angustifolia* were noted during review of the UAV imagery of the shallow subtidal areas covered and confirmed during the subtidal benthic survey reported separately. Seagrass beds are therefore present in the subtidal zone within both survey areas however these beds were not observed to extend into the intertidal zone at either site.

Kelp was identified at two target locations and observed during review of the UAV imagery at the northern end of the Iona survey area. Due to the difficulties encountered in defining the boundaries of these features (low confidence scores), no in-depth assessment on the presence and extent of kelp habitats representative of the PMFs ‘kelp beds’ and ‘kelp and seaweed communities on sublittoral sediment’ was carried on in this report. However, the subtidal benthic survey confirmed kelp to be abundant in the subtidal area as reported separately. No maerl beds or INNS were observed across either of the Iona or Fionnphort survey areas.

6. References

ByrneLooby (2019) Feasibility Study - Iona and Fionnphort Marine Access Improvements.

Crabb M, Wright P, Hymphrey O, Johnson G, Rush S, van Rein H, Hinchen H (2019) Unmanned Aerial Vehicles for use in marine monitoring. 1–36.

Davies J, Baxter J, Bradley M, Connor D, Khan J, Murray E, Sanderson W, Turnbull C, Vincent M (2001) Marine Monitoring Handbook March 2001.

Fuller I (1999) Kelp Forests - Scotland's living landscapes (SNH Publication).

Lancaster JE, McCallum S, Lowe AC, Taylor E, Chapman A, Pomfret J (2014) Development of detailed ecological guidance to support the application of the Scottish MPA selection guidelines in Scotland's seas. Scottish Natural Heritage Commissioned Report No. 491.

NatureScot (2021) Marine habitats | NatureScot

NRW (2019) GN030a Benthic habitat assessment guidance for marine developments and activities: A guide to characterising and monitoring intertidal rocky shore habitats and rockpools. 1–46.

OSPAR (2009) Background Document for Zostera beds, Seagrass beds. Biodivers Ser:39.

Parry ME V (2019) Guidance on Assigning Benthic Biotopes using EUNIS or the Marine Habitat Classification of Britain and Ireland (Revised 2019).

Simoes E, Salmon J (2020a) FIONNPHORT BREAKWATER AND OVERNIGHT BERTHING FACILITY.

Simoes E, Salmon J (2020b) IONA BREAKWATER AND BERTHING FACILITY.

Tyler-Walters H, James B, Carruthers M, Wilding C, Durkin O, Lacey C, Philpott E, Adams L, Chaniotis PD, Wilkes PT V, Seeley R, Neilly M, Dargie J, Crawford-Avis OT (2016) Descriptions of Scottish Priority Marine Features (PMFs). Scottish Natural Heritage Commissioned Report No. 406.

Wales NR (2019) GN030h Benthic habitat assessment guidance for marine developments and activities: A guide to characterising and monitoring subtidal sediments. Bangor.

Wyn G, Brazier P, Birch K., Bunker A, Cooke A, Jones M, Lough N (2006) CCW Handbook for Marine Intertidal Phase 1 Biotope Mapping Survey.

APPENDIX 8.3

Subtidal Survey

Ocean Ecology

Marine Surveys, Analysis & Consultancy

Iona & Fionnphort Marine Access Improvement Subtidal Benthic Survey

REF: OEL_RPSION0221_SUB

Details

Version	Date	Description	Author(s)	Reviewed By
V01	30/09/2021	Draft	Elena Lo Giudice Cappelli, Robyn Jones & Samuel Holmes	Ross Griffin

Updates

Contents

1. Non-Technical Summary

This report presents the findings of a subtidal benthic ecology survey conducted at Iona and Fionnphort for the Marine Access Improvement Project. The key aim was to characterise and map the key benthic habitats present within the subtidal areas within the proposed development areas to inform the drafting of an Environmental Impact Assessment (EIA).

The survey took place at Iona and Fionnphort between the 20th and 23rd of August 2021 and involved the completion of 21 Drop-Down Camera (DDC) stations, 28 DDC transects and collection of 20 grab samples. DDC sampling resulted in the collection of 1,033 still images. Grab sampling stations were micro-sited to avoid the notable seagrass beds that were identified during the in-field interpretation of the seabed imagery collected across both areas.

Sediments within both the Iona and Fionnphort survey areas were found to be dominated by sand, with the majority of sediment samples classified as Slightly Gravelly Sand ((g)S). Mud content was consistently low across both survey areas.

Diverse macrobenthic communities were identified across the survey areas with a total of 2,270 individuals and 336 taxa recorded. The amphipod *Bathyporeia guilliamsoniana* was present in 80% of all macrobenthic samples, while the bivalve *Goodallia triangularis* was the most abundant species recorded, accounting for 15.24% of all individuals. Four distinct macrobenthic groups were identified among sampled stations, with eight of the 20 sampled stations falling into Group D. This group was characterised by the presence of Nematoda, *B. guilliamsoniana,* Nemerteans and *Nephtys cirrosa*. The presence of *B. guilliamsoniana* and *N. cirrosa* and identification of sand dominated sediments led to the classification of sediments under the EUNIS biotope 'A5.233 *Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand'.

A total of 11 DDC stations and 15 DDC transects contained areas considered to be representative of the Priority Marine Feature (PMF) 'Seagrass beds', across both the Iona and Fionnphort survey areas, with areas of dense seagrass coverage (76-100%) identified at a six DDC stations and 11 DDC transects. Seagrass extent as well as the percentage cover of seagrass in DDC still images was subsequently mapped. The mapping was based on the seabed imagery interpretation and orthomosaic of the shallow subtidal created using the aerial imagery collected across both survey areas during the corresponding intertidal surveys (OEL, 2021).

The PMFs 'Kelp and seaweed communities on sublittoral sediment' and 'Kelp beds' were also observed and mapped throughout both the Iona and Fionnphort survey areas.

2. Introduction

2.1. Project Overview

Argyll and Bute Council appointed RPS to carry out an expert review of all works undertaken to date and draft a detailed Environmental Impact Assessment (EIA) to support marine access improvement works at Iona and Fionnphort, two sites in the Sound of Iona.

Iona is a small island located west of Mull, on the west coast of Scotland. A ferry service connects Iona to Fionnphort located in the southwest of Mull. Current facilities at both ports need upgrading and improving as difficulties have been identified in their use by all parties operating from each port (e.g., inter-island ferry, fishery and leisure boats). Several feasibility studies (Simoes & Salmon, 2020a, 2020b) have been carried out over the years to propose different options for the Iona and Fionnphort marine access improvement works with the selected projects consisting of a new rock armour breakwater, berthing piles and dredging in Iona and of a new rock armour breakwater, overnight berthing facilities and dredging in Fionnphort (ByrneLooby, 2019).

2.2. Project Background

RPS commissioned Ocean Ecology Limited (OEL) to conduct a subtidal benthic ecology survey within the Sound of Iona to inform the drafting of an Environmental Impact Assessment for Iona and Fionnphort marine access improvements. A Drop-Down Camera (DDC) survey was undertaken involving the collection of seabed imagery (video and still images) across two transect grids located at both Iona and Fionnphort survey areas (Figure 1). The seabed imagery underwent detailed analysis to provide an understanding of the key benthic habitats present within the subtidal areas with a particular focus on Priority Marine Features (PMFs). Additionally, subtidal macrobenthic and sediment samples were collected at 20 sampling stations (10 stations at each sampling site) using a grab sampler to help characterise the sediment habitats. The samples underwent macrobenthic and particle size distribution (PSD) analysis allowing for the production of a full coverage habitat/biotope map for the two survey areas when considered alongside the seabed imagery and aerial imagery collected during corresponding intertidal surveys (OEL, 2021).

2.3. Current Understanding

Nature Scot (previously Scottish Natural Heritage) identified a number of benthic habitats and marine species as PMFs (Tyler-Walters et al., 2016). Several of these important and sensitive habitats are known to occur around the West coast of Scotland (Fuller, 1999; NatureScot, 2021) and have the potential to occur within or near the survey area.

Existing habitat mapping obtained from the European Marine Observation and Data Network (EMODnet) and the Scottish National Marine Plan Interactive (NMPi) suggests the habitats present within the survey areas primarily consist of intertidal sandy shores with moderate-high energy intertidal rock with the potential of representing PMFs including biogenic habitats like seagrass beds known to occur north of the survey area in Fionnphort (**Error! Reference source not**

found.). Other PMFs that have been recorded on both Isles (Mull and Iona) include kelp and maerl beds which could potentially occur within the survey area.

The Sound of Iona lies within the boundaries of the Inner Hebrides and the Minches Special Area of Conservation (SAC) designated to protect harbour porpoises (*Phocena phocena*) as per Annex II of the Habitat Directive (The Council Directive 92/43/EEC).

2.3.1. Seagrass Beds

Seagrasses (also known as eelgrass) are marine flowering plants found in shallow coastal areas down to 10 m, often growing in dense beds or meadows. The plants can be annual or perennial and stabilise the sediment, creating productive habitats that provide shelter and food for a wide variety of plants and animals (including other species of conservation importance and commercially valued fish species), as well as being important for carbon sequestration.

Seagrass 'beds' formed by the genus *Zostera* are generally classed as having plant densities that provide at least 5% cover (OSPAR, 2009). Typically, *Zostera* spp. plant densities provide greater than 30% cover and in favourable conditions, extensive beds may form with up to 95% cover (Lancaster et al., 2014). A minimum area of 5 m x 5 m with at least 5% cover of *Zostera* spp. is required to qualify as a seagrass bed.

Zostera spp. beds are usually found in sands and muds from the upper shore down to 10 m, in areas at least moderately sheltered from wave action such as sea lochs, inlets, bays, sounds, channels and lagoons. *Z. marina* is predominantly subtidal, whilst the narrow-leaved variant, *Z. marina var. angustifolia*, can occur in the shallow subtidal and intertidally on the mid to lower shore. Meadows of seagrass formed by either or both species are protected in Scotland through designations as the PMF broad habitat 'Seagrass Beds' (Tyler-Walters et al., 2016), through inclusion on the OSPAR list of threatened and/or declining species and habitats and as a Section 2(4) Habitat of Principal Importance under the Nature Conservation (Scotland) Act 2004.

A consultation relating to the distribution of PMFs across Scotland reported the presence of *Z. marina var. angustifolia* beds to the north of the Fionnphort survey area whilst a single record from Seagrass Spotter[1] reports the presence of a notable *Z. marina* bed in the shallow subtidal with the potential to extend into the intertidal zone (Figure 1).

2.3.2. Maerl Beds

Maerl is a collective term for several species of red seaweed, with hard, chalky skeletons that grow as unattached rounded nodules or short, branched shapes on the seabed. As a result, maerl can form large beds, where layers of dead maerl build up with a thin layer of pink, living maerl on the top. These beds are a priority habitat under Section 2(4) of the Nature Conservation (Scotland) Act 2004 as they form an important habitat for many different types of marine life, which live

[1] https://seagrassspotter.org/sighting/271

amongst or are attached to the surface of maerl, or burrow in the coarse gravel of dead maerl beneath the top living layer. Maerl beds can be of importance to sustainable fisheries, providing nursery grounds for commercial species of fish and shellfish.

Due to the fragility of maerl, the beds are easily damaged and have probably declined substantially in some areas. Pressures on maerl beds include scallop dredging, bottom trawling, aquaculture, and pollution. Maerl beds are very slow to develop and are unlikely to return if removed or lost. As such, they should be treated as a non-renewable resource.

Maerl beds are granted protection under the EC Directive on the Conservation of Natural Habitats and Wild Fauna and Flora (92/43/ECC), through inclusion on the OSPAR list of threatened and/or declining species and habitats and as the PMF broad habitat 'Maerl Beds' (Tyler-Walters et al., 2016). There are no known existing records of maerl within the Sound of Iona.

2.3.3. Kelp Beds

Beds of the kelps such as *Laminaria hyperborea* and *Laminaria digitata* form forests and parks in rocky coastal areas, under a variety of wave and tidal conditions. The kelp provides a canopy under which a wide range of animals and other seaweeds thrive. A rich diversity of red seaweeds grows among the kelp and on the kelp stipes, while depending on conditions, sea mats and sea firs may colonise the fronds. The rocks below the kelp are often encrusted with coralline algae or support cushion forming fauna, such as sea anemones, sponges and sea squirts. Small crustaceans and worms live among the kelp holdfasts, while sea urchins and sea snails graze on the seaweeds, and fish find shelter from predators among the fronds.

Kelp beds occur in shallow waters (to a maximum of 20-30m), on bedrock and boulders in a range of wave exposure regimes and tidal conditions and are protected in Scotland through designation as the PMF broad habitat 'Kelp beds'. There are no existing records of the PMF broad habitat 'Kelp Beds' within the Sound of Iona however this is likely due to the lack of sampling rather than true absence given the rocky subtidal habitats known to occur across the area.

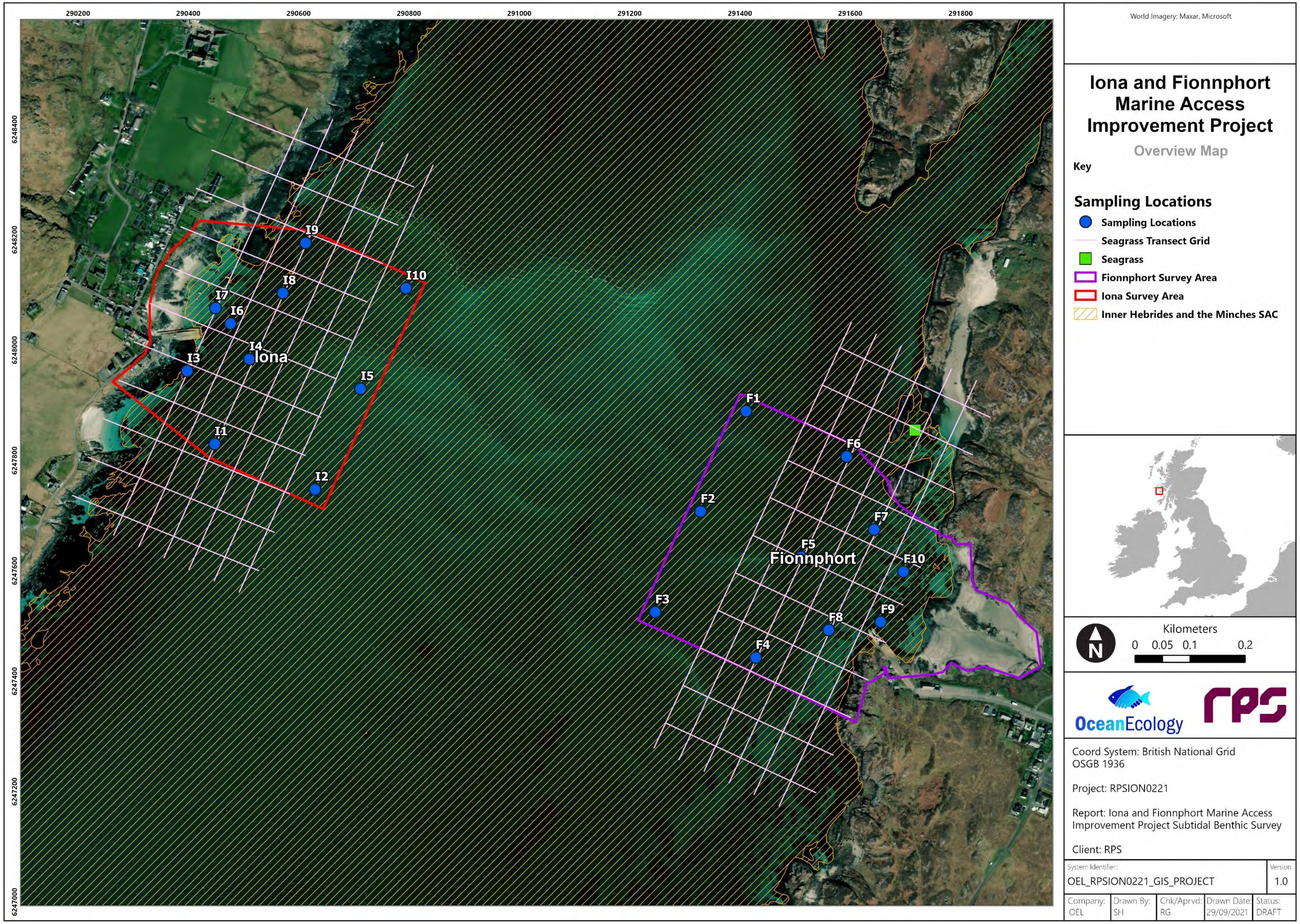

Figure 1 Location of sampling stations and seagrass transect grids within the Fionnphort and Iona survey areas located in the Inner Hebrides and the Minches SAC. Note the existing seagrass bed mapped north of the Fionnphort site.

3. Methods

3.1. Survey Design

Initially, the survey design comprised 20 sampling locations at which seabed imagery was to first be collected following by grab samples. The design was updated following the preliminary in-field review of the seabed imagery collected at these 20 locations. This identified extensive seagrass beds across both sites, requiring greater coverage of each survey area to fully map their extent whilst also allowing for micro-siting of the grab sampling stations as to not damage the seagrass beds. The updated sampling array included two grids of transect across each survey area along which seabed imagery was collected (Figure 1). Ten grab sampling stations were then positioned across each survey area (20 in total) in areas of sediment habitat where seagrass was confirmed to be absent (Figure 1).

3.2. Timings

All seabed imagery was obtained between 20th and 22nd August 2021 followed by the collection of the grab samples on 23rd August 2021 (Figure 1).

3.3. Field Methods

3.3.1. Survey Vessel

All seabed imagery and grab samples were collected aboard OEL's 10.0 m dedicated survey vessel, '*Seren Las*' (**Error! Reference source not found.**). The vessel was equipped with a Hemisphere V104s GPS Compass system that provided an offset position of the DDC and grab sampler when deployed from the stern. This provided a GPS feed to a dedicated survey navigation PC operating TimeZero Navigator v3 marine navigation with routing module and EIVA NaviPac.

Plate 1 Dedicated survey vessel, *Seren Las*, employed for the Iona and Fionnphort subtidal benthic survey.

3.3.2. Seabed Imagery

DDC sampling was undertaken at each target location and along each transect . At each location, video and still imagery was collected throughout the deployment using OEL's height-adjustable freshwater housing camera system providing a variety of options for view, lighting and focal length to maximise data quality with respect to prevailing conditions. Video footage was digitally overlaid with information including project, date, time and dGPS position (as a minimum) and recorded in a digital format to 5 MB or better. A laser scaling array was projected into the field of view to provide a method for determining scale.

Seabed imagery (simultaneous video and stills) was acquired along each DDC transect and at each DDC location using OEL's Rayfin PLE Camera System to collect High Definition (HD) video and high-resolution (up to 21 megapixels (MP)) still images. The camera system (**Error! Reference source not found.**) consisted of a SubC Imaging Rayfin PLE camera, seabed frame equipped with freshwater housing (Jones et al., 2021), two LED strip lights, a 300m umbilical and topside computer. The camera was powered with the use of an Uninterruptable Power Supply (UPS) to ensure no damage was caused should the vessel lose power or cause a power surge. The freshwater housing was height and angle adjustable providing a variety of options for view, lighting, and focal length to maximise data quality with respect to prevailing conditions (e.g., high turbidity).

Plate 2 OEL's drop-down camera and deployment frame.

All DDC transects were sampled in line consideration of the JNCC epibiota remote monitoring operational guidelines (Hitchin et al., 2015). Along each DDC transect, a 'bed-hopping' approach was employed to ensure representative imagery is collected along the full transect with still images taken every 5-10m along with continuous video recording. All footage underwent a preliminary review *in situ* by the OEL's marine ecologists.

3.3.3. Grab Sampling

Grab sampling was only conducted once suitable seabed videos and stills of the seabed were collected and no obstructions and/or features of interest (e.g. seagrass beds) were identified. Sampling was conducted using OEL's 0.1m^2 Day grab and sediment samples were collected within 20m of the target sampling location. Single grab samples were collected at each station to obtain approximately 10L of sediment from which a sub-sample of a minimum volume of 500ml was removed for characterisation of the physical nature of the substrate (particle size distribution (PSD) analysis) and frozen on board. The reminder of the sediment sample was sieved onboard over a 1.0mm sieve net, backwashed into a suitable plastic container and preserved in a 10% formalin seawater solution for subsequent macrobenthic analysis in the laboratory.

Pooling of samples was not undertaken. At stations where the initial samples did not achieve the required volume of at least 5L, repeat sampling was carried out until a valid sample was acquired.

3.4. Laboratory & Analytical Methods

On arrival to the laboratory, all samples were logged in and entered into the project database created in OEL's web-based data management application ABACUS in line with in-house Standard Operating Procedures (SOPs) and OEL's Quality Management System (QMS).

3.4.1. Seabed Imagery Analysis

Following the methods described in Section **Error! Reference source not found.**, digital photographic stills and video footage were successfully obtained along all transects and DDC stations and subsequently analysed to aid in the identification and delineation of Broad Scale Habitats (BSH), EUNIS habitats, PMFs and other possible features of interest across the survey areas. Prior to analysis, seabed images were enhanced using the open-source image editing software GNU Image Manipulation Program. All seabed imagery analysis was undertaken using the Bio-Image Indexing and Graphical Labelling Environment (BIIGLE) annotation platform (Langenkämper et al., 2017) and in consideration of the JNCC epibiota remote monitoring interpretation guidelines (Turner et al., 2016) latest NMBAQC/JNCC Epibiota Quality Assurance Framework (QAF) guidance and identification protocols.

Analysis of still images was undertaken in two stages. The first stage, "Tier 1", consisted of labels that referred to the whole image being assigned, providing appropriate metadata for the image. The second stage, "Tier 2", was used to assign percentage cover of reef types by drawing polygons. A full seagrass assessment was carried out on all images during the "Tier 1" stage whereby the percentage cover of seagrass in images was estimated based on the following percentage cover categories: 0, <5, 5-25, 26-50, 51-75 and 76-100% cover. To qualify as the PMF seagrass bed, the area covered by seagrass must have at least 5% coverage (Tyler-Walters et al., 2016). The "Tier 1" analysis also included a full reef habitat assessment on all images to determine whether habitats met the definitions of Annex I reef habitats as detailed in Table 1 and Table 2. The annotation label tree used during analysis had major headings for each of reef type. Under each reef type, labels were assigned for each of the categories required to determine whether reef habitat was present.

Table 1 Characteristics of stony reef (Irving, 2009).

Characteristic	'Reefiness'			
	Not a Reef	Low	Medium	High
Composition (proportion of boulders/cobbles (>64 mm))	<10 %	10-40 % matrix supported	40-95 %	>95 % clast-supported
Elevation	Flat seabed	<64 mm	64 mm - 5 m	>5 m
Extent	<25 m^2	>25 m^2		
Biota	Dominated by infaunal species	>80 % of species present composed of epibiotal species		

Table 2 Characteristics of *Sabellaria* spinulosa reef (Gubbay, 2007).

Characteristic	'Reefiness'			
	Not a Reef	Low	Medium	High
Elevation (cm)	< 2	2 - 5	5 – 10	> 10
Extent (m^2)	< 25	25 – 10,000	10,000 – 1,000,000	> 1,000,000
Patchiness (% Cover)	< 10	10 - 20	20 – 30	> 30

3.4.2. Particle Size Distribution (PSD) Analysis

Particle Size Distribution (PSD) analysis of sediment samples was undertaken by in-house laboratory technicians at OEL's NMBAQC (NE Marine Biological Analytical Quality Control Scheme) participating laboratory, in line with NMBAQC best practice guidance (*NMBAQC's Best Practice Guidance - Particle Size Analysis (PSA) for Supporting Biological Analysis*, 2016).

3.4.2.1. Sample Preparation

Frozen sediment samples were first transferred to a drying oven and thawed at 80°C for at least six hours prior to visual assessment of sediment type. Before any further processing (e.g., sieving or sub-sample removal), samples were mixed thoroughly with a spatula and all conspicuous fauna (>1 mm) which appeared to have been alive at the time of sampling removed from the sample. A representative sub-sample of the whole sample was then removed for laser diffraction analysis before the remaining sample screened over a 1mm sieve to sort coarse and fine fractions.

3.4.2.2. Dry Sieving

The >1mm fraction was then returned to a drying oven and dried at 80°C for at least 24 hours prior to dry sieving. Once dry, the sediment sample was run through a series of Endecott BS 410 test sieves (nested at 0.5 φ intervals) using a Retsch AS200 sieve shaker to fractionate the samples into particle size classes. The dry sieve mesh apertures used are given in Table 3.

Table 3. Sieve series employed for Particle Size Distribution (PSD) analysis by dry sieving (mesh size in mm).

Sieve aperture (mm)												
63	45	32	22.5	16	11.2	8	5.6	4	2.8	2	1.4	1

The sample was then transferred onto the coarsest sieve (63 mm) at the top of the sieve stack and shaken for a standardised period of 20 minutes. The sieve stack was checked to ensure the components of the sample had been fractioned as far down the sieve stack as their diameter would allow. A further 10 minutes of shaking was undertaken if there was evidence that particles had not been properly sorted.

3.4.2.3. Laser Diffraction

The fine fraction residue (<1mm sediments) was transferred to a suitable container and allowed to settle for 24 hours before excess water syphoned from above the sediment surface until a paste texture was achieved. The fine fraction was then analysed by laser diffraction using a Beckman Coulter LS13 320. For silty sediments, ultrasound was used to agitate particles and prevent aggregation of fines.

3.4.2.4. Data Merging

The dry sieve and laser data were then merged for each sample with the results expressed as a percentage of the whole sample. Once data was merged, PSD statistics and sediment classifications were generated from the percentages of the sediment determined for each sediment fraction using Gradistat v8 software.

Sediment were described by their size class based on the Wentworth classification system (Wentworth, 1922) (Table 4). Statistics such as mean and median grain size, sorting coefficient, skewness and bulk sediment classes (percentage silt, sand and gravel) were also derived in accordance with the Folk classification (Folk, 1954).

3.4.2.5. Sediment Classification

Sediment PSD statistics for each sample were calculated from the raw data using Gradistat V8.0 (Blott, 2010) and converted into Broad Scale Habitats (BSH) (EUNIS Level 3) using the adapted Folk trigon (Long, 2006).

Table 4. Classification used for defining sediment type based on the Wentworth Classification System (Wentworth, 1922).

Wentworth Scale	Phi Units (φ)	Sediment Types
>64000 µm	<-6	Cobble and boulders
32000 – 64000 µm	-5 to -6	Pebble
16000 – 32000 µm	-4 to -5	Pebble
8000 – 16000 µm	-3 to -4	Pebble
4000 - 8000 µm	-3 to -2	Pebble

Wentworth Scale	Phi Units (φ)	Sediment Types
2000 - 4000 µm	-2 to -1	Granule
1000 - 2000 µm	-1 to 0	Very coarse sand
500 - 1000 µm	0-1	Coarse sand
250 - 500 µm	1-2	Medium sand
125 - 250 µm	2-3	Fine sand
63 - 125 µm	3-4	Very fine sand
31.25 – 63 µm	4-5	Very coarse silt
15.63 – 31.25 µm	5-6	Coarse silt
7.813 – 15.63 µm	6-7	Medium silt
3.91 – 7.81 µm	7–8	Fine silt
1.95 – 3.91 µm	8-9	Very fine silt
<1.95 µm	<9	Clay

3.4.3. Macrobenthic Analysis

All elutriation, extraction, identification and enumeration of the grab samples was undertaken at OEL's NMBAQC scheme participating laboratory in line with the NMBAQC Processing Requirement Protocol (PRP) (Worsfold & Hall, 2010). All processing information and macrobenthic records were recorded using OEL's cloud-based data management application 'ABACUS' that employs MEDIN validated controlled vocabularies ensuring all sample information, nomenclature, qualifiers and metadata are recorded in line with international data standards.

For each macrobenthic sample, the excess formalin was drained off into a labelled container over a 1 mm mesh sieve in a well-ventilated area. The samples were then re-sieved over a 1 mm mesh sieve to remove all remaining fine sediment and fixative. The low-density fauna was then separated by elutriation with fresh water, poured over a 1 mm mesh sieve, transferred into a Nalgene and preserved in 70 % Industrial Denatured Alcohol (IDA). The remaining sediment from each sample was subsequently separated into 1 mm, 2 mm and 4 mm fractions and sorted under a stereomicroscope to extract any remaining fauna (e.g. high-density bivalves not 'floated' off during elutriation). All macrobenthos present was identified to species level, where possible, and enumerated by trained benthic taxonomists using the most up to date taxonomic literature and checks against existing reference collections. Nomenclature utilised the live link within ABACUS to the WoRMS REST webservice (World Register of Marine Species), to ensure the most up to date taxonomic classifications were recorded. Colonial fauna (e.g. hydroids and bryozoans) were recorded as present (P). For the purposes of subsequent data analysis, taxa recorded as P were given the numerical value of 1.

Following identification, all specimens from each sample were pooled into five major groups (Annelida, Crustacea, Mollusca, Echinodermata and Miscellaneous taxa) in order to measure blotted wet weight major group biomass to 0.0001g. As a standard, the conventional conversion factors as defined by Eleftheriou & Basford (1989) were applied to biomass data to provide equivalent dry weight biomass (Ash Free Dry Weight, AFDW). The conversion factors applied are as follows:

- Annelida = 15.5 %
- Crustacea = 22.5 %
- Mollusca = 8.5 %
- Echinodermata = 8.0 %
- Miscellaneous = 15.5 %

3.4.3.1. Data Truncation and Standardisation

The macrobenthic species list was checked using the R package '*worms*' (Holstein, 2018) to check against WoRMS taxon lists and standardise species nomenclature. Once the species nomenclature was standardised in accordance with WoRMS accepted species names, the species list was examined carefully by a senior taxonomist to truncate the data, combining species records where differences in taxonomic resolution were identified.

3.4.3.2. Pre-Analysis Data Treatment

All data were collated in excel spreadsheets and made suitable for statistical analysis. All data processing and statistical analysis was undertaken using R v 1.2 1335 (Team & R Core Team, 2020) and PRIMER v7 (Clarke & Gorley, 2015) software packages. To note that no replicate samples were available for macrobenthic analysis thus no mean values could be calculated per sampling station.

3.4.3.3. Multivariate Statistics

Prior to multivariate analyses, data were displayed as a shade plot with linear grey-scale intensity proportional to macrobenthic abundance (Clarke et al., 2014) to determine the most efficient pre-treatment (transformation) method. Macrobenthic abundance data from grab samples was square root transformed to prevent taxa with intermediate abundances from being discounted from the analysis, whilst allowing the underlying community structure to be assessed.

The PRIMER v7 software package (Clarke & Gorley, 2015) was utilised to undertake the multivariate statistical analysis on the biotic macrobenthic dataset. To fully investigate the multivariate patterns in the biotic data, macrobenthic assemblages were characterised based on their community composition, with hierarchical clustering and non-metric multidimensional scaling (nMDS) used to identify groupings of sampling stations that could be grouped together as a habitat type or community. SIMPER (similarities-percentage) analysis was then applied to identify which taxa contributed most to the similarity within that habitat type or community. A detailed description of analytical routines is provided in Appendix IV.

3.4.3.4. Determining EUNIS Classifications

Macrobenthic assemblages were characterised based on their community composition, with hierarchical clustering used to identify groupings of sampling stations that could be grouped together as a habitat type or community. Setting these groupings as factors within PRIMER, SIMPER analysis was then applied to identify which taxa contributed the most to the similarity within that community. EUNIS classifications were then assigned based on the latest JNCC guidance (Parry, 2019).

3.4.4. Habitat / Biotope mapping

Habitats and / or biotopes were identified and classified in accordance with the EUNIS habitat classification system, in consideration of JNCC guidance on assigning benthic biotopes (Parry 2019). Classifications were assigned based on the combined analysis of seabed imagery and broad scale habitat (BSH) data derived from both PSD and macrobenthic analyses, alongside existing habitat maps (EMODnet and NMPI). Seabed features were assigned as high-level classification as possible. All habitat / biotope determination was undertaken through consideration of the following:

- Existing habitat mapping (derived from EMODnet and Scotland's NMPI)
- Review and interpretation of seabed imagery
- PSD analysis results for determination of BSH (textual groups, sediment % contribution and mean grain size)
- Macrobenthic analysis results for the assignment of biotope where key and characterising taxa were identified
- Orthomosaic created using the aerial imagery collected across both survey areas during the corresponding intertidal benthic surveys (OEL, 2021).

All the above data sources were then used to manually delineate the boundaries (polygons) of the various habitats and biotopes encountered across the two survey areas. Confidence scores were assigned to all polygons to give an indication of their accuracy. Values ranged from 1 (one data source) to 3 (all data sources) depending on the following:

- Whether ground-truth data (seabed imagery, PSD and/or macrobenthic) was available within the polygon
- Whether multiple data sources confirmed/suggested the presence of the same habitat/biotope within a polygon
- Whether the boundaries of the habitat/biotope were clearly defined either by seabed imagery or thee aerial imagery orthomosaic

The highest scores were given to polygons where all data sources identified the same habitat/biotope, with distinct boundaries. Lower scores were assigned to polygons where the boundaries were not obvious. In these cases, polygons were drawn based upon expert judgement, given the information available.

4. Results

4.1. Sediment Type

All 20 grab samples (10 at each site) were analysed for full particle size classification. Full PSD and summary statistics are provided in Appendices V and VI.

4.1.1. Fionnphort

Sediment types at each of the 10 grab sampling stations as classified by the Folk (1954) classification are illustrated in Figure 2. Each Folk classification was converted to BSH type (EUNIS Level 3) using the adapted Folk triangle (Long, 2006). Despite some variation in sediment types between stations, most stations were dominated by sand. Mud content was overall low, with only 3 stations having mud content between 1% and 3%. Gravel content was variable with station F9 being made up of over 40% of gravel. Six out of 10 stations were dominated by sand and classified as Slightly Gravelly Sand ((g)S) representing EUNIS BSH A5.2 (Sand and Muddy Sand), while three stations were classified as Gravelly Sand (gS) and one as Sandy Gravel (sG, Station F9) representing EUNIS BSH A5.1 (coarse sediment) (Figure 3).

Most stations were classified as moderately to moderately well sorted as they mostly comprised medium to coarse sand while two stations classified as poorly sorted due to the mixed composition of all three principal sediment types (gravel, sand and mud).

4.1.2. Iona

Sediment types at each of the 10 grab sampling station as classified by the Folk (1954) classification are illustrated in Figure 2. Sediments were less variable than at Fionnphort with all stations dominated by sand. Mud content was low, with a maximum of 1.6% at stations I3 and I8. Gravel content was variable with station I9 being made up of over 20% of gravel. Eight out of 10 stations represented EUNIS BSH A5.2 (Sand and Muddy Sand) with two stations being classified as Sand (S) and 8 stations as Slightly Gravelly Sand ((g)S); conversely 2 stations were classified as Gravelly Sand (gS) and represented EUNIS BSH A5.1 (coarse sediment) (Figure 3).

All stations but one classified as moderately to moderately well sorted as they comprised sand with station I9 being classified as poorly sorted due to its relatively high gravel content.

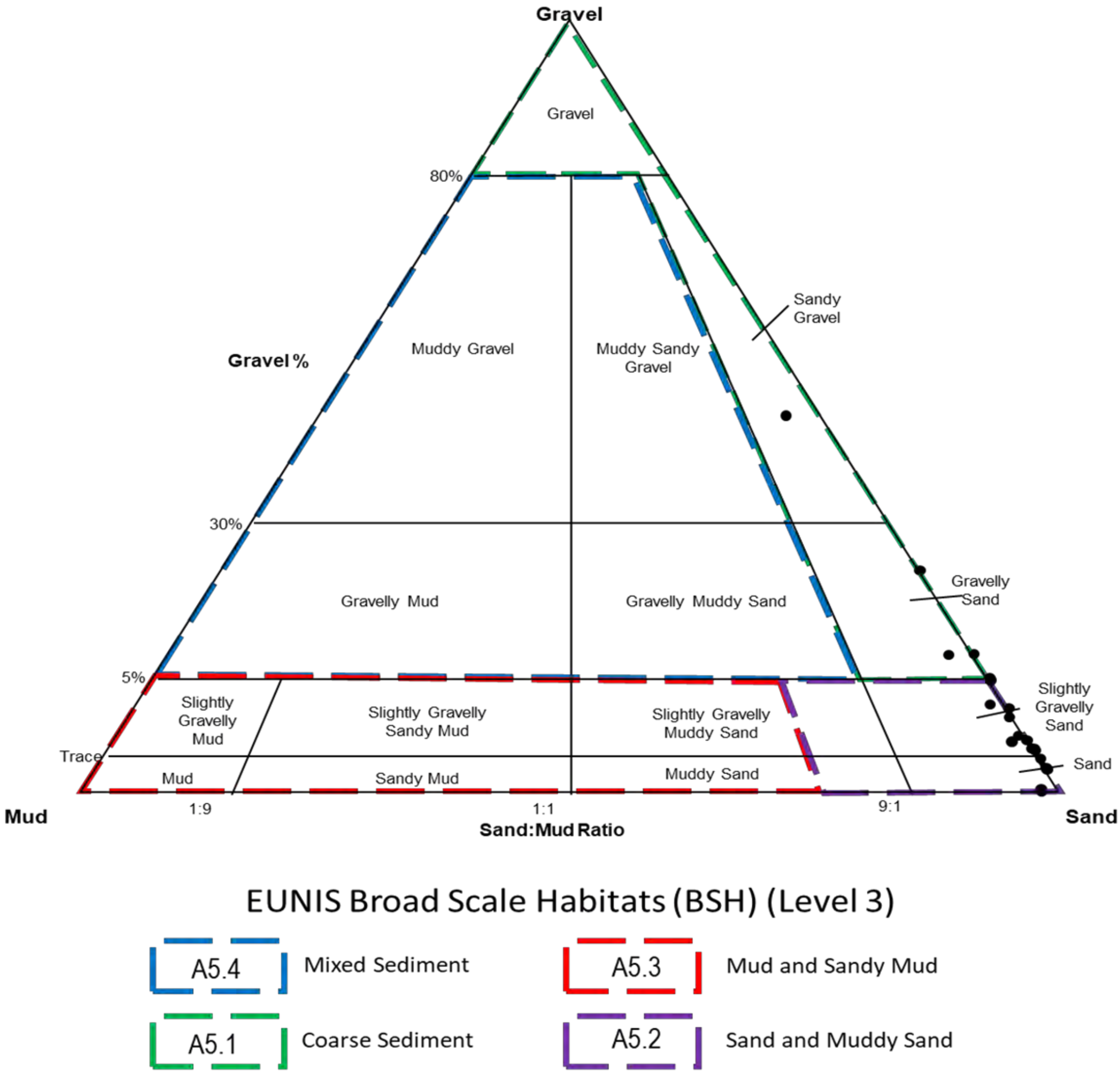

Figure 2 Folk (1954) triangle classifications of sediment gravel percentage and sand to mud ratio of samples collected across the Project Erebus Offshore Floating Wind Farm survey area, overlain by the modified Folk triangle for determination of mobile sediment BSHs under the EUNIS habitat classification system (adapted from (Long, 2006)).

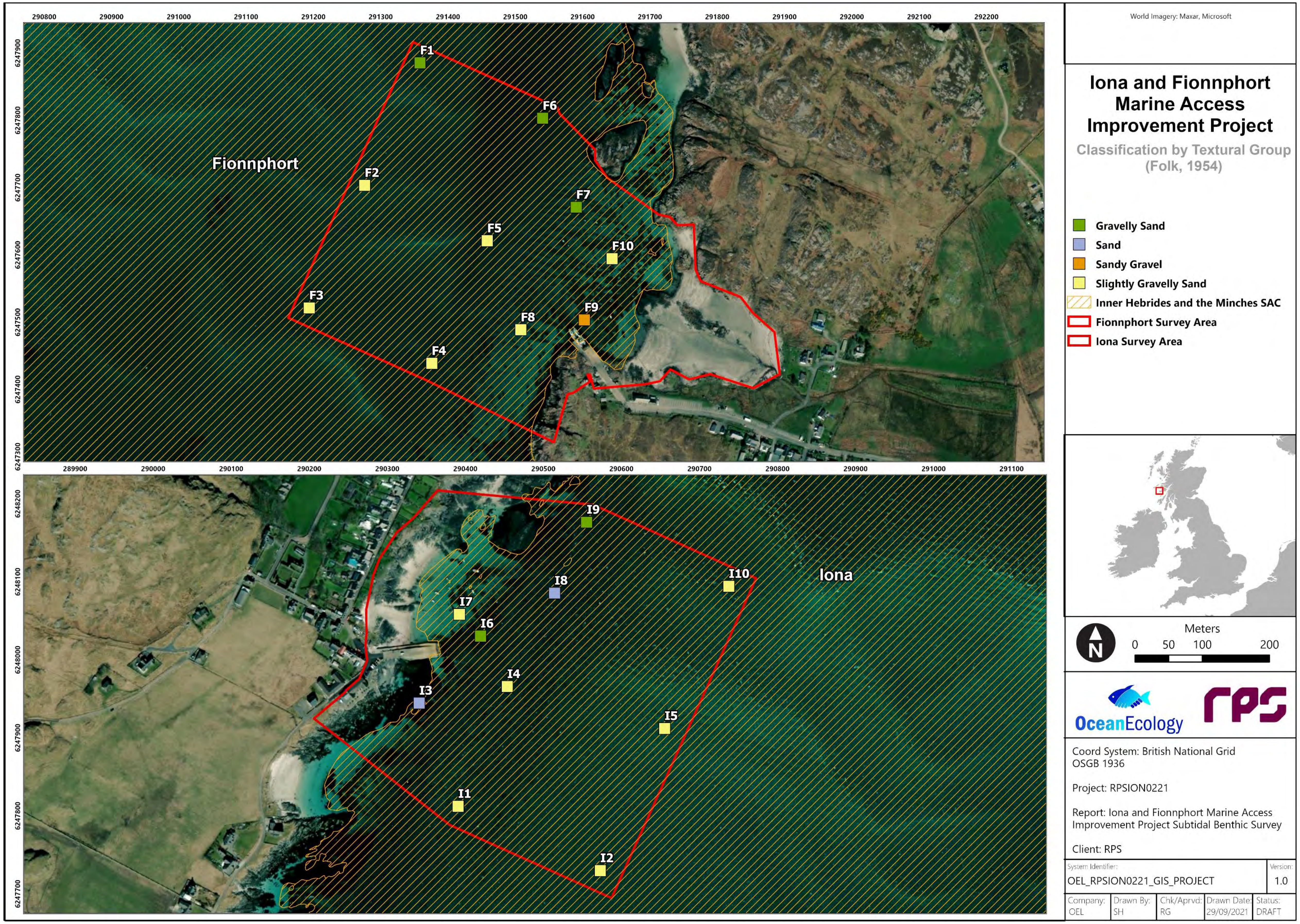

Figure 3 Folk (1954) sediment types as determined from PSD analysis of samples acquired during the survey.

4.2. Sediment Composition

The percentage contribution of gravels (> 2 mm), sands (0.63 mm to 2 mm) and fines (< 63 µm) at each station are presented in Table 5 and Figure 5. Sand was the main sediment fraction present at all stations, comprising the largest percentage contribution across the survey area as a whole. The mean proportion (± Standard Error, SE) of sand across all stations was 93.2 % (± 2.6), while the mean (±SE) mud and gravel content across the survey area was 0.6 % (± 0.2) and 6.2 (± 2.5) respectively. Sand content was greatest at station I5 and the lowest at station F9. The mean grain size at sampling stations ranged from 214.1 µm at station I3 to 1,535.0 µm at station F9 (Figure 4).

Table 5 PSD data of samples collected across the survey area.

Survey Area	Station	Textural Group Classification	Mean µm	Major Sediment Fractions		
				% Gravel	% Sand	% Mud
Fionnphort	F1	Gravelly Sand	572.1	10.4%	89.6%	0.0%
	F2	Slightly Gravelly Sand	509.7	0.4%	99.6%	0.0%
	F3	Slightly Gravelly Sand	487.5	1.4%	98.6%	0.0%
	F4	Slightly Gravelly Sand	565.0	1.9%	98.0%	0.1%
	F5	Slightly Gravelly Sand	626.2	1.3%	98.7%	0.0%
	F6	Gravelly Sand	710.1	6.5%	93.5%	0.0%
	F7	Gravelly Sand	330.4	10.3%	87.7%	2.0%
	F8	Slightly Gravelly Sand	453.6	2.1%	97.3%	0.6%
	F9	Sandy Gravel	1535.0	47.3%	50.0%	2.7%
	F10	Slightly Gravelly Sand	347.2	1.8%	96.9%	1.3%
Iona	I1	Slightly Gravelly Sand	596.3	3.2%	96.4%	0.4%
	I2	Slightly Gravelly Sand	492.1	1.4%	98.5%	0.2%
	I3	Sand	214.1	0.0%	98.4%	1.6%
	I4	Slightly Gravelly Sand	542.9	0.8%	99.2%	0.0%
	I5	Slightly Gravelly Sand	536.0	0.4%	99.6%	0.0%
	I6	Gravelly Sand	550.6	6.1%	93.9%	0.0%
	I7	Slightly Gravelly Sand	243.6	4.0%	94.8%	1.2%
	I8	Sand	235.4	0.0%	98.4%	1.6%
	I9	Gravelly Sand	951.9	24.1%	75.8%	0.1%
	I10	Slightly Gravelly Sand	543.4	3.7%	96.3%	0.0%

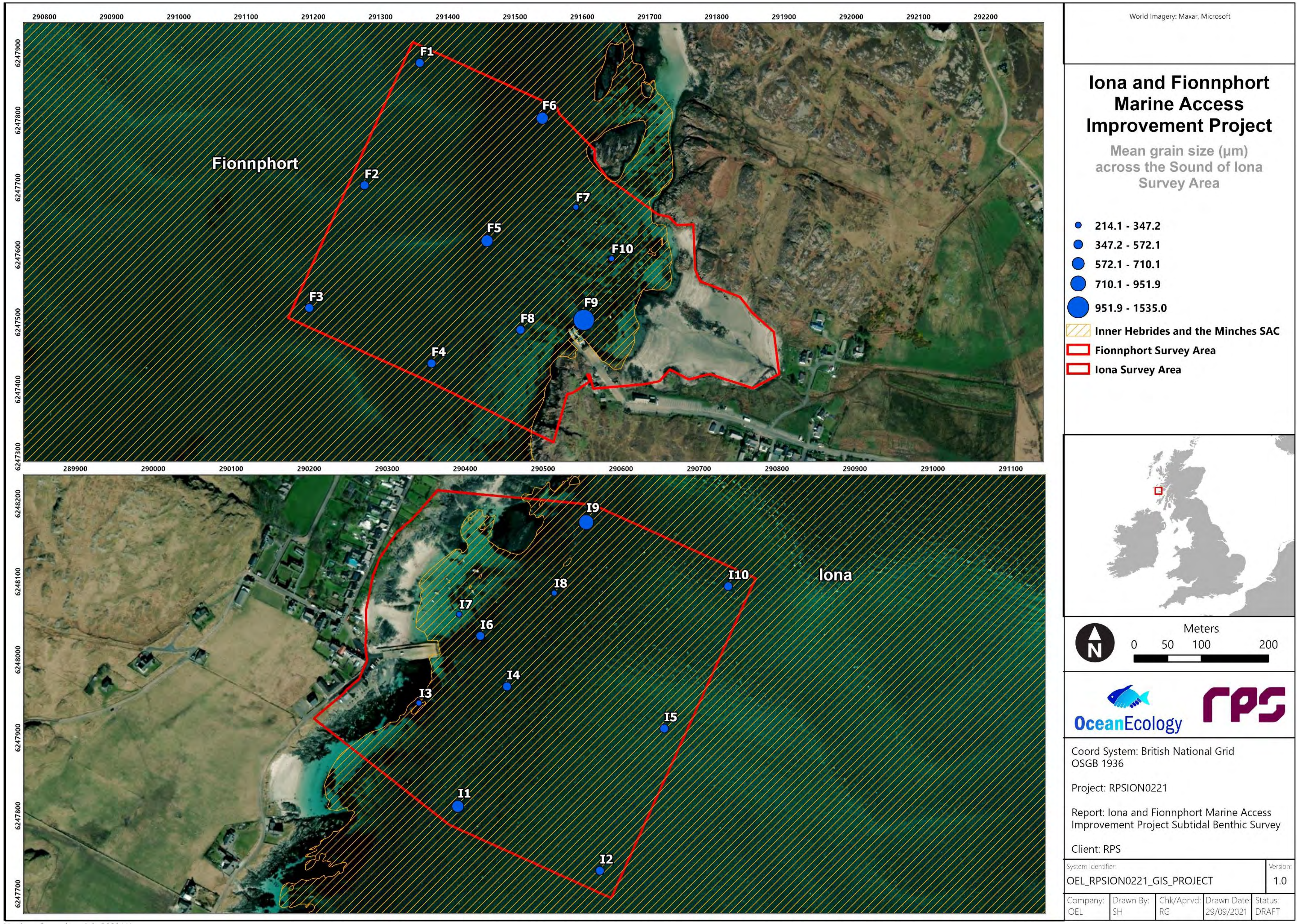

Figure 4 Comparison of mean sediment grain size (µm) of sediment samples collected across the survey area.

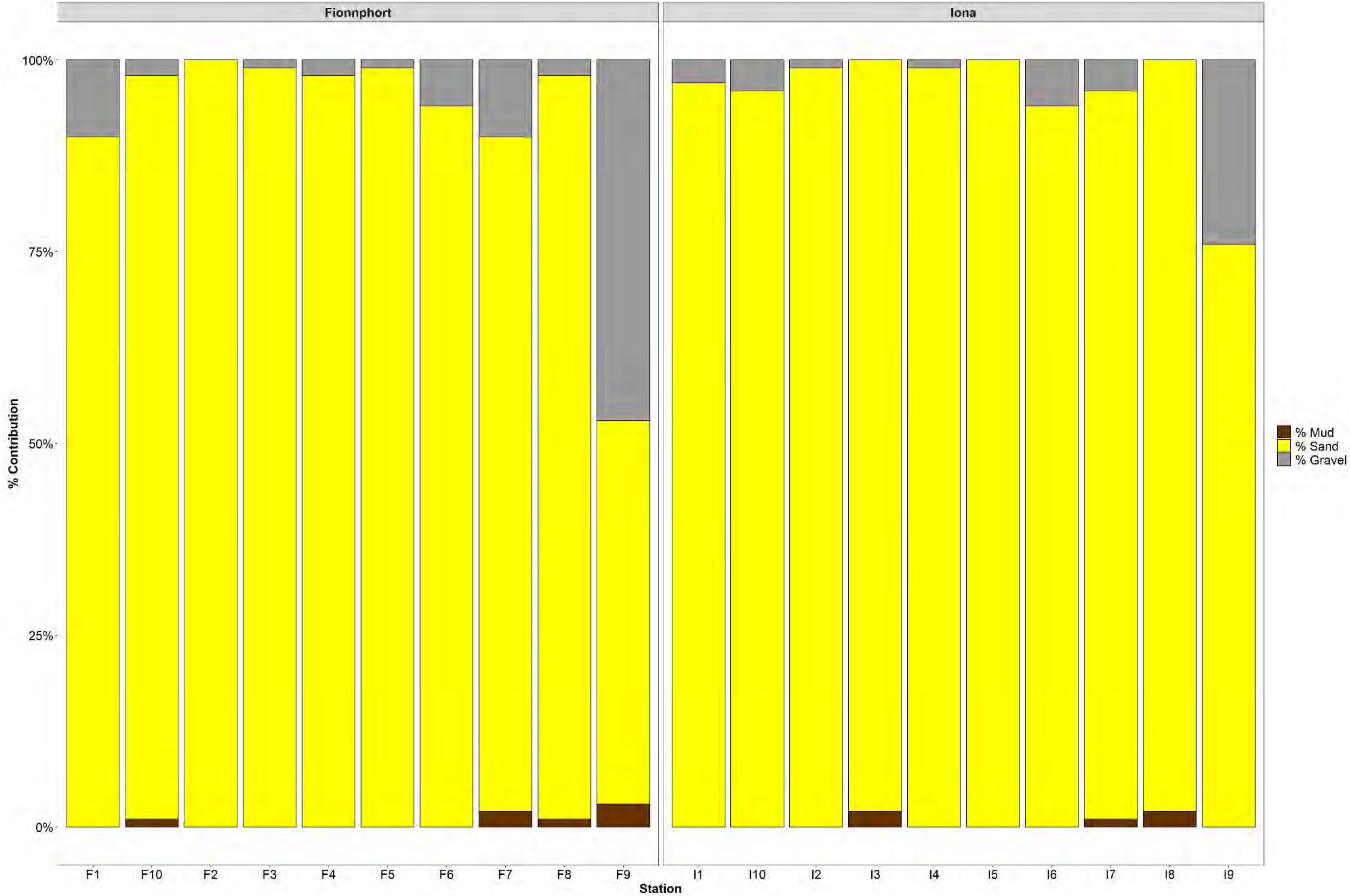

Figure 5 Percentage contribution of gravel, sand and mud at each sampling station across the two survey areas.

4.3. Seabed Imagery Analysis

Seabed imagery was collected at a total of 21 DDC stations and along 28 DDC transects across the two survey areas resulting in the collection of 1,033 still images. Full sample logs are presented in Appendix I and II.

The dominant BSH habitats across both survey sites identified through the analysis of the seabed imagery were A3.1 – High Energy Infralittoral Rock, A5.1 – Subtidal Coarse Sediment, A5.2 – Subtidal Sand and A5.5 - Subtidal Macrophyte Dominated Sediment.

4.3.1. Fionnphort

The DDC stations (F1 to F10) and DDC transects (T_001 to T_004, and T010 to T_016) sampled across the Fionnphort survey area were characterised by the following EUNIS habitats: A3.125 - Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock (3 image stills), A5.13 - Infralittoral coarse sediment (4 image stills), A5.23 - Infralittoral fine sand (119 image stills), A5.52 - Kelp and seaweed communities on sublittoral sediment (228 image stills), and A5.5331 - *Zostera marina/angustifolia* beds on lower shore or infralittoral clean or muddy sand (238 image stills) (Figure 6). Example images of these EUNIS habitats identified are presented in **Error! Reference source not found.**.

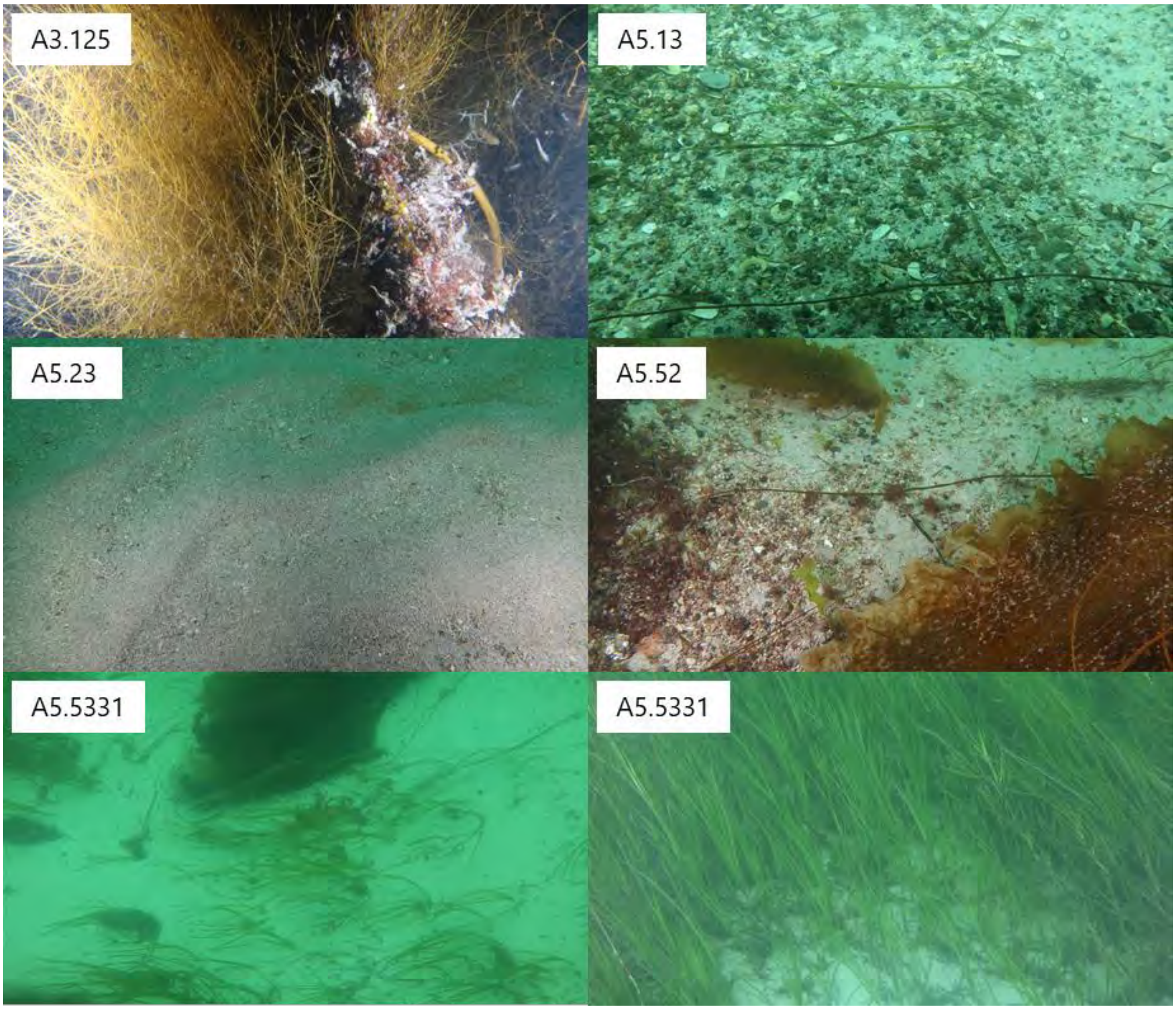

Plate 3 Example imagery of EUNIS classifications identified across the Fionnphort survey area. Bottom images represent PMF seagrass bed: left image 5-25 % seagrass coverage; right image 76-100 % seagrass coverage.

4.3.1.1. Seagrass Assessment

A full seagrass assessment was conducted on all images to determine coverage and whether habitats met the criteria of the PMF 'Seagrass beds' (> 5 % seagrass coverage), the results of which are presented in Table 6.

Table 6 Summary of seagrass assessment for each station and transect across Fionnphort. Numbers indicate number of pictures at each station/transect displaying seagrass.

Station / Transect	Seagrass Beds	Seagrass Cover (%)					
		0	<5	5-25	26-50	51-75	76-100
F1	0	6	0	0	0	0	0
F2	0	5	0	0	0	0	0
F3	0	6	0	0	0	0	0
F4	9	3	2	7	2	0	0
F5	4	5	3	1	1	2	0
F6	0	7	0	0	0	0	0
F7	13	6	1	6	2	2	3
F8	17	7	2	6	5	1	5
F9	15	4	4	3	0	4	8
F10	27	3	0	4	4	9	10
T_001	36	39	5	12	9	6	9
T_002	41	22	9	11	9	10	11
T_003	1	69	0	0	1	0	0
T_004	30	37	1	6	5	7	12
T_010	8	14	0	1	3	3	1
T_011	6	13	6	2	1	1	2
T_012	12	15	0	2	1	1	8
T_013	0	18	0	0	0	0	0
T_014	8	12	0	3	3	0	2
T_015	0	13	0	0	0	0	0
T_016	11	17	0	4	3	0	4
Seagrass	0	11	0	0	0	0	0

Areas considered to be representative of the PMF 'Seagrass beds' were identified across 6 stations and 8 transects within the Fionnphort survey area. Areas of 76-100% seagrass coverage were identified across 4 stations and 7 transects, most extensively at T_002 and T_004 with T_002 recording the highest number of images with seagrass beds present (41) (Figure 7).

4.3.1.2. Annex I Reef Assessment

A full reef habitat assessment was conducted on all images to determine whether habitats met the definitions of Annex I reef habitats as detailed in Table 1. Evidence of bedrock reef was identified in three images across T_004. No evidence of stony or biogenic reef which would qualify as Annex I reef were observed.

4.3.1.3. Other Priority Marine Features

In addition to seagrass beds, the PMFs 'Kelp and seaweed communities on sublittoral sediment' and 'Kelp beds' were also observed in 239 and 2 images respectively across the Fionnphort survey area. Dead maerl was observed across stations F1, F2 and F3, and transects T_003, T_010, T_011, T_012 and T_014.

4.3.2. Iona

The DDC stations (I1 to I10) and DDC transects (T018,T_020, T_024 toT_025 and T_027 to T_032) sampled at the Iona were characterised by the following EUNIS habitats: A3.125 - Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock (12 image stills), A5.13 - Infralittoral coarse sediment (15 image stills), A5.23 - Infralittoral fine sand (37 image stills), A5.52 - Kelp and seaweed communities on sublittoral sediment (263 image stills) and A5.5331 - *Zostera marina/angustifolia* beds on lower shore or infralittoral clean or muddy sand (95 image stills) (Figure 6). Example images of these EUNIS habitats identified are presented in Plate 4.

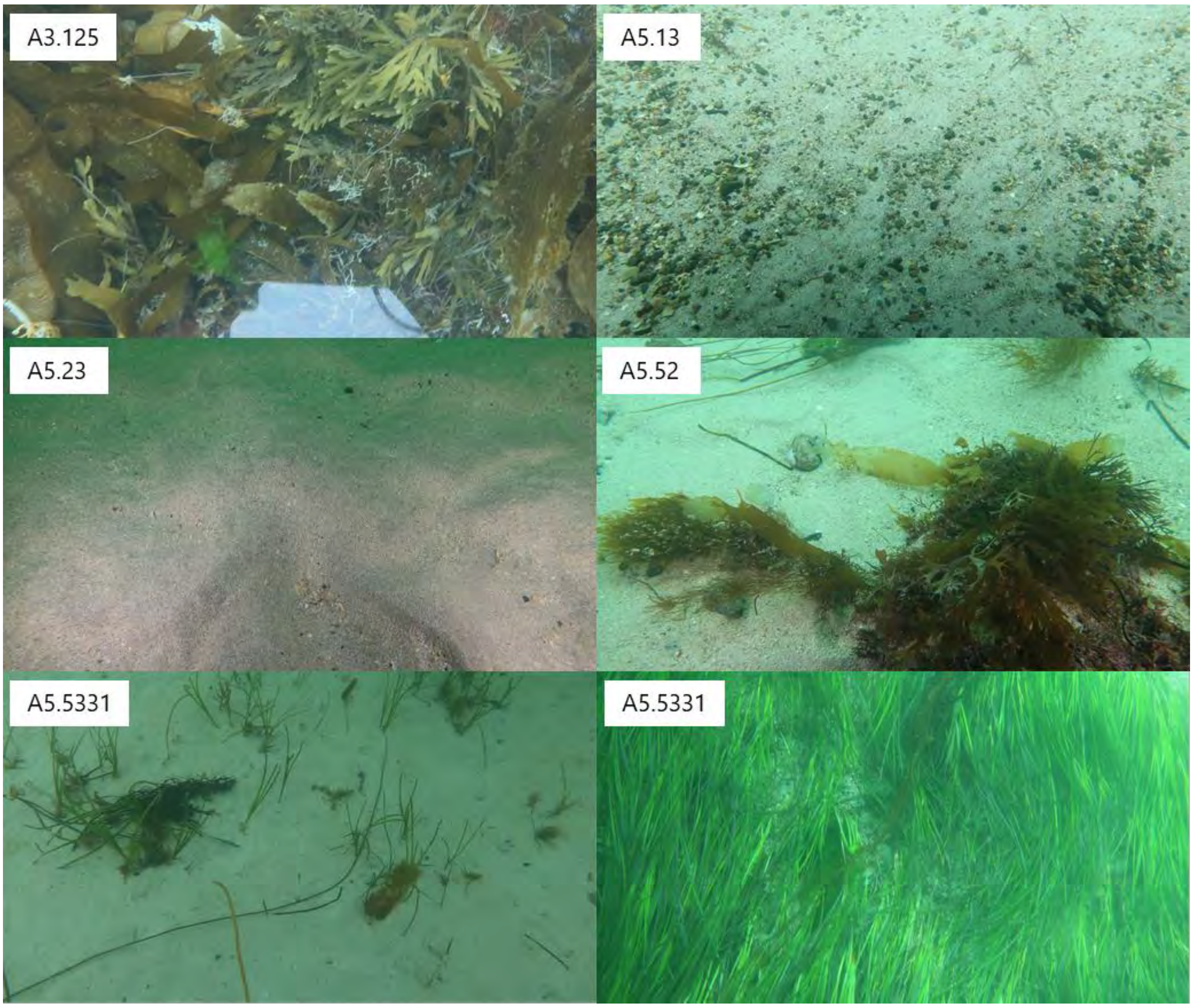

Plate 4 Example imagery of EUNIS classifications identified across the Iona survey area. Bottom images represent the PMF 'seagrass bed': left image 5-25 % seagrass coverage; right image 76-100 % seagrass coverage.

4.3.2.1. Seagrass Assessment

A full seagrass assessment was conducted on all images to determine coverage and whether habitats met the criteria of the PMF 'Seagrass beds' (> 5 % seagrass coverage), the results of which are presented in Table 7.

Table 7 Summary of seagrass assessment for each station and transect across Iona.

Station / Transect	Seagrass Beds	Seagrass Cover (%)					
		0	<5	5-25	26-50	51-75	76-100
I1	0	6	0	0	0	0	0
I2	0	7	0	0	0	0	0
I3	3	17	5	0	1	0	2
I4	5	4	1	0	4	1	0
I5	0	6	0	0	0	0	0
I6	1	5	1	1	0	0	0
I7	6	5	0	4	0	1	1
I8	1	7	1	1	0	0	0
I9	0	6	1	0	0	0	0
I10	0	6	0	0	0	0	0
T_018	13	37	19	3	6	2	2
T_020	32	58	7	11	12	3	6
T_024	7	11	3	2	2	0	3
T_025	4	13	5	4	0	0	0
T_027	0	15	1	0	0	0	0
T_028	13	9	11	3	4	5	1
T_029	0	10	7	0	0	0	0
T_030	5	4	15	2	3	0	0
T_031	0	6	4	0	0	0	0
T_032	5	7	7	2	0	1	2

Areas considered to be representative of the PMF 'Seagrass beds' were identified across 5 stations and 7 transects within the Iona survey area. Areas of 76-100% seagrass coverage were identified across 2 stations and 5 transects, most extensively at T_020 with this transect also recording the highest number of images with seagrass beds present (32) (Figure 7).

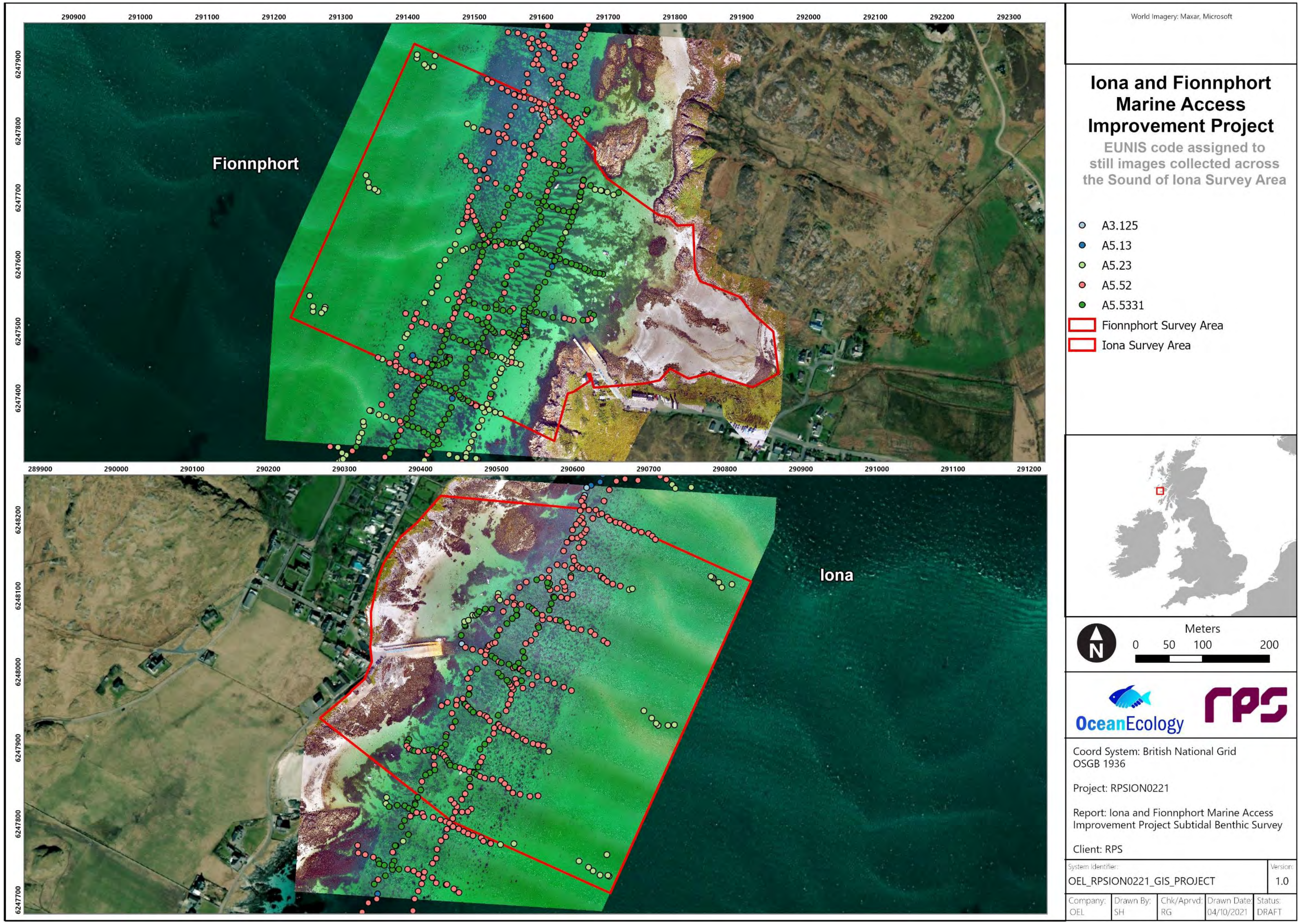

Figure 6 EUNIS Classifications of images collected across the survey area.

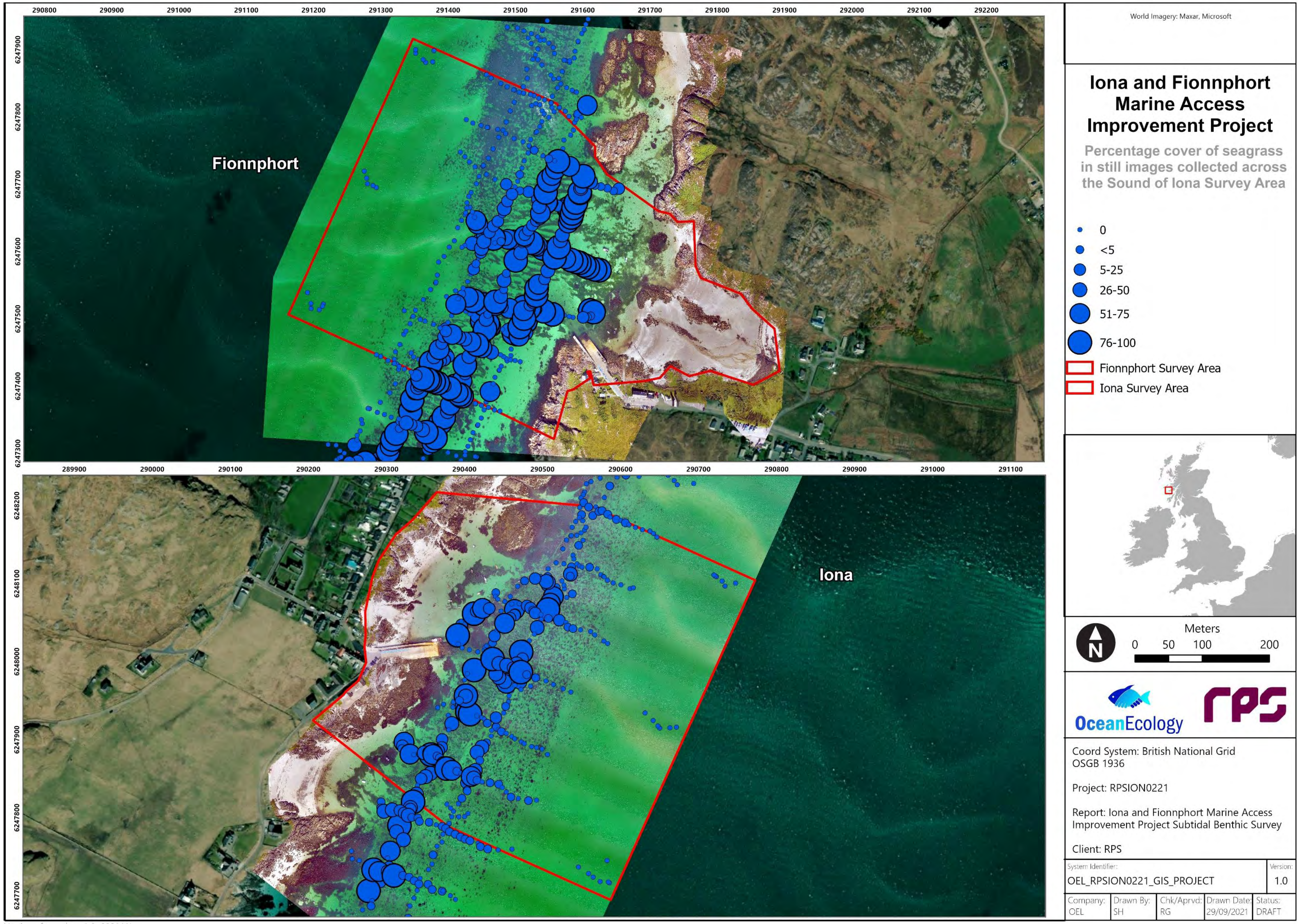

Figure 7 Seagrass assessment given to images collected across the survey area.

4.3.2.2. Annex I Reef Assessment

A full reef habitat assessment was conducted on all images to determine whether habitats met the definitions of Annex I reef habitats as detailed in Table 1. Evidence of bedrock reef was identified in 7 images across T_020. No evidence of stony or biogenic reef which would qualify as Annex I reef were observed during this survey.

4.3.2.3. Other Priority Marine Features

In addition to seagrass beds, the PMFs 'Kelp and seaweed communities on sublittoral sediment' and 'Kelp beds' were also observed in 263 and 12 images respectively across the Iona survey area. Dead maerl was observed across stations I3, I4 and I10, and transects T_018, T_020, T_024, T_025, T_027 and T_031.

4.3.2.4. Anthropogenic Activity

Evidence of a metal mooring chain was observed in two images across T_020 (RPSION0221_T20_21_08_21_476.JPG and RPSION0221_T20_21_08_21_496.JPG) (Plate 5).

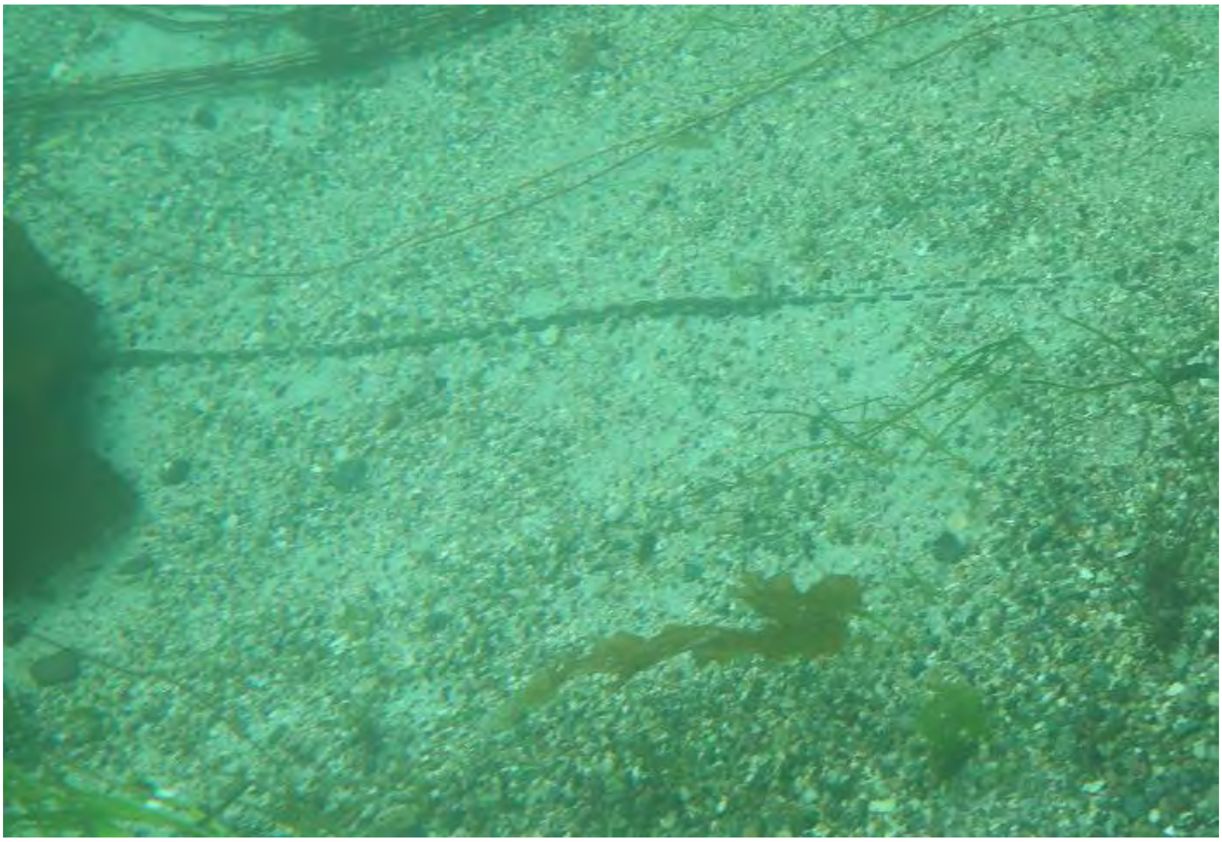

Plate 5 Metal chain observed at T_020.

4.4. Macrobenthos

4.4.1. Macrobenthic Composition

A total of 2,270 individuals and 336 taxa were recorded across the two survey areas. The mean (± SE) number of taxa per sample was 16.8 ± 3.2, with a mean abundance per sample of 113.5 ± 38.2 and mean biomass per sample of 0.197 ± 0.093 gAFDW.

The full abundance matrix is provided in Appendix VII. The biomass (gAFDW) of each major taxonomic group (Annelida, Crustacea, Mollusca, Echinodermata and Miscellaneous) in each sample collected is presented in Appendix VIII.

As shown in Figure 8, the bivalve *Goodallia triangularis* was the most abundant species recorded, accounting for 15.24% of all individuals recorded across both survey areas. *G. triangularis* also exhibited the maximum recorded abundance within a single sample and the greatest average density per sample (Figure 8c and Figure 8d). The amphipod *Bathyporeia guilliamsoniana* was another key taxon being the most frequently occurring macrobenthic species, occurring in 80% of all samples (Figure 8b).

Station F9 exhibited the highest recorded abundance of all stations at 741 individuals, followed by Station I1, the most station exhibiting the greatest abundance in the Iona survey area, with 385 individuals (Figure 10). Four hundred and fifty-six of the 741 individuals recorded from Station F9 were accounted for by three crustacean taxa, the amphipod family Gammaridae and amphipod *Nototropis swammerdamei*. and the isopod genus Idotea. Station F9 also had the highest recorded diversity of all stations at 66 recorded taxa, 36 of which were crustacean taxa (Figure 11). The most diverse station within the Iona survey area was Station I9, with 23 recorded taxa (Figure 11).

Biomass ranged between 0.0085 and 1.9 gAFDW, with the highest biomass recorded at Station F10 resulting from a high annelid biomass of 1.8 gAFDW (Figure 12). Annelida biomass was also the highest recorded major group biomass pooled across all sampled stations, however this was again driven by the large biomass recorded at Station F10. When considering data from stations excluding F10, Echinodermata biomass was the greatest contributor to total biomass. Figure 9 illustrates the relative contributions to total abundance, diversity, and biomass of the major taxonomic groups in the macrobenthic community sampled across both survey areas (all) and within the Fionnphort nearshore (middle panel) and Iona (bottom panel) survey areas.

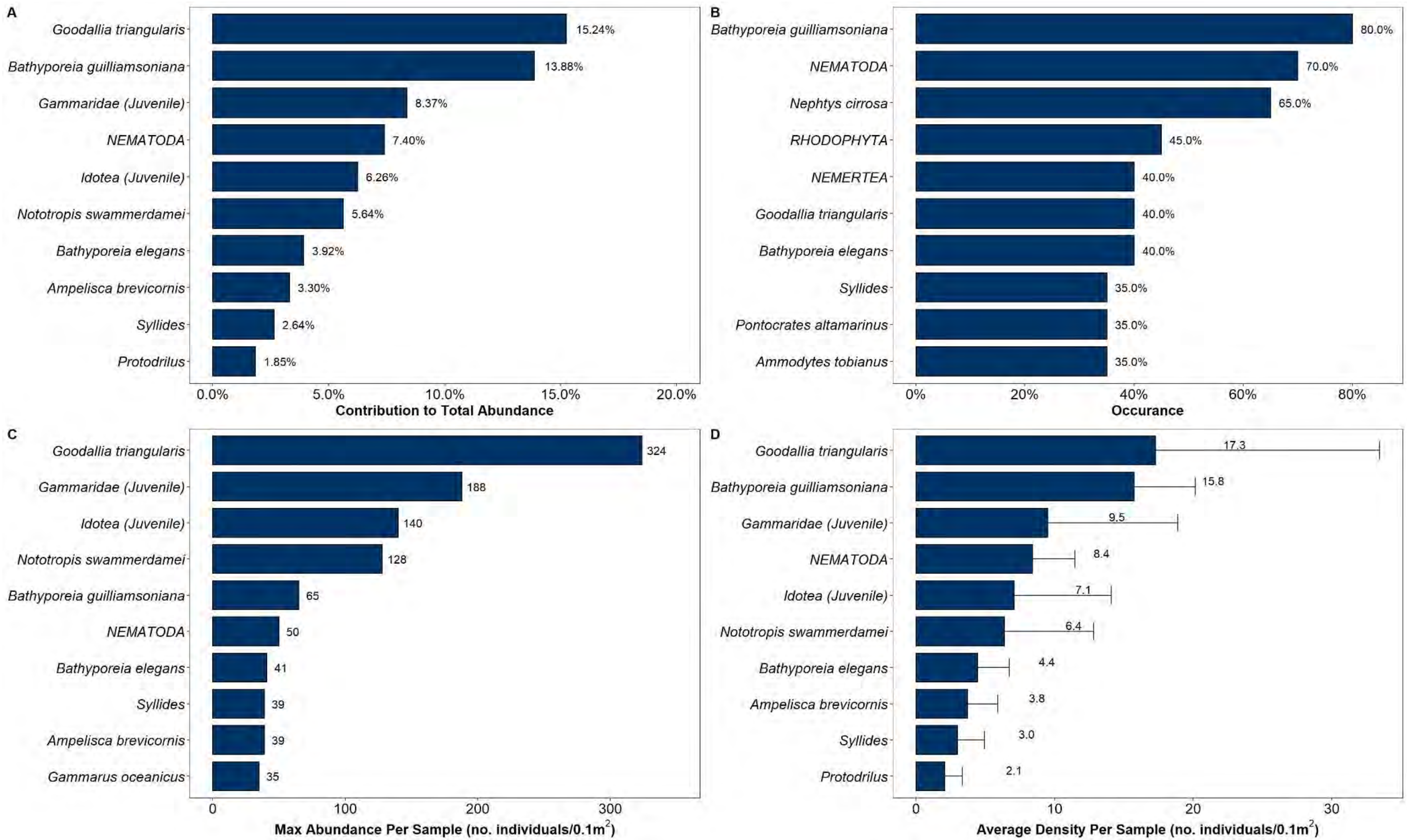

Figure 8 Percentage contributions of the top 10 macrobenthic taxa to total abundance (a) and occurrence (b) from samples collected across the two survey areas. Also shown are the maximum abundance of the top 10 taxa per sample (c) and average densities of the top 10 taxa per sample (d).

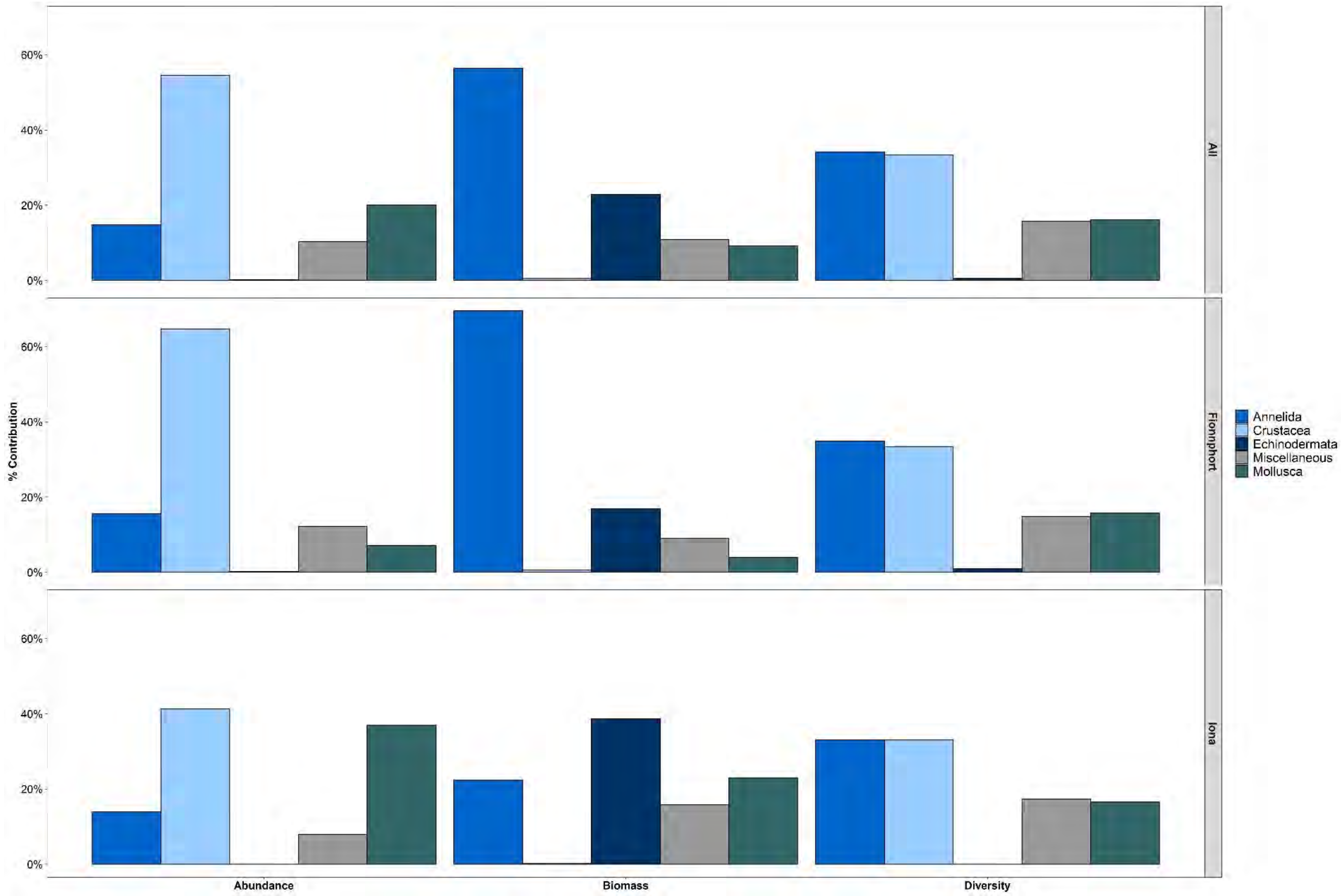

Figure 9 Relative contribution of the major taxonomic groups to the total abundance, diversity and biomass of the macrobenthos sampled across the two survey areas. Abundance counts exclude colonial taxa.

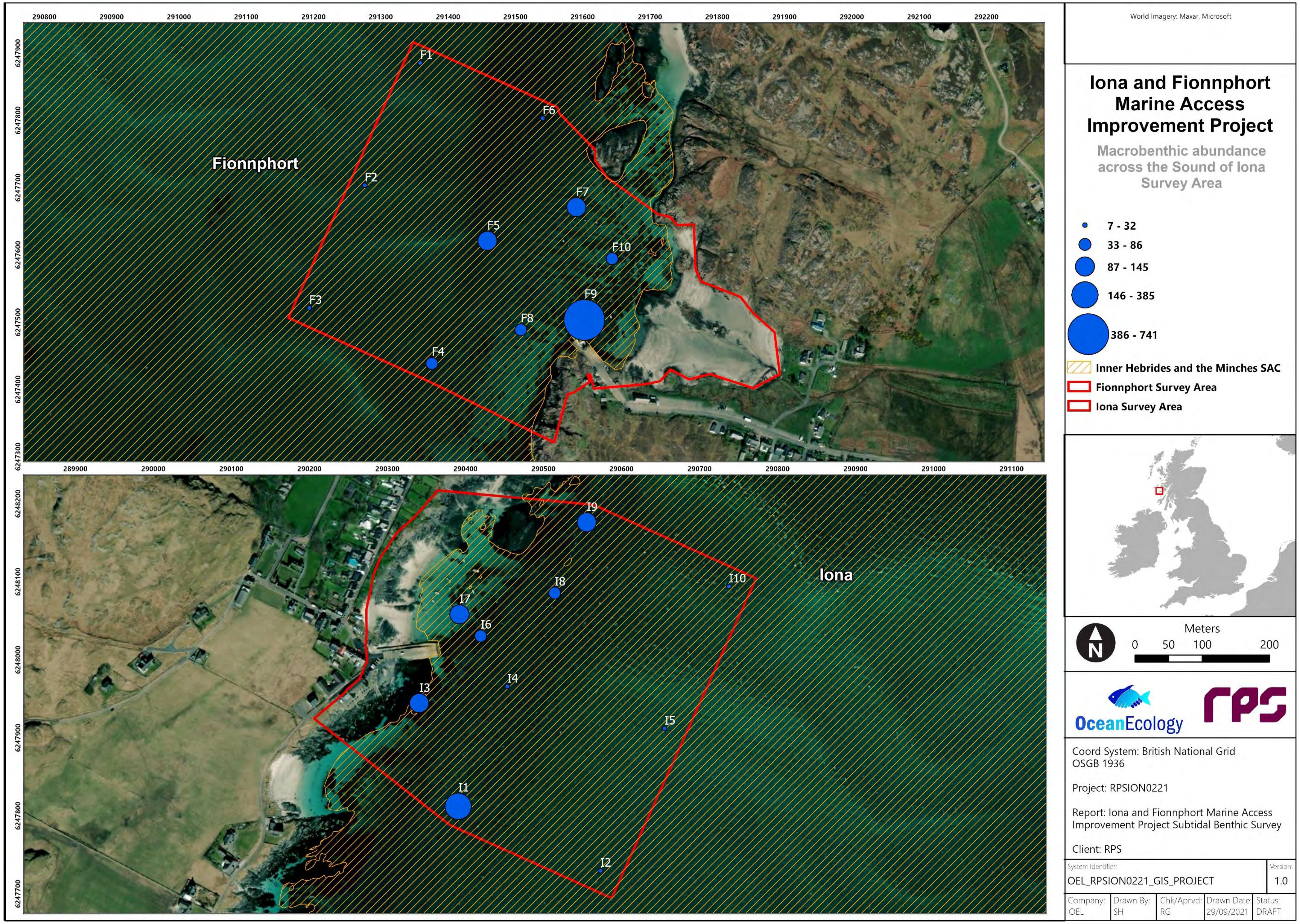

Figure 10 Macrobenthic abundance at stations sampled across the Iona and Fionnphort survey areas.

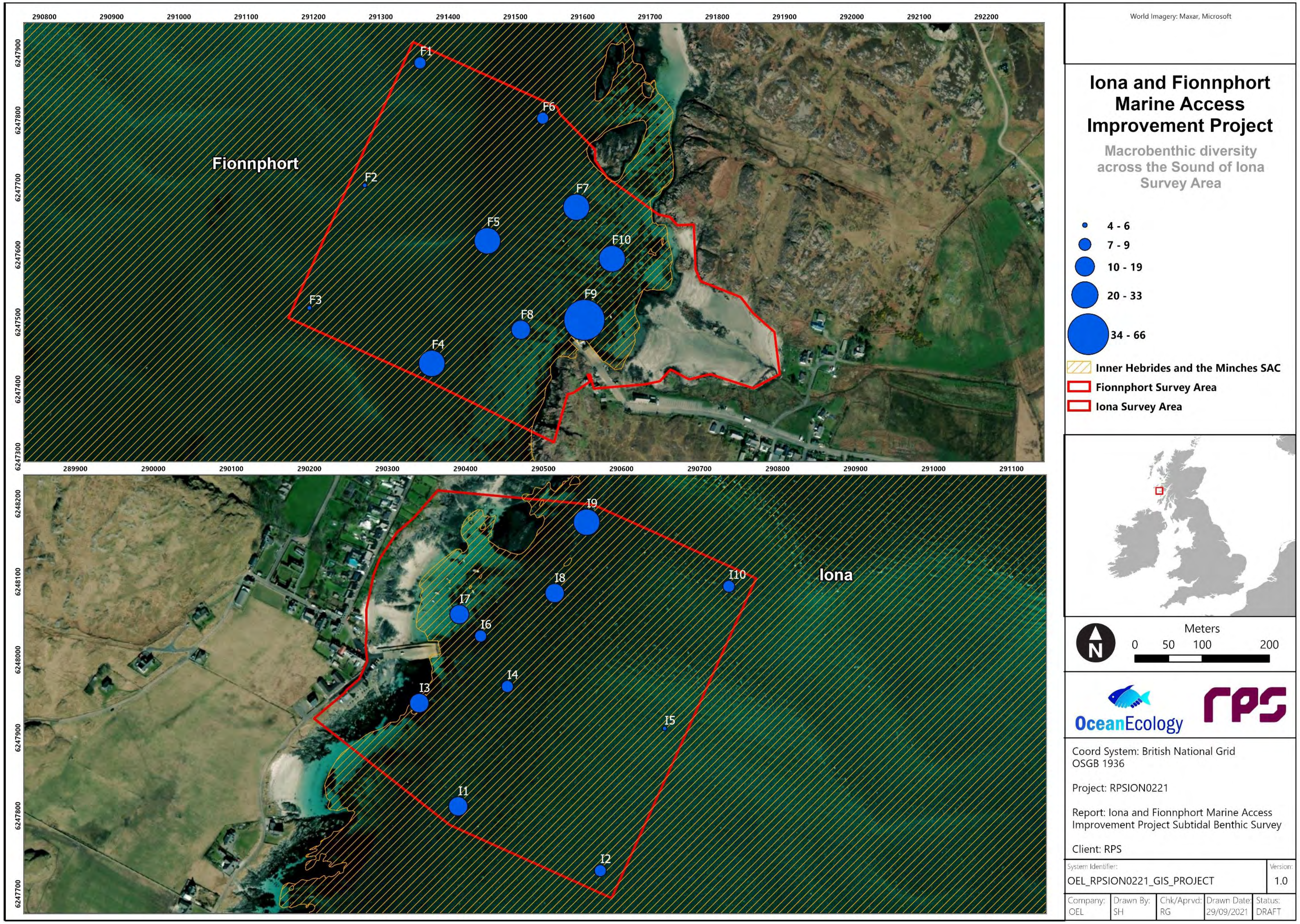

Figure 11 Macrobenthic diversity at stations sampled across the Iona and Fionnphort survey areas.

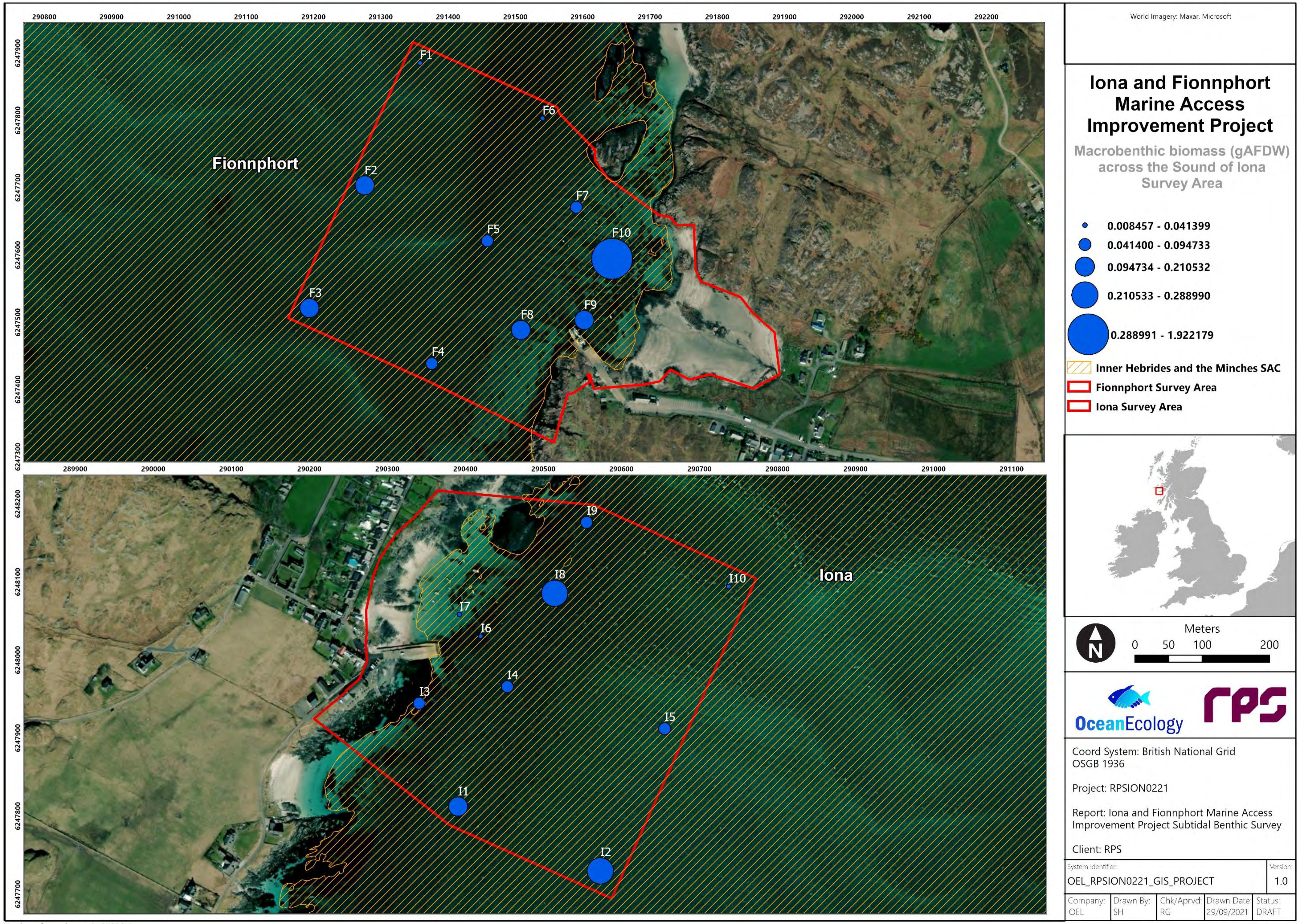

Figure 12 Macrobenthic biomass (gAFDW) at stations sampled within the Iona and Fionnphort survey areas.

4.4.2. Notable Taxa

Three species of interest were identified within the 20 samples which underwent macrobenthic analysis (Table 8). The most abundant of these species, *Crassicorophium crassicorne*, was recorded at only two stations, stations F7 and I8 with 10 and five individuals at each station, respectively. One individual of the economically important shrimp species *Crangon crangon* was identified at Station F9. One ocean quahog of small size, *Arctica islandica*, was identified at Station I7. *A. islandica* is listed on the OSPAR list of Threatened and/ or Declining Species and Habitats, and is also considered a PMF within Scotland.

Table 8 Notable taxa found during the Iona and Fionnphort subtidal benthic survey.

Taxon	Major Group	Designation	N of Individuals
Arctica islandica	Mollusca	OSPAR listed and PMF	1
Crangon crangon	Arthropoda	Economically Important	1
Crassicorophium crassicorne	Arthropoda	Invasive & Non-native	15

4.5. Macrobenthic Faunal Groupings

Multivariate analysis was undertaken on the square-root transformed macrobenthic grab abundance data, to identify spatial distribution patterns in faunal assemblages across the two survey areas and identify characterising taxa present.

Cluster analysis of the macrobenthic data was performed on a Bray-Curtis similarity matrix to analyse the spatial similarities in macrobenthic communities recorded across all sampled stations. The dendrogram resulting from the cluster analysis and associated Type 1 SIMPROF (similarity profile routine) permutation test of all nodes within the dendrogram, identified 5 statistically significantly similar groups ($p > 0.05$). To note that of these 5 groups, station F9 in Fionnphort was an outlier and did not plot close to any of the other sampling locations.

To visualise the relationships between the sampled macrobenthic assemblages, a non-metric multi-dimensional scaling (nMDS) plot was generated on the community abundance data (Figure 13**Error! Reference source not found.**). The nMDS represents the relationships between the communities sampled, based on the distance between sample (station) points. The stress value of the nMDS ordination plot (0.15) indicates that the two-dimensional plot provides an adequate representation of the similarity between stations. The degree of clustering of intra-group sample points demonstrates the level of within group similarity (e.g., points within Macrobenthic Groups D, E and G show distinct clustering), whilst the degree of overlap of inter-group sample points is indicative of the level of similarity between different Macrobenthic Groups (e.g. Macrobenthic Groups A, C and F).

The spatial distribution of the four Macrobenthic Groups and outlier is mapped in Figure 14. SIMPER (similarity percentage analysis) was used to identify the key taxa contributing to the within group similarity (see Appendix IX for SIMPER results).

Macrobenthic Group A - Five stations fell into this group, three located in Iona and two in Fionnphort, in the further offshore area at each site and to the south. The taxon characterising these locations was the sand eel *Ammodytes tobianus* contributing alone to the 48% of the group composition with an average similarity of 30.47 %. Other taxa of notice within this group were the amphipods *Bathyporeia pelagica* and *Pontocrates altamarinus*.

Macrobenthic Group B – Only two stations belonged to this group, F7 and F10, both located close to shore and to the north in Fionnphort. Taxa contributing the most to the group average similarity of 41.24 % were the round worm Nematoda, the white catworm *Nephtys cirrosa*, the sea snail *Retusa obtusa* and the amphipod *Bathyporeia elegans*.

Macrobenthic Group C – Four stations made up this group, with only one station located in Fionnphort. All locations were in proximity of the shore. The characterising taxa for this group were three amphipods *Bathyporeia guilliamsoniana, B. elegans* and *Ampelisca brevicornis* altogether accounting for over 70 % of the group composition with an average similarity of 42.87 %.

Macrobenthic Group D – was the largest group comprising 8 out of the 20 sampling stations. Taxa contributing the most to the group average similarity and composition were Nematoda, *B. guilliamsoniana,* the ribbon worm Nemertea and *N. cirrosa*.

4.5.1. Biotope Assignment

For each of the four Macrobenthic Groups determined using cluster analysis, biotopes were assigned according to the JNCC classification (JNCC, 2015) based upon their faunal and physical characteristics. Correlation of EUNIS/MNCR (Marine Nature Conservation Review) biotopes was undertaken using the JNCC correlation table (JNCC, 2018).

The biotope that most closely aligned with the community observed across the two survey areas was 'A5.233 *Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand' for all the macrobenthic groups observed, which is consistent with the survey area being generally composed of sandy sediments, as demonstrated by the PSD data (Figure 3 and Figure 5) and seabed imagery analysis (**Error! Reference source not found.** and Plate 4).

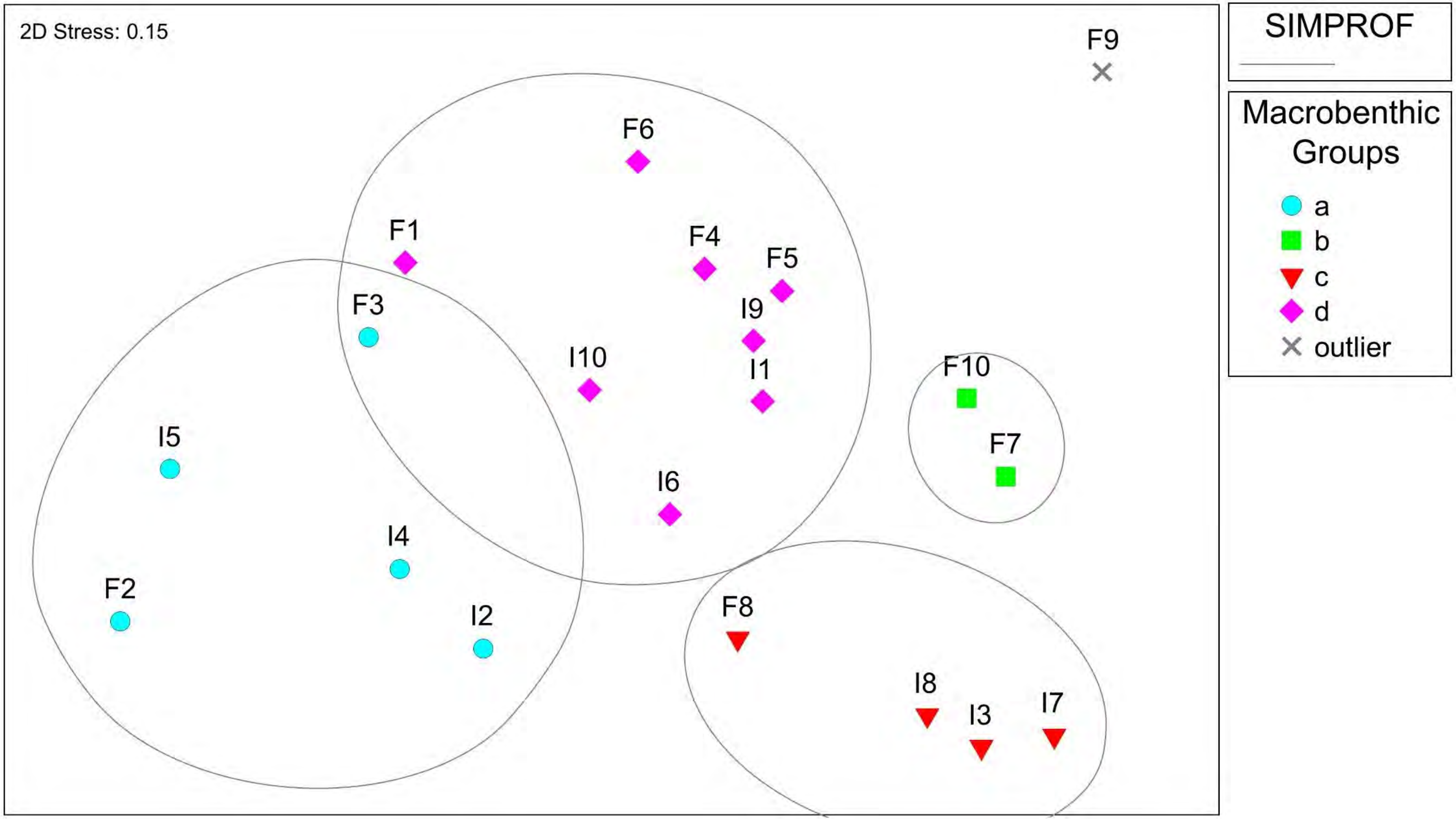

Figure 13 Two-dimensional nMDS ordination of macrobenthic communities sampled across the two survey areas, based on square root transformed and Bray-Curtis similarity abundance data. Macrobenthic Groups were identified based on SIMPROF routine (grey circles).

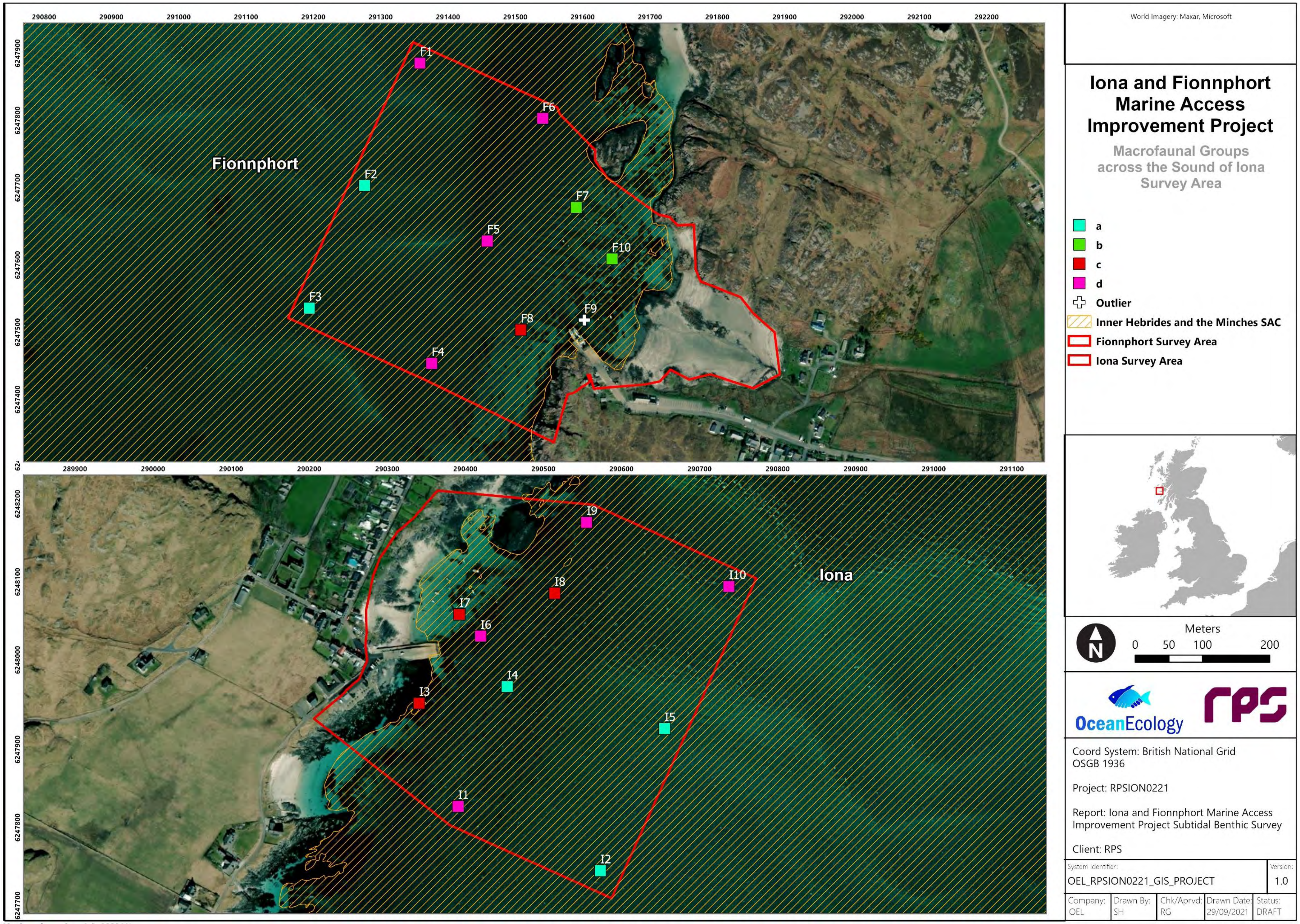

Figure 14 Spatial distribution of Macrobenthic Groups identified for each station across the two survey areas.

4.6. Habitat/ Biotope Mapping

The same five habitats/ biotopes (Table 9) were identified within the Iona and Fionnphort survey areas. The main subtidal habitats identified across the two survey areas were A5.233 '*Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand', A5.52 'Kelp and seaweed communities on sublittoral sediment' and A5.5331 '*Zostera marina/angustifolia* beds on lower shore or infralittoral clean or muddy sand' as mapped in Figure 15 and Figure **16**. The EUNIS classification A5.233 was more prevalent within the Fionnphort survey area than the Iona survey area, which had a larger area of EUNIS classification A5.52 (seagrass beds), here classified to EUNIS A5.5331 (Figure 15 and Figure **16**). Note that the habitat mapping presented in Figure 15 and Figure **16** includes the areas extending from MHWS to MLWS which were surveyed during separate intertidal surveys (OEL, 2021).

All habitat / biotope mapping is provided in shapefile (.shp) format as Appendix X.

Table 9 Subtidal EUNIS classifications identified across the two survey areas.

EUNIS Level 4	EUNIS Level 5	EUNIS Description
A3.12	A3.125	Mixed kelps with scour-tolerant and opportunistic foliose red seaweeds on scoured or sand-covered infralittoral rock
A5.13	-	Infralittoral coarse sediment
A5.23	A5.233	*Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand
A5.52	-	Kelp and seaweed communities on sublittoral sediment
A5.53	A5.5331	*Zostera marina/angustifolia* beds on lower shore or infralittoral clean or muddy sand

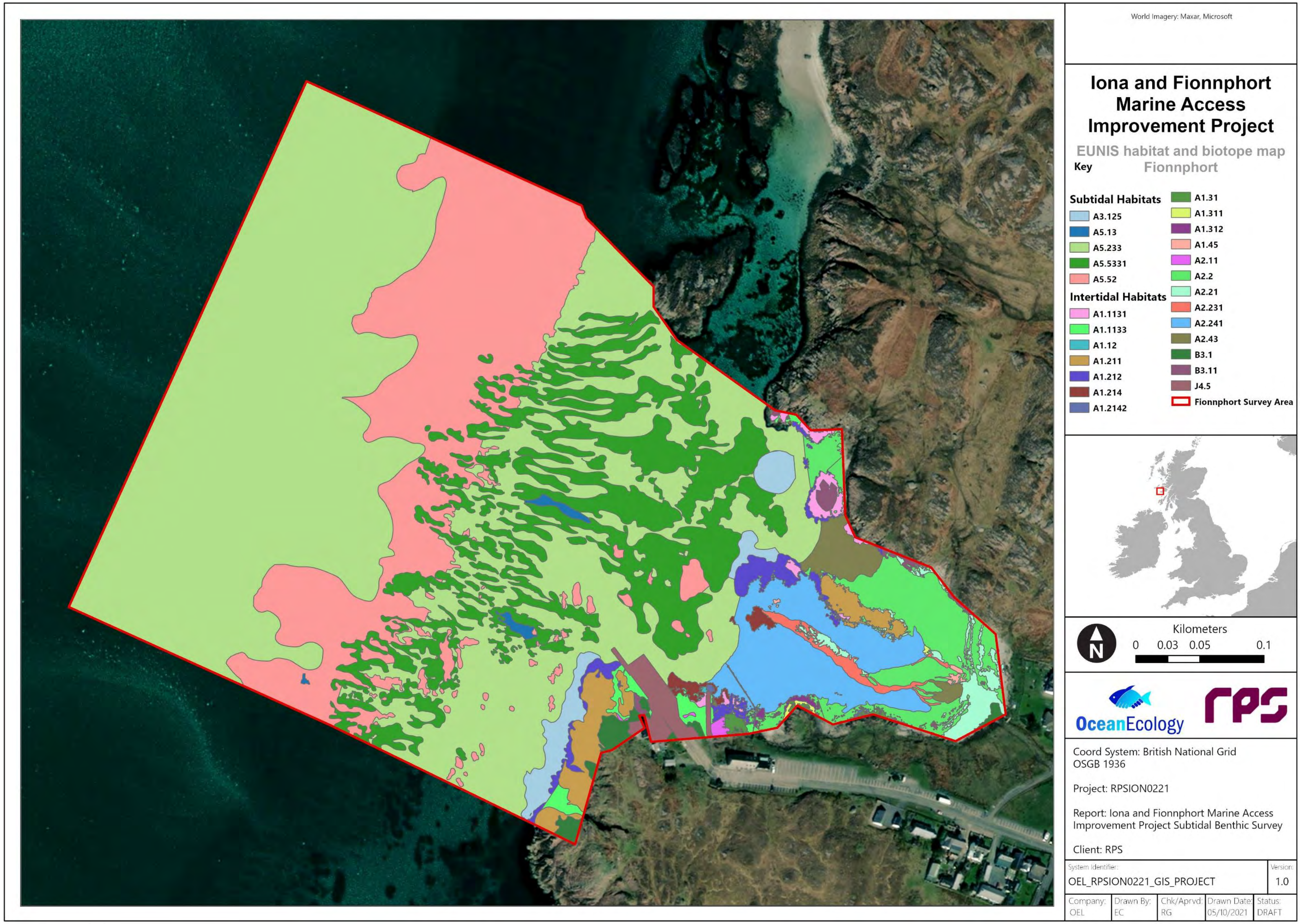

Figure 15 EUNIS habitat / biotope mapping across the subtidal and intertidal zones of the Fionnphort survey area.

Figure 16 EUNIS habitat / biotope mapping across the subtidal and intertidal zones of the Iona survey area.

5. Discussion

A multi-method survey approach involving the collection of seabed imagery and grab samples combined with existing aerial imagery was used here to characterise and map the key benthic habitats present across the subtidal zones of the proposed development areas of the Marine Access Improvement Project.

Sandy sediments dominated both survey areas, with the majority of sediment samples at each site classified as Slightly Gravelly Sand ((g)S). Only one station was classified as anything other than a sand dominated sediment, that being Sandy Gravel (sG) and Station F9. Mud content was consistently low across both survey areas.

The bivalve *Goodallia triangularis* was the most abundant taxa recorded in all macrobenthic samples, however, the most abundant major taxonomic group was Crustacea owing to the consistently high numbers of various amphipod and isopod taxa in samples. The presence of *Nephtys cirrosa* and several species of the genus *Bathyporeia* coupled with the classification of sand dominated sediments throughout the survey area led to the identification of EUNIS biotope A5.233 as the dominant sediment biotope.

Analysis of seabed imagery led to the identification of four further EUNIS habitats and biotopes within the survey area (Table 9). Of the habitats and biotopes identified, the primary classifications accounting for the largest areas were EUNIS classification A5.233 '*Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand', A5.52 'Kelp and seaweed communities on sublittoral sediment' and A5.5331 '*Zostera marina/angustifolia* beds on lower shore or infralittoral clean or muddy sand' (Figure 15 and Figure **16**).

Z. marina var. angustifolia beds were known to be present within the broad vicinity of the Sound of Iona survey area (National Marine Plan Interactive (NMPI) - PMFs consultation – July 2018) prior to the completion of this survey however there were no previous records relating to the presence of extensive seagrass beds representative of the PMF 'Seagrass beds' within the two surveys areas as observed during this survey. Thorough analysis of seabed still imagery revealed a total of 11 stations and 15 transects containing areas considered to be representative of the PMF 'Seagrass beds', across both the Iona and Fionnphort survey areas. Areas of dense seagrass coverage (76-100 %) were identified at a total of six stations and 11 transects (Figure 7).

Due to the low winds and excellent underwater visibility on the day of the aerial imagery acquisition (OEL, 2021), the orthomosaic created for the two survey areas could be used to help accurately delineate the boundaries of the seagrass beds. As the orthomosaic coverage extends beyond the subtidal survey areas it appears that the seagrass beds observed are very likely to extend along the coast beyond the areas mapped and potentially along much of the shallow subtidal areas of the Sound of Iona.

In addition to seagrass beds, the PMFs 'Kelp and seaweed communities on sublittoral sediment' and 'Kelp beds' were also observed across both areas and are also likely to extend along much of the shallow subtidal areas of the Sound of Iona.

No live maerl was identified in the seabed imagery or grab samples, however dead maerl was observed in seabed imagery across both survey areas. Maerl beds are known to be present along the west coast of Scotland and north of the Sound of Iona on the west coast of the Isle of Mull and around the Threshnish Isles (Tyler-Walters et al., 2016). It is possible therefore that the observed dead maerl has been transported from one of these known beds, or that there are additional unmapped maerl beds in the general vicinity of the two survey areas.

Broad trends in the distribution of habitats and biotopes were apparent at both survey sites, whereby habitats further offshore were characterised as infralittoral sand biotopes (EUNIS A5.233) with a clear transition into areas dominated by kelp (EUNIS A5.52) closer to the shoreline. Kelp dominated habitats were more prevalent within the Iona survey area and extended all the way to the intertidal zone, concurrent with observations noted in the intertidal habitat assessment (OEL, 2021). At the Fionnphort site, kelp habitats also gave way to the biotope A5.233 closer to the shoreline. Seagrass beds (EUNIS A5.5331) at both survey sites were confined largely to the nearer-shore areas with beds orientated perpendicular to the shoreline limited in extent by the availability of light, extending towards/away from the shore. Seagrass beds were observed covering a greater area across the Fionnphort survey area and were largely present interspersed with areas of the EUNIS biotope A5.233. At the Iona site, seagrass habitats were almost exclusively present in areas of kelp habitat (A5.52), whereby seagrass was observed in the seabed imagery immediately adjacent to kelp beds. Seagrass was only observed in the shallow subtidal zone towards the southern extent of the Iona survey area, and not at all in Fionnphort survey area, which is broadly concurrent with observations made during the intertidal habitat assessment (OEL, 2021).

6. References

Blott, S. (2010). Grain Size Distribution and Statistics Packages for the Analysis of Unconslidated Sediment by Sieving or Laser Granulometer. *Kenneth Pye Associates Ltd.*

ByrneLooby. (2019). *Feasibility Study - Iona and Fionnphort Marine Access Improvements*.

Clarke, K. ., Tweedley, J. R., & Valesini, F. J. (2014). Simple shade plots aid better long-term choices of data pre-treatment in multivariate assemblage studies. *Journal of the Marine Biological Association of the United Kingdom*, *94*(01), 1–16. https://doi.org/10.1017/S0025315413001227

Clarke, K. R., & Gorley, R. N. (2015). *PRIMER v7: User Manual/Tutorial.*

Eleftheriou, A., & Basford, D. . (1989). The macrobenthic infauna of the offshore northern North Sea. *Journal of the Marine Biological Association*, *69*, 123–143.

Folk, R. . (1954). The distribution between grain size and mineral composition in sedimentary rock nomenclature. *Journal of Geology*, *62*, 344–359.

Fuller, I. (1999). *Kelp Forests - Scotland's living landscapes (SNH Publication)*.

Gubbay, S. (2007). Defining and managing Sabellaria spinulosa reefs: Report of an inter-agency workshop. *JNCC Report No.405*, *44*(405), 22.

Hitchin, R., Turner, J., & Verling, E. (2015). Epibiota Remote Monitoring from Digital Imagery: Operational Guidelines. *NMBAQC and JNCC*.

Holstein, J. (2018). *worms: Retriving Aphia Information from World Register of Marine Species*. *package ve*.

Irving, R. (2009). The identification of the main characteristics of stony reef habitats under the Habitats Directive. Summary report of an inter-agency workshop 26-27 March 2008. JNCC Rep No 432:44. In *JNCCJNCC Report No. 432*.

JNCC. (2015). *The Marine Habitat Classification for Britain and Ireland Version 15.03.* https://mhc.jncc.gov.uk/

JNCC. (2018). *Marine habitat correlation tables version 201801*.

Jones, R. E., Unsworth, R. K. F., Hawes, J., & Griffin, R. A. (2021). Improving benthic biodiversity assessments in turbid aquatic environments. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *31*(6), 1379–1391. https://doi.org/10.1002/aqc.3509

Lancaster, J. E., McCallum, S., Lowe, A. C., Taylor, E., Chapman, A., & Pomfret, J. (2014). *Development of detailed ecological guidance to support the application of the Scottish MPA selection guidelines in Scotland's seas. Scottish Natural Heritage Commissioned Report No. 491.*

Langenkämper, D., Zurowietz, M., Schoening, T., & Nattkemper, T. W. (2017). BIIGLE 2.0 - Browsing and Annotating Large Marine Image Collections. *Frontiers in Marine Science*, *4*, 83. https://doi.org/10.3389/fmars.2017.00083

Long, D. (2006). BGS detailed explanation of seabed sediment modified folk classification. *Folk*.

NMBAQC's Best Practice Guidance - Particle Size Analysis (PSA) for Supporting Biological Analysis, 77 (2016) (testimony of Claire Mason).

NatureScot. (2021). *Marine habitats | NatureScot*.

OEL. (2021). *Iona & Fionnphort Marine Access Improvement Project - Intertidal Habitat Assessment*.

OSPAR. (2009). Background Document for Zostera beds, Seagrass beds. *Biodiversity Series*, 39.

Parry, M. E. V. (2019). *Guidance on Assigning Benthic Biotopes using EUNIS or the Marine Habitat Classification of Britain and Ireland (Revised 2019)*.

Simoes, E., & Salmon, J. (2020a). *FIONNPHORT BREAKWATER AND OVERNIGHT BERTHING FACILITY*.

Simoes, E., & Salmon, J. (2020b). *IONA BREAKWATER AND BERTHING FACILITY* (Vols. 00040-33/S).

Team, R. C., & R Core Team. (2020). *R: A Language and Environment for Statistical Computing* (4.0.0). R Foundation for Statistical Computing. https://www.r-project.org/

Turner, J. A., Hitchin, R., Verling, E., & van Rein, H. (2016). *Epibiota remote monitoring from digital imagery: Interpretation guidelines* (Issue June).

Tyler-Walters, H., James, B., Carruthers, M., Wilding, C., Durkin, O., Lacey, C., Philpott, E., Adams, L., Chaniotis, P. D., Wilkes, P. T. V, Seeley, R., Neilly, M., Dargie, J., & Crawford-Avis, O. T. (2016). *Descriptions of Scottish Priority Marine Features (PMFs). Scottish Natural Heritage Commissioned Report No. 406.*

Wentworth, C. . (1922). A scale of grade and class terms for clastic sediments. *Journal of Geology*, *30*, 377–392.

Worsfold, T., & Hall, D. (2010). *Guidelines for processing marine macrobenthic invertebrate samples: a Processing Requirements Protocol* (Issue June).

APPENDIX 8.4

Subsea Noise Modelling

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Iona and Fionnphort Ferry Ports

Subsea Noise Modelling

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Table of Contents

1 Introduction

The location of the Iona Breakwater Project is illustrated in Figure 1.1. The planned construction activities at Iona and Fionnphort involve drilled piles, dredging and rock placement.

Noise is readily transmitted underwater and there is potential for sound emissions from the survey to affect marine mammals and fish. At long ranges the introduction of additional noise could potentially cause short-term behavioural changes, for example to the ability of species to communicate and to determine the presence of predators, food, underwater features, and obstructions. At close ranges and with high noise source levels, permanent or temporary hearing damage may occur, while at very close range, gross physical trauma is possible. This report provides an overview of the potential effects due to underwater noise from the survey on the surrounding marine environment.

The primary purpose of this underwater noise study is to predict the likely range of onset for potential injury (i.e. permanent threshold shifts in hearing) and behavioural effects.

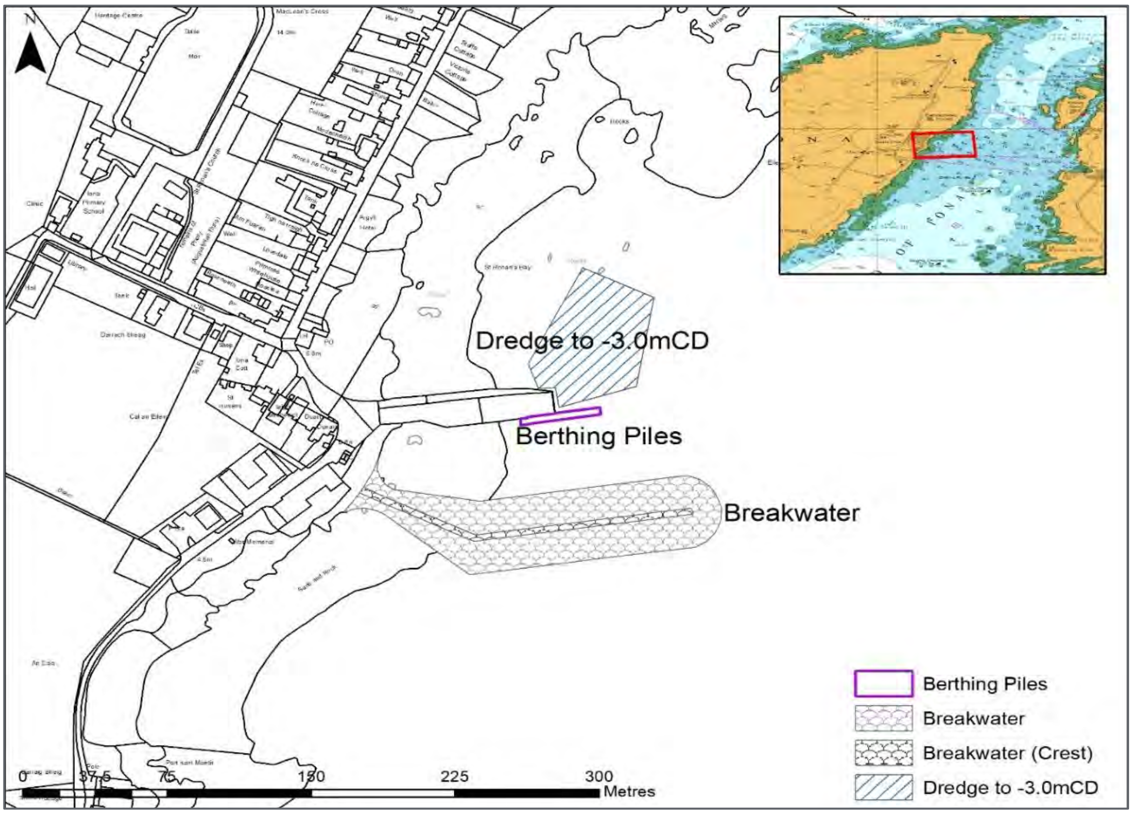

Figure 1.1: Iona Breakwater Project

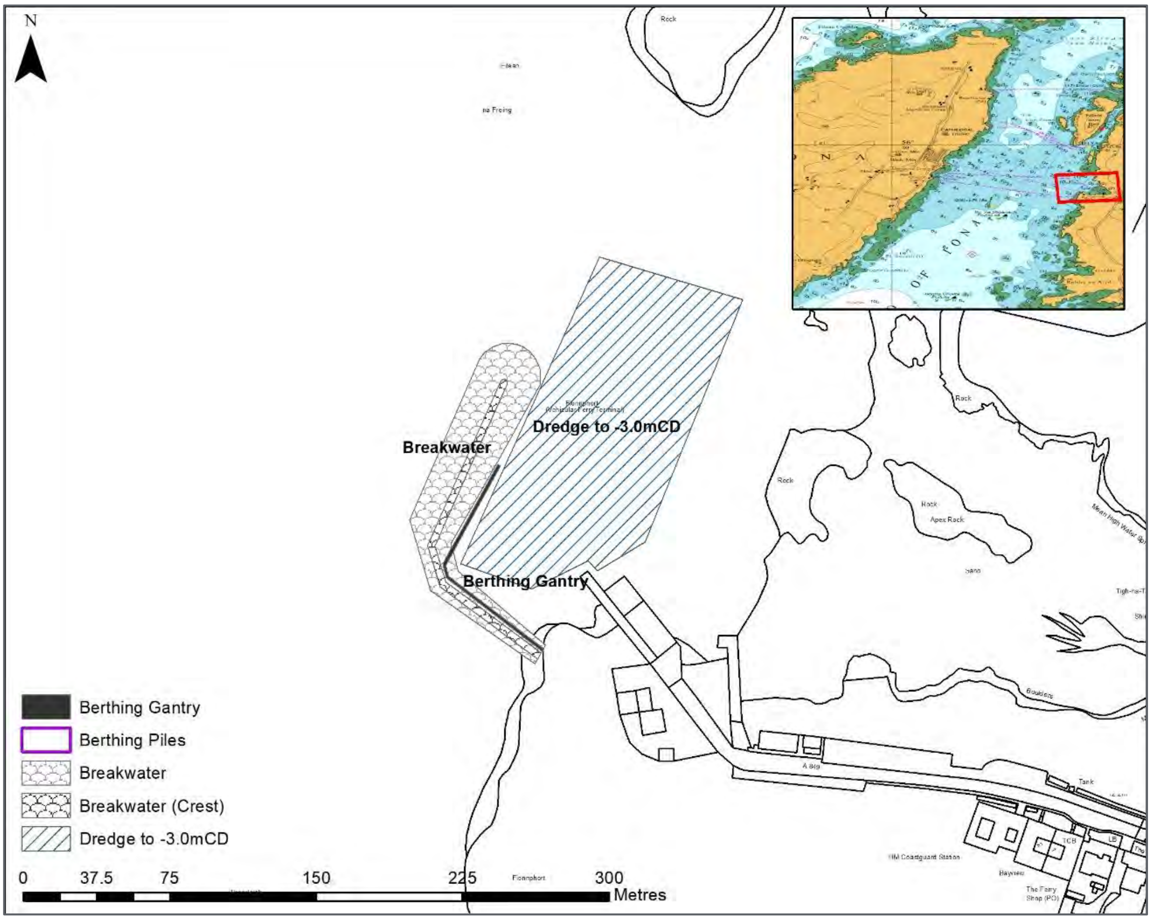

Figure 1.2 Fionnphort Breakwater and Overnight Berth Project

2 Acoustic Concepts and Terminology

Sound travels through the water as vibrations of the fluid particles in a series of pressure waves. The waves comprise a series of alternating compressions (positive pressure) and rarefactions (negative pressure). Because sound consists of variations in pressure, the unit for measuring sound is usually referenced to a unit of pressure, the Pascal (Pa). The decibel (dB) scale is used to conveniently communicate the large range of acoustic pressures encountered, with a known pressure amplitude chosen as a reference value (i.e., 0 dB). In the case of underwater sound, the reference value (P_{ref}) is taken as 1 μPa, whereas the airborne sound is usually referenced to a pressure of 20 μPa. To convert from a sound pressure level referenced to 20 μPa to one referenced to 1 μPa, a factor of 20 log (20/1) i.e., 26 dB has to be added to the former quantity. Thus 60 dB re 20 μPa is the same as 86 dB re 1 μPa, although differences in sound speeds and different densities mean that the decibel level difference in sound intensity is much more than the 26 dB when converting pressure from air to water. All underwater sound pressure levels in this report are quantified in dB re 1 μPa.

There are several descriptors used to characterise a sound wave. The difference between the lowest pressure variation (rarefaction) and the highest-pressure variation (compression) is called the peak to peak (or pk-pk) sound pressure level. The difference between the highest variation (either positive or negative) and the mean pressure is called the peak pressure level. Lastly, the root mean square (rms) sound pressure level is used as a description of the average amplitude of the variations in pressure over a specific time window. Decibel values reported should always be quoted along with the P_{ref} value employed during calculations. For example, the measured SPL_{rms} value of a pulse may be reported as 100 dB re 1 μPa. These descriptions are shown graphically in Figure 2.1.

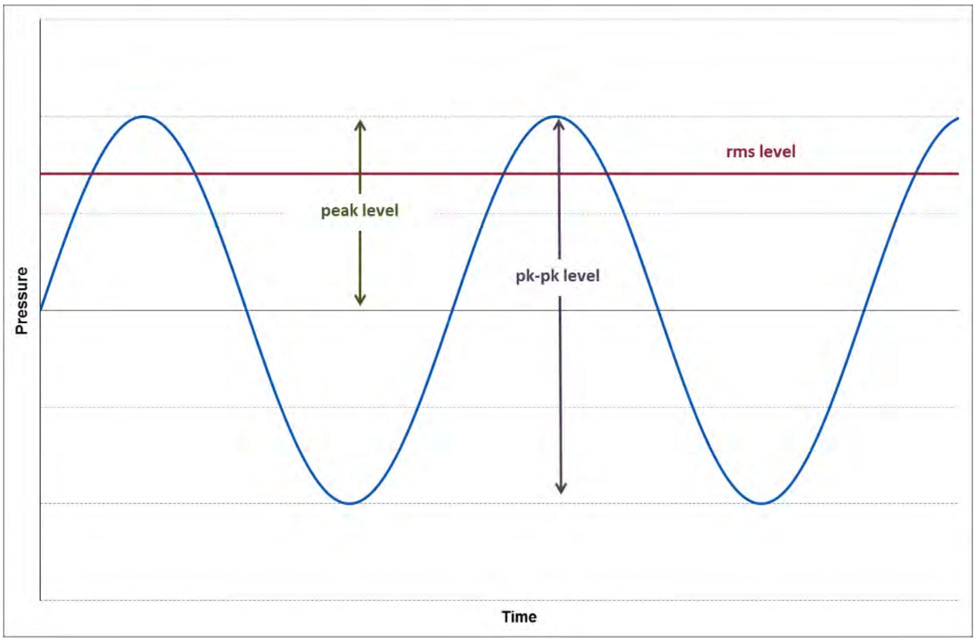

Figure 2.1: Graphical representation of acoustic wave descriptors

The rms sound pressure level (SPL) is defined as follows:

$$SPL_{rms} = 10log_{10}\left(\frac{1}{T}\int_{0}^{T}\left(\frac{p^2}{p_{ref}^2}\right)dt\right) \tag{1}$$

The magnitude of the rms sound pressure level for an impulsive sound (such as that from a seismic source array) will depend upon the integration time, T, used for the calculation (Madsen 2005). It has become customary to utilise the T90 time period for calculating and reporting rms sound pressure levels. This is the interval over which the cumulative energy curve rises from 5% to 95% of the total energy and therefore contains 90% of the sound energy.

Another useful measure of sound used in underwater acoustics is the Sound Exposure Level, or SEL. This descriptor is used as a measure of the total sound energy of an event or a number of events (e.g., over the course of a day) and is normalised to one second. This allows the total acoustic energy contained in events lasting a different amount of time to be compared on a like for like basis[1]. The SEL is defined as follows:

$$SEL = 10log_{10}\left(\int_{0}^{T}\left(\frac{p^2(t)}{p_{ref}^2 t_{ref}}\right)dt\right) \qquad (2)$$

The frequency, or pitch, of the sound is the rate at which the acoustic oscillations occur in the medium (air/water) and is measured in cycles per second, or Hertz (Hz). When sound is measured in a way which approximates to how a human would perceive it using an A-weighting filter on a sound level meter, the resulting level is described in values of dBA. However, the hearing faculty of marine mammals is not the same as humans, with marine mammals hearing over a wider range of frequencies and with a different sensitivity. It is therefore important to understand how an animal's hearing varies over its entire frequency range to assess the effects of anthropogenic sound on marine mammals. Consequently, use can be made of frequency weighting scales (m-weighting) to determine the level of the sound in comparison with the auditory response of the animal concerned. A comparison between the typical hearing response curves for fish, humans and marine mammals is shown in Figure 2.2. (It is worth noting that hearing thresholds are sometimes shown as audiograms with sound level on the y axis rather than sensitivity, resulting in the graph shape being the inverse of the graph shown.)

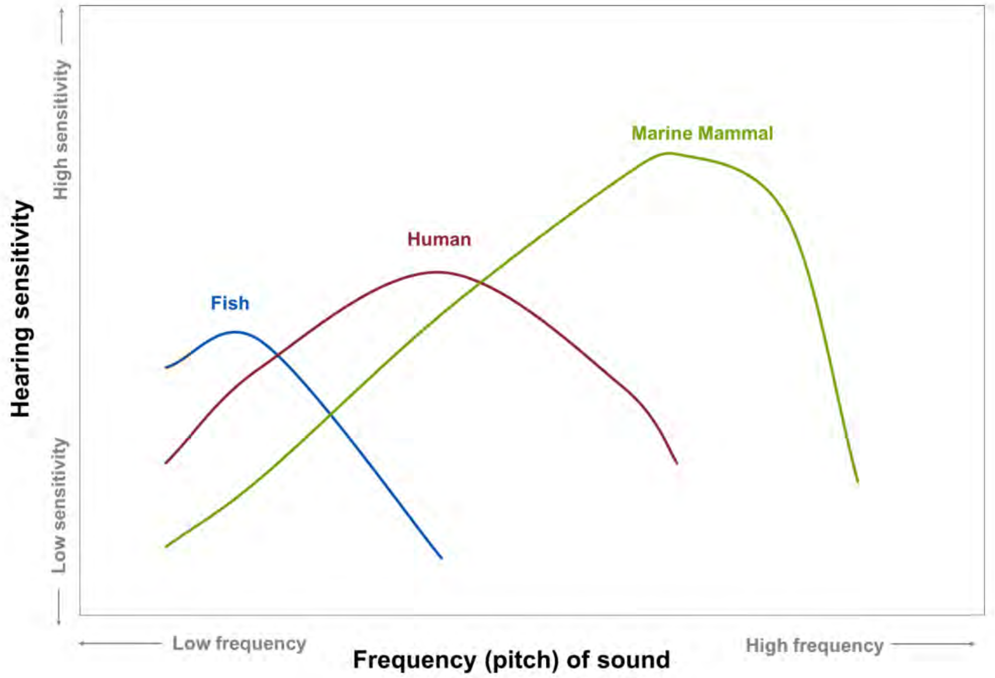

Figure 2.2: Comparison between hearing thresholds of different animals

Other relevant acoustic terminology and their definitions used in the report are detailed below.

1/3rd octave bands

The broadband acoustic power (i.e., containing all the possible frequencies) emitted by a sound source, measured/modelled at a location within the survey region is generally split into and reported in a series of frequency bands. In marine acoustics, the spectrum is generally reported in standard 1/3rd octave band frequencies, where an octave represents a doubling in sound frequency.

1 Historically, use was primarily made of rms and peak sound pressure level metrics for assessing the potential effects of sound on marine life. However, the SEL is increasingly being used as it allows exposure duration and the effect of exposure to multiple events to be considered.

Source level (SL)

The source level is the sound pressure level of an equivalent and infinitesimally small version of the source (known as *point source*) at a hypothetical distance of 1 m from it. The source level may be combined with the transmission loss (TL) associated with the environment to obtain the received level (RL) in the *far field* of the source. The far field distance is chosen so that the behaviour of the distributed source can be approximated to that of a point source. Source levels do not indicate the real sound pressure level at 1 m.

Transmission loss (TL)

TL at a frequency of interest is defined as the loss of acoustic energy as the signal propagates from a hypothetical (point) source location to the chosen receiver location. The TL is dependent on water depth, source depth, receiver depth, frequency, geology, and environmental conditions. The TL values are generally evaluated using an acoustic propagation model (various numerical methods exist) accounting for the above dependencies.

Received level (RL)

The RL is the sound level of the acoustic signal recorded (or modelled) at a given location, that corresponds to the acoustic pressure/energy generated by a known active sound source. This considers the acoustic output of a source and is modified by propagation effects. This RL value is strongly dependant on the source, environmental properties, geological properties and measurement location/depth. The RL is reported in dB either in rms or peak-to-peak SPL, and SEL metrics, within the relevant third-octave band frequencies. The RL is related to the SL as

$$RL = SL - TL \qquad (3)$$

where TL is the transmission loss of the acoustic energy within the survey region.

The directional dependence of the source signature and the variation of TL with azimuthal direction α (which is strongly dependent on bathymetry) are generally combined and interpolated to report a 2-D plot of the RL around the chosen source point up to a chosen distance.

3 Acoustic Assessment Criteria

3.1 Introduction

Underwater noise has the potential to affect marine life in different ways depending on its noise level and characteristics. Richardson et al. (1995) defined four zones of noise influence which vary with distance from the source and level. These are:

- **The zone of audibility:** this is the area within which the animal can detect the sound. Audibility itself does not implicitly mean that the sound will have an effect on the marine mammal.
- **The zone of masking:** this is defined as the area within which noise can interfere with detection of other sounds such as communication or echolocation clicks. This zone is very hard to estimate due to a paucity of data relating to how marine mammals detect sound in relation to masking levels (for example, humans can hear tones well below the numeric value of the overall noise level).
- **The zone of responsiveness:** this is defined as the area within which the animal responds either behaviourally or physiologically. The zone of responsiveness is usually smaller than the zone of audibility because, as stated previously, audibility does not necessarily evoke a reaction.
- **The zone of injury / hearing loss:** this is the area where the sound level is high enough to cause tissue damage in the ear. This can be classified as either temporary threshold shift (TTS) or permanent threshold shift (PTS). At even closer ranges, and for very high intensity sound sources (e.g., underwater explosions), physical trauma or even death are possible.

For this study, it is the zones of injury and disturbance (i.e., responsiveness) that are of concern (there is insufficient scientific evidence to properly evaluate masking). To determine the potential spatial range of injury and disturbance, a review has been undertaken of available evidence, including international guidance and scientific literature. The following sections summarise the relevant thresholds for onset of effects and describe the evidence base used to derive them.

3.2 Injury (Physiological Damage) to Mammals

Sound propagation models can be constructed to allow the received noise level at different distances from the source to be calculated. To determine the consequence of these received levels on any marine mammals which might experience such noise emissions, it is necessary to relate the levels to known or estimated impact thresholds. The injury criteria proposed by Southall et al (2019). are based on a combination of linear (i.e., un-weighted) peak pressure levels and mammal hearing weighted sound exposure levels (SEL). The hearing weighting function is designed to represent the bandwidth for each group within which acoustic exposures can have auditory effects. The categories include:

- **low-frequency (LF) cetaceans** (i.e., marine mammal species such as baleen whales);
- **high-frequency (HF) cetaceans** (i.e., marine mammal species such as dolphins, toothed whales, beaked whales and bottlenose whales);
- **very high-frequency (VHF) cetaceans** (i.e., marine mammal species such as true porpoises, river dolphins and pygmy/dwarf sperm whales and some oceanic dolphins, generally with auditory centre frequencies above 100 kHz);
- **phocid pinnipeds (PCW)** (i.e., true seals; hearing in air is considered separately in the group PCA); and
- **other marine carnivores (OCW)** (including otariid pinnipeds (e.g., sea lions and fur seals), <Redacted> and polar bears; air hearing considered separately in the group OCA).

These weightings have therefore been used in this study and are shown in Figure 3.1.

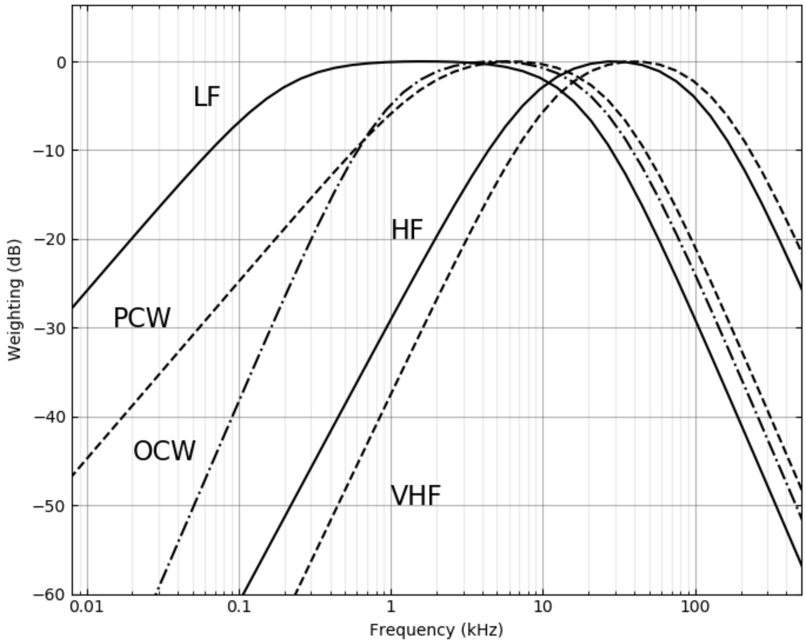

Figure 3.1: Hearing weighting functions for pinnipeds and cetaceans (Southall et al. 2019)

Injury criteria are proposed in Southall et al (2019) are for two different types of sound as follows:

- **Impulsive sounds** which are typically transient, brief (less than 1 second), broadband, and consist of high peak sound pressure with rapid rise time and rapid decay (ANSI 1986; NIOSH 1998; ANSI 2005). This category includes sound sources such as seismic surveys, impact piling and underwater explosions; and
- **Non-impulsive sounds** which can be broadband, narrowband or tonal, brief or prolonged, continuous or intermittent and typically do not have a high peak sound pressure with rapid rise/decay time that impulsive sounds do (ANSI 1995; NIOSH 1998). This category includes sound sources such as continuous running machinery, sonar and vessels.

The criteria for non-impulsive sound have been adopted for this study given the nature of the sound source used during port construction activities.

The relevant criteria proposed by Southall et al. (2019) are as summarised in Table 3.1.

Table 3.1: Summary of PTS onset acoustic thresholds (Southall et al. 2019 Tables 6 and 7)

Hearing Group	Parameter	Impulsive	Non-impulsive
Low-frequency (LF) cetaceans	Peak, unweighted	219	-
	SEL, LF weighted	183	199
High-frequency (HF) cetaceans	Peak, unweighted	230	-
	SEL, MF weighted	185	198
Very High-frequency (VHF) cetaceans	Peak, unweighted	202	-
	SEL, HF weighted	155	173
Phocid Carnivores in Water (PCW)	Peak, unweighted	218	-
	SEL, PW weighted	185	201
Other Marine Carnivores in Water (OCW)	Peak, unweighted	232	-
	SEL, OW weighted	203	219

These updated marine mammal injury criteria were published in March 2019 (Southall et al. 2019). The paper utilised the same hearing weighting curves and thresholds as presented in the preceding regulations document NMFS (2018) with the main difference being the naming of the hearing groups and introduction of additional thresholds for animals not covered by NMFS (2018). A comparison between the two naming conventions is shown in Table 3.2.

For avoidance of doubt, the naming convention used in this report is based upon those set out in Southall et al (2019). Consequently, this assessment utilises criteria which are applicable to both NMFS (2018) and Southall et al. (2019).

Table 3.2: Comparison of hearing group names between NMFS 2018 and Southall 2019

NMFS (2018) hearing group name	Southall et al. (2019) hearing group name
Low frequency cetaceans (LF)	Low-frequency cetaceans (LF)
Mid frequency cetaceans (MF)	High-frequency cetaceans (HF)
High frequency cetaceans (HF)	Very high-frequency cetaceans (VHF)
Phocid pinnipeds in water (PW)	Phocid carnivores in water (PCW)

3.3 Disturbance to Marine Mammals

Beyond the area in which injury may occur, the effect on marine mammal behaviour is the most important measure of impact. Significant (i.e., non-trivial) disturbance may occur when there is a risk of animals incurring sustained or chronic disruption of behaviour or when animals are displaced from an area, with subsequent redistribution being significantly different from that occurring due to natural variation.

To consider the possibility of significant disturbance resulting from the project, it is therefore necessary to consider the likelihood that the sound could cause non-trivial disturbance, the likelihood that the sensitive receptors will be exposed to that sound and whether the number of animals exposed are likely to be significant at the population level. Assessing this is however a challenging task due to the complex and variable nature of sound propagation, the variability of documented animal responses to similar levels of sound, and the availability of population estimates, and regional density estimates for all marine mammal species.

Southall et al. (2007) recommended that the only currently feasible way to assess whether a specific non-impulsive sound could cause disturbance is to compare the circumstances of the situation with empirical studies. The more severe the response on the scale, the lower the amount of time that the animals will tolerate it before there could be significant negative effects on life functions, which would constitute a disturbance under the relevant regulations. The Southall scale is shown in Table 3.3.

Table 3.3: Southall et al. (2007) behavioural disturbance scale.

Response Score	Corresponding Behaviours in free-ranging subjects
0	• No observable response
1	• Brief orientation response (investigation / visual orientation)
2	• Moderate or multiple orientation behaviours • Brief or minor cessation/modification of vocal behaviour • Brief or minor change in respiration rates
3	• Prolonged orientation behaviour • Individual alert behaviour • Minor changes in locomotion speed, direction, and/or dive profile but no avoidance of sound source • Moderate change in respiration rate • Minor cessation or modification of vocal behaviour (duration < duration of source operation)
4	• Moderate changes in locomotion speed, direction, and/or dive profile but no avoidance of sound source • Brief, minor shift in group distribution • Moderate cessation or modification of vocal behaviour (duration more or less equal to the duration of source operation)
5	• Extensive or prolonged changes in locomotion speed, direction, and/or dive profile but no avoidance of sound source • Moderate shift in group distribution • Change in inter-animal distance and/or group size (aggregation or separation) • Prolonged cessation or modification of vocal behaviour (duration > duration of source operation)
6	• Minor or moderate individual and/or group avoidance of sound source • Brief or minor separation of females and dependent offspring • Aggressive behaviour related to noise exposure (e.g. tail/flipper slapping, fluke display, jaw clapping/gnashing teeth, abrupt directed movement, bubble clouds) • Extended cessation or modification of vocal behaviour • Visible startle response • Brief cessation of reproductive behaviour
7	• Extensive or prolonged aggressive behaviour • Moderate separation of females and dependent offspring • Clear anti-predator response • Sever and/or sustained avoidance of sound source • Moderate cessation of reproductive behaviour
8	• Obvious aversion and/or progressive sensitization • Prolonged or significant separation of females and dependent offspring with disruption of acoustic reunion mechanisms • Long-term avoidance of area (> source operation) • Prolonged cessation of reproductive behaviour
9	• Outright panic, flight, stampede, attack of conspecifics, or stranding events • Avoidance behaviour related to predator detection.

For non-pulsed sound, the lowest sound pressure level at which a score of 5 or more occurs for low-frequency cetaceans is 90 - 100 dB re 1 μPa (rms). However, this relates to a study involving migrating grey whales. A study for minke whales showed a response score of 3 at a received level of 100 – 110 dB re 1 µPa (rms), with no higher severity score encountered for this species. For high-frequency cetaceans, a response score of 8 was encountered at a received level of 90 - 100 dB re 1 µPa (rms), but this was for one mammal (a sperm whale) and might not be applicable for the species likely to be encountered near the project. For very high-frequency cetaceans, several individual responses with a response score of 6 are noted ranging from 80 dB re 1 µPa (rms) and upwards. There is a significant increase in the number of mammals responding at a response score of 6 once the received sound pressure level is greater than 140 dB re 1 µPa (rms).

Clearly, there is much intra-category and perhaps intra-species variability in behavioural response. As such, a conservative approach should be taken to ensure that the most sensitive marine mammals remain protected.

This assessment therefore adopts a conservative approach and uses the US National Marine Fisheries Service (NMFS, 2005) Level B harassment thresholds for non-impulsive sounds. Level B Harassment is defined as having the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioural patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild. This description of non-trivial disturbance has therefore been used as the basis for onset of behavioural change in this assessment.

The (NMFS, 2005) guidance sets the marine mammal level B harassment threshold for continuous noise at 120 dB re 1 µPa (rms). This value sits approximately mid-way between the range of values identified in Southall et al. (2007) for continuous sound but is lower than the value at which the majority of mammals responded at a response score of 6 (i.e., once the received rms sound pressure level is greater than 140 dB re 1 µPa). Considering the paucity and high-level variation of data relating to onset of behavioural effects due to continuous sound, it is recommended that any ranges predicted using this number are viewed as probabilistic and potentially over-precautionary.

The relevant criteria for marine mammals are summarised in Table 3.4. This includes the thresholds for non-impulsive sound based on the relevant guidelines (NMFS 2018, NMFS 2005). In Table 3.4 SELs are expressed as dB re 1 µPa^{2}s (cumulative over a 24-hour period) and RMS sound pressure levels are in dB re 1 µPa (rms).

Table 3.4: Summary of acoustic thresholds for marine mammals for non-impulsive sound.

Hearing group	Parameter	PTS	TTS	Disturbance
Low-frequency (LF) cetaceans	SEL, LF weighted dB re 1 µPa^{2}s	199	179	-
	RMST90 dB re 1 µPa (rms)	-	-	120
High-frequency (HF) cetaceans	SEL, MF weighted dB re 1 µPa^{2}s	198	178	-
	RMST90 dB re 1 µPa (rms)	-	-	120
Very High-frequency (VHF) cetaceans	SEL, HF weighted dB re 1 µPa^{2}s	173	153	-
	RMST90 dB re 1 µPa (rms)	-	-	120
Phocid carnivores (PCW)	SEL, PW weighted dB re 1 µPa^{2}s	201	181	-
	RMST90 dB re 1 µPa (rms)	-	-	120
Other marine carnivores (OCW)	SEL, OW weighted dB re 1 µPa^{2}s	219	199	-
	RMST90 dB re 1 µPa (rms)	-	-	120

3.4 Fish

Adult fish not in the immediate vicinity of the noise generating activity are generally able to vacate the area and avoid physical injury. However, larvae and spawn are not highly mobile and are therefore more likely to incur injuries from the sound energy, including damage to their hearing, kidneys, hearts, and swim bladders. Such effects are unlikely to happen outside of the immediate vicinity of even the highest energy sound sources.

For fish, the most relevant criteria for injury are considered to be those contained in ASA S3/SC1.4 TR-2014, Sound Exposure Guidelines for Fishes and Sea Turtles (Popper et al. 2014) (Table 3.5). The guidelines set out criteria for injury due to different sources of noise. Those relevant to this project are for injury due to continuous noise (which are applicable for vessel operation, drilled pin piling activities, and operational noise). The criteria include a mixture of indices including SEL, rms and peak sound pressure levels. Where insufficient data exists to determine a quantitative guideline value the risk is categorised in relative terms as “high”, “moderate” or “low” at three distances from the source: “near” (i.e. in the tens of metres), “intermediate” (i.e. in the hundreds of metres) or “far” (i.e. in the thousands of metres). It should be noted that these qualitative criteria cannot differentiate between exposures to different noise levels and therefore all sources of noise, no matter how noisy, would theoretically elicit the same assessment result. However, because the qualitative risks are generally qualified as “low”, with the exception of a moderate risk at “near” range (i.e. within tens of meters) for some types of animal and impairment effects, this is not considered to be a significant issue with respect to determining the potential effect of noise on fish.

Table 3.5: ASA guideline criteria for injury in fish due to non-impulsive sound.

Type of animal	Mortality and potential mortal injury	Impairment	
		Recoverable injury	TTS
Fish: no swim bladder (particle motion detection)	(Near) Low (Intermediate) Low (Far) Low	(Near) Low (Intermediate) Low (Far) Low	(Near) Moderate (Intermediate) Low (Far) Low
Fish: where swim bladder is not involved in hearing (particle motion detection)	(Near) Low (Intermediate) Low (Far) Low	(Near) Low (Intermediate) Low (Far) Low	(Near) Moderate (Intermediate) Low (Far) Low
Fish: where swim bladder is involved in hearing (primarily pressure detection)	(Near) Low (Intermediate) Low (Far) Low	170 dB re 1 µPa (rms) for 48 hours	158 dB re 1 µPa (rms) for 12 hours
Eggs and larvae	(Near) Low (Intermediate) Low (Far) Low	(Near) Low (Intermediate) Low (Far) Low	(Near) Low (Intermediate) Low (Far) Low
Notes: *Range of effect classified as Near = tens of meters / Intermediate= hundreds of meters / Far = thousands of meters* *Relative risk classified as high, moderate or low*			

Behavioural reactions of fish to sound have been found to vary between species based on their hearing sensitivity. Typically, fish sense sound via particle motion in the inner ear which is detected from sound-induced motions in the fish’s body. The detection of sound pressure is restricted to those fish which have air filled swim bladders; however, particle motion (induced by sound) can be detected by fish without swim bladders.

Highly sensitive species such as herring have elaborate specialisations of their auditory apparatus, known as an otic bulla - a gas-filled sphere connected to the swim bladder which enhances hearing ability. The gas filled swim bladder in species such as cod and salmon may be involved in their hearing capabilities, so although there is no direct link to the inner ear, these species are able to detect lower sound frequencies and as such are considered to be of medium sensitivity to noise. Flat fish and elasmobranchs have no swim bladders and as such are considered to be relatively less sensitive to sound pressure.

The most recent criteria for disturbance are considered to be those contained in ASA S3/SC1.4 TR-2014, Sound Exposure Guidelines for Fishes and Sea Turtles (Popper et al., 2014) which set out criteria for disturbance due to different sources of noise (Table 3.6). The risk of behavioural effects is categorised in relative terms as "high", "moderate" or "low" at three distances from the source: "near" (i.e. in the tens of metres), "intermediate" (i.e. in the hundreds of metres) or "far" (i.e. in the thousands of metres).

Table 3.6: ASA guideline criteria for onset of behavioural effects in fish due to non-impulsive sound.

Type of Animal	Relative Risk of Behavioural Effects
Fish: no swim bladder (particle motion detection)	(Near) Moderate (Intermediate) Moderate (Far) Low
Fish: where swim bladder is not involved in hearing (particle motion detection)	(Near) Moderate (Intermediate) Moderate (Far) Low
Fish: where swim bladder is involved in hearing (primarily pressure detection)	(Near) High (Intermediate) Moderate (Far) Low
Eggs and larvae	(Near) Moderate (Intermediate) Moderate (Far) Low

It is important to note that the ASA criteria for disturbance due to sound are qualitative rather than quantitative criteria. Consequently, a source of noise of a particular type (e.g. drilled pin piling or sound from vessels etc.) would result in the same predicted impact, no matter the level of noise produced or the propagation characteristics.

4 Baseline noise

Background or “ambient” underwater noise is generated by a number of natural sources, such as rain, breaking waves, wind at the surface, seismic noise, biological noise and thermal noise. Biological sources include marine mammals (which use sound to communicate, build up an image of their environment and detect prey and predators) as well as certain fish and shrimp also contribute to this spectrum. Anthropogenic sources add to the existing background noise, including from sources such as fishing boats, ships, industrial noise, seismic surveys, and leisure activities. Generalised ambient noise spectra trends (Wenz, 1962) attributable to various noise sources including both natural and anthropogenic sources are shown in Figure 4.1.

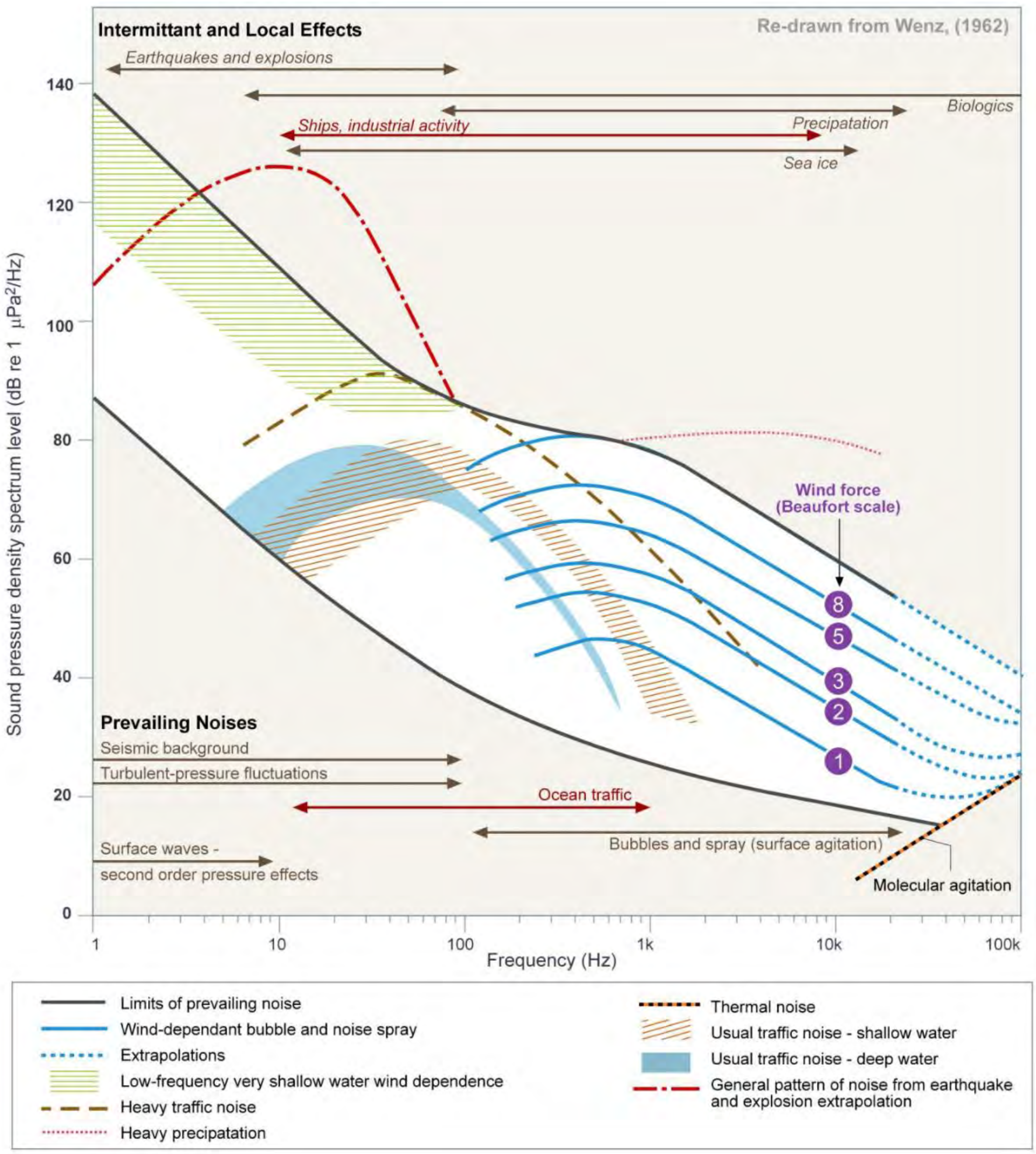

Figure 4.1: Generalised ambient noise spectra attributable to various noise sources (Wenz 1962).

The vast majority of research relating to both physiological effects and behavioural disturbance due to noise on marine species is based on determining the absolute noise level for the onset of that particular effect. As a result, criteria for assessing the effects of noise on marine mammals and fish tend to be based on the absolute noise criteria, as opposed to the difference between the baseline noise level and the specific noise being assessed (e.g. Southall et al., 2007). Given the lack of evidence-based studies investigating the effects of noise relative to background on marine wildlife, the value of establishing the precise baseline noise level is somewhat diminished. It is important to understand that baseline noise levels will vary significantly depending on, amongst other factors, seasonal variations and different sea states, meaning that the usefulness of establishing such a value would be very limited. Nevertheless, it can be useful (though not essential) when undertaking an assessment of underwater noise, to have an understanding of the range of noise levels likely to be prevailing in the area, so that any noise predictions can be placed in the context of the baseline. It is important to note however, that even if an accurate baseline noise level could be determined, there is a paucity of scientific understanding regarding how various species distinguish anthropogenic sound relative to masking noise.

An animal's perception of sound is likely to depend on numerous factors including the hearing integration time, the character of the sound, and hearing sensitivity. It is not known for example, to what extent marine mammals and fish can detect tones of lower magnitude than the background masking noise, or how they distinguish time varying sound. Therefore, it is necessary to exercise considerable caution if attempting any comparison between noise from the proposed development and the baseline noise level. For example, it does not follow that because the broadband sound pressure level due to the source being considered is below the numeric value of the baseline level, that this means that marine mammals or fish cannot detect that sound. This is particularly true where the background noise is dominated by low frequency sound which is outside the animal's range of best hearing acuity. Until such a time as further research is conducted to determine a dose response relationship between the "signal-to-noise" level and behavioural response, a precautionary approach should be adopted.

For the reasons given above, and due to the relatively low risk of non-impulsive marine sound, Seiche has reviewed baseline noise studies carried out in UK waters for other projects in order to determine the likely magnitude of noise encountered in such waters.

A review of noise data relating to other sites in UK waters was undertaken for the Beatrice Wind Farm including a review of baseline underwater noise measurements in UK coastal waters (Brooker et al., 2012). These noise data are summarised in Table 4.1 and power spectral density levels are shown graphically in Figure 4.2 (Sea State 1) and Figure 4.3 (Sea State 3).

Table 4.1: Summary of average background levels of noise around the UK coast (Brooker et al., 2012).

	Overall (Un-Weighted) Average Background Noise Levels, dB re 1 μPa (rms)	
	Sea State 1	**Sea State 3**
Minimum	92	94
Maximum	126	132
Mean	111	112

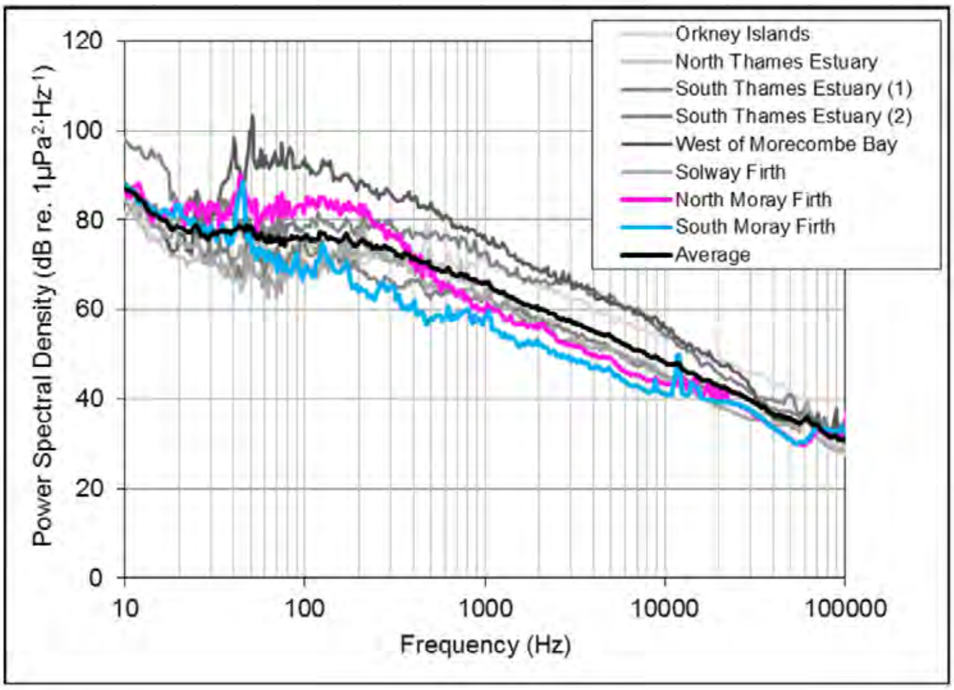

Figure 4.2: Summary of Power Spectral Density levels of background underwater noise at Sea State 1 at sites around the UK coast (Brooker, Barham, and Mason 2012).

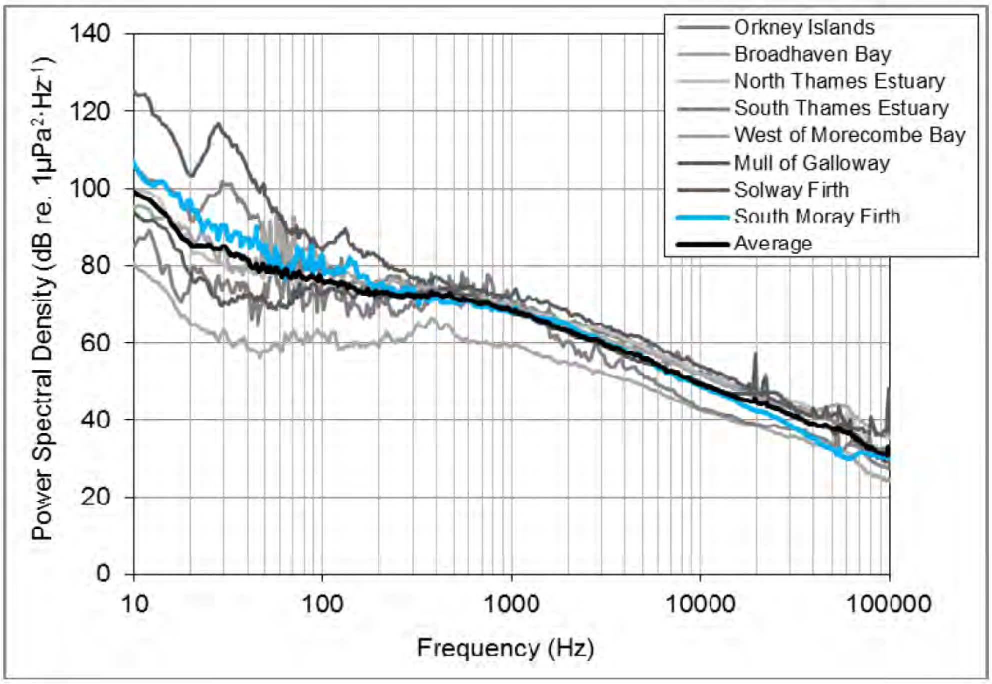

Figure 4.3: Summary of Power Spectral Density levels of background underwater noise at Sea State 3 at sites around the UK coast (Brooker et al., 2012).

The measured power spectral density levels (maximum values in red, mean values in black and minimum values in green, in dB re 1 μPa^{2}Hz^{-1}) and third octave band sound pressure levels (light blue, in dB re 1 μPa) are shown in Figure 4.4 taken from Kongsberg (2012).

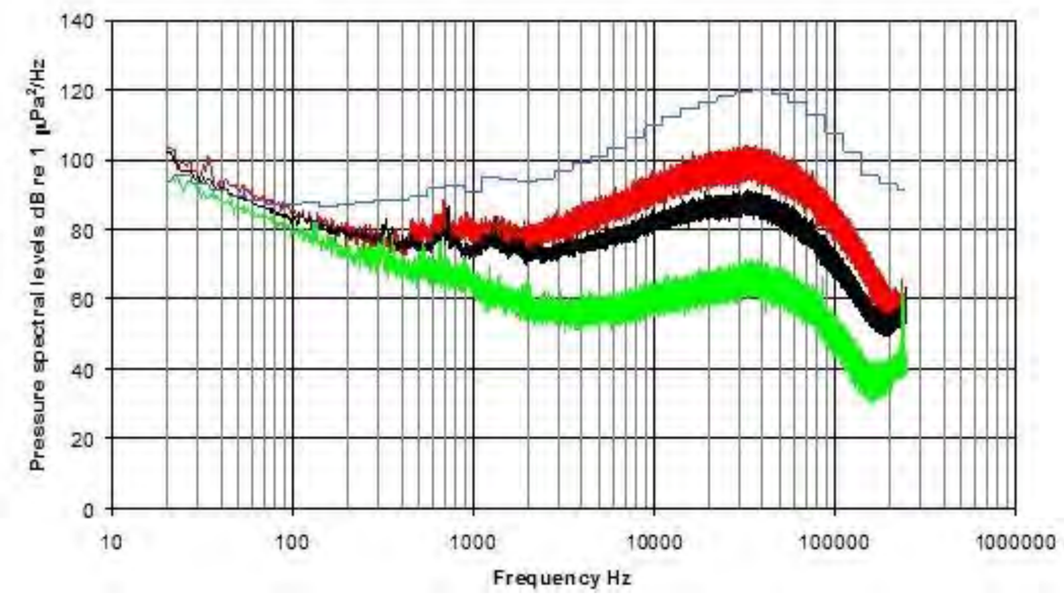

Figure 4.4: Summary of power spectral density levels and third octave band sound pressure levels of background underwater noise measured in the Inner Sound (Meygen), August 2011 (Kongsberg, 2012).

A “drifting-buoy” style assessment of background noise was undertaken by the Low Carbon Research Institute (LCRI) marine division in July 2014. Over an eleven-hour period, noise levels at the Inner Sound site were seen to vary from 91 dB re 1μPa during periods of low tidal flow speed to 121 dB re 1 μPa at high tidal flow speeds.

Based on the review, it is concluded that baseline underwater noise levels in high-tidal, coastal areas are likely to be in the range 91 to 121 dB re 1 μPa (rms).

5 Assessment Methodology

5.1 Source Levels

Underwater noise sources are usually quantified in dB re 1 μPa, as if measured at a hypothetical distance of 1 m from the source (the Source Level). In practice, it is not usually possible to measure at 1 m from a source, but this metric allows comparison and reporting of different source levels on a like-for-like basis. In reality, for a large sound source this imagined point at 1 m from the acoustic centre does not exist. Furthermore, the energy is distributed across the source and does not all emanate from this imagined acoustic centre point. Therefore, the stated sound pressure level at 1 m does not actually occur for large sources. In the acoustic near-field (i.e. close to the source), the sound pressure level will be significantly lower than the value predicted by the SL.

A wealth of experimental data is available which allows us to predict with a good degree of accuracy the sound generated by a drilling pile at discrete frequencies.

For this project, the assessment has been carried out using a scenario of installation of piles on the Fionnphort and Iona docks using drilling. In addition to the pile drilling operation, impact assessment was evaluated for dredging and vessel noise operations on both sides of the Sound of Iona.

Due to the continuous nature of these three noise sources under consideration in the Southall (2019) metrics for non-impulsive noise sources were considered for impact assessment. This assessment is prominently based on the SEL metric. The Root mean square (rms) sound pressure levels for 1-second time window (which is numerically equal to SEL metric) were extracted from the literature and were employed for Source Level data.

Noise source data on continuous construction and operational vessel have been extracted from literature and are set out in *Table 5.1*. Frequencies of modelling were chosen to coincide with the maximum energy bands emitted by the sources and cut-off frequency limitations for propagation of acoustic energy in some of the shallower regions of the Sound of Iona.

Table 5.1: Source level values used for modelling.

	Third octave centre frequency bands (Hz)	63	80	100	125	160	200	250	315	400	500	630	800	1000
RMS Source level dB re 1 μPa	Shipping/tugboat	149	158	158	159	158	159	160	160	161	161	161	156	158
	Drill piling	141	145	148	143	145	148	154	152	152	147	147	149	145
	Dredging	154	155	156	159	153	152	152	155	158	156	155	155	155

5.2 Propagation Model

As distance from the sound source increases the level of sound recorded reduces, primarily due to the spreading of the sound energy with distance, in combination with attenuation due to absorption of sound energy by molecules in the water. This latter mechanism is more important for higher frequency sound than for lower frequencies.

The way that the sound spreads (geometrical divergence) will depend upon several factors such as water column depth, pressure, temperature gradients, salinity as well as water surface and bottom (i.e. seabed) conditions. Thus, even for a given locality, there are temporal variations to the way that sound will propagate. However, in simple terms, the sound energy may spread out in a spherical pattern (close to the source) or a cylindrical pattern (much further from the source), although other factors mean that decay in sound energy may be somewhere between these two simplistic cases.

In acoustically shallow waters[2] in particular, the propagation mechanism is coloured by multiple interactions with the seabed and the water surface (Lurton 2002; Etter 2013; Urick 1983; Brekhovskikh and Lysanov 2014; Kinsler et al., 1999). Whereas in deeper waters, the sound will propagate further without encountering the surface or bottom of the sea, in shallower waters the sound may be reflected from either or both boundaries (potentially more than once).

At the sea surface, the majority of sound is reflected back into the water due to the difference in acoustic impedance (i.e. sound speed and density) between air and water. However, scattering of sound at the surface of the sea can be an important factor with respect to the propagation of sound. In an ideal case (i.e. for a perfectly smooth sea surface), the majority of sound energy will be reflected back into the sea. However, for rough seas, much of the sound energy is scattered (e.g. Eckart 1953; Fortuin 1970; Marsh, Schulkin, and Kneale 1961; Urick and Hoover 1956). Scattering can also occur due to bubbles near the surface such as those generated by wind or fish or due to suspended solids in the water such as particulates and marine life. Scattering is more pronounced for higher frequencies than for low frequencies and is dependent on the sea state (i.e. wave height). However, the various factors affecting this mechanism are complex.

Because surface scattering results in differences in reflected sound, its effect will be more important at longer ranges from the sound source and in acoustically shallow water (i.e. where there are multiple reflections between the source and receiver). The degree of scattering will depend upon the sea state/wind speed, water depth, frequency of the sound, temperature gradient, grazing angle and range from source. It should be noted that variations in propagation due to scattering will vary temporally within an area primarily due to different sea-states / wind speeds at different times. However, over shorter ranges (e.g. several hundred meters or less) the sound will experience fewer reflections and so the effect of scattering should not be significant.

When sound waves encounter the bottom, the amount of sound reflected will depend on the geoacoustic properties of the bottom (e.g. grain size, porosity, density, sound speed, absorption coefficient and roughness) as well as the grazing angle and frequency of the sound (Cole 1965; Hamilton 1970; Mackenzie 1960; McKinney and Anderson 1964; Etter 2013; Lurton 2002; Urick 1983). Thus, bottoms comprising primarily mud or other acoustically soft sediment will reflect less sound than acoustically harder bottoms such as rock or sand. This will also depend on the profile of the bottom (e.g. the depth of the sediment layer and how the geoacoustic properties vary with depth below the sea floor). The effect is less pronounced at low frequencies (a few kHz and below). A scattering effect (similar to that which occurs at the surface) also occurs at the bottom (Essen 1994; Greaves and Stephen 2003; McKinney and Anderson 1964; Kuo 1992), particularly on rough substrates (e.g. pebbles).

Waveguide effect should also be considered, which defines the shallow water columns do not allow the propagation of low frequency sound (Urick 1983; Etter 2013). The cut-off frequency of the lowest mode in a channel can be calculated based on the water depth and knowledge of the sediment geoacoustic properties. Any sound below this frequency will not propagate far due to energy losses through multiple reflections.

Sound speed gradient is the final piece of the puzzle. Changes in the water temperature and the hydrostatic pressure with depth imply that the speed of sound varies throughout the water column. This can lead to significant variations in sound propagation and can also lead to sound channels, particularly for high frequency sound. Sound can propagate in a duct-like manner within these channels, effectively focussing the sound, and conversely they can also lead to shadow zones. The frequency at which this occurs depends on the characteristics of the sound channel but, for example, a 25 m thick layer would not act as

2 Acoustically, shallow water conditions exist whenever the propagation is characterised by multiple reflections with both the sea surface and bottom (Etter 2013). Consequently, the depth at which water can be classified as acoustically deep or shallow depends upon numerous factors including the sound speed gradient, water depth, frequency of the sound and distance between the source and receiver.

a duct for frequencies below 1.5 kHz. The temperature gradient can vary throughout the year and thus there will be potential variation in sound propagation depending on the season.

Sound energy is also absorbed due to interactions at the molecular level converting the acoustic energy into heat. This is another frequency dependent effect with higher frequencies experiencing much higher losses than lower frequencies.

5.2.1 Modelling approach

There are several methods available for modelling the propagation of sound between a source and receiver ranging from very simple models which simply assume spreading according to a 10 log (R) or 20 log (R) relationship (as discussed above, and where R is the range from source to receiver) to full acoustic models (e.g. ray tracing, normal mode, parabolic equation, wavenumber integration and energy flux models). In addition, semi-empirical models are available, whose complexity and accuracy is somewhere in between these two extremes.

In choosing the correct propagation model to employ, it is important to ensure that it is fit for purpose and produces results with a suitable degree of accuracy for the application in question, taking into account the context (as detailed in Monitoring Guidance for Underwater Noise in European Seas Part III, NPL Guidance Wang et al 2014, and Farcas et al., 2016). Thus, in some situations (e.g. low risk due to underwater noise, range dependent bathymetry is not an issue, non-impulsive sound) a simple (N log R) model will be sufficient, particularly where other uncertainties outweigh the uncertainties due to modelling. On the other hand, some situations (e.g. very high source levels, impulsive sound, complex source and propagation path characteristics, highly sensitive receivers and low uncertainties in assessment criteria) warrant a more complex modelling methodology.

The first step in choosing a propagation model is therefore to examine these various factors, such as set out below:

- Balancing of errors / uncertainties;
- Range dependant bathymetry;
- Frequency dependence;
- Source characteristics.

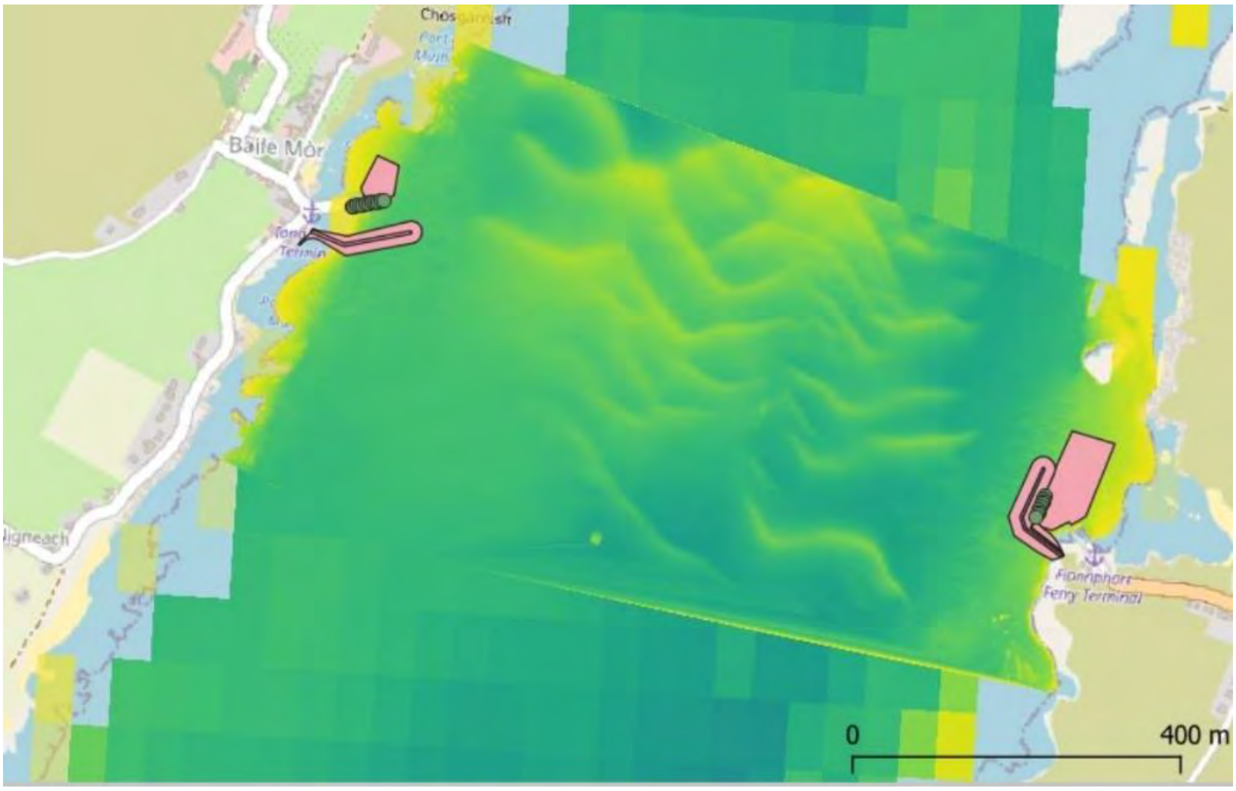

Figure 5.1: High-resolution (1-m) bathymetry in the survey area, island of Iona on the left (west).

For the sound field model, and relevant survey parameters based on a combination of data provided by the client combined with that gathered from publicly available literature. These parameters were fed into an appropriate propagation model routine suited to the region and the frequencies of interest. The frequency-dependent loss of acoustic energy with distance (transmission loss, TL) values were then evaluated along different transects around the chosen source points. The frequencies of interest in the present study are up to 1 kHz since these dominate the acoustic energy for the sources of concern. These frequencies overlap with the hearing sensitivities of some of the marine mammals that are likely to be present in the survey area.

For the calculation of the transmission loss, a range-dependent sound propagation model based on RAMGeo was used to cover the full range of frequencies of interest, which is suitable for frequencies below 1 kHz. RAMGeo is a range-dependent, parabolic equation solver for *elastic* seabed. The code derives from the RAM modelling routine (Collins, 1993) for *fluid* seabed. RAMSGeo receives an environmental input file, which includes the bathymetry (see Figure 5.1), the environmental characteristics, the simulation frequency, and spatial discretisation parameters, and returns the complex transmission loss at each point within the grid of receivers (at different ranges and depths).

RAMSGeo is available as part of the Acoustic Toolbox[3], a free-access compilation of routines and executables for underwater sound propagation modelling. The modelling routines were run through AcTUP (Duncan and Maggi, 2006), an open-source graphic user interface based on the Acoustic Toolbox. By using an in-house developed wrapper for AcTUP to access the RAMSGeo codes directly, we were able to execute the propagation modelling routines for each azimuthal transect around each source point with improved efficiency and control over the processing steps.

[3] http://oalib.hlsresearch.com/AcousticsToolbox/

The propagation and sound exposure calculations were conducted over a range of water column depths in order to determine the likely range for injury and disturbance.

It should be borne in mind that noise levels (and associated range of effects) will vary depending on actual conditions at the time (day-to-day and season-to-season) and that the model predicts a typical worst-case scenario. Considering factors such as animal behaviour and habituation, any injury and disturbance ranges should be viewed as indicative and probabilistic ranges to assist in understanding potential impacts on marine life rather than lines either side of which an impact will or will not occur. (This is a similar approach to that adopted for airborne noise where a typical worst case is taken, though it is known that day to day levels may vary to those calculated by 5 - 10 dB depending on wind direction etc.).

The acoustical properties of different layers employed in the propagation modelling are presented in Table **5.2**. This data is evaluated using recommendations by Hamilton (1980) based on the geological layers present in the survey region and the acoustic properties of the water column. Due to the shallow nature of the Sound of Iona, only a single speed of sound in the water column was considered.

Table 5.2: Acoustical properties of the water layer and sediment used for propagation modelling.

	Max depth (m)	Speed of sound (m/s)		Density	Attenuation (dB/λ)	
		Compressional	Shear	kg/m^3	Shear	Compressional
Water column	100	1500	0	1024	0	0.1
Geological layer	500	1700	250	200	10	0.5

5.2.2 Batch Processing

To improve the performance and reduce the time taken to process and evaluate multiple TL calculations required for this study, Seiche's proprietary software was employed. This software iteratively evaluates the propagation modelling routine for the specified number of azimuthal bearings radiating from a source point, providing a fan of range-dependent TL curves departing from the noise source for each given frequency and receiver depth. We then employ in-house MATLAB routines to interpolate the TL values across transects, to give an estimate of the sound field for the whole area around the source point.

5.3 Received Levels

Once the TL values were evaluated at the source points in all azimuthal directions and at all frequencies of interest for all the sources, the results were coupled with the corresponding SL values in third-octave frequency bands. The combination of SL with TL data provided us with the third-octave band received levels (RL) at each point in the receiver grid (i.e. at each modelled range, depth and azimuth of the receiver).

The received levels were evaluated for the SPL_{rms} or equivalent SEL metric, for each source type, source location, and azimuthal transect to produce the associated 2-D maps. The broadband RL were then calculated for these metrics and from the third-octave band results. The set of simulated RL transects were circularly interpolated to generate the broadband 2-D RL maps centred around each source point.

5.4 Exposure Calculations

As well as calculating the un-weighted rms sound pressure levels at various distances from the source, it is also necessary to calculate the acoustic signal in the SEL metric for a mammal using the relevant hearing weightings to which it is exposed. For operation of the different sources, the SEL sound data was numerically equal to the SPL rms value integrated over 1-second window as the sources are continuous and non-impulsive. These SEL values are employed for calculation of cSEL (cumulative SEL) metric for different marine mammal groups to assess impact ranges.

Exposure modelling could assume that the mammal either being static and at a fixed distance away from the noise source or the mammal is swimming at a constant speed in a perpendicular direction away from a noise source. For fixed receiver calculations, it has been assumed that a mammal will stay at a known distance from the noise source for a period of 24-hours. As the animal does not move, the noise will be constant over the integration period of 24-hours (assuming the source does not change its operational characteristics over this time). Hence the cSEL value calculate would imply the cumulative SEL over the time accumulate by the marine mammal. Although this is a worst case compared to a swimming animal model, this presents a comparative and quicker estimate of impact ranges and can be considered as a worst case.

It should be noted that the sound exposure calculations are based on the simplistic assumption that the noise source is active continuously over a 24-hour period. The real-world situation is more complex. The SEL calculations presented in this study do not take any breaks in activity into account.

Furthermore, the continuous sound criteria described in the Southall et al (2019) guidelines assume that the animal does not recover hearing between periods of activity. It is likely that both the intervals between operations could allow some recovery from temporary hearing threshold shifts for animals exposed to the sound and, therefore, the assessment of sound exposure level is conservative.

In this report, the static mammal 24-hour cSEL calculation was employed using the Southall (2019) metric for non-impulsive noise sources.

6 Sound Modelling Results

TTS impact ranges on most frequently occurring marine mammal groups for the survey region for the sources studied in the current survey are summarised in Table 6.1, Table 6.2, and Table 6.3. The distances presented in the table reflect the start point of the mammal relative to the source when the source first starts up, rounded to the nearest 10 m. The mammal is assumed to stay at the start-up distance, so the distance between the mammal and the source does not increase over time. It should be noted that the rms values in the table use the estimated 1-second time window at various distances from the source.

Table 6.1: Summary of potential TTS zones for marine mammals (N/E – not exceeded)

Source type	Source Location	Group	TTS range (m)	PTS range (m)
Vessel / tug	Centre of the channel	Low frequency cetacean (HF)	250	N/E
		High frequency cetacean (HF)	N/E	N/E
		Very High frequency cetacean (VHF)	20	N/E
		Phocid carnivores (in water; PCW)	30	N/E
		Other carnivores (in water; OCW)	N/E	N/E
	Iona	Low frequency cetacean (LF)	270	N/E
		High frequency cetacean (HF)	N/E	N/E
		Very High frequency cetacean (VHF)	20	N/E
		Phocid carnivores (in water; PCW)	20	N/E
		Other carnivores (in water; OCW)	N/E	N/E
	Fionnphort	Low frequency cetacean (LF)	270	N/E
		High frequency cetacean (HF)	N/E	N/E
		Very High frequency cetacean (VHF)	20	N/E
		Phocid carnivores (in water; PCW)	30	N/E
		Other carnivores (in water; OCW)	N/E	N/E

Table 6.2: Summary of potential TTS zones for marine mammals (N/E – not exceeded)

Source type	Source Location	Group	TTS range (m)	PTS range (m)
Pile drilling	Centre of the channel	Low frequency cetacean (LF)	30	N/E
		High frequency cetacean (HF)	N/E	N/E
		Very High frequency cetacean (VHF)	N/E	N/E
		Phocid carnivores (in water; PCW)	10	N/E
		Other carnivores (in water; OCW)	N/E	N/E
	Iona	Low frequency cetacean (HF)	30	N/E
		High frequency cetacean (HF)	N/E	N/E
		Very High frequency cetacean (VHF)	N/E	N/E
		Phocid carnivores (in water; PCW)	10	N/E
		Other carnivores (in water; OCW)	N/E	N/E
	Fionnphort	Low frequency cetacean (LF)	40	N/E
		High frequency cetacean (HF)	N/E	N/E
		Very High frequency cetacean (VHF)	N/E	N/E
		Phocid carnivores (in water; PCW)	10	N/E
		Other carnivores (in water; OCW)	N/E	N/E

Table 6.3: Summary of potential TTS zones for marine mammals (N/E – not exceeded)

Source type	Source Location	Group	TTS range (m)	PTS range (m)
Dredging	Centre of the channel	Low frequency cetacean (LF)	180	N/E
		High frequency cetacean (HF)	N/E	N/E
		Very High frequency cetacean (VHF)	10	N/E
		Phocid carnivores (in water; PCW)	20	N/E
		Phocid carnivores (in water; OCW)	N/E	N/E
	Iona	Low frequency cetacean (LF)	180	N/E
		High frequency cetacean (HF)	N/E	N/E
		Very High frequency cetacean (VHF)	10	N/E
		Phocid carnivores (in water; PCW)	20	N/E
		Other carnivores (in water; OCW)	N/E	N/E
	Fionnphort	Low frequency cetacean (LF)	190	N/E
		High frequency cetacean (HF)	N/E	N/E
		Very High frequency cetacean (VHF)	10	N/E
		Phocid carnivores (in water; PCW)	20	N/E
		Other carnivores (in water; OCW)	N/E	N/E

The largest impact ranges are for low-frequency cetaceans which would not be expected to traverse the channel.

For all marine mammal groups, the largest range for impact to behaviour is 8,170 km. This is the maximum distance where sound levels exceed 120 dB re 1 µPa (rms).

The potential ranges presented for injury and disturbance are not a hard and fast 'line' where an impact will occur on one side and not on the other. Potential impact is more probabilistic than that; dose dependency in PTS onset, individual variations and uncertainties regarding behavioural response and swim speed/direction all mean that it is much more complex than drawing a contour around a location. These ranges are designed to provide an understandable way in which a wider audience can appreciate the potential spatial extent of the impact.

A 2D contour map representation of the sound levels radiated into the Sound of Iona by the source model Tugboat is shown in Figure 6.1. In this plot the source was placed at centre of the model is 129272, 723741 (OSBG 1936) and the RL results are calculating up to either 10 km distance from the sources or when we encounter land. Two additional contour map plots for the Iona port side and Fionnphort port side are presented in Figure 6.2 and Figure 6.3 respectively. These plots show the RMS unweighted broadband received levels in dB re 1 µPa for Tugboat source radiating noise at each of these ports (source locations are given in figure labels).

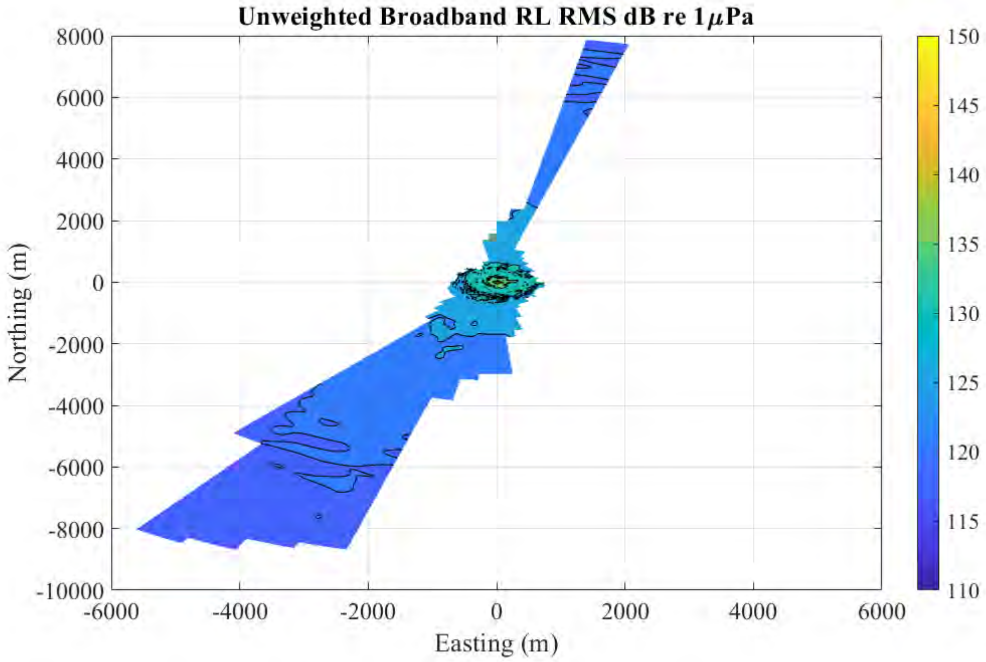

Figure 6.1: A 2D contour map of modelled unweighted SPL rms from the Tugboat source model. Centre of the model in the plot above is 129272, 723741 (OSBG 1936) in the Sound of Iona.

The calculations that are based on an individual mammal being exposed to sound resulting from continuous source activation which, as noted previously, could be a simplification. Care should be taken in interpreting any results within tens of meters of the source due to near-field effects potentially overestimating exposure.

The SPL rms levels within 10 m of the source location are less than 154 dB re 1 μPa for all sources, which is below the TTS exposure level for fish with swim bladders (158 dB re 1 μPa from Table 3.5).

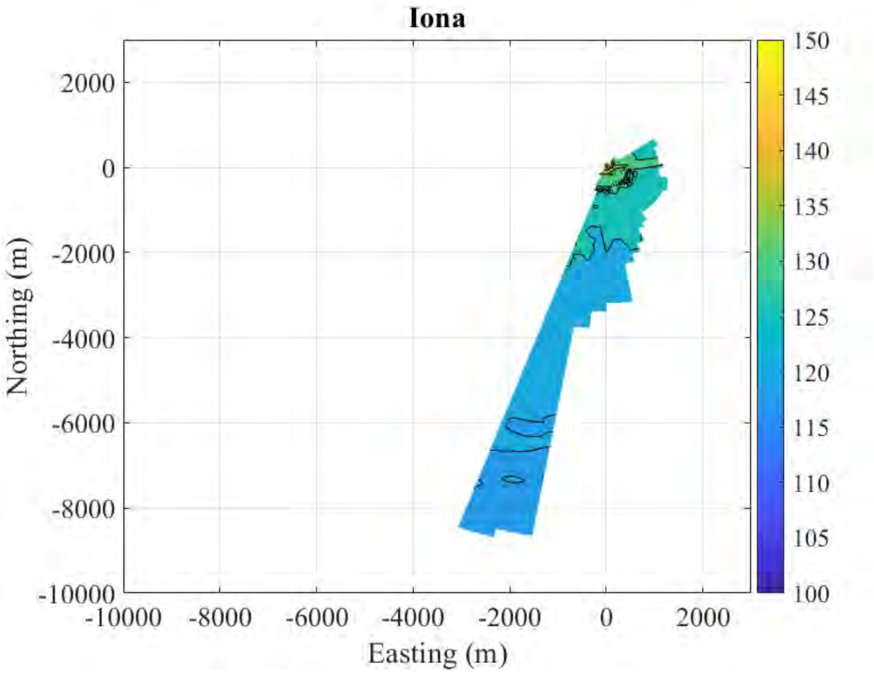

Figure 6.2: A 2D contour map of modelled unweighted SPL rms from the Tugboat source model. Centre of the model in the plot above ***is 128692, 724001 (OSBG 1936) in the port of Iona.***

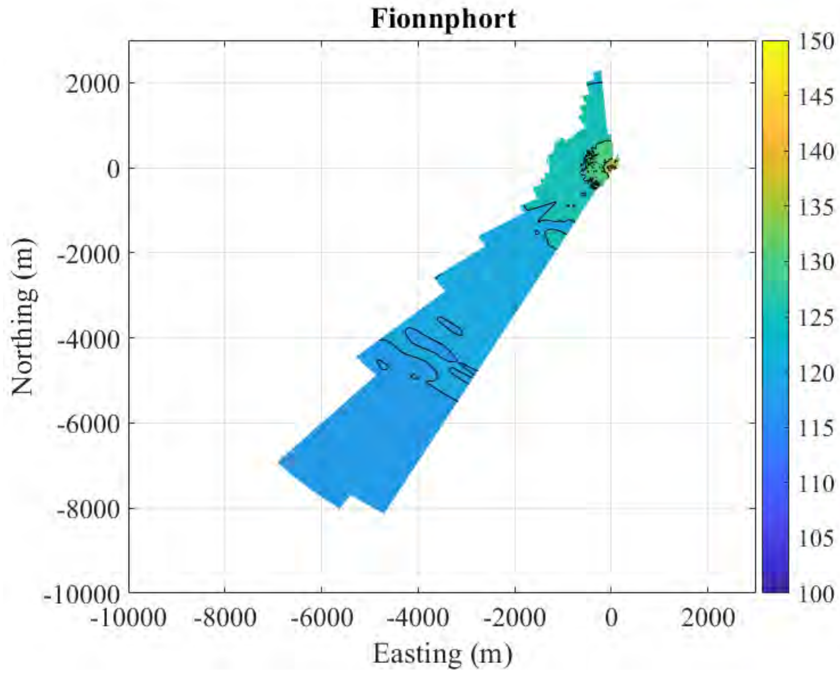

Figure 6.3: A 2D contour map of modelled unweighted SPL rms from the Tugboat source model. Centre of the model in the plot above is 129849, 723482 (OSBG 1936) on the port of Fionnphort.

7 Mitigation

Without any mitigation measures in place, the noise causing activities were identified as having the potential to cause temporary threshold shift at a range of up to 30 m from the source (for vessel or Tugboat) for phocid marine mammal ground underwater, 20 m for very high frequency cetaceans, and 0 m for high frequency cetaceans and other marine mammal carnivores. The impact ranges for dredging and pile drilling are much smaller than those generated by shipping noise.

The impact ranges are higher for low frequency marine mammal group at 270 m for vessel type noise source (and much lower for other noise sources). However, it is very rare to find LF marine mammals in this region (particularly due to very shallow water depths in some places of the survey).

Given the low potential for injury from the construction activities, it is unlikely that mitigation measures will be required.

8 Conclusions

Based on the modelling conducted here, there is little potential for TTS/PTS to be experienced by marine mammals or fish due to the construction activities. Impact only occurs for a stational seal being with 30 m of the construction work for 24 hours. This represents a worst-case scenario, and it is considered highly unlikely that a marine mammal would remain within this range for a period of 24 hours. Consequently, it is considered highly unlikely that any PTS or TTS will occur as a result of the activities. For fish with swim bladders, the maximum impact range is 10 m for a prolonged period of 12 hours. In conclusion, there is minimal concert for disturbance to either marine mammals or fish.

References

Brekhovskikh, Leonid Maksimovich, and I͡Uriĭ Lysanov. 2014. Fundamentals of Ocean Acoustics.

Cole, B. F. 1965. “Marine Sediment Attenuation and Ocean-Bottom-Reflected Sound.” The Journal of the Acoustical Society of America 38 (2): 291–97.

Eckart, Carl. 1953. “The Scattering of Sound from the Sea Surface.” The Journal of the Acoustical Society of America 25 (3): 566–70.

Essen, H.-H. 1994. “Scattering from a Rough Sedimental Seafloor Containing Shear and Layering.” The Journal of the Acoustical Society of America 95 (3): 1299–1310.

Etter, Paul C. 2013. Underwater Acoustic Modeling and Simulation. CRC Press.

Farcas, Adrian, Paul M. Thompson, and Nathan D. Merchant. 2016. “Underwater Noise Modelling for Environmental Impact Assessment.” Environmental Impact Assessment Review 57: 114–22.

Fortuin, Leonard. 1970. “Survey of Literature on Reflection and Scattering of Sound Waves at the Sea Surface.” The Journal of the Acoustical Society of America 47 (5B): 1209–28.

Greaves, Robert J., and Ralph A. Stephen. 2003. “The Influence of Large-Scale Seafloor Slope and Average Bottom Sound Speed on Low-Grazing-Angle Monostatic Acoustic Scattering.” The Journal of the Acoustical Society of America 113 (5): 2548–61.

Hamilton, Edwin L. 1970. “Reflection Coefficients and Bottom Losses at Normal Incidence Computed from Pacific Sediment Properties.” Geophysics 35 (6): 995–1004.

Hamilton, Edwin L. 1980. “Geoacoustic modelling of the sea floor.”, The Journal of Acoustical Society of America, 68, 1313.

Harris, Ross E., Gary W. Miller, and W. John Richardson. 2001. “Seal Responses to Airgun Sounds during Summer Seismic Surveys in the Alaskan Beaufort Sea.” Marine Mammal Science 17 (4): 795–812.

Hastings, M. C. 2002. “Clarification of the Meaning of Sound Pressure Levels & the Known Effects of Sound on Fish.”

Kinsler, Lawrence E., Austin R. Frey, Alan B. Coppens, and James V. Sanders. 1999. “Fundamentals of Acoustics.” Fundamentals of Acoustics, 4th Edition, by Lawrence E. Kinsler, Austin R. Frey, Alan B. Coppens, James V. Sanders, Pp. 560. ISBN 0-471-84789-5. Wiley-VCH, December 1999. 1. http://adsabs.harvard.edu/abs/1999fuac.book.....K.

Kuo, Edward YT. 1992. “Acoustic Wave Scattering from Two Solid Boundaries at the Ocean Bottom: Reflection Loss.” Oceanic Engineering, IEEE Journal of 17 (1): 159–70.

Lurton, Xavier. 2002. An Introduction to Underwater Acoustics: Principles and Applications. Springer Science & Business Media.

Mackenzie, K. V. 1960. “Reflection of Sound from Coastal Bottoms.” The Journal of the Acoustical Society of America 32 (2): 221–31.

Madsen, P. T. 2005. “Marine Mammals and Noise: Problems with Root Mean Square Sound Pressure Levels for Transients.” The Journal of the Acoustical Society of America 117: 3952.

Marsh, H. Wyser, and M. Schulkin. 1962. “Shallow-Water Transmission.” The Journal of the Acoustical Society of America 34: 863.

Marsh, H. Wysor, M. Schulkin, and S. G. Kneale. 1961. “Scattering of Underwater Sound by the Sea Surface.” The Journal of the Acoustical Society of America 33 (3): 334–40.

McKinney, C. Mo, and C. D. Anderson. 1964. “Measurements of Backscattering of Sound from the Ocean Bottom.” The Journal of The Acoustical Society of America 36 (1): 158–63.

NMFS 2005. “Scoping Report for NMFS EIS for the National Acoustic Guidelines on Marine Mammals.” National Marine Fisheries Service.

NMFS 2016. “Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts.” National Marine Fisheries Service (NOAA).

NMFS. 2018. ‘2018 Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0)’. NOAA Technical Memorandum NMFS-OPR-59. National Oceanic and Atmospheric Administration.

Popper, Arthur N., Anthony D. Hawkins, Richard R. Fay, David A. Mann, Soraya Bartol, Thomas J. Carlson, Sheryl Coombs, et al. 2014. ASA S3/SC1.4 TR-2014 Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report Prepared by ANSI-Accredited Standards Committee S3/SC1 and Registered with ANSI. Springer.

Richardson, William John, Denis H. Thomson, Charles R. Greene, Jr., and Charles I. Malme. 1995. Marine Mammals and Noise. Academic Press.

Southall, Brandon L., Ann E. Bowles, William T. Ellison, James J. Finneran, Roger L. Gentry, Charles R. Greene Jr, David Kastak, et al. 2007. “Marine Mammal Noise-Exposure Criteria: Initial Scientific Recommendations.” Aquatic Mammals 33 (4): 411–521.

Southall, Brandon L., James J. Finneran, Colleen Reichmuth, Paul E. Nachtigall, Darlene R. Ketten, Ann E. Bowles, William T. Ellison, Douglas P. Nowacek, and Peter L. Tyack. "Marine mammal noise exposure criteria: Updated scientific recommendations for residual hearing effects." Aquatic Mammals 45, no. 2 (2019): 125-232.

Urick, Robert J. 1983. Principles of Underwater Sound. McGraw-Hill.

Urick, Robert J., and Robert M. Hoover. 1956. “Backscattering of Sound from the Sea Surface: Its Measurement, Causes, and Application to the Prediction of Reverberation Levels.” The Journal of the Acoustical Society of America 28 (6): 1038–42.

Wang, Lian, Kevin D. Heaney, Tanja Pangerc, Pete Theobald, Stephen Robinson, and Michael A. Ainslie. 2014. “Review of Underwater Acoustic Propagation Models.” AIR (RES) 086. NPL.

APPENDIX 9.1

Ornithology

9 ORNITHOLOGY

9.1 Introduction

9.1.1 Purpose and Scope of the Report

This report details the results of ornithology surveys undertaken for the proposed Iona Breakwater Project ('the Proposed Development') (Figure 9-1). These surveys were designed to assess the baseline conditions within the Site boundary and surrounding area. The findings of these surveys will be used to inform the Iona Breakwater Project Ecological Impact Assessment.

9.1.2 Report Objectives

The main objectives of these surveys were to identify any areas:

- Which may support significant numbers of relevant qualifying ornithology features of nearby designated sites that may have connectivity to the habitats present within the Proposed Development;
- Which may be of importance for large assemblages of wetland birds;
- Which may support important numbers of notable or legally protected wetland bird species; and
- Seasonal periods of sensitivity for wetland birds (e.g., traditional feeding and roosting grounds).

9.2 Relevant Legislation

A summary of the legislation relevant to ornithology, or those which may pose a potential constraint to the scheme as identified in this report include:

- Environmental Impact Assessment Directive 2014/52/EU (the EIA Directive);
- Directive 2009/147/EC on the Conservation of Wild Birds (the Birds Directive);
- Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the Habitats Directive);
- The Conservation (Natural Habitats &c.) Amendment (Scotland) Regulations 2012, relating to reserved matters in Scotland;
- Wildlife and Countryside Act 1981 (as amended);
- The Nature Conservation Act (Scotland) Act 2004;
- The Wildlife and Natural Environment (Scotland) Act (2011);
- Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017, which transpose the EIA Directive into the Scottish planning system;
- Planning Circular 1/2017 – Environmental Impact Assessment regulations (Scottish Government 2017);
- PAN 51: Planning Environmental Protection and Regulation (revised 2006);
- PAN 60: Planning for Natural Heritage (Scottish Government 2000);

- Nature Conservation: Implementation in Scotland of the Habitats and Birds Directives: Scottish Executive Circular 6/1995 as amended (June 2000);
- Scottish Planning Policy (2020).

9.3 Methodology

9.3.1 Desk Study

A desk study was undertaken to gather information on the potential value of the site and wider area for ornithological species through the following:

- A request was made to Argyll Biological Record Centre (ABReC) for records from the last 10 years relating to:
  - Ornithological species - 2km buffer; and
  - Non-statutory designated sites (e.g., Scottish Wildlife Nature Reserves, Local Nature Conservation Sites (LNCS) - 2km buffer.

The desk study also sought to collate relevant information on all sites with designated ornithological features including: Ramsar sites and Special Protected Areas (SPAs) (within 30km); and Sites of Special Scientific Interest (SSSIs) and Sites of Importance for Nature Conservation (SINCs) (within 5km) where there may be existing ecological connectivity between the Proposed Development and qualifying bird populations. This included a review of international sites with qualifying mobile species whose range (e.g., foraging, migratory, overwintering, breeding or natural habitat range) overlapped with the Proposed Development. For example, during the breeding season, the mean-maximum foraging range of gannet is 315.2km (Woodward *et al.,* 2019) therefore there is potential for gannets observed within the Proposed Development to originate from SPA colonies located within that distance. However, it should be noted that most seabirds feed offshore in summer, with the exception of terns which may feed close to the colonies.

A search for relevant designated sites was made using online sources, allowing the identification of all designated sites with qualifying ornithological interests. The search radius of 30km for internationally designated sites is consistent with published connectivity distances, across which any bird populations may have interaction with the Site. The online sources used to obtain this information were

- NatureScot Sitelink[6];
- Scotland's environment web[7];
- JNCC website[8];
- Argyll and Bute Council open data website[9]; and

[6] https://sitelink.nature.scot/home

[7] Map | Scotland's environment web

[8] https://jncc.gov.uk/our-work/list-of-spas/

[9] https://data-argyll-bute.opendata.arcgis.com/datasets/open-data-local-nature-conservation-site

- Aerial imagery which was studied prior to the survey to inform any areas of high sensitivity which might require additional survey effort during the site visit.

In addition, information from both confidential and public domain survey data, scientific publications, grey literature (i.e., information not produced or controlled by commercial publishers, e.g., policy documents, web content, conference proceedings, etc.) and ES/EIA/Consultations for nearby developments was searched to build understanding of ornithological interests in and around the Proposed Development.

The British Trust for Ornithology (BTO) Wetland Bird Survey (WeBS) website was also consulted to identify if count data was held for the site and immediate environs. No relevant data was held pertaining to the Proposed Development.

9.3.2 Ornithology

The intertidal and nearshore surveys comprised a programme of monthly surveys carried out over a period of five months between April and August 2021 inclusive.

The survey area comprised a 500m buffer area around the Proposed Development area in the intertidal and nearshore habitats. During each survey the number of birds present along the foreshore and near shore coastal waters was counted. Observations of bird species (including the numbers of each species in a given location and behaviour – see below) were plotted onto a field map using standard BTO species codes and notation.

Surveys were scheduled to cover a range of different tidal conditions (high, low and mid-tide; spring and neap tides) throughout the survey programme. Survey methods were based on the high tide (core count) methodology of the BTO/ Joint Nature Conservancy Committee (JNCC)/ Royal Society for the Protection of Birds (RSPB)/ Wildfowl and Wetlands Trust (WWT) WeBS scheme (Musgrove *et al.* 2003 and Holt *et al.* 2011). This involved the surveyor counting birds from vantage points along the coast using binoculars and a telescope. In addition to the location and number of birds, notes were also made as to whether they were foraging, roosting or loafing. Flying birds were also recorded although for the purposes of this report only those birds which were obviously using the habitats of the survey area (e.g., terns or gannets, as opposed to birds simply flying over/through the sectors) have been included here.

Field records were transferred to a Geographic Information System (GIS). This produced accurate information on the distribution of birds within the study area and enabled maps to be produced so that areas of ornithological importance could be identified.

Weather conditions including wind speed (using the Beaufort Scale), cloud cover (estimated as eighths or octas of the sky), visibility and temperature were also recorded as well as sources of disturbance to birds encountered during surveys.

Full survey details are presented in Table 9-1 below.

Table 9-1 Intertidal and nearshore survey effort

Date	Start time	End time	Tidal cycle	Wind speed (direction)	Precipitation	Cloud cover	Visibility	Snow / frost
26/04/21	10:18	14:18	M-L	2-3 (NE)	1-2	8	3	0
			L-M	3 (NE)	0-4	8	2-3	0
26/04/21	16:20	20:20	M-H	4 (NE)	1	8	3	0

Date	Start time	End time	Tidal cycle	Wind speed (direction)	Precipitation	Cloud cover	Visibility	Snow / frost
			H-M	4 (NE)	0	8	3	0
27/04/21	10:50	14:50	M-L	2-3 (SW)	0	5	4	0
			L-M	3 (SW)	0	4	4	0
27/04/21	16:50	20:50	M-H	3 (SW)	0	5	4	0
			H-M	4 (SW)	0	4	4	0
26/05/21	10:29	14:29	M-L	2 (SE)	0	2	4	0
			L-M	2 (SE)	0	3	4	0
26/05/21	16:29	20:29	M-H	2 (SE)	0	3	4	0
			H-M	1-2 (SE)	0	1	4	0
27/05/21	11:07	15:07	M-L	3 (SW)	0	2-3	4	0
			L-M	3 (NW)	0	1-2	4	0
27/05/21	17:17	21:17	M-H	2 (NW)	0	8	4	0
			H-M	2 (NW)	0	8	4	0
15/06/21	07:30	11:30	M-H	4 (NW)	0	8	3	0
			H-M	4-5 (NW)	0	8	3	0
15/06/21	13:38	17:38	M-L	4 (NW)	1-2	8	2-3	0
			L-M	4 (NW)	3	8	3	0
16/06/21	08:15	12:15	M-H	2-3 (NW)	0	5-6	3-4	0
			H-M	3 (NW)	0-1	5-6	3	0
16/06/21	14:27	18:27	M-L	2 (NW)	0	4-5	4	0
			L-M	2-3 (NW)	0	5	4	0
07/07/21	09:08	13:08	M-L	3 (E)	0	6	3	0
			L-M	2 (E)	0	5	4	0
07/07/21	15:02	19:02	M-H	2 (SE)	0	7-8	4	0
			H-M	2 (SE)	0	7-8	4	0
08/07/21	09:44	13:44	M-L	3-4 (SE)	0-1	7-8	2-3	0
			L-M	2-3 (SE)	0-1	7-8	4	0
08/07/21	15:44	18:44	M-H	1 (SE)	0	6-7	4	0
			H-M	1 (SE)	0	6	4	0
03/08/21	12:49	16:49	M-H	2-3 (NW)	0	5-8	3-4	0
			H-M	2 (NW)	0	3	4	0
03/08/21	19:09	23:09	M-L	2 (NW)	0	6	4	0
			L-M	1-2 (NW)	0	7	3-4	0
04/08/21	07:53	11:53	M-L	3-4 (NW)	0	6	4	0
			L-M	3-4 (NW)	0	5-6	4	0
04/08/21	13:59	17:59	M-H	4 (NW)	0-2	8	3	0
			H-M	3 (NW)	0-1	8	3	0

Wind speed (Beaufort) 0-5; Wind direction: NE = North east, NW = North west, SE: South east, SW = South west, E = East; Precipitation: 0 = none, 1 = drizzle, 2 = Light showers, 3 = heavy showers, 4 = heavy rain; Cloud cover (octas); Visibility: 0 = very poor (<500m), 1 = Poor (<1km), 2 = Moderate (1-3km), 3 = Good (3-5km), 4 = Excellent (>5km); Tidal cycle: H-M (high to mid), M-L (mid to low), L-M (low to mid), M-H (mid to high).

9.4 Results

9.4.1 Desk Study

The desk study identified four international sites with seabirds or migratory waterbirds as qualifying interest features within 30km of the Proposed Development, as shown in Table 9-2. The sites are listed together with the mean-maximum foraging range of qualifying interest features (where available, from Woodward *et al*., 2019) and the distance of the site to the Proposed Development.

Table 9-2 International Sites designated for ornithological features (including mean-maximum foraging range) within 30km of the Proposed Development. For mean-maximum the error is presented as ± Standard Deviation (SD) and the sample sizes are shown in parentheses (i.e. the number of sites from which maximum or mean foraging ranges were available)

Site	Site Code	Relevant qualifying ornithology interest features	Mean-maximum foraging range (km)	Distance to the Proposed Development (km)
Treshnish Isles SPA	UK9003041	European storm petrel *Hydrobates pelagicus*	339* (1)	14.3
		Greenland barnacle goose *Branta leucopsis*	N/A	
Coll and Tiree SPA	UK9020310	Great northern diver *Gavia immer*	N/A	25.0
		Common eider *Somateria mollissima*	N/A	
North Colonsay and Western Cliffs SPA	UK9003171	Chough *Pyrrhocorax pyrrhocorax*	N/A	25.1
		Black-legged kittiwake *Rissa tridactyla*	156.1±144.5 (37)	
		Common guillemot *Uria aalge*	73.2±80.5 (16)	
		Breeding seabird assemblage	N/A	

**The foraging distance presented for storm petrel and common gull is the maximum from a single colony, therefore no mean nor SD*

A fourth SPA, Cnuic agus Cladach Mhuile, was located within the 30km search radius, to the east of the Proposed Development. Cnuic agus Cladach Mhuile SPA is a large, predominantly upland site on the island of Mull in the Inner Hebrides, designated for its breeding population of <Redacted>

The Proposed Development lies within the mean-maximum foraging range of a number of qualifying features/interests of SPAs outwith the 30km search radius, for example gannet (mean-maximum foraging range of 315.2km) which is a qualifying feature of Aisla Craig SPA and St Kilda SPA, located 174km and 234km from the Proposed Development respectively. Given the very low number of individual birds recorded during the survey effort and the nature of the Proposed Development (i.e., the works are of a small-scale and local spatial extent), the impact on qualifying features of these SPAs is considered *de minimis* and therefore not considered further in the assessment.

No other statutory designated sites (e.g., SSSIs) were located within a 5km search radius of the Proposed Development.

9.4.2 Survey Results

A total of 16 bird species were recorded during the surveys undertaken between April and August 2021, of which two were qualifying species for SPAs within foraging range distance: black-legged kittiwake and great northern diver.

Figures 9-1 to 9-15, show the distribution and activity of these birds across the survey area, and monthly peak counts of all 16 species recorded are presented in Table 9-3 below.

The most commonly observed species recorded were greylag goose (peak count 130 individuals in July 2021) and shag (peak count 114 individuals in August 2021). Other species were generally observed in numbers between 1 and 20 individuals.

Black-legged kittiwake were only recorded within the survey area on one occasion, with a count of one individual (August) which represented significantly less than 1% (1/9,024 i.e., 0.0001) of the latest SPA population estimate for North Colonsay and Western Cliffs SPA, which is in foraging range of black-legged kittiwake. The extremely limited presence and low number of kittiwake in the survey area suggests that it is not of significant importance to this species.

Great northern diver were recorded on just two occasions and were represented by no more than two individuals (recorded in April). These counts also represented less than 1% (3/452 i.e., 0.0066) of the Tiree and Coll SPA population which is within 25km of the Proposed Development. The limited presence and low numbers of great northern diver in the survey area suggests that it is not of significant importance to this species.

All other species recorded in the survey area were typically coastal birds which included gulls, other seabirds (e.g., gannets, shags, cormorant and Manx shearwater) and waterfowl (e.g., Canada and greylag geese).

All of these species recorded are common and widespread and regularly occur in the coastal waters of west Scotland either throughout the year, or during the breeding or non-breeding season. All species were recorded in relatively low numbers compared to their national breeding populations.

The site and surrounding survey area are therefore only of local importance for all 16 species recorded.

Table 9-3 Monthly peak counts of intertidal and coastal birds recorded in the Iona Breakwater survey area

Species	SPA population	Month, Year					Peak Count	% SPA population
		April 2021	May 2021	June 2021	July 2021	August 2021		
				SPA Qualifying species				
Great northern diver	452 individuals	2	1	-	-	-	2	<1
Black-legged kittiwake	4,512 pairs	-	-	-	-	1	-	<1
				Non-SPA Species				
Cormorant	-	-	-	1	3	-	3	N/A
Canada goose	-	-	1	-	-	-	-	N/A
Common gull	-	3	2	5	4	6	6	N/A
Great black-backed gull	-	1	-	-	-	7	7	N/A
Greylag goose	-	-	9	24	130	42	130	N/A
Grey heron	-	-	-	-	1	-	1	N/A
European herring gull	-	8	6	9	1	57	58	N/A
Mallard	-	-	-	1	-	-	-	N/A
Manx shearwater	-	-	-	-	1	-	-	N/A
Eurasian oystercatcher	-	7	9	15	20	11	20	N/A

Species	SPA population	Month, Year					Peak Count	% SPA population
		April 2021	May 2021	June 2021	July 2021	August 2021		
Common ringed plover	-	4	-	-	-	-	-	N/A
Northern gannet	-	6	1	-	-	2	6	N/A
European shag	-	8	6	10	4	114	-	N/A
Common shelduck	-	-	5	-	9	-	9	N/A

9.5 Conclusion

From the desk study and surveys completed of the Proposed Development and surrounding survey area, the baseline information collated on birds show that all species recorded were in relatively low numbers compared to their national breeding populations.

The Proposed Development site and surrounding survey area are, in fact, only of local importance for all 16 species recorded.

Furthermore, there are no sites within or in proximity to the Proposed Development that have been designated to protect bird species, and there is no risk of any likely significant effect from the Proposed Development on any SPA, Ramsar site or SSSI within connectivity distance of the site.

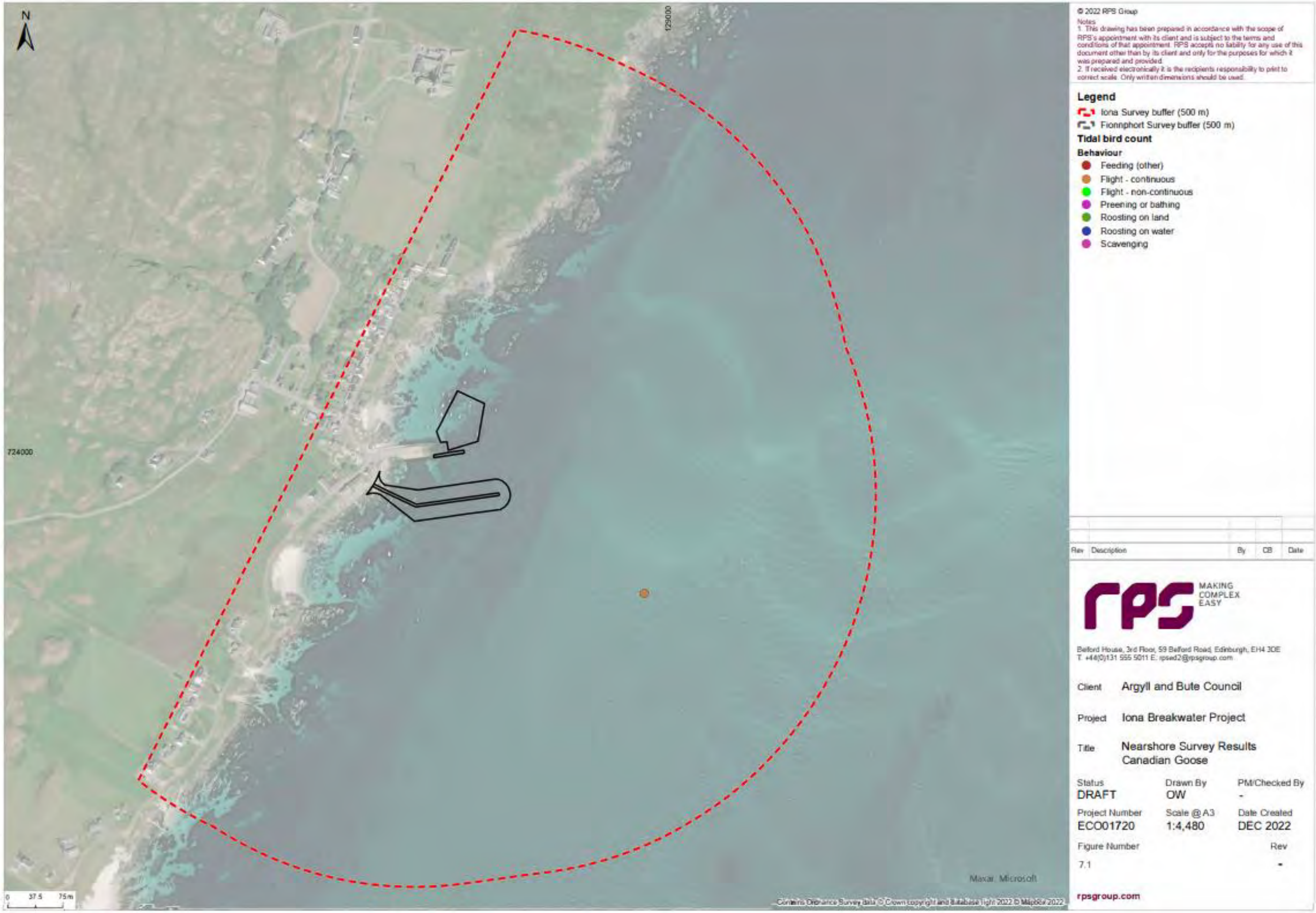

Figure 9-1 Nearshore survey results – Canada goose

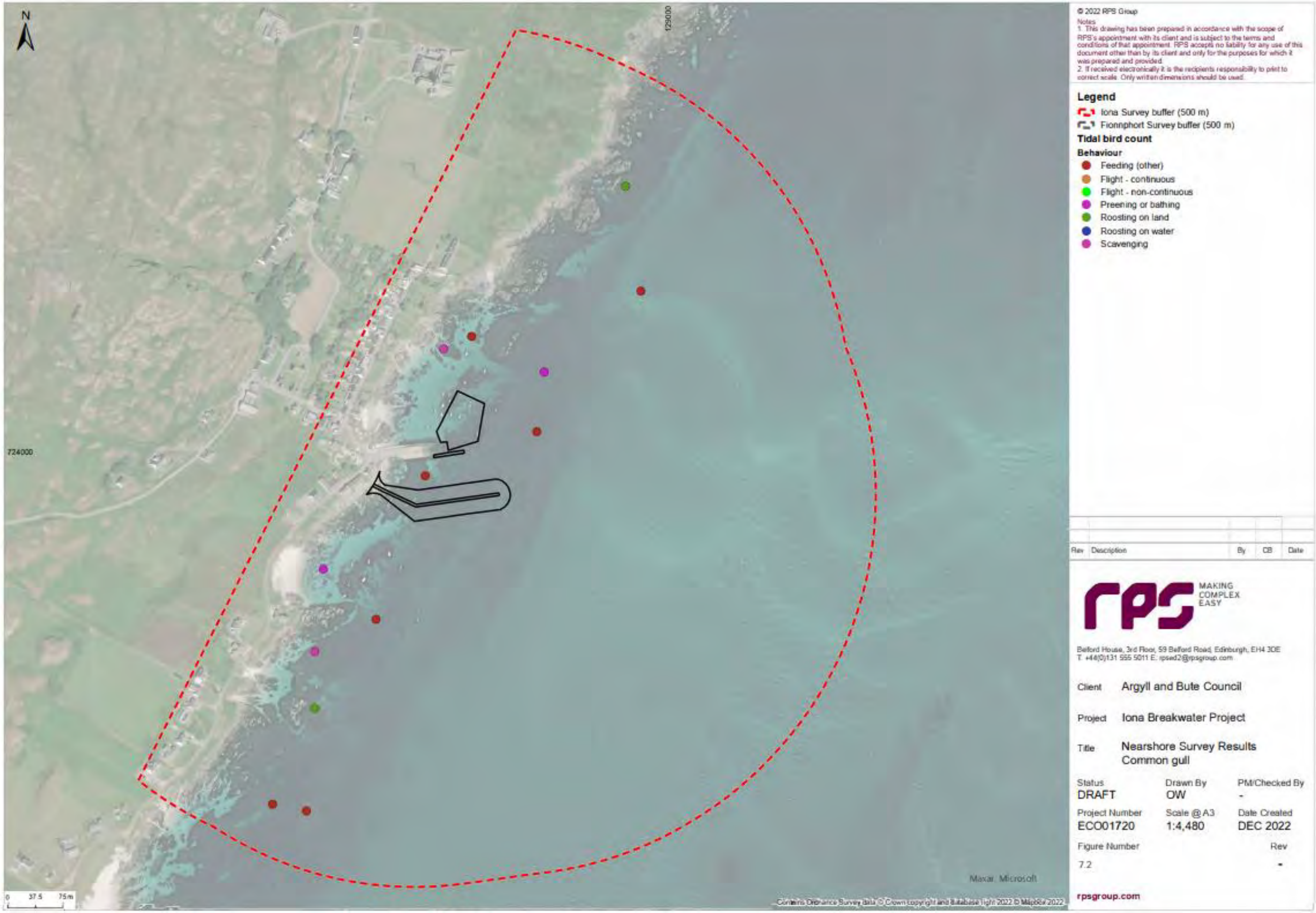

Figure 9-2 Nearshore survey results – Common gull

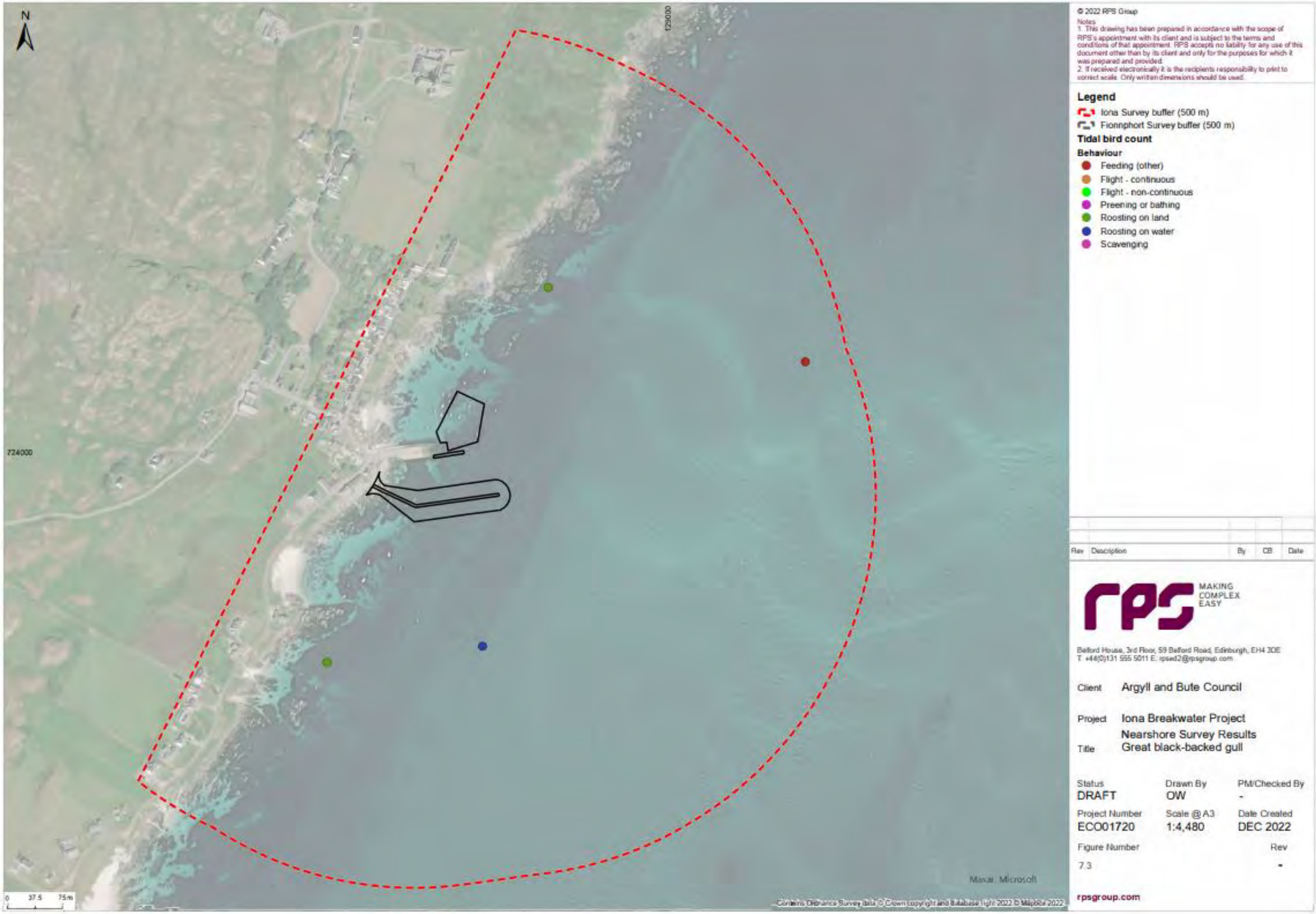

Figure 9-3 Nearshore survey results – Great black-backed gull

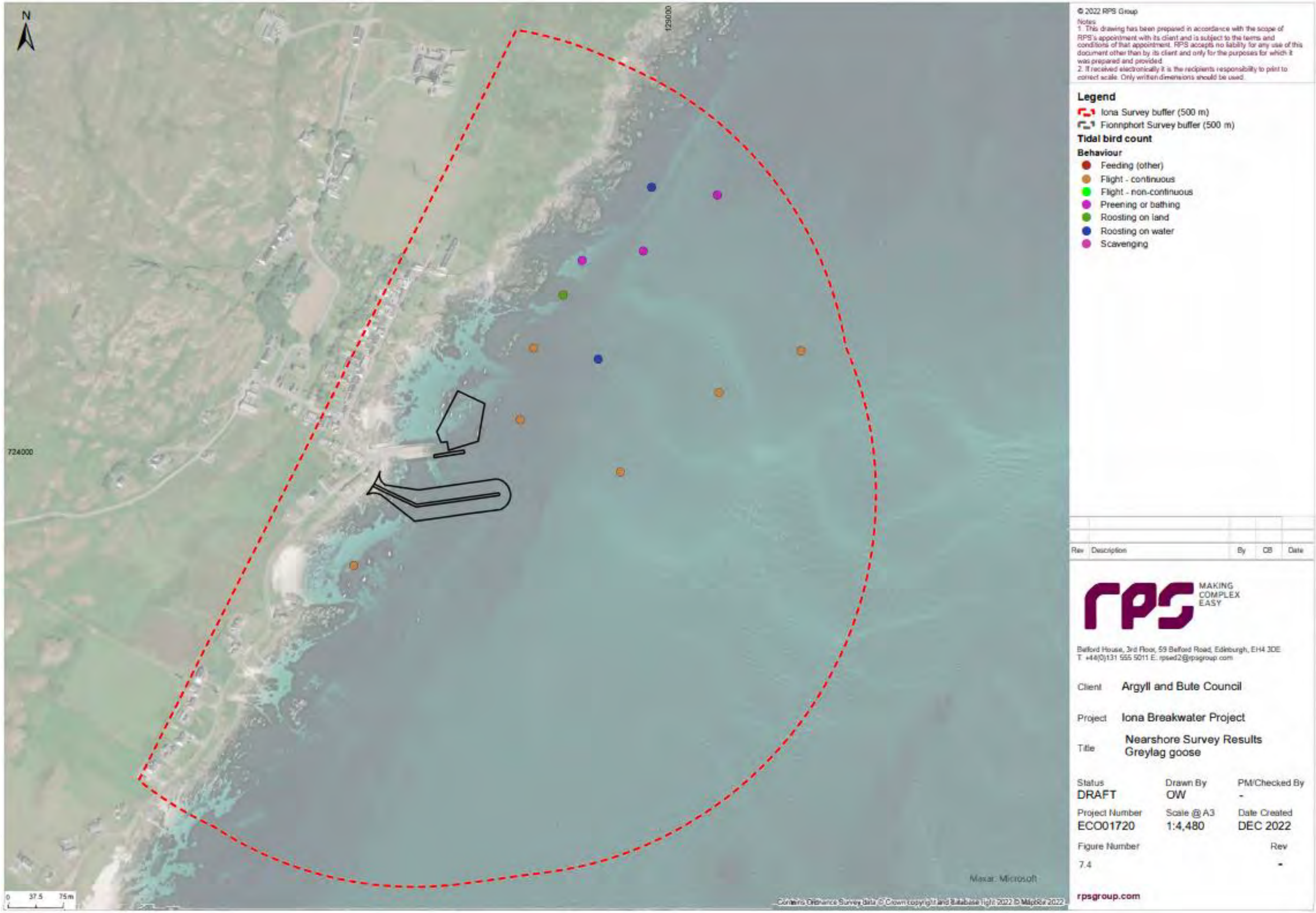

Figure 9-4 Nearshore survey results – Greylag goose

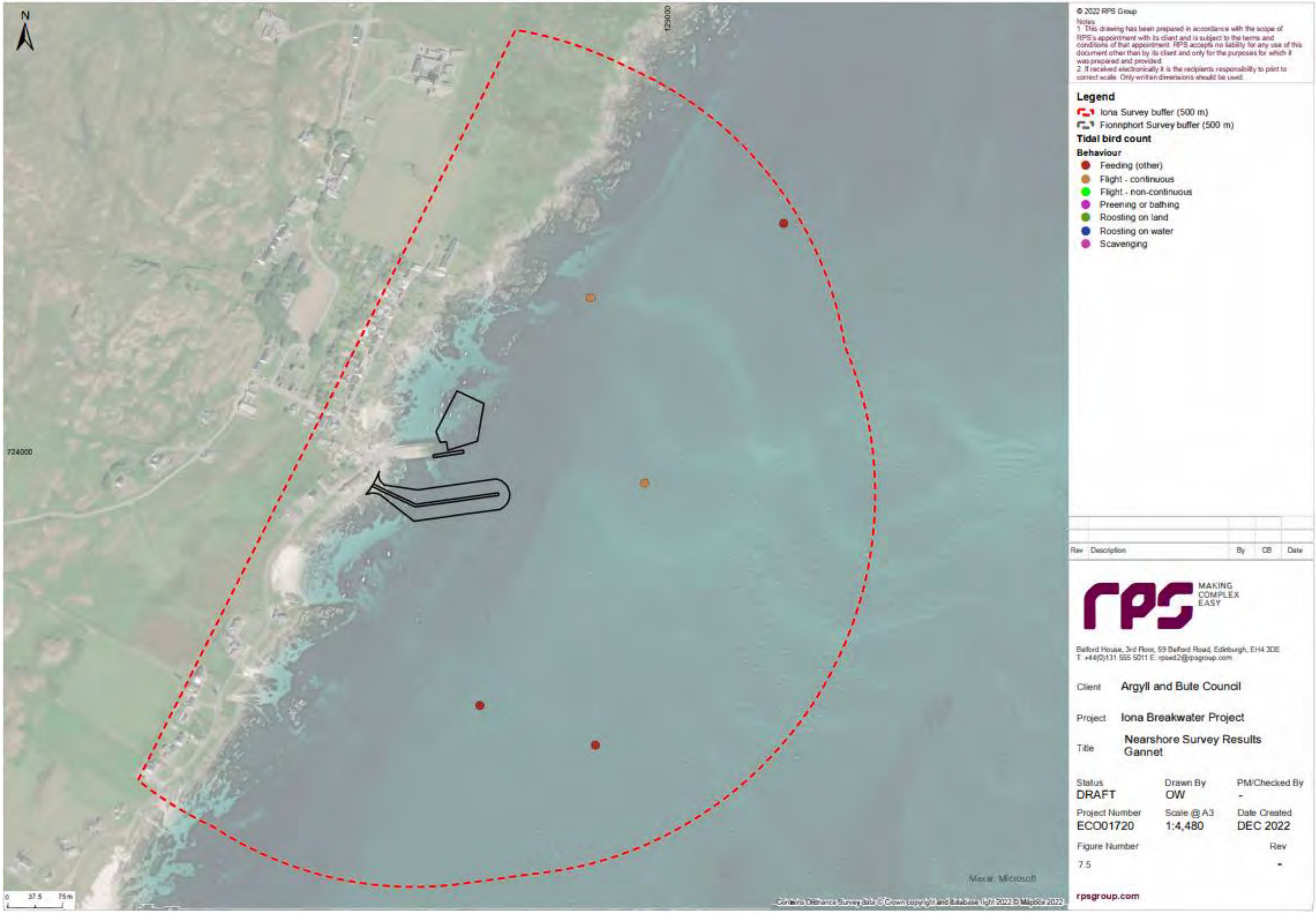

Figure 9-5 Nearshore survey results – Gannet

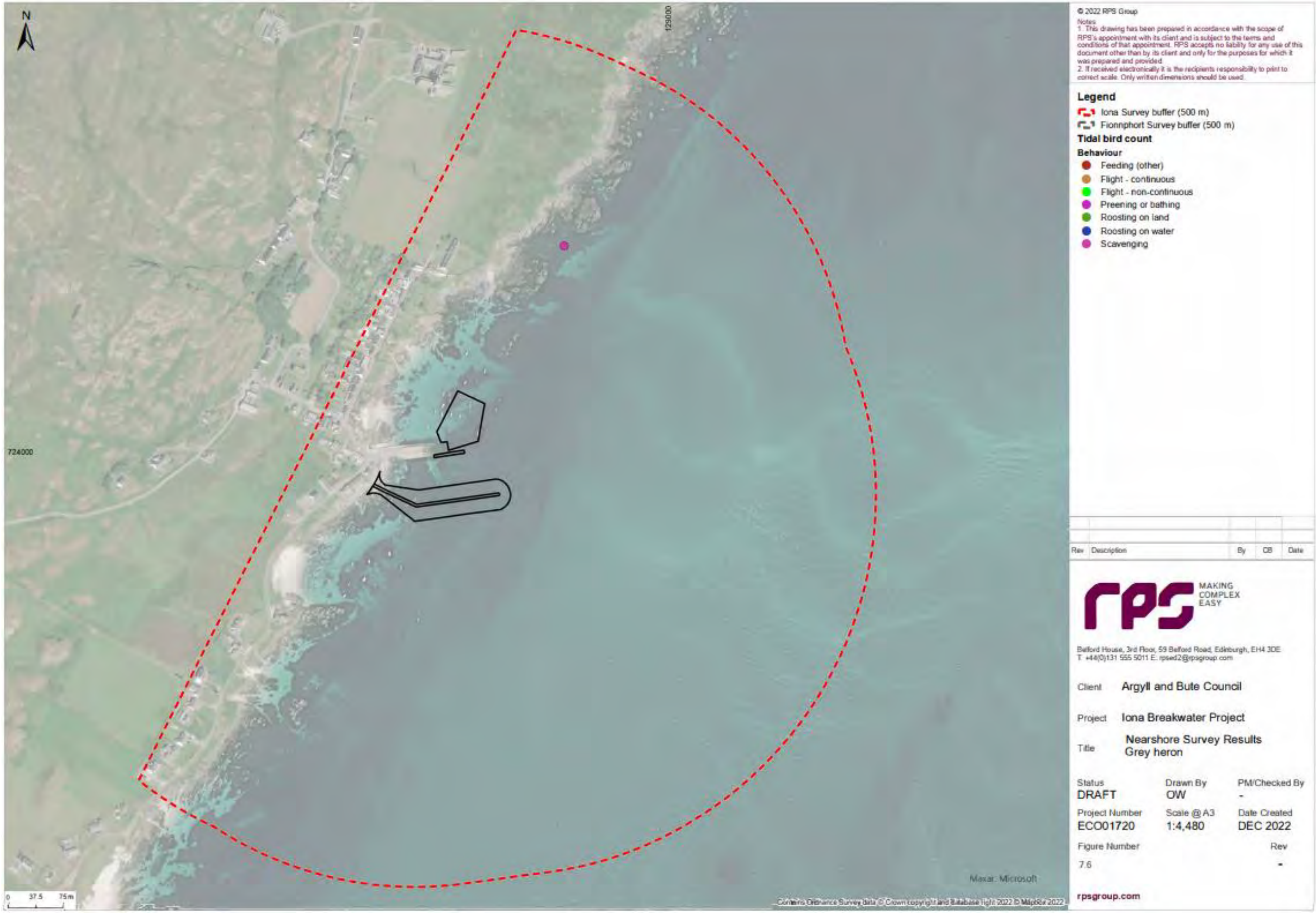

Figure 9-6 Nearshore survey results – Grey heron

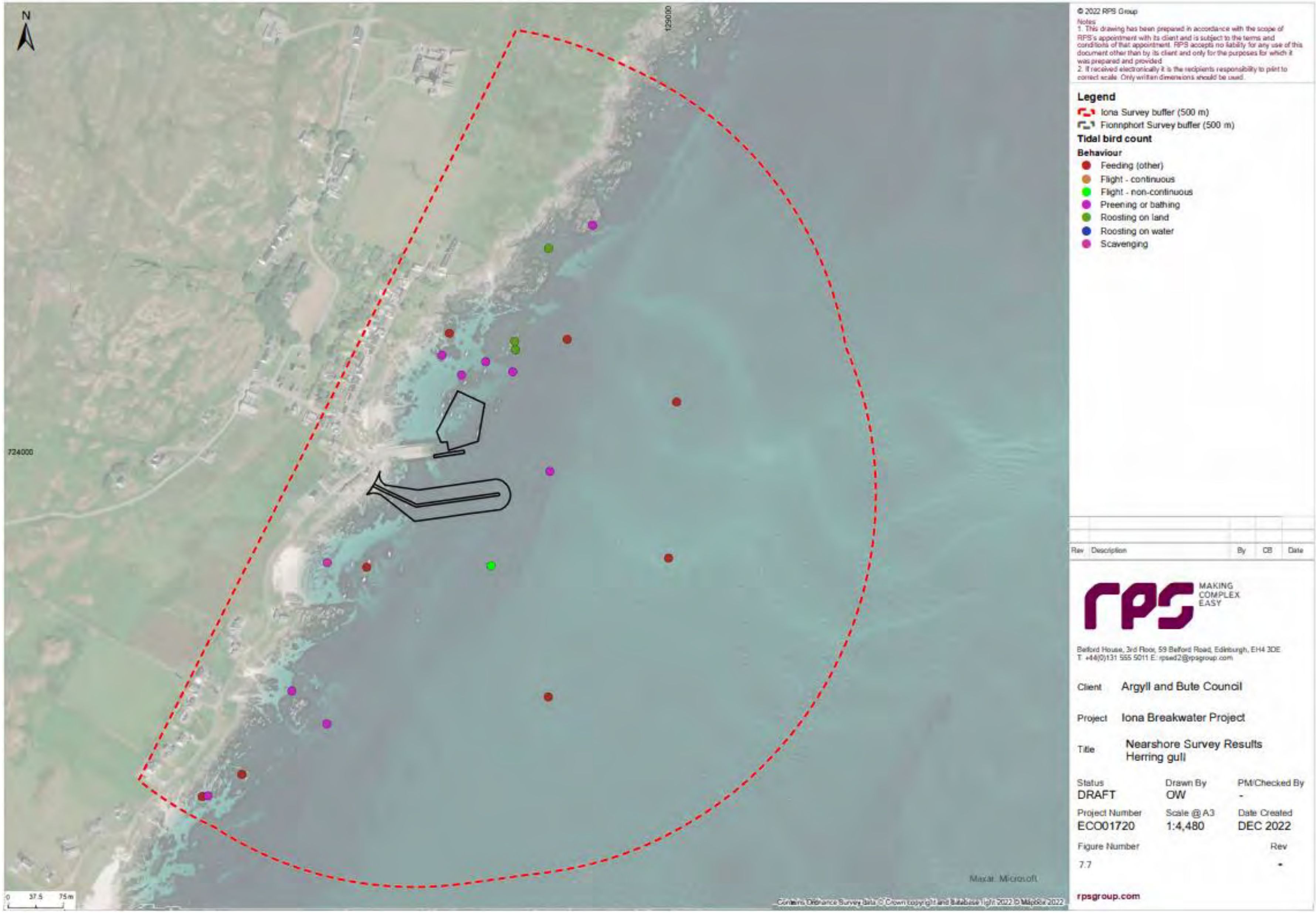

Figure 9-7 Nearshore survey results – Herring gull

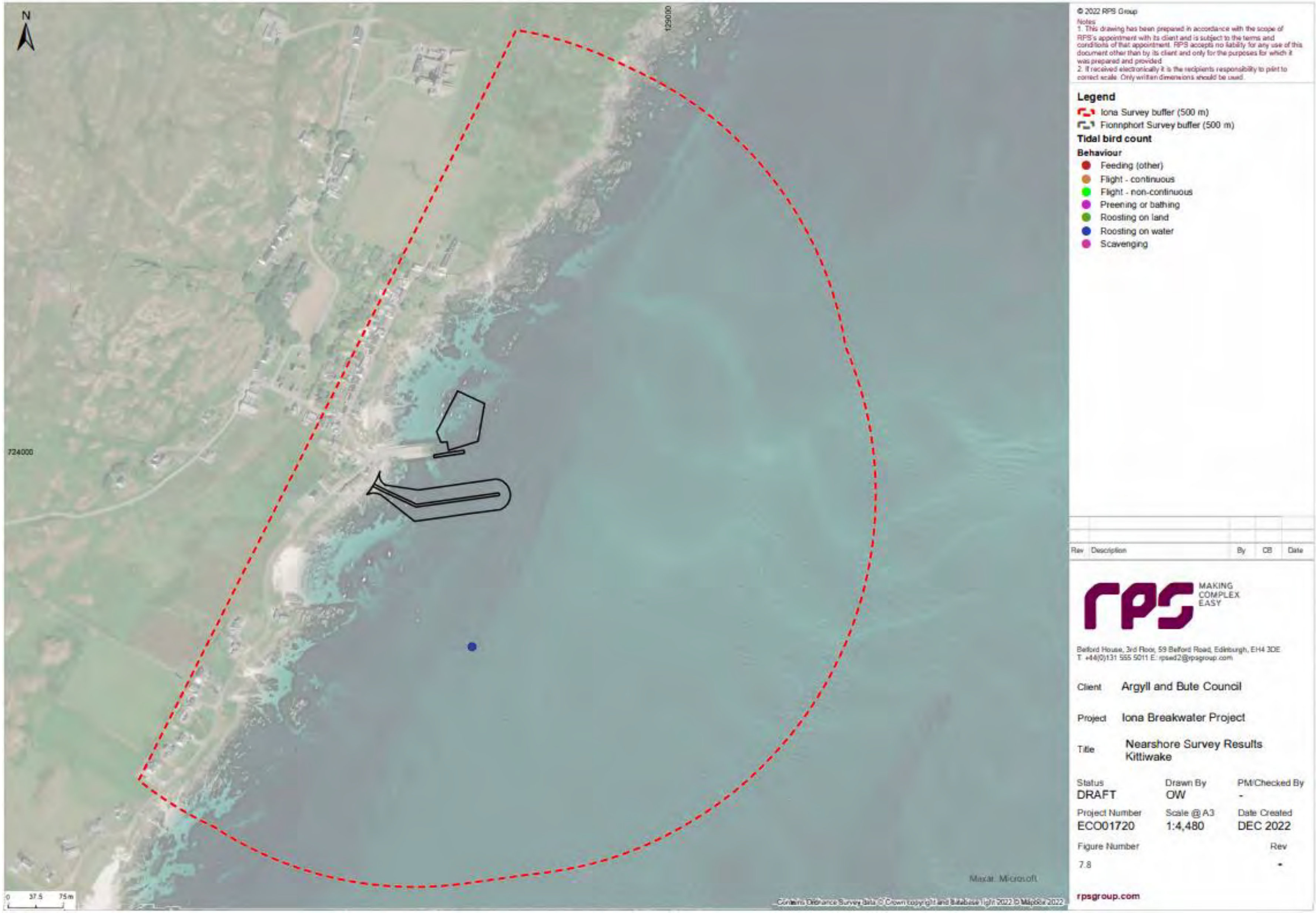

Figure 9-8 Nearshore survey results – Black-legged kittiwake

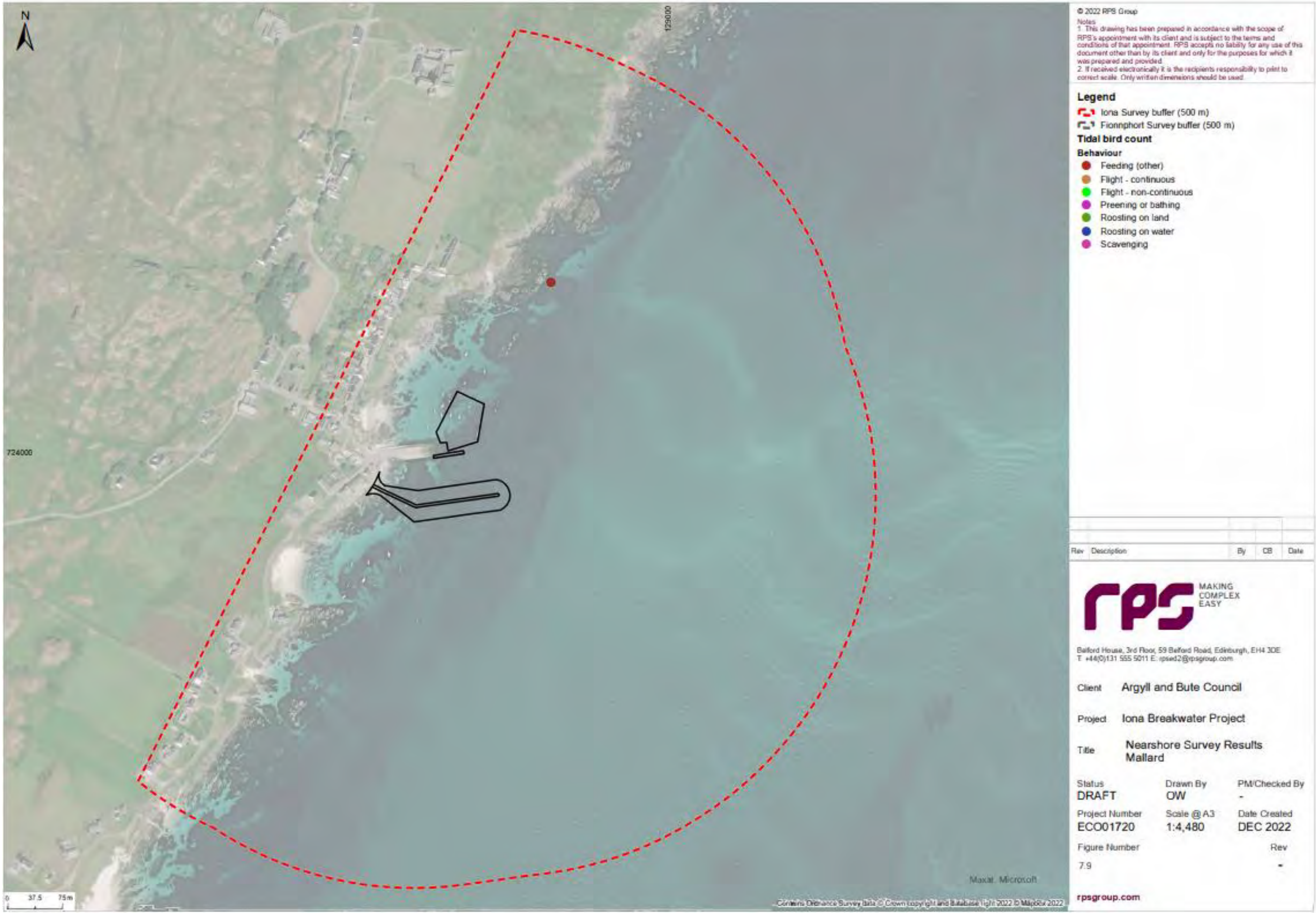

Figure 9-9 Nearshore survey results – Mallard

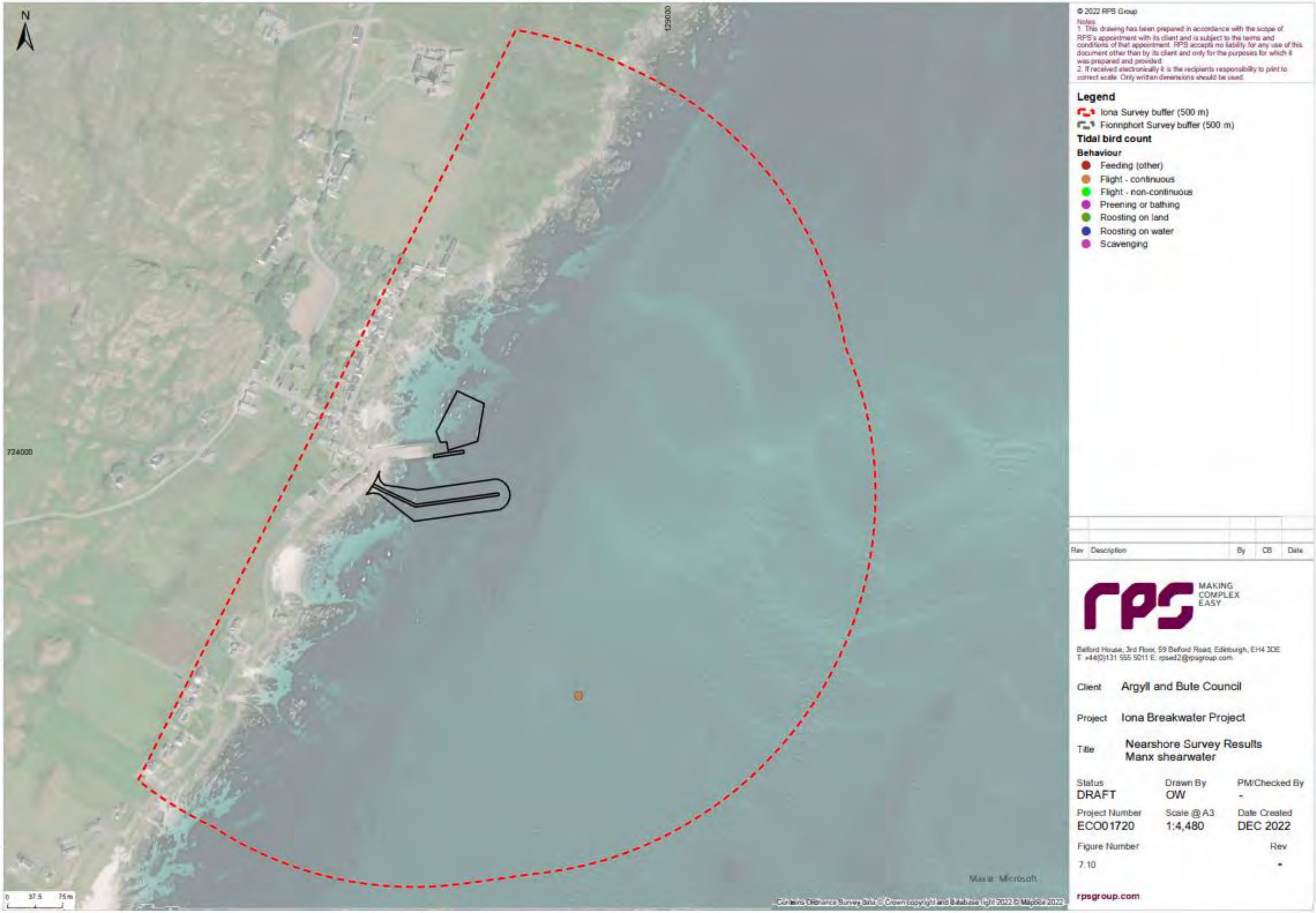

Figure 9-10 Nearshore survey results – Manx shearwater

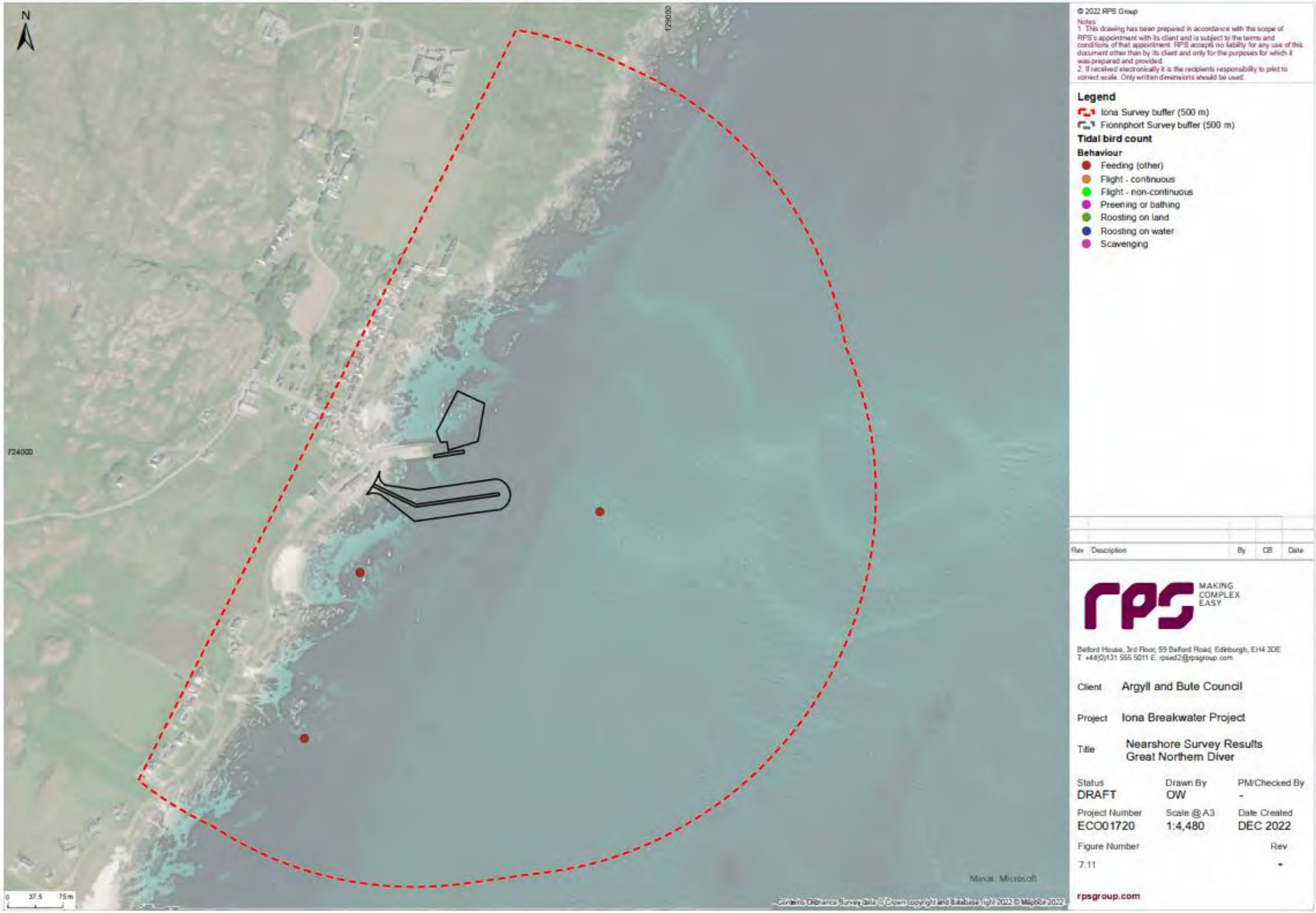

Figure 9-11 Nearshore survey results – Great northern diver

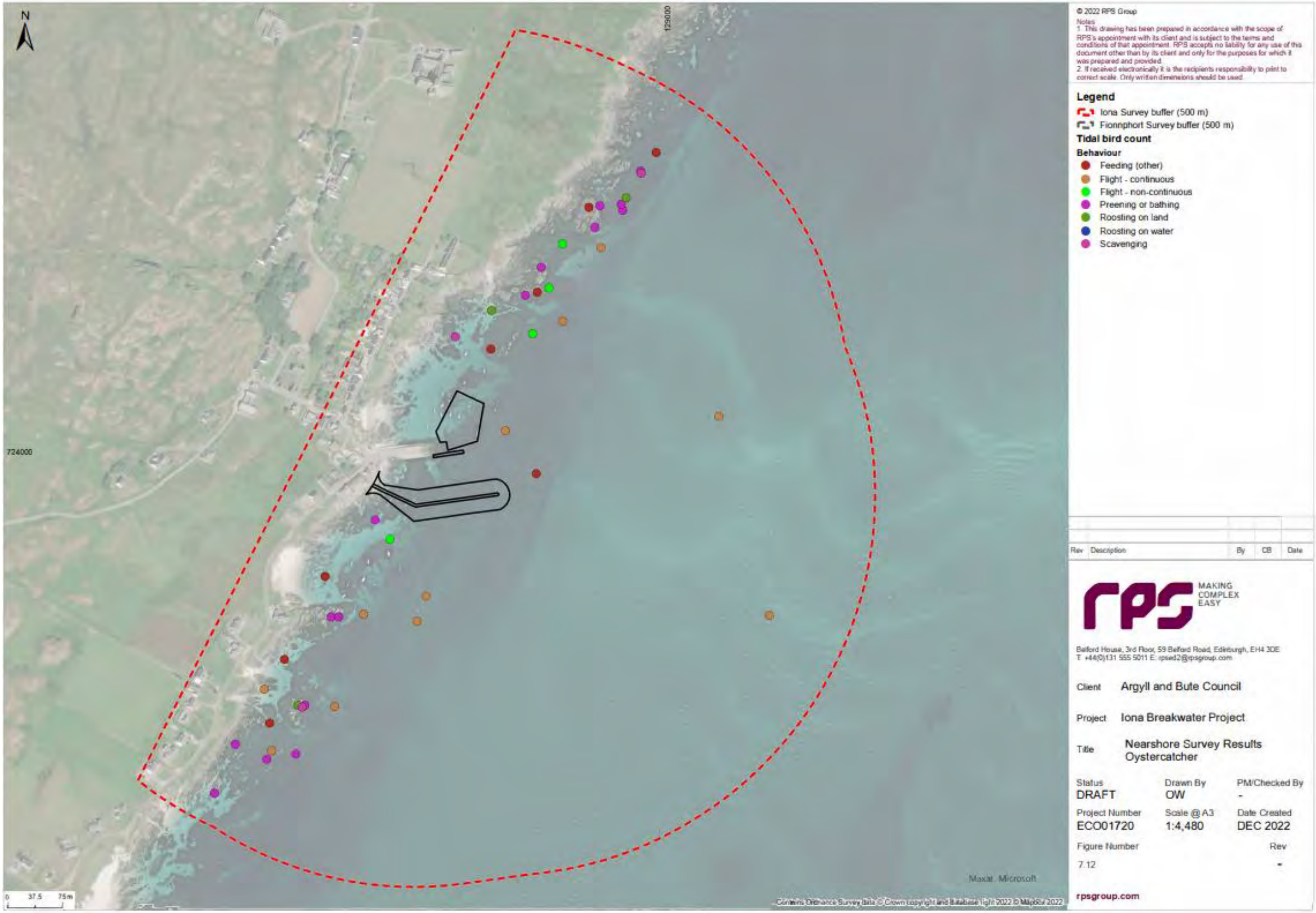

Figure 9-12 Nearshore survey results – Oystercatcher

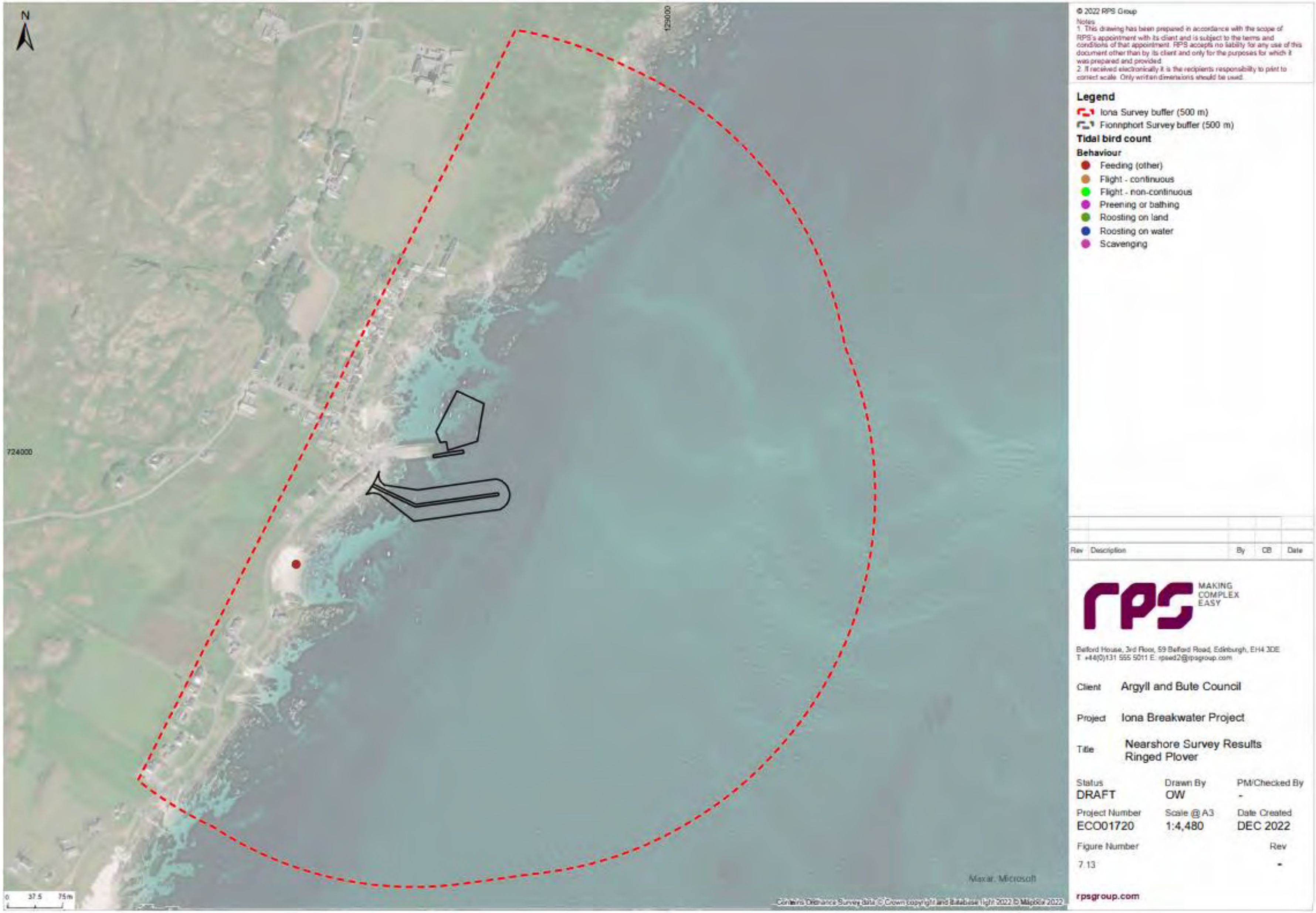

Figure 9-13 Nearshore survey results – Ringed plover

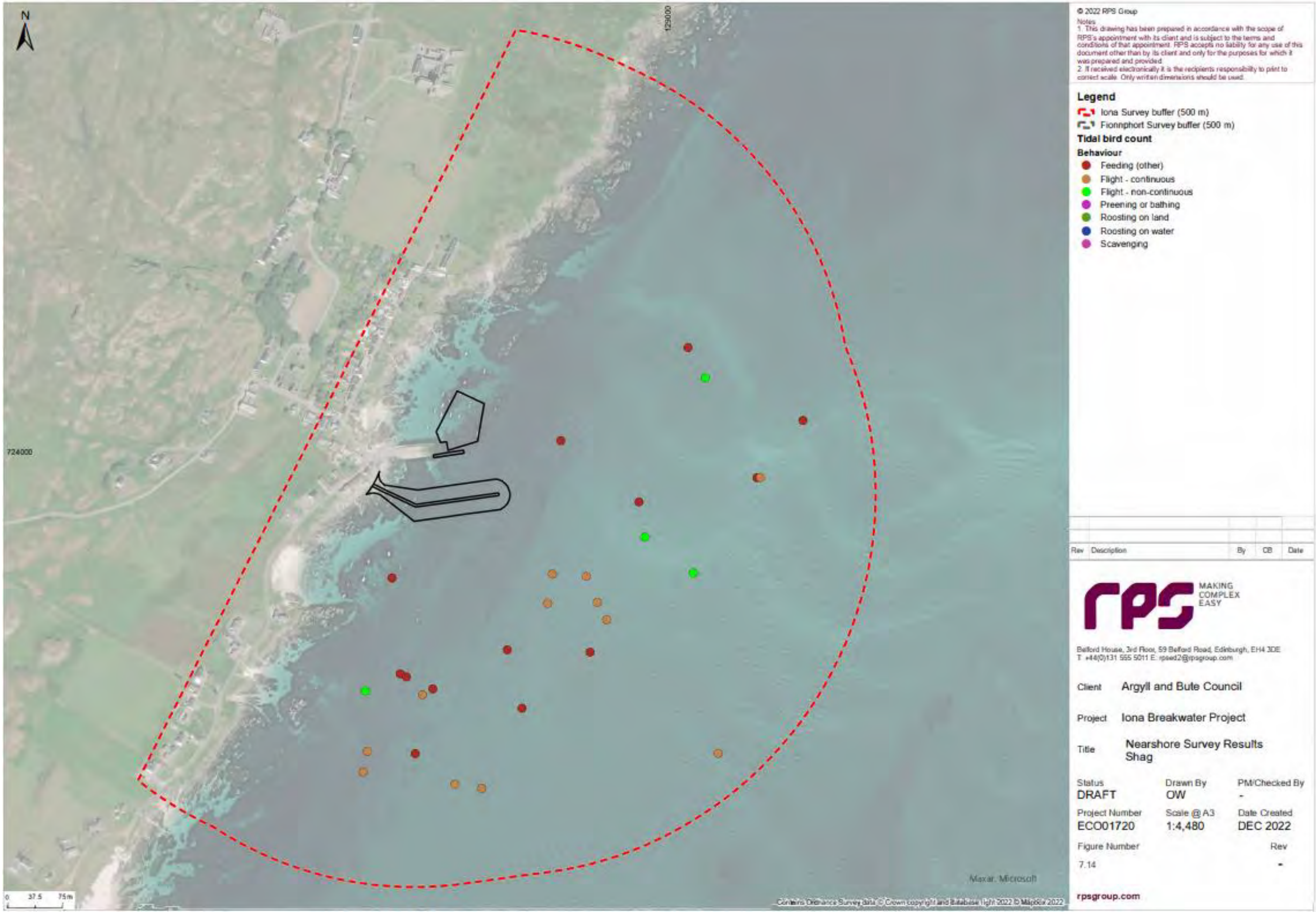

Figure 9-14 Nearshore survey results – Shag

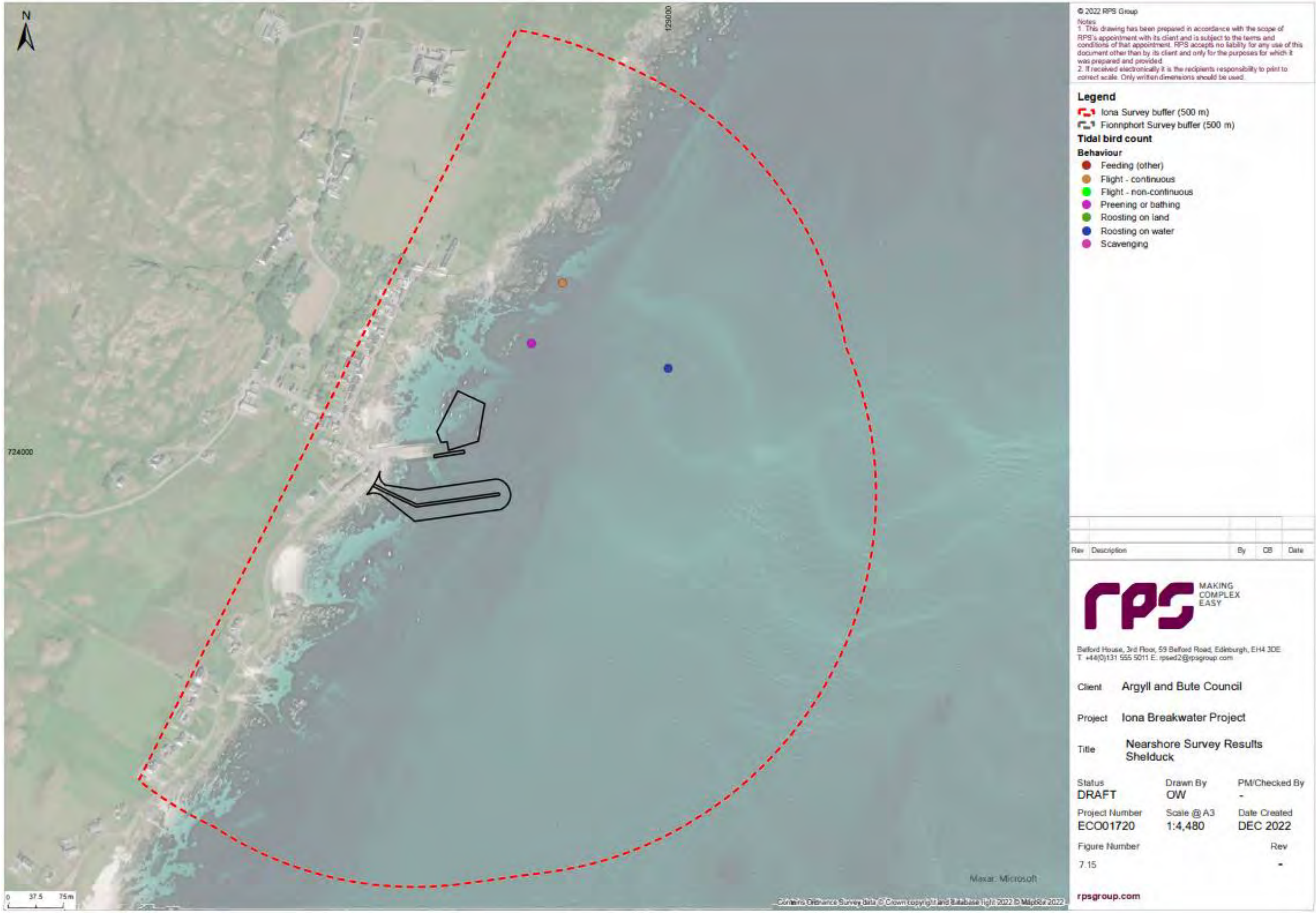

Figure 9-15 Nearshore survey results – Shelduck

9.6 References

- Argyll and Bute Planning Service (2017) A Biodiversity Technical Note for Planners And Developers.
- Burns, F., Eaton, M.A., Balmer, D.E., Banks, A., Caldow, R., Donelan, J.L., Douse, A., Duigan, C., Foster, S., Frost, T., Grice, P.V., Hall, C., Hanmer, H.J., Harris, S.J., Johnstone, I., Lindley, P., McCulloch, N., Noble, D.G., Risely, K., Robinson, R.A., Wotton, S. (2020) The State of the UK's Birds. The RSPB, BTO, WWT, DAERA, JNCC, NatureScot, NE and NRW, Sandy, Bedfordshire.
- Gilbert, G., Gibbons, D.W. and Evans, J. (1998) Bird Monitoring Methods. RSPB, Sandy.
- Musgrove A., Langston, R., Baker, H. and Ward, R. (2003). Estuarine Waterbirds at Low Tide: The WeBS Low Tide Counts 1992–93 to 1988–99. WSG/BTO/WWT/RSPB/JNCC, Thetford.
- Stanbury, A., Eaton, M., Aebischer, N., Balmer, D., Brown, A., Douse, A., Lindley, P., McCulloch, N., Noble, D., and Win I. (2021) The status of our bird populations: the fifth Birds of Conservation Concern in the United Kingdom, Channel Islands and Isle of Man and second IUCN Red List assessment of extinction risk for Great Britain. British Birds 114: 723-747.
- Woodward, I., Thaxter, C.B., Owen, E. and Cook, A.S.C.P. (2019) Desk-based revision of seabird foraging ranges used for HRA screening. BTO Research Report No. 724. The British Trust for Ornithology, Thetford, Norfolk.

Scientific Names of Species Included in this Report

Greenland barnacle goose *Branta leucopsis*

Canada goose *Branta canadensis*

Greylag goose *Anser anser*

Common shelduck *Tadorna tadorna*

Mallard *Anas platyrhynchos*

Common eider *Somateria mollissima*

Oystercatcher *Haematopus ostralegus*

Ringed plover *Charadrius hiaticula*

Black-legged kittiwake *Rissa tridactyla*

Common gull *Larus canus*

Great black-backed gull *Larus marinus*

Herring gull *Larus argentatus*

Guillemot *Uria aalge*

Great northern diver *Gavia immer*

Gannet *Morus bassanus*

Cormorant *Phalacrocorax carbo*

Shag *Gulosus aristotelis*

European storm petrel *Hydrobates pelagicus*

Manx shearwater *Puffinus puffinus*

Grey heron *Ardea cinerea*

Chough *Pyrrhocorax pyrrhocorax*

APPENDIX 10.1

Noise Monitoring Methodology

Instrumentation

The noise monitoring instrumentation used for the baseline noise monitoring survey conforms to the requirements for integrating averaging sound level meters (Type 1) as specified in BS EN 60804. All noise monitoring equipment specifications ae illustrated below in Table 10.A.1 below.

Table 10 A.1: Noise Monitoring Equipment Specification

Noise Monitoring Location	Sound Level Meter Type	Sound Level Meter Serial Number	Date of Issue	Microphone Serial Number	Preamp Serial Number
1	Norsonic 140	1406913	30/05/2019	208201	21061

The microphone in the noise kits was protected with a foam windshield.

The noise kit has been calibrated by a UKAS accredited laboratory within the previous 24 months. The kit was also field calibrated at the commencement and conclusion of each survey using the calibrator, which had themselves been calibrated by a UKAS accredited laboratory within the previous twelve months. No significant drift in the calibration signal was noted.

Sound Level Meter Calibration Certificates

Figure 10.A.1: Norsonic Calibrator Calibration Certificate

Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, CM6 1HD, England
www.campbell-associates.co.uk
info@campbell-associates.co.uk
Phone 01371 871030 Facsimile 01371879106

CALIBRATION

0789

Certificate number: U34705

Certificate of Calibration and Conformance

Test object:	**Sound Calibrator**
Manufacturer:	**Norsonic**
Type:	**1251**
Serial no:	**31060**
Customer:	The Airshed Limited
Address:	5 Lauder Place, East Linton East Lothian. EH40 3DB
Contact Person:	Hilary Fraser

Measurement Results	Level	Level Stability	Frequency	Frequency Stability	Distortion
1:	114.08 dB	0.05 dB	1000.11 Hz	0.00 %	0.36 %
2:	114.07 dB	0.05 dB	1000.10 Hz	0.00 %	0.37 %
3:	114.07 dB	0.05 dB	1000.10 Hz	0.00 %	0.36 %
Result (Average):	**114.07 dB**	**0.05 dB**	**1000.10 Hz**	**0.00 %**	**0.36 %**
Expanded Uncertainty:	0.10 dB	0.02 dB	1.00 Hz	0.01 %	0.10 %
Degree of Freedom:	>100	>100	>100	>100	>100
Coverage Factor:	2.00	2.00	2.00	2.00	2.00

The stated level is relative to 20µPa. The level is traceable to National Standards.
The stated level is valid at reference conditions. The following correction factors have been applied during the measurement: Pressure: 0.0005 dB/kPa Temperature: 0.003 dB/°C Relative humidity: 0.000 dB/%RH Load volume: 0.0003 dB/mm3
The reported expanded uncertainty of measurements is based on a standard uncertainty multiplied by the coverage factor of k=2, providing a level of confidence of approximately 95%. Where the degrees of freedom are insufficient to maintain this confidence level, the coverage factor is increased to maintain this confidence level. The uncertainty has been determined in accordance with UKAS requirements.
Records: K:\CA\Calibration\Nor-1504\Nor-1018 CalCal\2020\NOR1251_31060_M1.nmf

Environmental conditions:	Pressure:	Temperature:	Relative humidity:
Reference conditions:	101.325 kPa	23.0 °C	50 %RH
Measurement conditions:	101.591 ± 0.042 kPa	24.1 ± 0.1 °C	33.9 ± 1.2 %RH

Date received for calibration:	30/04/2020
Date of calibration:	05/05/2020
Date of issue:	05/05/2020
Engineer	

Michael Tickner

Supervisor

pp Darren Batten TechIOA

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Template UKAS_PS v2 10 Doc# Cert-C5001

Figure 10.A.2: Norsonic Sound Level Meter Class 1 Calibration Certificate

Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, GB-CM6 1HD
www.campbell-associates.co.uk
Phone 01371 871030 Facsimile 01371879106

CALIBRATION

0789

Certificate of Calibration and Conformance

Certificate number: **U31946**

Test object:	**Sound Level Meter, BS EN IEC 61672-1:2003 Class 1 (Precision)**
Producer :	**Norsonic**
Type :	**140**
Serial No.:	**1406913**
Customer:	**The Airshed Ltd**
Address:	**5 Lauder Place, East Linton, EH40 3DB.**
Contact Person:	**Hilary Fraser.**

Method :
Calibration has been performed as set out in CA Technical Procedures TP01 & 02 as appropriate. These are based on the procedures for periodic verification of sound level meters as set out in BS EN IEC 61672-3:2006. Results and conformance statement are overleaf and detailed results are in the attached Test Report.

Tested

	Producer	Type	Serial No	Certificate number
Microphone	Norsonic	1225	208201	31946
Calibrator*	Norsonic	1251	30873	U30563
Preamplifier	Norsonic	1209	21061	Included

Additional items that also have been submitted for verification
Wind shield -
Attenuator -
Extension cable -
These items have been taken into account wherever appropriate

Instruction manual: Im140_1Ed6R3En Firmware version 4.0.1282 The test object is a single channel instrument.

Conditions	Pressure	Temperature	Humidity
Reference conditions:	101.325 kPa	23.0 °C	50 %RH
Measurement conditions:	101.34 ±0.05 kPa	22.0 ±0.2 °C	47.0 ±0.7 %RH

Date received for calibration:	22/05/2019
Date of calibration:	30/05/2019
Date of issue:	30/05/2019

Engineer

Michael Tickner

Supervisor

Darren Batten TechIOA

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.
* The calibrator was complete with any required coupler for the microphone specified.

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APPENDIX 10.2

Noise Monitoring Location

Noise Monitoring Location (NML) 1 was located at Iona House, Iona. The baseline noise monitoring survey started at 17:00hrs on Tuesday 29th June 2021 and ended on Friday 2nd July 2021 at 12:45hrs.

Photograph 10.B.1: Noise Monitoring Survey at NML1

APPENDIX 10.3

Baseline Noise Monitoring Survey Data

Noise Monitoring Location 1

Attended Noise Monitoring at NML 1

The baseline noise monitoring survey started at 17:00hrs on 29/06/21 and ended at 12:45 on 02/07/2021. The survey was attended during the following periods:

- 10:08hrs – 11:13hrs on 30th June 2021;
- 22:00hrs – 00:00hrs on 30th June 2021;
- 18:00hrs – 20:00hrs on 1st July 2021; and
- 23:00hrs – 00:00hrs on 1st July 2021.

Notes from the attended periods of the baseline noise monitoring survey as summarised in Tables 10.C.1 – 10.C.4 below.

Table 10.C.1: Subjective Survey Notes during Attended period 10:08hrs – 11:13hrs on 30th June 2021

Date	Time	Subjective Survey Notes
30/06/21	10.08	Survey Start, Ferry at Iona slip
	10.10	Ferry departs, announcement
	10.11	Post van
	10.12	Van
	10.14	Outboard motor in Sound of Iona
	10.15	Van
	10.22	Van
	10.29	Car
	10.31	Van
	10.33	Car
	10.36	Engine, boat or aircraft
	10.37	Boat in SoI, car
	10.41	Ferry approaching slip
	10.49	Ferry departs, announcement
	10.54	Car
	10.55	Car
	10.56	Outboard motor in Sound of Iona
	11.05	Van
	11.08	Car
	11.10	Van
	11.13	Van

Table 10.C.2: Subjective Survey Notes during Attended period 22:00hrs – 00:00hrs on 30th June 2021

Date	Time	Subjective Survey Notes
30/06/21	22.00	Survey Start
	22.55	Tracked low frequency plant noise to rear of post office shed. Constant low hum.
	23.21	Car
	23.27	Car
	00.00	Survey End

Table 10.C.3: Subjective Survey Notes during Attended period 18:00hrs – 20:00hrs on 1st July 2021

Date	Time	Subjective Survey Notes
01/07/21	18.00	Survey Start
	18.01	Ferry departs, announcement
	18.02	Car
	18.04	Boat in Sol, then at slip
	18.05	Joiners at work approx 40 metres uphill. Power tools, saws.
	18.07	Boat leaves slip
	18.13	Generator running at joiners worksite
	18.17	Aircraft over Sol
	18.20	Car
	18.22	Car, Boat at slip
	18.30	Ferry at slip, Car
	18.32	Ferry departs, announcement, passengers near meter
	18.35	Car
	18.39	Chains being handled in boat park
	18.43	Outboard motor in Sol. Power tools continue.
	18.46	Car
	18.51	Aircraft over Sol
	18.52	Power tools continue
	19.04	Power tools continue
	19.14	Power tools continue
	19.27	Car
	19.37	Hammering from worksite
	19.39	Van - joiners leaving
	19.49	Angle grinder from the north
	19.52	Car
	19.54	Tractor
	19.55	Opera singer near field
	20.00	Survey End

Table 10.C.4: Subjective Survey Notes during Attended period 23:00hrs – 00:00hrs on 1st July 2021

Date	Time	Subjective Survey Notes
01/07/21	23.00	Survey Starts
	23.40	Pedestrians
	23.47	Pedestrians
	00.00	Survey Ends

Unattended Noise Monitoring at NML 1

Figure 10.C.1: Complete Noise Data Graph (29/06/2021 – 02/07/2021)

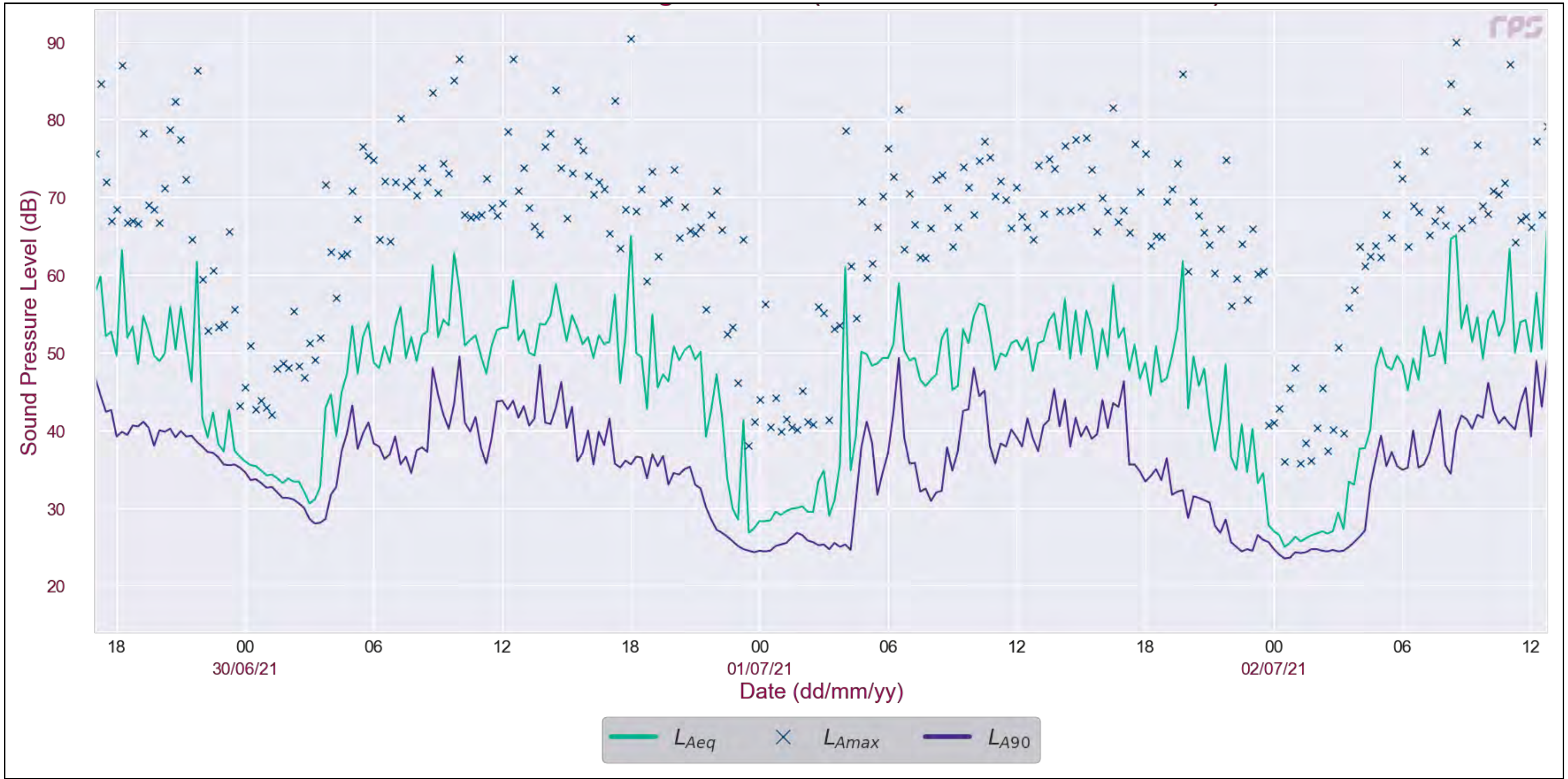


Figure 10.C.2: Complete Noise Data and Weather Data Graph (29/06/2021 – 02/07/2021)

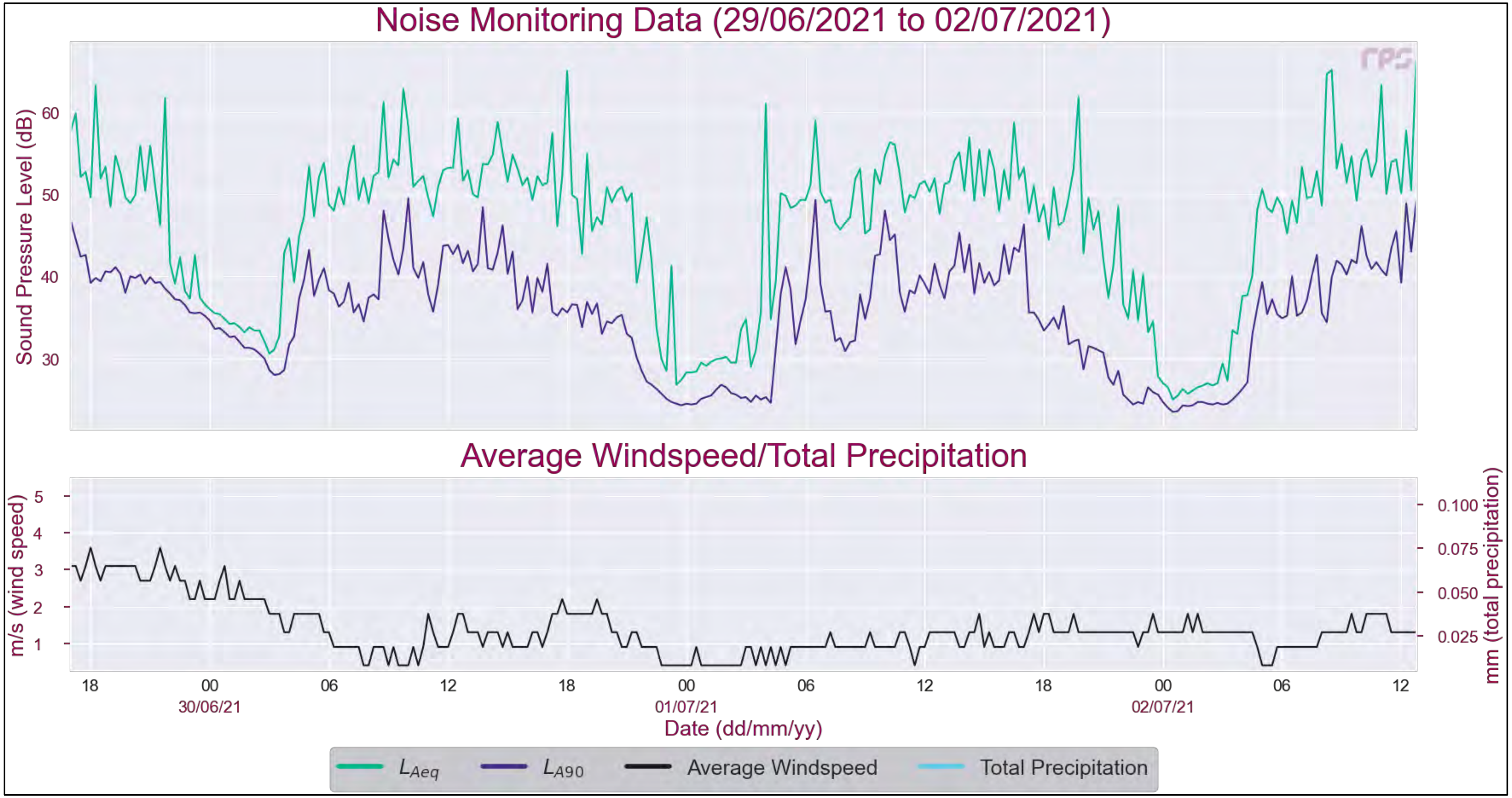


Figure 10.C.3: Frequency Daytime (1hour) Graph (29/06/2021 – 02/07/2021)

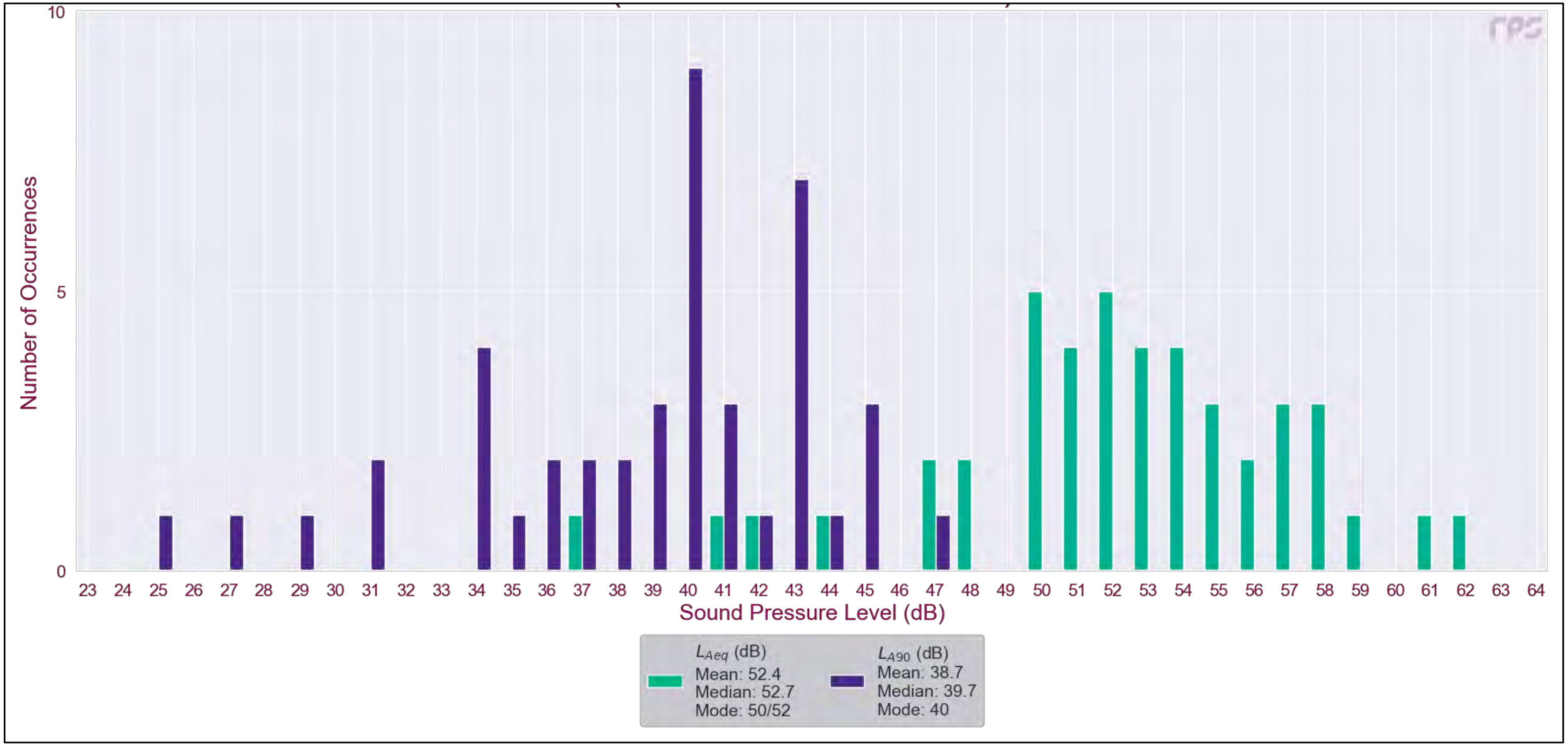
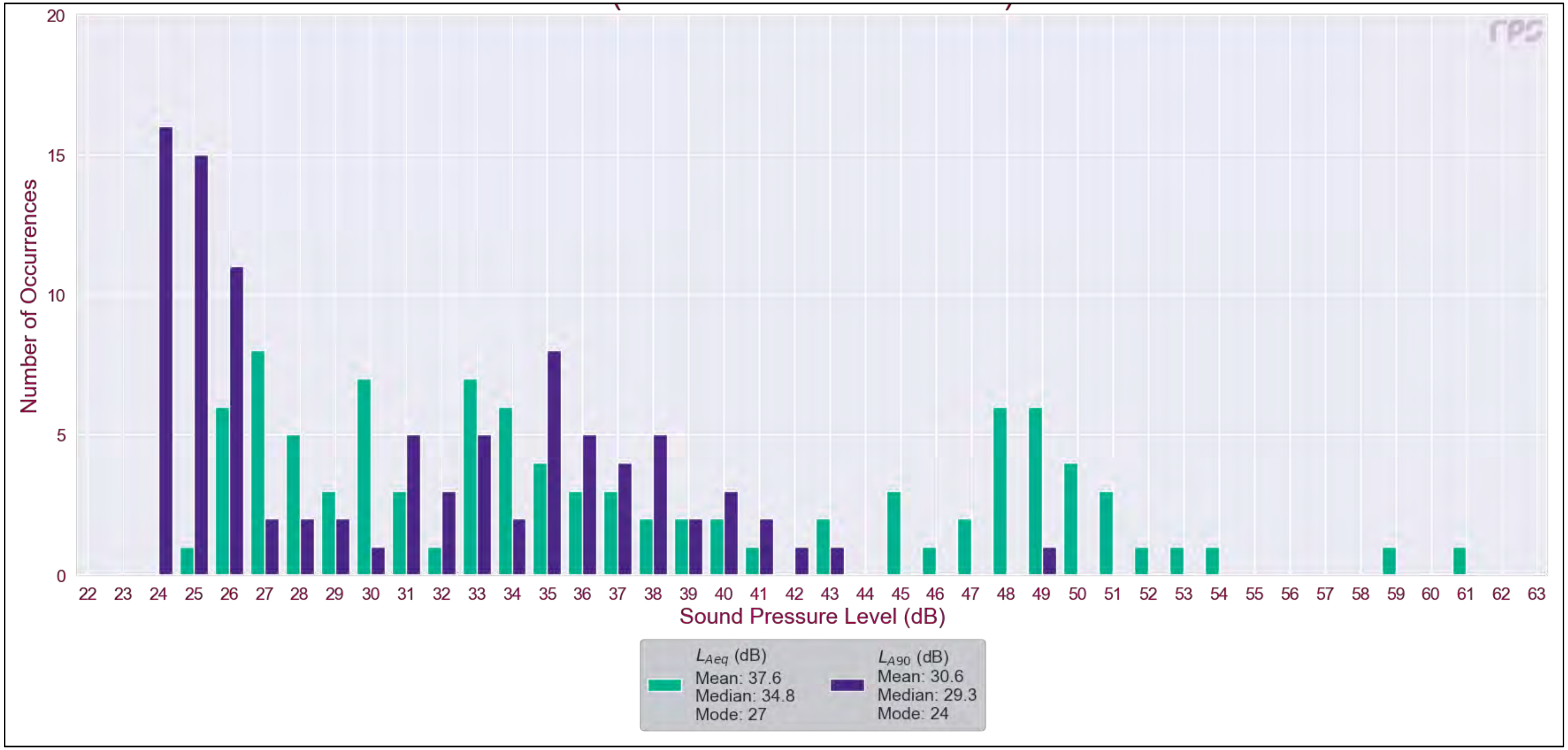


Figure 10.C.4: Frequency Night time (15minutes) Graph (29/06/2021 – 02/07/2021)



The typical background noise levels are summarised below in Table 9.C.5 including statistical analysis L_{A90} noise levels:

Table 10.C.5: Unattended Typical Daytime and Night time L_{A90} and L_{Aeq} Noise Levels NML 1 (29/06/2021 – 02/07/2021) (Mode)

Datasets	L_{A90} Analysis		L_{Aeq} Analysis	
	Daytime dB	Night time dB	Daytime dB	Night time dB
NML 1	40	24	50/52	27

APPENDIX 10.4

Construction Noise Receptors

Table 10.D.1: Noise Sensitive Receptors Details

Noise Sensitive Receptor ID	Easting (X)	Northing (Y)	Residential
1	128573	724560	Yes
2	128673	724525	No
3	128591	724456	No
4	128501	724431	Yes
5	128554	724373	No
6	128520	724378	No
7	128490	724337	No
8	128673	724251	No
9	128640	724245	Yes
10	128447	724268	Yes
11	128498	724253	No
12	128480	724215	No
13	128608	724179	Yes
14	128585	724128	No
15	128437	724120	Yes
16	128555	724058	No
17	128541	724036	No
18	128578	723992	Yes
19	128372	724052	Yes
20	128370	723997	Yes
21	128543	723958	No
22	128515	723941	No
23	128298	723992	No
24	128247	723961	Yes
25	128463	723775	Yes
26	128412	723769	Yes
27	128404	723732	Yes
28	128356	723694	Yes
29	128350	723678	Yes
30	128349	723660	Yes
31	128334	723641	Yes
32	128332	723609	Yes
33	128317	723591	No
34	128287	723571	Yes

Figure 10.D.1: Location of Construction Noise Sensitive Receptors

APPENDIX 10.5

Construction Noise Monitoring Assessment

Figure 10.E.1: Construction Noise Receptors and Locations of Proposed Construction Activity

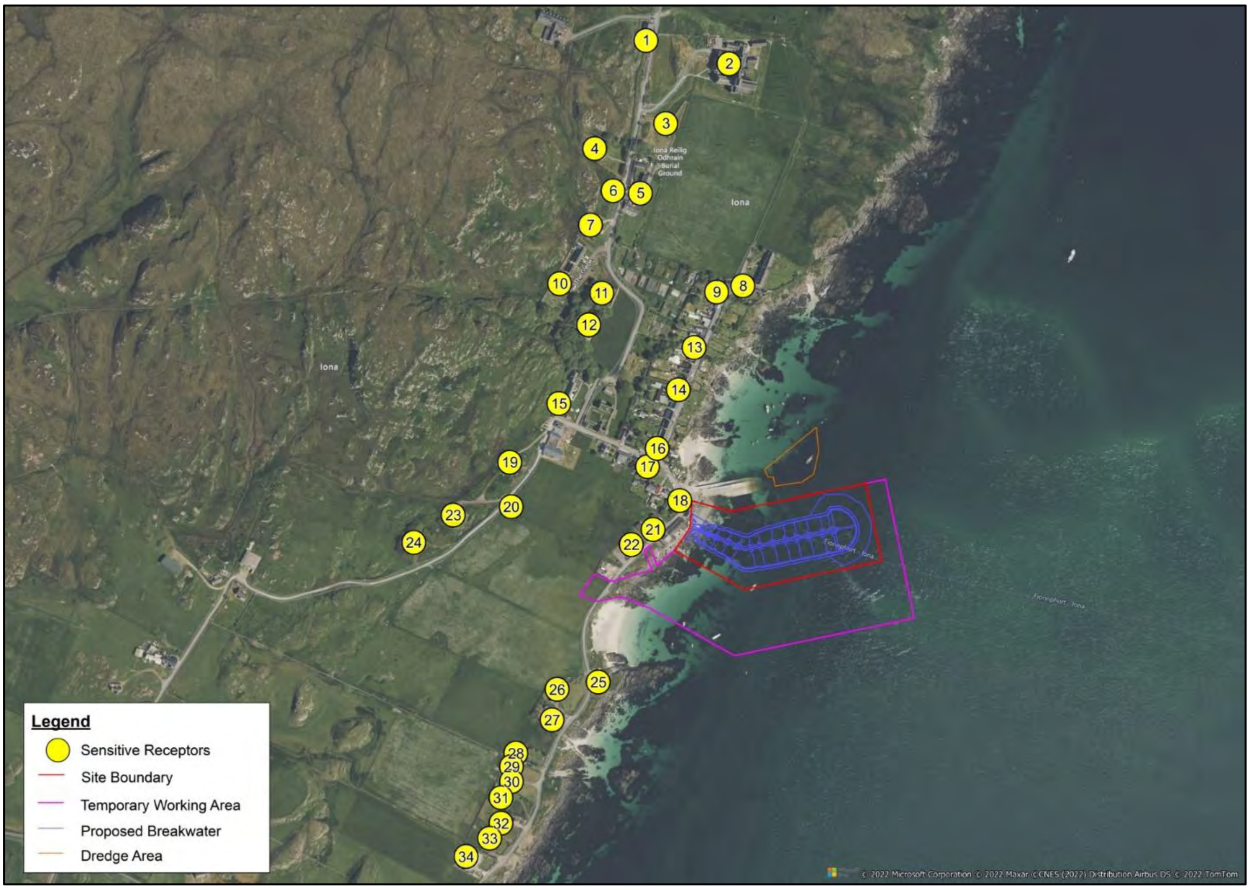


Table 10.E.1: Construction Noise Receptors and BS 5228 ABC Category

Construction Receptor ID	Easting	Northing	Residential	Sensitivity	BS5228 ABC Category A (daytime) dB	BS5228 Category A Guideline (Night time) dB
1	128573	724560	**Yes**	**High**	65	45
2	128673	724525	No	Medium	65	45
3	128591	724456	No	Medium	65	45
4	128501	724431	**Yes**	**High**	65	45
5	128554	724373	No	Medium	65	45
6	128520	724378	No	Medium	65	45
7	128490	724337	No	Medium	65	45
8	128673	724251	No	Medium	65	45
9	128640	724245	**Yes**	**High**	65	45
10	128447	724268	**Yes**	**High**	65	45
11	128498	724253	No	Medium	65	45
12	128480	724215	No	Medium	65	45
13	128608	724179	**Yes**	**High**	65	45
14	128585	724128	No	Medium	65	45
15	128437	724120	**Yes**	**High**	65	45
16	128555	724058	No	Medium	65	45
17	128541	724036	No	Medium	65	45
18	128578	723992	**Yes**	**High**	65	45
19	128372	724052	**Yes**	**High**	65	45
20	128370	723997	**Yes**	**High**	65	45
21	128543	723958	No	Medium	65	45
22	128515	723941	No	Medium	65	45
23	128298	723992	No	Medium	65	45
24	128247	723961	**Yes**	**High**	65	45
25	128463	723775	**Yes**	**High**	65	45
26	128412	723769	**Yes**	**High**	65	45
27	128404	723732	**Yes**	**High**	65	45
28	128356	723694	**Yes**	**High**	65	45
29	128350	723678	**Yes**	**High**	65	45
30	128349	723660	**Yes**	**High**	65	45
31	128334	723641	**Yes**	**High**	65	45
32	128332	723609	**Yes**	**High**	65	45
33	128317	723591	**No**	**High**	65	45
34	128287	723571	**Yes**	**High**	65	45

Table 10.E.2: Distance from Construction Noise Receptors to Construction Area Boundaries

Construction Receptor ID	Site Boundary (m)	Dredging Works (m)	Construction of Breakwater (m)
1	569	520	585
2	540	460	543
3	466	418	481
4	450	438	465
5	384	361	400
6	394	384	409
7	362	369	377
8	269	197	277
9	259	207	275
10	313	341	327
11	279	296	294
12	251	281	265
13	189	172	205
14	138	145	154
15	203	266	213
16	78	135	92
17	69	144	80
18	15	111	23
19	229	314	233
20	208	315	216
21	37	155	40
22	54	187	65
23	276	387	286
24	321	441	332
25	186	324	204
26	223	366	241
27	257	397	275
28	316	457	334
29	332	473	351
30	347	486	365
31	371	510	389
32	397	534	415
33	420	557	438
34	455	593	473

Table 10.E.3: Construction of Breakwater Noise Predictions

Construction Receptor ID	Closest Distance to Construction of Breakwater (m)	BS5228 Category A Guideline (Daytime)	BS5228 Category A Guideline (Night time)	Construction of Breakwater Total SPL (dB)
1	520	65	45	54.7
2	460	65	45	55.3
3	418	65	45	56.4
4	438	65	45	56.7
5	361	65	45	58.0
6	384	65	45	57.8
7	369	65	45	58.5
8	197	65	45	61.2
9	207	65	45	61.2
10	341	65	45	59.7
11	296	65	45	60.7
12	281	65	45	61.6
13	172	65	45	63.8
14	145	65	45	66.3
15	266	65	45	63.5
16	135	65	45	70.8
17	144	65	45	71.9
18	111	65	45	82.9
19	314	65	45	62.7
20	315	65	45	63.3
21	155	65	45	78.0
22	187	65	45	73.8
23	387	65	45	60.9
24	441	65	45	59.6
25	324	65	45	63.8
26	366	65	45	62.4
27	397	65	45	61.3
28	457	65	45	59.5
29	473	65	45	59.1
30	486	65	45	58.8
31	510	65	45	58.2

Construction Receptor ID	Closest Distance to Construction of Breakwater (m)	BS5228 Category A Guideline (Daytime)	BS5228 Category A Guideline (Night time)	Construction of Breakwater Total SPL (dB)
32	534	65	45	57.7
33	557	65	45	57.2
34	593	65	45	56.5

Table 10.E.4: Dredging Construction Noise Predictions

Construction Receptor ID	Closest Distance to Dredging Works (m)	BS5228 Category A Guideline (Daytime)	BS5228 Category A Guideline (Night time)	Predicted Noise Level Dredging SPL (dB)
1	520	65	45	50.7
2	460	65	45	51.7
3	418	65	45	52.6
4	438	65	45	52.2
5	361	65	45	53.9
6	384	65	45	53.3
7	369	65	45	53.7
8	197	65	45	59.1
9	207	65	45	58.7
10	341	65	45	54.4
11	296	65	45	55.6
12	281	65	45	56.0
13	172	65	45	60.3
14	145	65	45	61.8
15	266	65	45	56.5
16	135	65	45	62.4
17	144	65	45	61.8
18	111	65	45	64.1
19	314	65	45	55.1
20	315	65	45	55.0
21	155	65	45	61.2
22	187	65	45	59.6
23	387	65	45	53.3
24	441	65	45	52.1
25	324	65	45	54.8
26	366	65	45	53.7
27	397	65	45	53.0
28	457	65	45	51.8
29	473	65	45	51.5
30	486	65	45	51.3
31	510	65	45	50.9
32	534	65	45	50.5

Construction Receptor ID	Closest Distance to Dredging Works (m)	BS5228 Category A Guideline (Daytime)	BS5228 Category A Guideline (Night time)	Predicted Noise Level Dredging SPL (dB)
33	557	65	45	50.1
34	593	65	45	49.6

APPENDIX 11.1

Transitional and Coastal waters Morphological Impact Assessment System (TraC MiMAS)

TRAC MIMAS ASSESSMENT

MImAS Stage 1 Outputs

Waterbody Name	**Sound of Iona**
Size	12.1km2
TraC Type	CW2 (Exposed, meso-tidal)
MImAS Scale of Assessment	Stage 1. Preliminary scale - 0.5km^2
MImAS Type	Coastal, Moderately to exposed, macro-tidal. Sedimentary.
Existing Modications	
Existing slipway	0.001km^2
Zone	
Hydrodynamics	0% (Below 5% high status MCL)
Intertidal	0.03% (Below 5% high status MCL)
Subtidal	0.04% (Below 5% high status MCL)
Current Status	**High**
New Modifications	
Proposed Dredge	0.002017 km^2
Proposed Breakwater	0.197 km^2
Zone	
Hydrodynamics	5.5% (Exceeds 5% high status MCL)
Intertidal	29.6% (Exceeds 5% high status MCL)
Subtidal	24.1% (Exceeds 5% high status MCL)
Predicted Status	**Less than Good**

MImAS Stage 2 Outputs

Waterbody Name	**Sound of Iona**
Size	12.1 km^2
TraC Type	CW2 (Exposed, meso-tidal)
MImAS Scale of Assessment	Stage 2 - Water body scale
MImAS Type	Coastal, Moderately to exposed, macro-tidal. Sedimentary.
Existing Modifications	
Existing slipway	0.001 km^2
Existing Fionnphort	0.001 km^2
Zone	
Hydrodynamics	0% (Below 5% high status MCL)
Intertidal	0.% (Below 5% high status MCL)
Subtidal	0% (Below 5% high status MCL)
Current Status	**High**
New Modifications	
Proposed Dredge	0.002017 km^2
Proposed Breakwater	0.197 km^2
Zone	
Hydrodynamics	0.14% (Below 5% high status MCL)
Intertidal	0.76% (Below 5% high status MCL)
Subtidal	0.62% (Below 5% high status MCL)
Predicted Status	**High**

Stage 2 MImAS Cumulative Assessment with proposed Fionnphort development

Waterbody Name	**Sound of Iona**
Size	12.1 km^2
TraC Type	CW2 (Exposed, meso-tidal)
MImAS Scale of Assessment	Stage 2 - Water body scale
MImAS Type	Coastal, Moderately to exposed, macro-tidal. Sedimentary.
Existing Modifications	
Existing slipway	0.001 km^2
Existing Fionnphort	0.001 km^2
Zone	
Hydrodynamics	0% (Below 5% high status MCL)
Intertidal	0.% (Below 5% high status MCL)
Subtidal	0% (Below 5% high status MCL)
Current Status	**High**
New Modifications	
Proposed Dredge	0.002017 km^2
Proposed Breakwater	0.197 km^2
Proposed Dredge (Fionnphort)	0.013 km^2
Proposed Breakwater (Fionnphort)	0.175 km^2
Zone	
Hydrodynamics	0.27% (Below 5% high status MCL)
Intertidal	1.44% (Below 5% high status MCL)
Subtidal	1.18% (Below 5% high status MCL)
Predicted Status	**High**

APPENDIX 15.1

Photomontages

PHOTOMONTAGES

Iona Breakwater
October 2022

Argyll & Bute Council

Baseline image

Map image

Tripod location

Camera	Sony ILCE-7RM3	Easting	128188
Date	22.10.21 - 13.45	Northing	723902
View height	1.56 m AGL	Direction	90°
Field of View	60°	Distance	425 m

Title:
VP01
Moal Farm Track
Existing View

FIG ##		Drawn by:	PM
Projection:	OSGB	Checked:	RH
Data Source:	RPS 2022	Job Ref:	NI 2353
Status:	Draft	Date:	Oct 2022

Project:
Iona Breakwater

Client:
Argyll & Bute COUNCIL

rps MAKING COMPLEX EASY

Elmwood House, 74 Boucher Road
BELFAST, BT12 6RZ
028 9066 7914

Photomontage

Map image

Tripod location

Camera	Sony ILCE-7RM3	Easting	128188
Date	22.10.21 - 13.45	Northing	723902
View height	1.56 m AGL	Direction	90°
Field of View	60°	Distance	425 m

Title:
VP01
Moal Farm Track
Proposed View

FIG ##		Drawn by:	PM
Projection:	OSGB	Checked:	RH
Data Source:	RPS 2022	Job Ref:	NI 2353
Status:	Draft	Date:	Oct 2022

Project:
Iona Breakwater

Client:
Argyll & Bute COUNCIL

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Elmwood House, 74 Boucher Road
BELFAST, BT12 6RZ
028 9066 7914

Baseline image

Map image

Tripod location

Camera	Sony ILCE-7RM3	Easting	128407	Title: VP02 Moal Farm Track Existing View	FIG ##	Drawn by:	PM	Project: Iona Breakwater	Client: Argyll & Bute Council	rps
Date	22.10.21 - 13.15	Northing	724031		Projection: OSGB	Checked:	RH			Elmwood House, 74 Boucher Road
View height	1.56 m AGL	Direction	110°		Data Source: RPS 2022	Job Ref:	NI 2353			BELFAST, BT12 6RZ
Field of View	60°	Distance	210 m		Status: Draft	Date:	Oct 2022			028 9066 7914

Photomontage

Map image

Tripod location

Camera	Sony ILCE-7RM3	Easting	128407
Date	22.10.21 - 13.15	Northing	724031
View height	1.56 m AGL	Direction	110°
Field of View	60°	Distance	210 m

Title:

VP02
Moal Farm Track
Proposed View

FIG ##		Drawn by:	PM
Projection:	OSGB	Checked:	RH
Data Source:	RPS 2022	Job Ref:	NI 2353
Status:	Draft	Date:	Oct 2022

Project:

Iona Breakwater

Client:

Argyll & Bute COUNCIL

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BELFAST, BT12 6RZ
028 9066 7914

Baseline image

Map image

Tripod location

Camera	Sony ILCE-7RM3	Easting	128634	Title:	VP03 Ballmore Cottage Existing View
Date	22.10.21 - 15.30	Northing	724181		
View height	1.56 m AGL	Direction	170°		
Field of View	60°	Distance	220 m		

FIG ##		Drawn by:	PM
Projection:	OSGB	Checked:	RH
Data Source:	RPS 2022	Job Ref:	NI 2353
Status:	Draft	Date:	Oct 2022

Project: Iona Breakwater

Client: Argyll & Bute Council

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Elmwood House, 74 Boucher Road
BELFAST, BT12 6RZ
028 9066 7914

Photomontage

Map image

Tripod location

Camera	Sony ILCE-7RM3	Easting	128634	FIG ##		Drawn by:	PM
Date	22.10.21 - 15.30	Northing	724181	Projection:	OSGB	Checked:	RH
View height	1.56 m AGL	Direction	170°	Data Source:	RPS 2022	Job Ref:	NI 2353
Field of View	60°	Distance	220 m	Status:	Draft	Date:	Oct 2022

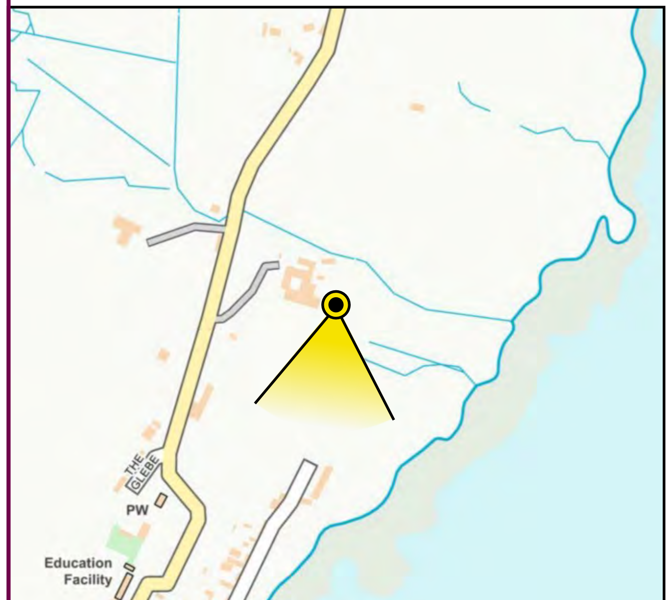
Title:
VP03
Ballmore Cottage
Proposed View

Project:
Iona Breakwater

Client:
Argyll & Bute Council

rps
Elmwood House, 74 Boucher Road
BELFAST, BT12 6RZ
028 9066 7914

Baseline image



Map image

Tripod location

Camera	Sony ILCE-7RM3	Easting	128724
Date	22.10.21 - 14.50	Northing	725400
View height	1.56 m AGL	Direction	185°
Field of View	60°	Distance	550 m

Title:

VP04
Iona Abbey
Existing View

FIG ##		Drawn by:	PM
Projection:	OSGB	Checked:	RH
Data Source:	RPS 2022	Job Ref:	NI 2353
Status:	Draft	Date:	Oct 2022

Project:

Iona Breakwater

Client:

Argyll & Bute Council

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028 9066 7914

Photomontage

Map image

Tripod location

Camera	Sony ILCE-7RM3	Easting	128724	Title:	VP04 Iona Abbey Proposed View
Date	22.10.21 - 14.50	Northing	725400		
View height	1.56 m AGL	Direction	185°		
Field of View	60°	Distance	550 m		

FIG ##		Drawn by:	PM
Projection:	OSGB	Checked:	RH
Data Source:	RPS 2022	Job Ref:	NI 2353
Status:	Draft	Date:	Oct 2022

Project: Iona Breakwater

Client: Argyll & Bute Council

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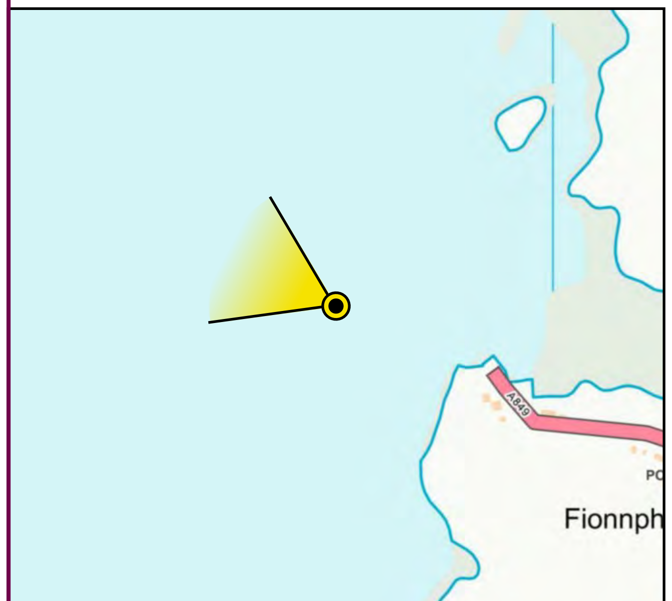
BELFAST, BT12 6RZ
028 9066 7914



Map image

Camera	Sony ILCE-7RM3	Easting	129621	Title:	FIG ##	Drawn by:	PM	Project:	Client:		
Date	22.10.21 - 12.20	Northing	723584	VP05 On the Ferry Existing View	Projection: OSGB	Checked:	RH	Iona Breakwater	Argyll & Bute Council		
View height	1.56 m AGL	Direction	305°		Data Source: RPS 2022	Job Ref:	NI 2353				
Field of View	60°	Distance	1000 m		Status: Draft	Date:	Oct 2022				

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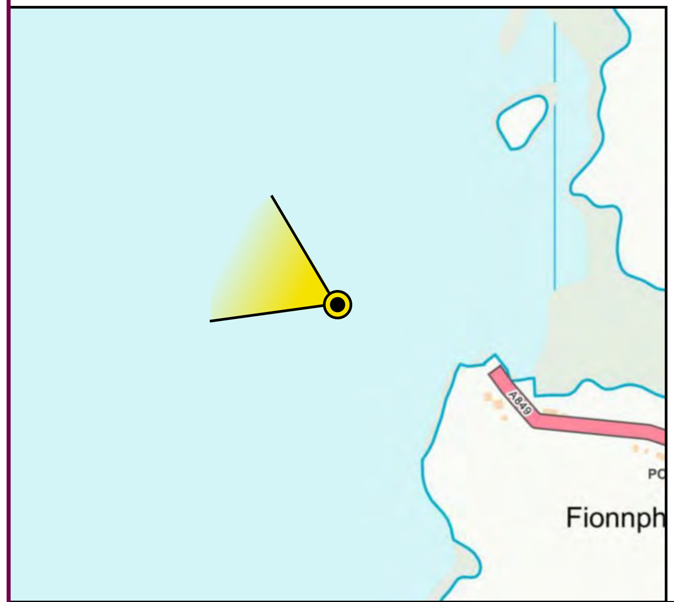
028 9066 7914



Map image

Camera	Sony ILCE-7RM3	Easting	129621	Title: VP05 On the Ferry Proposed View	FIG ##		Drawn by:	PM	Project: Iona Breakwater	Client: Argyll & Bute Council
Date	22.10.21 - 12.20	Northing	723584		Projection:	OSGB	Checked:	RH		
View height	1.56 m AGL	Direction	305°		Data Source:	RPS 2022	Job Ref:	NI 2353		
Field of View	60°	Distance	1000 m		Status:	Draft	Date:	Oct 2022		

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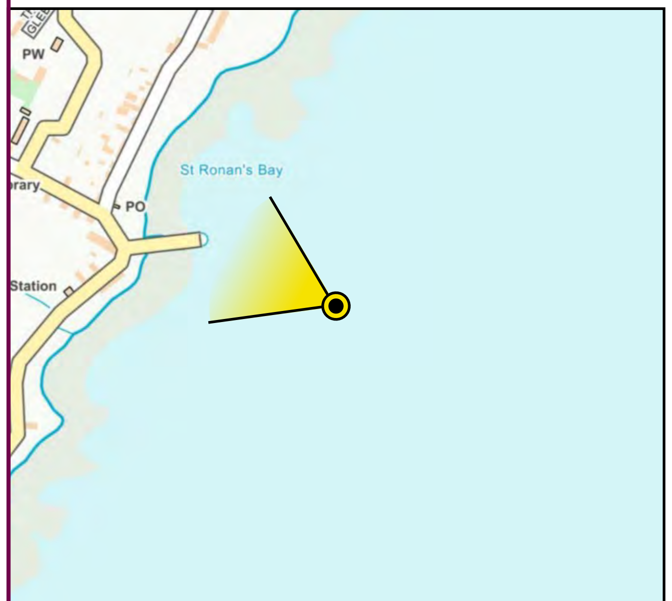
BELFAST, BT12 6RZ
028 9066 7914



Map image

Camera	Sony ILCE-7RM3	Easting	128999	Title: VP06 On the Ferry Approaching Iona Existing View	FIG ##	Drawn by:	PM	Project: Iona Breakwater	Client: Argyll & Bute Council
Date	22.10.21 - 12.25	Northing	723780		Projection: OSGB	Checked:	RH		
View height	1.56 m AGL	Direction	305°		Data Source: RPS 2022	Job Ref:	NI 2353		
Field of View	60°	Distance	265 m		Status: Draft	Date:	Oct 2022		

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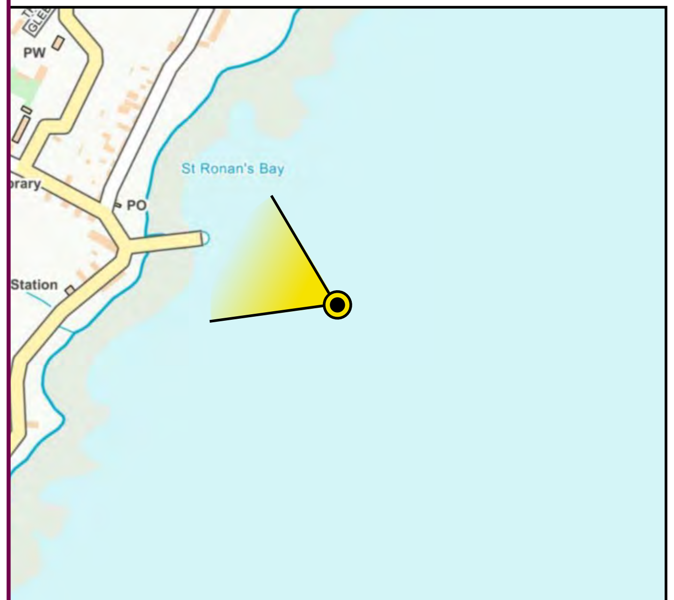
Elmwood House, 74 Boucher Road
BELFAST, BT12 6RZ
028 9066 7914



Map image

Camera	Sony ILCE-7RM3	Easting	128999	Title: VP06 On the Ferry Approaching Iona Proposed View	FIG ##		Drawn by:	PM
Date	22.10.21 - 12.25	Northing	723780		Projection:	OSGB	Checked:	RH
View height	1.56 m AGL	Direction	305°		Data Source:	RPS 2022	Job Ref:	NI 2353
Field of View	60°	Distance	265 m		Status:	Draft	Date:	Oct 2022

Project: Iona Breakwater

Client: Argyll & Bute Council

rps
Elmwood House, 74 Boucher Road
BELFAST, BT12 6RZ
028 9066 7914

Baseline image

Map image

Tripod location

Camera	Sony ILCE-7RM3	Easting	128462	Title: VP07 Martyrs Bay - Roadside Existing View	FIG ##	Drawn by:	PM	Project: Iona Breakwater	Client: Argyll & Bute Council
Date	22.10.21 - 12.50	Northing	723830		Projection: OSGB	Checked:	RH		
View height	1.56 m AGL	Direction	60°		Data Source: RPS 2022	Job Ref:	NI 2353		
Field of View	60°	Distance	175 m		Status: Draft	Date:	Oct 2022		

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BELFAST, BT12 6RZ
028 9066 7914

Photomontage

Map image

Tripod location

Camera	Sony ILCE-7RM3	Easting	128462	Title:	FIG ##	Drawn by:	PM	Project:	Client:	
Date	22.10.21 - 12.50	Northing	723830	VP07	Projection: OSGB	Checked:	RH	Iona Breakwater	Argyll & Bute Council	rps
View height	1.56 m AGL	Direction	60°	Martyrs Bay - Roadside	Data Source: RPS 2022	Job Ref:	NI 2353			
Field of View	60°	Distance	175 m	Proposed View	Status: Draft	Date:	Oct 2022			

Elmwood House, 74 Boucher Road
BELFAST, BT12 6RZ
028 9066 7914

Baseline image

Map image

Tripod location

Camera	Sony ILCE-7RM3	Easting	128488	Title: VP08 Martyrs Bay - Beach Existing View	FIG ##		Drawn by:	PM	Project: Iona Breakwater
Date	22.10.21 - 12.40	Northing	723840		Projection:	OSGB	Checked:	RH	Client: Argyll & Bute Council
View height	1.56 m AGL	Direction	60°		Data Source:	RPS 2022	Job Ref:	NI 2353	
Field of View	60°	Distance	150 m		Status:	Draft	Date:	Oct 2022	

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BELFAST, BT12 6RZ
028 9066 7914

Photomontage

Map image

Tripod location

Camera	Sony ILCE-7RM3	Easting	128488	Title: VP08 Martyrs Bay - Beach Proposed View	FIG ##	Drawn by:	PM	Project: Iona Breakwater	Client: Argyll & Bute Council
Date	22.10.21 - 12.40	Northing	723840		Projection: OSGB	Checked:	RH		
View height	1.56 m AGL	Direction	60°		Data Source: RPS 2022	Job Ref:	NI 2353		
Field of View	60°	Distance	150 m		Status: Draft	Date:	Oct 2022		

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BELFAST, BT12 6RZ
028 9066 7914

APPENDIX 16.1

Cultural Heritage Baseline

IONA BREAKWATER PROJECT

Heritage Baseline

JAC27210
Iona_DBA
1
November 2022

rpsgroup.com

Quality Management					
Version	**Status**	**Authored by**	**Reviewed by**	**Approved by**	**Review date**
[Text]	[Text]	[Text]	[Text]	[Text]	[Text]

Approval for issue		
[Name]	[Signature]	[Date]

File/Model Location	
Document location:	V:\Jobs Directory\27000-27999\27210_Iona and Fionnphort\Reports\DBA\JAC27210_Iona_DBA_1_221128_Report.docx
Model / Appendices location:	

Prepared by:

RPS

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E richard.conolly@rpsgroup.com

Prepared for:

Argyll and Bute Council

Argyll and Bute Council
Kilmory, Lochgilphead
PA31 8RT

EXECUTIVE SUMMARY

In keeping with relevant guidance, this baseline assessment draws together the available evidence in order to clarify the heritage significance and archaeological potential of the Iona Ferry Terminal and to identify heritage assets in the surrounding area that may be affected by the proposed upgrading of the terminal.

The Site lies partially within the Baile Mor Conservation Area and it is considered that the Proposed Development will affect the Conservation Area and the setting of St Mary's Abbey, which is both a Scheduled Monument and a Category A Listed Building, MacLeans Cross and Iona Nunnery, both of which are Scheduled Monuments, and the Replica of St John's Cross, which is a Category A Listed Building. It is considered that the proposed development will affect these. The assessment of impacts is presented in the EIAR Chapter.

The bays to the north and south of the terminal are natural landings and are likely to have seen activity through all periods, but given the conditions and the results of the review of hydrographic data it is considered that the potential for previously unrecorded heritage assets to be present below the high water mark is low in respect of the Medieval and earlier periods and negligible for Post-Medieval and Modern periods. The site of the proposed temporary construction compound lies adjacent to An Eala, the site an Early Medieval or Medieval cemetery, and the traditional line of the Street of the Dead. The results of a previous geophysical survey indicate that features associated with An Eala, namely a revetting wall or kerb and a possible ditch extend into the area of the temporary construction compound. No trace of features relating to the Street of the Dead has been recorded. It is considered that there is high potential for related archaeology to An Eala to be present within the temporary working area. The potential elsewhere is considered to be negligible.

Contents

Figures

Appendices

1 INTRODUCTION AND SCOPE OF STUDY

1.1 This report has been prepared by Richard Conolly MA(Hons) MCIfA of RPS on behalf of Argyll & Bute Council Ltd.

1.2 The subject of this baseline assessment, henceforth referred to as the Site, takes in the pier and slipway and adjacent land and seabed at Iona, Mull (Figure 1, site centre NGR NM 287 240). It is proposed to construct a rock armour breakwater and berthing piles. In addition, an area of approximately 3400m^2 will be dredged to a depth of 3m below chart datum (CD) to accommodate the navigation channel requirements. The dredged material will be disposed of at the nearest licenced site.

1.3 This assessment has been prepared in accordance with relevant policy and guidance and considers the potential effects of the proposed development upon heritage assets, both during the construction and operation. It draws upon the following data sources:

- Historic Environment Scotland designations downloads;
- National Record of the Historic Environment (NRHE);
- West of Scotland Archaeology Service (WoSAS) Historic Environment Records (HER);
- Maps and charts held by the National Library of Scotland;
- UK Hydrographic Office data (INSPIRE);
- Geotechnical data;
- Satellite imagery; and
- Readily available published sources.

1.4 The desk-based work was augmented and verified through a site visit and the archaeological assessment of hydrographic data (MSDS 2021). The study provides an assessment of the archaeological potential of the Site and the significance of heritage assets within and around the Site, and considers the potential impacts of the study upon these. The consideration of potential impacts upon designated heritage assets (Figure 2) in the surrounding area has been undertaken in accordance with the guidance provided in Managing Change in the Historic Environment: Setting (HES 2020), which advocates the use of a three-stage process:

- Stage 1: Identify the historic assets that may be affected by the proposed development.
- Stage 2: define and analyse the setting by establishing how the surroundings contribute to the ways in which the historic asset or place is understood, appreciated and experienced.
- Stage 3: evaluate the potential impact of the proposed changes on the setting, and the extent to which any negative impacts can be mitigated

Only Stage 1 and 2 are contained in this baseline. Where it is identified that assets will be adversely affected, Stage 3 is presented in the EIAR Cultural Heritage chapter.

2 PLANNING BACKGROUND AND DEVELOPMENT PLAN FRAMEWORK

Legislation

2.1 The Ancient Monuments and Archaeological Areas Act 1979 and the Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997 provide the legislative basis for the protection of the historic environment. Of particular relevance in the current context, are the statutory duties placed on the decision maker by the latter:

59. General duty as respects listed buildings in exercise of planning functions.

(1) In considering whether to grant planning permission for development which affects a listed building or its setting, a planning authority or the Secretary of State, as the case may be, shall have special regard to the desirability of preserving the building or its setting or any features of special architectural or historic interest which it possesses.

(2) Without prejudice to section 64, in the exercise of the powers of disposal and development conferred by the provisions of sections 191 and 193 of the principal Act, a planning authority shall have regard to the desirability of preserving features of special architectural or historic interest and, in particular, listed buildings.

(3) In this section, "preserving", in relation to a building, means preserving it either in its existing state or subject only to such alterations or extensions as can be carried out without serious detriment to its character, and "development" includes redevelopment.

64. General duty as respects conservation areas in exercise of planning functions.

(1) In the exercise, with respect to any buildings or other land in a conservation area, of any powers under any of the provisions in subsection (2), special attention shall be paid to the desirability of preserving or enhancing the character or appearance of that area.

(2) Those provisions are—

(a) the planning Acts, and

(b) Part I of the Historic Buildings and Ancient Monuments Act 1953.

2.2 The above acts were amended by the Historic Environment (Amendment) (Scotland) Act 2011.

2.3 Marine historic assets of national importance within Scottish Territorial Waters (STW) are protected primarily by the Marine (Scotland) Act 2010 (content available on the UK Government Website accessed August 2022 - legislation.gov.uk), in particular Part 5 Section 73. This states that an area may be designated as an Historic Marine Protected Area (MPA) if Scottish Ministers consider it desirable to preserve a marine historic asset which is located in the area.

2.4 A marine historic asset is defined as a vessel, vehicle or aircraft (or part of), the remains of a vessel, vehicle or aircraft (or part of), an object contained in or formerly contained in a vessel, vehicle or aircraft, a building or other structure (or part of), a cave or excavation, and a deposit or artefact or any other thing which evidences previous human activity.

2.5 The purpose of Historic MPAs is to preserve by law, marine historic assets of national importance. There is no requirement for specific permission to carry out work inside a Historic MPA, however permission under the Town and Country (Scotland) Planning Act (1997) or a Marine Licence (ML) under the Marine and Coastal Access Act (MCCA) 2009 (in waters 12 nm to 200 nm), or under the Marine (Scotland) Act 2010 (from Mean High Water Springs (MHWS) to 12 nm) may be required (content available on the United Kingdom (UK) Government Website accessed August 2022 legislation.gov.uk).

2.6 Clear preservation objectives are provided for each Historic MPA and their boundaries define an exclusion zone to activities that could lead to disturbance of the marine historic asset.

2.7 In Scotland, the Marine Scotland Act 2010 has replaced Section 1 of the Protection of Wrecks Act 1973.

2.8 Section 2 of the Protection of Wrecks Act 1973 (content available on the UK Government Website accessed August 2021 legislation.gov.uk) provides guidance on the protection of wrecks that are designated as dangerous due to their contents. Protections are administered by the Maritime and Coastguard Agency (MCA) through the Receiver of Wreck (RoW).

2.9 The Protection of Military Remains Act 1986 makes it an offence to interfere with the wreckage of any crashed, sunken or stranded military aircraft or designated vessel, without a licence. This is irrespective of whether there was loss of life associated with the wreck, or whether the loss of the aircraft or vessel occurred during peacetime or wartime.

2.10 All crashed military aircraft receive automatic protection under this Act, but vessels must be individually designated. There are two levels of protection offered by this Act:

- designation as a Protected Place: Protected Places include the remains of any aircraft which crashed while in military service or any vessel designated (by name, not location) which sank or stranded in military service after 04 August 1914. Although crashed military aircraft receive automatic status as a Protected Place, vessels need to be specifically designated by name. The location of a vessel does not need to be known for it to be designated as a Protected Place; and
- designation as a Controlled Site: Controlled Sites are designated areas which encompass the remains of military aircraft or a vessel sunk or stranded in military service within the last 200 years. Diving operations are effectively prohibited in these sites without a specific licence granted by the Secretary of State in accordance with the provisions of the Act.

National Planning Policy

2.11 Scottish Planning Policy (SPP; June 2014) provides national policy for dealing with the historic environment in the planning process in paragraphs 135-151. SPP stresses that the planning system should promote the care and protection of the historic environment and that change should be sensitively managed to avoid or minimise adverse impacts on assets. Additional policy in relation to the historic environment is provided in Historic Environment Policy for Scotland (HEPS, 2019) and a strategy has been set out in ‘Our Place in Time - the Historic Environment Strategy for Scotland’ (2014).

2.12 GEN 6 Historic Environment of Scotland’s National Marine Plan (Scottish Government 2015) states that:

Development and use of the marine environment should protect and, where appropriate, enhance heritage assets in a manner proportionate to their significance.

2.13 Paragraph 4.24 requires that development proposals that may affect the historic environment should be supported by information on the significance of known heritage assets and the potential for new discoveries to arise and how impacts will be avoided, minimised or mitigated. Where this is not possible the benefits of the proposal should be set out. Paragraph 4.25 requires that where substantial change to a heritage asset is accepted, applicants should be required to undertake suitable mitigating actions to record and advance understanding of the asset in a proportionate manner.

2.14 In July 2011, the government published the Planning Advice Note PAN 2/2011: Planning and Archaeology. It provides advice and technical information alongside SPP, HEPS and the Managing Change in the Historic Environment Guidance Notes, which together set out the Scottish Ministers' policies and guidance for planning and the historic environment.

2.15 Sections 4-9 of the PAN, entitled Archaeology and Planning provides guidance for planning authorities, property owners, developers and others on the policy of the Scottish Government relating to archaeological sites and monuments. Overall, the guidance can be summarised:

- Policy is to protect and preserve sites and monuments and their settings in situ where feasible. Where this is not possible planning authorities should consider applying conditions to consents to ensure that an appropriate level of excavation, recording, analysis, publication and archiving is carried out before and/or during development.
- In consideration of applications, planning authorities should take into account the relative importance of archaeological sites. Not all sites and monuments are of equal importance. In determining planning applications that may impact on archaeological features or their setting, planning authorities may balance the benefits of development against the importance of archaeological features.

2.16 Section 12 of the PAN notes that when determining a planning application, the desirability of preserving a monument (whether scheduled or not) and its setting is a material consideration. It reiterates that preservation in situ should be the objective but where not possible an alternative approach is recording and/or excavation followed by analysis and publication of the results.

2.17 Sections 13 and 14 note that prospective developers should undertake assessment to determine whether a property or area contains, or is likely to contain, archaeological remains as part of their pre-planning application research into development potential. Where it is known, or there is good reason to believe, that significant remains exist developers should be open to modifying their plans in order to preserve remains.

2.18 Section 17 notes that in many cases a desk-based assessment (this document) may be sufficient to allow authorities to make a planning decision. Where the judgement of the authority's archaeological advisor indicates that significant remains may exist, it is reasonable for the planning authority to request an archaeological evaluation before the application is determined. Planning authorities should require only the information necessary for them to make an informed decision on the proposal, and this should be proportionate to the importance of the potential resource.

2.19 Section 19 notes that developers should supply the results of desk-based assessments and evaluations as part of their planning applications.

2.20 The UK Marine Policy Statement (MPS) sets out high level marine objectives for ensuring that marine resources are used in a sustainable way. It was published by the UK Government in 2011.

2.21 Section 2.6.6 of the MPS sets out the aspects of the historic environment that merit consideration in marine planning and advises that heritage assets should be conserved through marine planning in a manner appropriate and proportionate to the significance of the asset. When considering the significance of a heritage asset and its setting, the marine planning authority should take into account the particular nature of the interest held in the asset and the value it might hold for this and future generations.

2.22 Designated heritage assets in coastal/intertidal zones and inshore/offshore waters may include Scheduled Monuments, Protected Wreck Sites and sites designated under the protection of the Military Remains Act 1986. Non-designated heritage assets of equivalent status should be considered under the same policy principles as designated heritage assets.

2.23 Where the loss of the whole or material part of a heritage asset's significance is justified, suitable mitigation measures should be put in place. Mitigation requirements should be based on advice from relevant regulators and advisors.

2.24 The Scottish National Marine Plan (NMP) was published in 2015 and reviewed in 2018 and 2021 and sets out high-level objectives for managing offshore development and advise for the preparation of future Regional Marine Plans.

2.25 General Policy 6 within the National Marine Plan relates to the historic environment and states that '*Development and use of the marine environment should protect and, where appropriate, enhance heritage assets in a manner proportionate to their significance*'.

2.26 The NMP advises that designated heritage assets should be protected in situ within an appropriate setting, and that substantial loss of harm to designated assets should be exceptional and should only be permitted 'if this is necessary to deliver social, economic or environmental benefits that outweigh the harm or loss '.

2.27 The NMP further identifies that non-designated heritage assets that meet designation criteria or make a positive contribution should also be protected in situ, wherever possible, and consideration given 'to the potential for new discoveries of historic or archaeological interest to arise'.

2.28 The NMP outlines that proposals for development that may '*affect the historic environment should provide information on the significance of known heritage assets and the potential for new discoveries to arise. They should demonstrate how any adverse impacts will be avoided, or if not possible, minimised and mitigated. Where it is not possible to minimise or mitigate impacts, the benefits of proceeding with the proposal should be clearly set out'*.

2.29 The NMP also states that 'where the case for substantial change to heritage asset is accepted, marine decision-making authorities should require applicants to undertake suitable mitigating actions to record and advance understanding of the significance of the heritage asset before it is lost, in a manner proportionate to that significance'.

Local Planning Policy

2.30 The Argyll and Bute Local Development Plan was adopted in 2015. Detailed policy is presented in Supplementary Guidance (adopted 2016) and contains the following policy relating to the historic environment that are relevant in the current context:

SG LDP ENV 20 – Development Impact on Sites of Archaeological Importance

1. There is a presumption in favour of retaining, protecting, preserving and enhancing the existing archaeological heritage and any future discoveries found in Argyll and Bute. When development is proposed that would affect a site of archaeological significance, the following will apply:

(a) The prospective developer will be advised to consult the Council and its advisers the West of Scotland Archaeology Service at the earliest possible stage in the conception of the proposal; AND,

(b) An assessment of the importance of the site will be provided by the prospective developer as part of the application for planning permission or (preferably) as part of the pre-application discussions.

2. When development that will affect a site of archaeological significance is to be carried out, the following will apply:

(a) Developers will be expected to make provision for the protection and preservation of archaeological deposits in situ within their developments, where possible by designing foundations that minimise the impact of the development on the remains; AND,

(b) Where the Planning Authority deems that the protection and preservation of archaeological deposits in situ is not warranted for whatever reason, it shall satisfy itself that the developer has made appropriate and satisfactory provision for the excavation, recording, analysis and publication of the remains.

3. Where archaeological remains are discovered after a development has commenced, the following will apply:

(a) The developer will notify the West of Scotland Archaeology Service and the Council immediately, to enable an assessment of the importance of the remains to be made; AND,

(b) Developers should make appropriate and satisfactory provision for the excavation, recording, analysis and publication of the remains. (Developers may see fit to insure against the unexpected discovery of archaeological remains during work).

Note: The West of Scotland Archaeology Service must be consulted for all sites in each category

2.31 In line with relevant planning policy and guidance, this desk-based assessment seeks to clarify the site's archaeological potential and the likely significance of that potential.

3 GEOLOGY AND TOPOGRAPHY

Geology

3.1 The Site is underlain by sandstone and metasandstone of the Iona Group with a dyke of camptonite and monchiquite at the southern end of St Ronan's Bay (www.bgs.co.uk). In St Ronan's Bay superficial deposits comprise marine deposits of sand, behind which are raised beach deposits of gravel, sand and silt. The sand in the bay is coarse with shell fragments (Causeway Geotech 2018 & Structural Soils 2020).

Topography

3.2 The proposed development is located at the southern end of St Ronan' Bay and northern end of Martyrs Bay. The bays have sandy beaches but around the existing jetty, including the area of the proposed breakwater there is only bare rock (Plates 1-7).

3.3 The greater part of the Site lies below Mean High Water Springs (MHWS). The seabed shelves gently. Within the area of proposed dredging, it lies between 0.8 and 3.4m below chart datum (CD). In the area of the proposed rock armour, it lies 4.2m below CD at its deepest.

4 DESIGNATED HERITAGE ASSETS

Introduction

4.1 This section presents Stages 1 and 2 of the three-stage approach to assessing the impact of change in the setting of heritage assets (HES 2016). Stage 3, evaluating the impact is presented in the EIAR chapter. The Stage 2 element focuses on those aspects that are relevant to the current assessment, in particular relationships with the wider landscape.

Stage 1: Identify Receptors

4.2 Within the study area there are:

- Three Scheduled Monuments:
  - Iona Nunnery (SM90350) – 150m to the north-west of the breakwater;
  - MacLean's Cross (SM90173) – 280m to the north-west of the breakwater;
  - St Mary's Abbey, Iona, monastic settlement (SM12968) – 280m to the north of the breakwater.
- Four Listed Buildings:
  - Iona Abbey (LB12310 – Category A) – 560m to the north of the breakwater;
  - Iona Kirk (LB12318 – Category B) – 300m to the north-west of the breakwater;
  - Iona Manse (LB12319 – Category C) – 280m to the north-west of the breakwater; and
  - Replica of St John's Cross (LB52541 – Category A) – 550m to the north of the breakwater.
- One Conservation Area:
  - Iona.

4.3 There are no Inventory Gardens, Designed Landscapes or Battlefields within the study area. Nor are there any Historic Marine Protected Areas or Protected Military Remains.

4.4 The cultural significance of the Scheduled Monuments and Category A Listed Buildings is inter-related by their common history relating to Iona as a place of pilgrimage and their location on the pilgrims' route to the abbey. Consequently, whilst there is no intervisibility between the Site and Iona Nunnery, McLean's Cross, and the replica of St John's Cross, development of the Site will affect their setting to some degree as all visitors will pass the proposed development when arriving on the island. The abbey, nunnery and crosses have therefore been identified as receptors and taken through to Stages 2 and 3.

4.5 The Site lies at the fringe of the Iona Conservation Area. It is seen both from within the Conservation Area and when approaching from the sea. The Conservation Area has therefore been taken through to Stages 2 and 3.

4.6 There is no intervisibility between the Site and Iona Kirk and Manse, both of which are of 19th century date. They are not inherently tied to the island's history as a place of pilgrimage and it is not considered that there is potential for the Proposed Development to affect their setting and they are not considered further.

4.7 The cultural significance of the scheduled monuments is detailed in the appended Statements of Significance and that of the Listed Buildings in the appended listing descriptions and statements of special interest. The summaries are provided in the following section.

Stage 2: Define and Analyse Setting

St Mary's Abbey, Iona, monastic settlement (SM12968 & LB12310)

Cultural Significance

Iona and its abbey, inextricably linked to St Columba, are recognised by people around the world as a special, sacred place. It has a universally acknowledged spiritual presence, which together with the heritage of sanctity contribute to a numinous and sublime quality perceived by most visitors. This sets it apart from other properties in care. The following bullet points outline the most important aspects which contribute to Iona's cultural significance:

- *Iona Abbey has had an important spiritual, cultural and political influence on Scotland (and sometimes further afield) for many centuries, from the time of Columba to the era of the Lords of the Isles.*
- *The legacy of St Columba can still be tangibly felt when visiting the site. The tiny shrine chapel (though extensively rebuilt) holds the greatest cultural significance of any of the buildings on Iona. It was created to contain Columba's relics which were the richest treasure of the monastery. It is probably the oldest church building in Scotland. Radiocarbon dating has confirmed that a structure atop Tòrr an Aba dates from Columba's time and thus is likely to be his writing hut.*
- *Iona contains the largest and most important collection of early sacred sculpture of any British monastery. This includes the spectacular high crosses such as St Martin's which has stood in its original position outside the monastery for 1250 years. The Lapis Echodi inscribed stone may be the oldest surviving memorial to a king in Britain. Eochaid Buide, king of Dal Riata died c 629.*
- *Iona was a major centre of literacy, the introduction of which revolutionised life in Scotland, especially in relation to governance. The Iona chronicles dating from 630-720 are amongst the oldest post-Roman chronicles in Europe and it is now widely accepted that the Book of Kells, the finest Gospel book of the western European church, was produced on Iona around 800.*
- *Adomnán's Life of Columba, written on Iona c 690, is a prime evidential resource which provides unique insights into the reality of the monastery and the island during his own lifetime and places associated with Columba. Another Adomnán work, De Locis Sanctis, is an account of Christianity's sacred places, including Jerusalem. It provides a framework for understanding how the planning and development of Iona and its liturgical landscape was conceived as a reflection of the heavenly Jerusalem.*
- *The site exhibits the best preserved and most complex physical remains of an early monastery in Britain; it is therefore of immense research value. The vallum, the shrine chapel, Sràid nam Marbh, Torr an Aba and the high crosses represent extraordinary, in-situ evidence of the reality of the Columban monastery.*
- *The Benedictine Abbey is the largest and most elaborate ecclesiastical foundation in the West Highlands and Islands. Its design features express particularly the importance of pilgrimage in the planning of the site. Contemporary with the abbey, the Nunnery is one of only two Augustinian nunneries in Scotland and is one of the best-preserved medieval convents in Britain. Its presence evidences the importance of women's participation in religious life and especially pilgrimage. For further details see HES Statement of Significance, Iona Nunnery, St Ronan's Church and MacLean's Cross.*
- *Reilig Odhrain is of considerable importance as the burial place of the monastic communities, and of some kings. In later medieval times it was the popular burial place of the best men of*

the clans, their graves covered by more than 100 beautifully carved slabs. Today it retains significance as the last resting place of people of national and local importance such as the burial here of John Smith, leader of the Labour Party, in 1994.

- *The patronage of the Gaelic-Norse lords and then the Lords of the Isles has led to the presence of a large and important collection of carved stones at the abbey, although it is difficult to know for certain which of the later graveslabs were produced here. The later medieval graveslabs can illuminate many aspects of life and society amongst the clergy and warrior elites of the West Highlands.*
- *Iona is also significant as a place of pilgrimage. Since the time of Columba's death people have come from afar and walked along Sràid nam Marbh, following in the footsteps of saints and hoping their prayers would be answered. Pilgrimage is a continuing tradition in the life of the island.*
- *The various phases of conservation and restoration at the abbey, particularly in the 19th and early 20th century, are testament to the continuing significance of Iona. In particular the circumstances around the creation of the Iona Cathedral Trust and the rebuilding work by Rev. George Macleod are of considerable social significance, particularly in regard to the development of so-called Celtic spirituality.*

(HES 2018, 3-5)

Contribution of Setting

4.8 The Abbey's setting makes a substantive contribution to its cultural significance. The relevant aspects comprise:

- Views of the Abbey when approaching the island on the ferry. This is the first view of the Abbey. The site of the abbey against the rugged backdrop of the island is striking and provides a distinct sense of arrival in a 'special' place. It is easy for the visitor to appreciate the sense of awe that must have been felt by Medieval pilgrims as when nearing the end of their journey they were confronted by the abbey.
- Views of the Abbey from the landing jetty. These are again aesthetically striking; the abbey is seen on the skyline above the houses in the foreground from the jetty and the bay to the north. Views from south of the jetty (ie Martyrs Bay) to the Abbey are possible, but the modern buildings at the fringe of these views rather clutter them and are likely to detract from their aesthetic appreciation. In addition to their aesthetic value, these views are important as they a provide a tangible connection between the historic landing points and the abbey and thereby contribute to a sense of continuity between modern day visitors and Medieval pilgrims. The modern buildings do not detract from this aspect.
- The approach to the Abbey. This has a processional quality and ties the abbey into other key elements of the ecclesiastical site. Most visitors will follow the sign from the jetty and walk along the road east, following the line of the Medieval Martyr Street, past the nunnery before turning north towards the abbey. Initially the abbey is partially obscured by trees, but is then clearly visible, appearing to stand at the end of the road. They then pass MacLean's Cross, where the road doglegs before heading north again past St Oran's Chapel and the associated graveyard, Reilig Odhrain.
- *The view east across the Sound from the front of the abbey is of great significance. This was where the monks expected to see the risen Christ appear on the last day. The view is spectacular, and entirely natural and unchanged since Columban times, with progressive bands of green field, shoreline, water, the blood red Mull granite, with a band of higher dark hills behind, then the sky* (HES 2018, 23).

Iona Nunnery (SM90350) and MacLean's Cross (SM90173)

Cultural Significance

- *Iona Nunnery is one of the best-preserved medieval nunneries in Britain, and one of only two houses of Augustinian nuns established in Scotland.*
- *Iona Nunnery forms part of an internationally-renowned group of monuments set within an almost wholly unspoilt landscape, attracting what is thought to be in excess of 100,000 visitors each year.*
- *The nunnery is built adjacent to an early Christian burial ground, which may be as old as the primary phase of missionary activity on Iona, forming a link between the early monastery and the later convent.*
- *Architectural details throughout the nunnery are of high quality indicating its importance and significance. The convent church possessed one of the few rib-vaults in the Western Highlands.*
- *The 15th century enlargements suggest the nunnery continued to flourish in the later Middle Ages, a time when many religious houses were declining.*
- *St Ronan's Church, adjacent to the nunnery, occupies the site of an early Christian church possibly dating from the 8th century, itself built on the site of an earlier burial ground. It houses an excellent collection of late medieval West Highland style graveslabs, all the work of masons of the Iona School of carving. Iona was instrumental in the creation of a distinctive West Highland style of carving, one of the most important cultural developments in late medieval Scotland.*
- *Several famous travellers have visited the monument since the Reformation, including Martin Martin, James Boswell and Dr Samuel Johnson, Sir Walter Scott, Prince Albert and Felix Mendelssohn.*
- *Prince Albert's visit in 1847 helped create an interest in the island as a fashionable holiday destination, much in the same way as Victoria and Albert's travels through the Highlands did.*
- *MacLean's Cross is one of a significant group of 15th-century carved stones produced by the Iona School of carvers.*

(HES 2005, 5-6)

Contribution of Setting

4.9 The nunnery has not been restored to the same extent as the abbey and its more modest ruins are much less visible in the landscape; although visible from the ferry, they are generally lost to view amongst the surrounding buildings. The ruins have a somewhat enclosed feel and some sense of seclusion. Consequently, direct visual relationships with the surroundings make a relatively slight contribution to their significance. However, as noted above, they are passed by visitors on their way to the abbey and will be experienced as a part of the wider ecclesiastical site. Consequently, despite the lack of visual relationships, the nunnery's setting makes a substantial contribution to its cultural significance.

Replica of St John's Cross (LB52541 – Category A)

Cultural Significance

The Mac-samhail Crois Naoimh Eòin / replica of St John's Cross meets the criteria of special architectural or historic interest for the following reasons:

- *It is unique as the only full-scale and accurate (as was known at the time) replica in the primary location of the original early medieval high cross.*
- *It is of significance because of the scholarly, artistic, engineering and craft skills that went into its unusual, materially 'authentic' design and execution in concrete to accurately resemble the exceptional quality and intricacy of the carvings of the original cross (as known at the time).*
- *It is an integral part of the history and contemporary experience of Iona, its authenticity, social, communal, sacred and spiritual values.*

Contribution of Setting

This replica cross has been erected in the composite box-like base of the original cross. It sits immediately in front of the west gable of St Columba's shrine-chapel. The shrine was and remains the most important building on Iona because it was built over Columba's burial. As in the past, the physical setting of the replica continues to affect how people encounter and experience it, generating diverse social, communal, sacred and spiritual values.

The positioning of Iona's high crosses within the symbolic and physical setting of the abbey is critical to understanding their significance. A feature of contemporary special interest is that the St John's Cross replica casts a shadow on the shrine in the late afternoon and evening as the original cross was designed to do. The interplay with natural phenomena such as sunlight and the casting of shadows onto other structures or locations is understood to be a deliberate design feature of these high crosses. The shadow positions of the crosses would have figured prominently in the daily lives of the monks, as a constant reminder of the canonical hours of worship.

Iona has the largest and most important collection of sacred sculpture of any early British monastery, long recognised as among the most significant collections of early medieval art in Europe. The St John's Cross is part of a group of historic high crosses on Iona, along with St Martin's Cross and St Oran's Cross. St John's Cross is the most ambitious and has become a symbol of Iona.[1]

Iona Conservation Area

4.10 There is no Conservation Area Appraisal. It is outside the scope of the current study to carry out a full appraisal of the Conservation Area and the following focuses on those elements that are relevant in the current context.

4.11 The Conservation Area is extensive and varied. In its north-eastern part it takes in the scheduled area of St Mary's Abbey. This area is grassy and open, dominated by the Abbey. The north-western part takes in craggy ground rising to the west, with scattered buildings. The central part takes in core of the settlement of Baile Mor. This consists of a row of primarily 19th century cottages and the Argyll Hotel along the western side of the village street. To the east of the street is a strip of land occupied by their gardens, beyond which is the sandy beach of St Ronan's Bay, fringed with rocks. To the rear are their gardens, open space and Iona Nunnery, beyond which is Main Street, leading to the Abbey. MacLean's Cross stands at the point Sraid nam Marbh (Street of the Dead), and St Ronan Street formerly converged. The former ran from Port nam Mairtir and the latter from St Ronan's Bay. To the west of the road is further open ground, the 19th century kirk and former manse, both Listed Buildings, and a row of modern cottages. The Conservation Area takes in the craggy rising ground to the west of these. The historic southern limit of the settlement

[1] http://portal.historicenvironment.scot/designation/LB52541

is marked by the road leading from the slipway to Main Street, this follows the line of the Medieval Martyr Street. The Conservation Area to the south of this road, is primarily occupied by fields, with buildings scattered along the road. These are a mixture of 19th century cottages and houses and modern buildings, most notably the Martyr's Bay restaurant next to the ferry slipway.

4.12 The Conservation Area's cultural significance derives from its unique character and appearance which are a product of its rich ecclesiastical history and its landscape setting, in particular:

- The visible remains of buildings and features associated with the island's ecclesiastical history, including the vallum bank and ditch, which defined the early monastic enclosure, the high crosses, Augustinian nunnery, Benedictine monastery, St Oran's Chapel and Reilig Odhrain cemetery.
- Landscape features with strong historical relationships with the monastery, including Tòrr an Aba (hill of the abbot), Port nam Mairtir and St Ronan's Bay.
- A street plan that reflects and incorporates elements of the Early Medieval and Medieval Sraid nam Marbh processional way, Martyr Street and St Ronan Way. This combined with the presence of the nunnery and MacLean's Cross which are passed on the way to the Abbey, which is the focus of northward views on Main Street, creates a strong feeling of continuity of religious practices. This street plan also includes numerous open areas allowing numerous views to the surrounding landscape and seascape.
- The scale and stye of the later, primarily 19th century, buildings and the materials is characteristic of western Scotland and complement the aesthetics of the earlier buildings and surrounding landscape creating a strong sense of place, which ties in to spiritual and religious associations of the island. This is experienced not only whilst moving around the Conservation Area, but also when approaching on the ferry.

4.13 There are few detracting features. The scattering of late 20th century buildings and structures includes several that are unsympathetic in their design and finish, most notable in the current context being the Martyrs Bay Restaurant adjacent to the jetty. These have only a very localised impact. Perhaps the largest detracting factor may be the very large numbers of tourists visiting the island, which at certain times of year may be felt to detract from the sense of the island being a place of religious contemplation.

5 ARCHAEOLOGICAL AND HISTORICAL BACKGROUND WITH ASSESSMENT OF SIGNIFICANCE

Timescales used in this report

Prehistoric

Palaeolithic	450,000 -	10,000 BC
Mesolithic	10,000 -	4,000 BC
Neolithic	4,000 -	1,800 BC
Bronze Age	1,800 -	600 BC
Iron Age	600 -	AD 410

Historic

Early Medieval	AD 410 -	1100
Medieval	AD 1100 -	1560
Post Medieval	AD 1560 -	1745
Modern	AD 1745 -	Present

Introduction

5.1 This section briefly reviews the relevant archaeological evidence for the Site and the surrounding area, and, in accordance with SPP, considers the potential for any as yet to be discovered archaeological evidence on the Site. There is a very large body of archaeological and historical information for this area, reflecting the importance of Iona in the Early Medieval and Medieval periods as an ecclesiastical centre. However, the Site lies in the inter-tidal zone and below the low-water mark. That part in the intertidal zone comprises bare rock and hence has no archaeological potential. Consequently, the evidence of activity above the high-water mark is considered only so far as it is relevant to the potential of that part of the Site below the low-water mark.

5.2 This section considers data for a study area extending 500m from the Site (Figures 2, 3 & 4) from Historic Environment Scotland datasets, WoSAS Historic Environment Record (HER) and the National Record of the Historic Environment (NRHE), together with a historic map regression exercise charting the development of the study area from the 19th century. In addition, the INSPIRE Wrecks dataset maintained by the UK Hydrographic Office (UKHO), geotechnical data has been examined and bathymetry data has been reviewed (MSDS 2021).

Non-Designated Heritage Assets (Terrestrial)

5.3 No non-designated heritage assets have been recorded previously in the Site. Whilst the HER contains an entry for the slipway (46066), this 20th century structure cannot be considered to represent a heritage asset.

5.4 The HER contains 66 entries for the study area. They are discussed where relevant below.

Non-Designated Heritage Assets (Maritime)

5.5 There are no Canmore Maritime records for the study area.

5.6 The UKHO's Inspire dataset does not hold any records of wrecks or obstructions in the study area.

5.7 Bathymetry data has been assessed as part of this project (MSDS 2021) to identify potential anthropogenic material and anomalies that may be of archaeological interest. This identified no anomalies within the footprint of the proposed breakwater or dredging area. Three anomalies were identified in the wider study area. These were all considered to have low archaeological potential, with two being likely to be debris and one probably geological in origin (Figure 3).

Previous Archaeological Work

5.8 No intrusive works have been undertaken previously within the Site. However, a geophysical survey undertaken in 2016 (Rose 2016) took in the location of the proposed temporary construction compound (Figure 4). The survey comprised both gradiometer and resistivity surveys. The results are discussed below where appropriate.

5.9 Numerous, mostly small-scale interventions have taken place within the study area, mostly in Baile Mor. None have taken place on the shore. Again, these interventions are of limited relevance to the Site, beyond providing evidence of activity from the Prehistoric onwards. Those of greatest relevance in the current context comprise:

- Excavation of long cist cemetery comprising around 40 burials at An Eala immediately adjacent to the temporary working area (235, not recorded as an event by HER).
- Excavation (E5213 – Trench 2) of small trench on An Eala immediately adjacent to the temporary working areas.
- Excavation of a small trench approximately 130m from the temporary works area (E5213 – Trench 5) placed to intercept the Street of the Dead, found no trace of it;
- Geophysical survey (E6372) extending to within 30m of the temporary works area, this recorded an anomaly corresponding with the line of the Street of Dead as shown on historic mapping.
- Watching briefs (E5218) near and on the line of the Street of the Dead, recorded no features associated with the Street of the Dead.
- Watching briefs (E5216 & E6648) immediately adjacent to the temporary works area recorded no archaeology.
- Watching brief (E4325) undertaken approximately 100m to the north-west of the breakwater. This recorded undated midden deposits and wind-blown sand.

Prehistoric

5.10 The earliest evidence for human activity recorded in the study area is a Mesolithic scraper recovered 500m to the north of breakwater (254), whilst possibly Neolithic lithics were recovered during a watching brief approximately 175m to the north-west of the Site (E6648). The only other certainly prehistoric evidence recorded is substantially later, being an assemblage of late Prehistoric worked stone recovered from Medieval deposits 240m to the north of the breakwater (59899). The deposit they were found in had been reworked and it was unclear whether these finds were imported or residual.

5.11 These finds indicate that the area of Baile Mor saw activity throughout the prehistoric period. Archaeological features and deposits of this period are either obscured by later features and deposits or have been disturbed or removed by later activity. It may be assumed that the foreshore saw activity during the Prehistoric period; St Ronan's Bay and Martyrs Bay are both natural landings and are therefore likely to have seen use during this period. There is no evidence of structures or marine losses associated with this activity, nor has the 2016 geophysical survey recorded any features in the Site that might relate to this period.

Early Medieval and Medieval

5.12 There is extensive recorded archaeological evidence of Early Medieval and Medieval activity in the study area.

5.13 The bulk of the HER entries are focussed on the area occupied by the present-day settlement of Baile Mor and the abbey to the north, and have little direct relevance to the Site. To the south of Baile Mor evidence is sparse, despite several archaeological interventions having taken place. Whilst these interventions have been small the complete absence of Early Medieval and Medieval finds is strongly indicative of this area not having seen widespread intensive activity during this period. Nevertheless, there are several known foci of activity relating primarily to ritual activity and reflecting the traditional use of Martyrs Bay as a landing place for funeral parties; adjacent to the temporary compound area is a natural mound known as An Eala (WoSAS 235, Figures 3 & 6). Traditionally upon landing, the corpse would be placed on the mound and the funeral party would perform the 'deisiol' three times around the mound before proceeding to the Reilig Odhráin by way of the Street of the Dead or Sraid nam Marbh (WoSAS 217).

5.14 An Eala also served as a burial place. Around forty burials, including long cists, were excavated there in the 1960s. These were not well dated, but it was thought likely that they dated between the 6th and 10th centuries AD (Canmore 21641). A geophysical survey (Rose 2016) of the fields to the south of Baile Mor recorded a curving high resistance anomaly (Anomaly 10) around the mound suggestive of a kerb or revetment with a fainter anomaly possibly indicating the presence of an external ditch. These anomalies extend into the southern fringe of the temporary construction compound (Figure 3 inset).

5.15 There is no surface trace of the Street of the Dead in this area and its line as depicted on First Edition Ordnance survey (Figure 5) must be considered indicative. This indicative line intersects with the limit of the temporary works area. It appears unlikely, however, that there are any subsurface features present relating to it, as the geophysical survey (Rose 2016) recorded no anomalies corresponding with it either here or elsewhere and test-pitting targeting it has found no trace[2]. A second geophysical survey (E6372) recorded an anomaly that coincided with the indicative line, but seen in the context of the more extensive survey it seems unlikely that this relates to the Street of the Dead.

5.16 St Ronan's Bay and Martyrs Bay are both natural landings and are known to have seen use during this period. There is no evidence of structures or marine losses associated with this activity.

Post Medieval & Modern (including map regression exercise)

5.17 Again there are numerous entries for the Post-Medieval and Modern periods for the study area that relate to the settlement of Baile Mor. Martyr's Bay and St Ronan's Bay continued in use for landing boats. The Ordnance Survey map dated 1875 shows an 'Old Pier' to the north of the St

[2] https://www.cambridge.org/core/journals/antiquaries-journal/article/new-jerusalem-at-the-ends-of-the-earth-interpreting-charles-thomass-excavations-at-iona-abbey-195663/36F808DDF43B6311D307417A3B8D2434#r142

Ronan's Bay (Figure 5). No visible trace of this remains. It also shows a pier slightly to the north of the current jetty. This was much smaller than the current jetty and again no visible trace remains.

5.18 The 1897 Ordnance Survey map shows a slightly more substantial pier that coincides with the northern side of the existing jetty.

5.19 Between the road and Martyrs Bay stands a war memorial (WoSAS 43380).

5.20 Elements of the pier shown on the 1897 map may be subsumed within the current jetty, but would have no archaeological interest. It is considered that there is negligible potential for previously unrecorded assets to be present of Post-Medieval or later date to be present.

Assessment of Archaeological Potential

5.21 Within the construction footprint of the breakwater there are no superficial deposits present. There is therefore no potential for previously unrecorded archaeology to be present. In the area of dredging there is coarse sand and gravel, which are indicative of relatively high energy conditions. In such conditions, there is potential for residual artefacts to be present, but this potential is relatively low.

5.22 Within the Temporary Working Area there is high potential for previously unrecorded archaeology to be present in the construction compound area. This potential relates to features associated with An Eala, the site of an Early Medieval to Medieval cemetery. A geophysical survey undertaken previously indicates that such features are present at the limit of the area and hence smaller features not readily identified through geophysics may be present. Elsewhere within the temporary works area, the potential is negligible as the bedrock is exposed.

Significance (Non-Designated Assets)

5.23 As identified by desk-based work and previous geophysical survey, archaeological potential by period and the likely importance of any archaeological remains which may be present is summarised in table form below.

Period:	Identified Archaeological Potential	Identified Archaeological Importance
Prehistoric	Low	If present most probably of local importance
Early Medieval	High	If present most potentially of regional importance
Medieval	High	If present most potentially of regional importance
Post Medieval	Negligible	If present most probably of local importance

6 SUMMARY AND CONCLUSIONS

6.1 In keeping with relevant guidance, this baseline assessment draws together the available evidence in order to clarify the heritage significance and archaeological potential of the Iona Ferry Terminal and to identify heritage assets in the surrounding area that may be affected by the proposed upgrading of the terminal.

6.2 The Site lies partially within the Baile Mor Conservation Area and it is considered that the Proposed Development will affect the Conservation Area and the setting of St Mary's Abbey, which is both a Scheduled Monument and a Category A Listed Building, MacLeans Cross and Iona Nunnery, both of which are Scheduled Monuments, and the Replica of St John's Cross, which is a Category A Listed Building. It is considered that the proposed development will affect these. The assessment of impacts is presented in the EIAR Chapter.

6.3 The bays to the north and south of the terminal are natural landings and are likely to have seen activity through all periods, but given the conditions and the results of the review of hydrographic data it is considered that the potential for previously unrecorded heritage assets to be present below the high water mark is low in respect of the Medieval and earlier periods and negligible for Post-Medieval and Modern periods. The site of the proposed temporary construction compound lies adjacent to An Eala, the site an Early Medieval or Medieval cemetery, and the traditional line of the Street of the Dead. The results of a previous geophysical survey indicate that features associated with An Eala, namely a revetting wall or kerb and a possible ditch extend into the area of the temporary construction compound. No trace of features relating to the Street of the Dead has been recorded. It is considered that there is high potential for related archaeology to An Eala to be present within the temporary working area. The potential elsewhere is considered to be negligible.

Sources Consulted

General

National Library of Scotland

WoSAS Historic Environment Record

Internet

British Geological Survey – http://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html

Bibliographic

Causeway Geotech 2018 *Fionnphort and Iona- Ground Investigation*

Chartered Institute for Archaeologists *Standard & Guidance for historic environment desk-based assessment* 2014, updated 2020.

Historic Environment Scotland 2014 *Our Place in Time - the Historic Environment Strategy for Scotland.*

Historic Environment Scotland 2019 *Historic Environment Policy for Scotland*

Historic Environment Scotland 2020 *Managing Change in the Historic Environment: Setting*

MSDS 2021 *Iona and Fionnphort: Archaeological Assessment of Hydrographic Data*. Unpublished client report.

Rose Geophysics 2016 *Geophysical Survey Report Martyr's Bay, Iona.* Unpublished client report.

SNH & HES 2018 *Environmental Impact Assessment Handbook*

Scottish Government 2014 *Scottish Planning Policy*

Scottish Government 2015 *Scotland's National Marine Plan*

Structural Soils 2020 *Iona and Fionnphort: Seabed Sediment Analysis.*

Cartographic

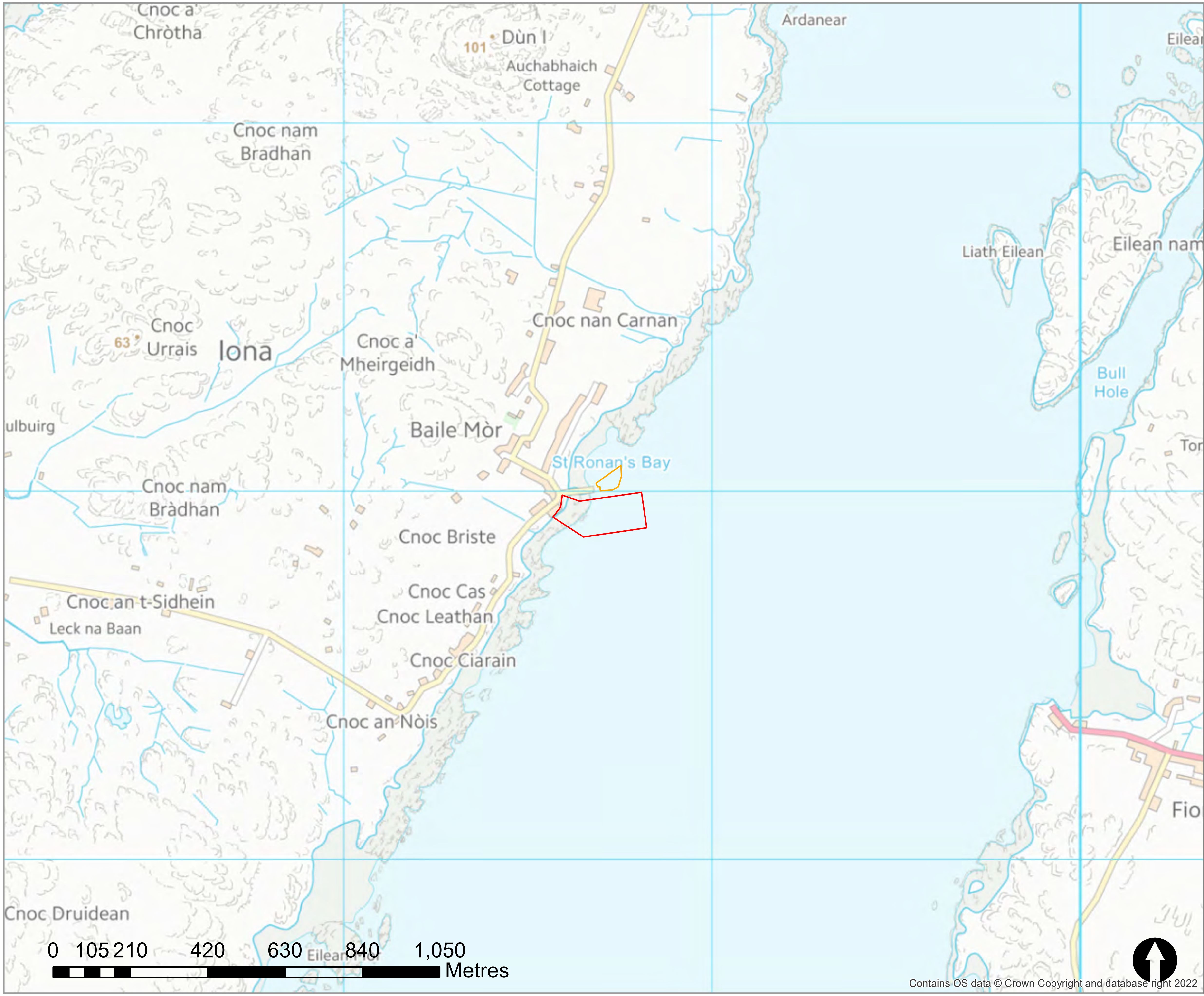
Admiralty Sound of Iona 1859, 1860, 1886, 1902,1933, 1957, 1962

Blaeu, J 1654 Mula Insula

Ordnance Survey 1880, 1881, 1899, 1900, 1976

Thomson, J 1832 Northern Part of Argyllshire

FIGURES



Legend

Site Boundary

Dredge Area

rev	ammendments	drawn	date

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TITLE

FIGURE 1
SITE LOCATION

Project Number	Sheet Size	Drawing Scale
--	A3	1:10000

Drawing Number	Datum
--	OSGB

Drawn by	Status	Revision
RJC	FINAL	--

Checked By	Approved By	Date
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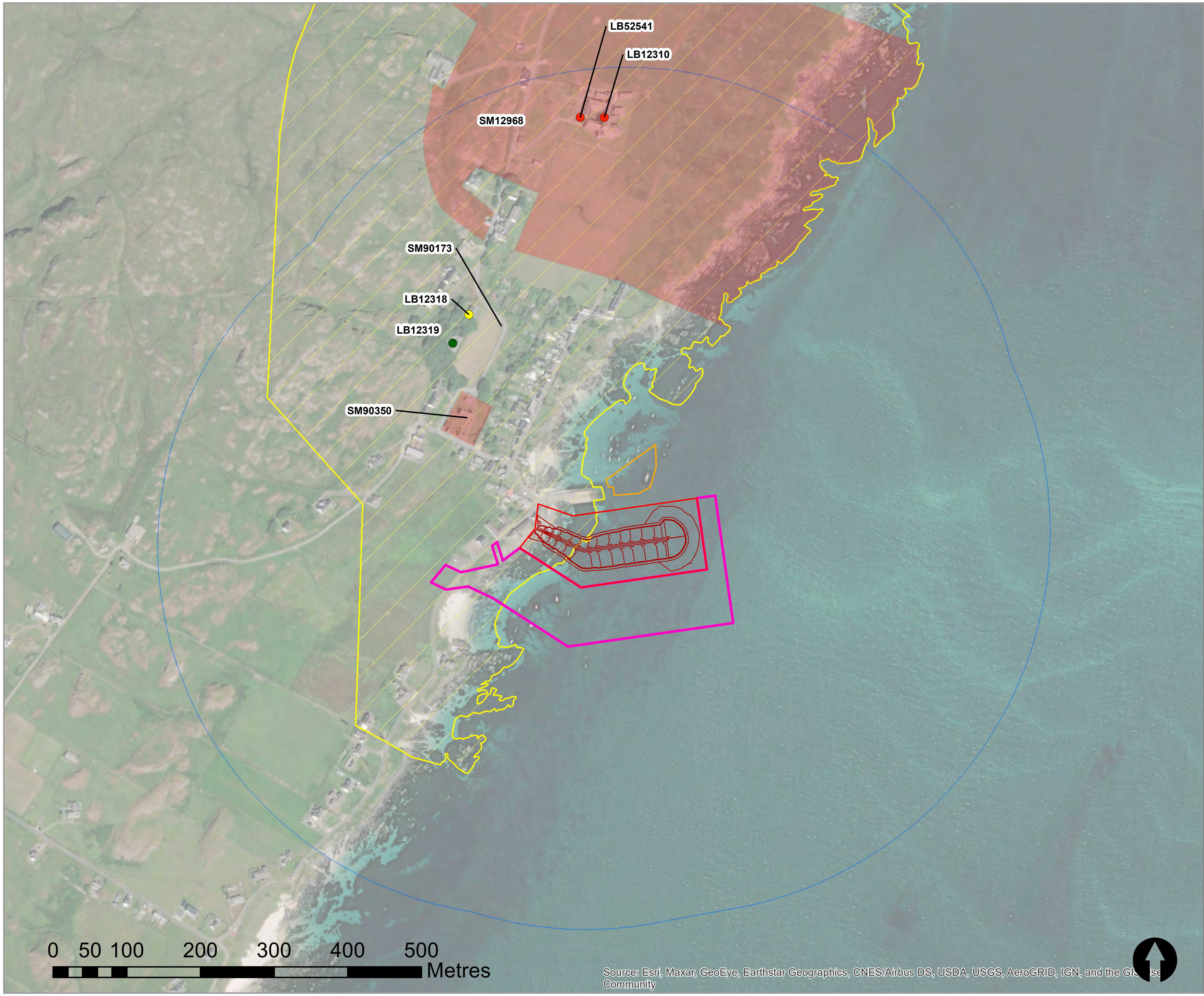

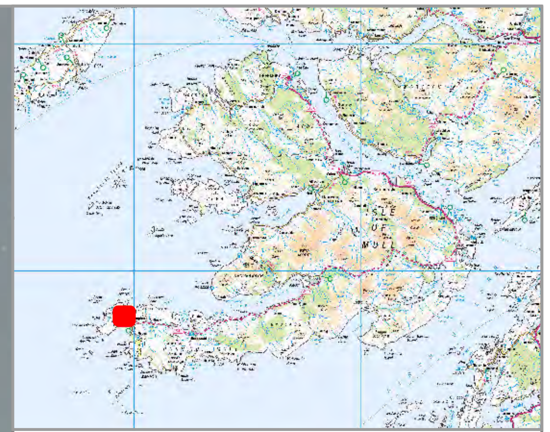

Legend

- Site Boundary
- Temporary Working Areas
- Dredge Area
- Proposed Breakwater
- Study Area
- Scheduled Monument
- Category A Listed Building
- Category B Listed Building
- Category C Listed Building
- Conservation Area

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FIGURE 2
DESIGNATED HERITAGE ASSETS

Project Number	Sheet Size	Drawing Scale
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Drawing Number	Datum
--	OSGB

Drawn by	Status	Revision
RJC	FINAL	--

Checked By	Approved By	Date
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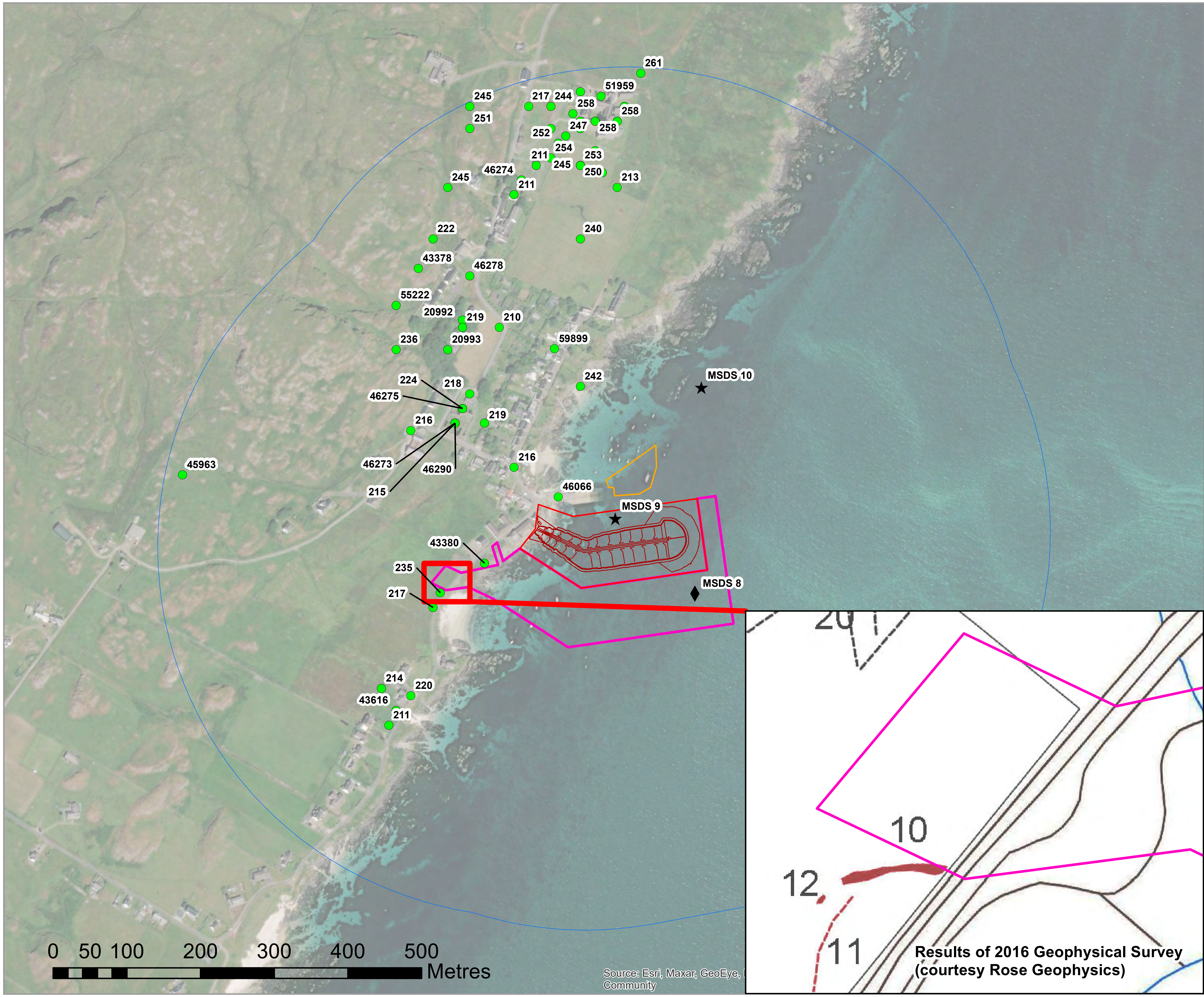

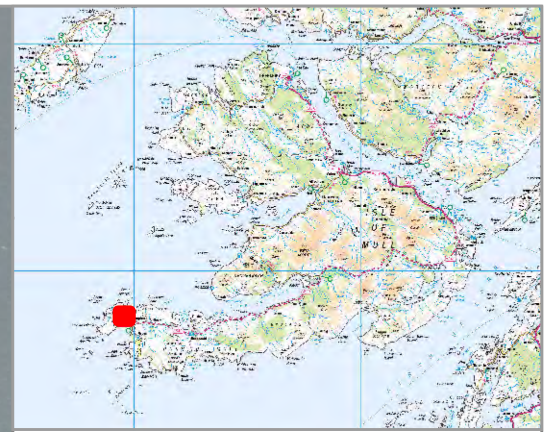

Legend

- Site Boundary
- Proposed Breakwater
- Dredge Area
- Temporary Working Areas
- Study Area
- HER Entry

Anomaly

- Likely Geological
- Potential Debris

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FIGURE 3
HER ENTRIES, HYDROGRAPHIC & GEOPHYSICAL ANOMALIES

Project Number	Sheet Size	Drawing Scale
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Drawing Number	Datum
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Drawn by	Status	Revision
RJC	FINAL	--

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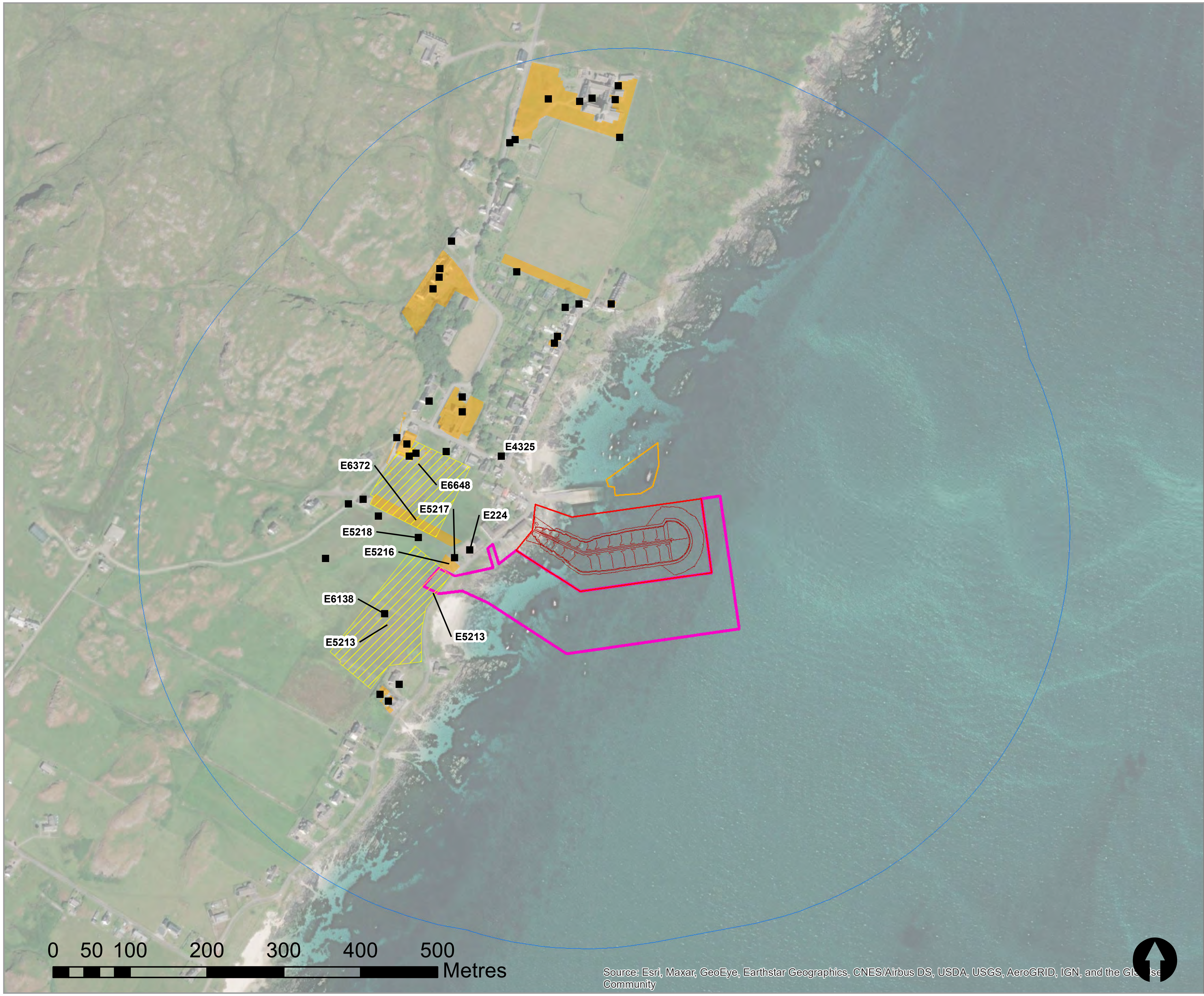

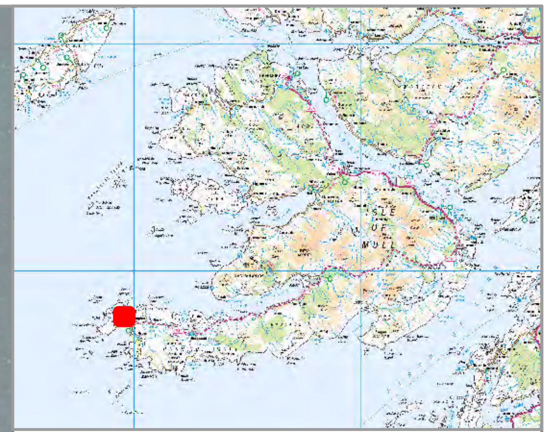

Legend

- Site Boundary
- Temporary Working Areas
- Dredge Area
- Proposed Breakwater
- Study Area
- HER Event
- HER Event
- 2016 Geophysical Survey

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FIGURE 4
HER EVENTS AND 2016 SURVEY

Project Number	Sheet Size	Drawing Scale
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Drawing Number	Datum
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Drawn by	Status	Revision
RJC	FINAL	--

Checked By	Approved By	Date
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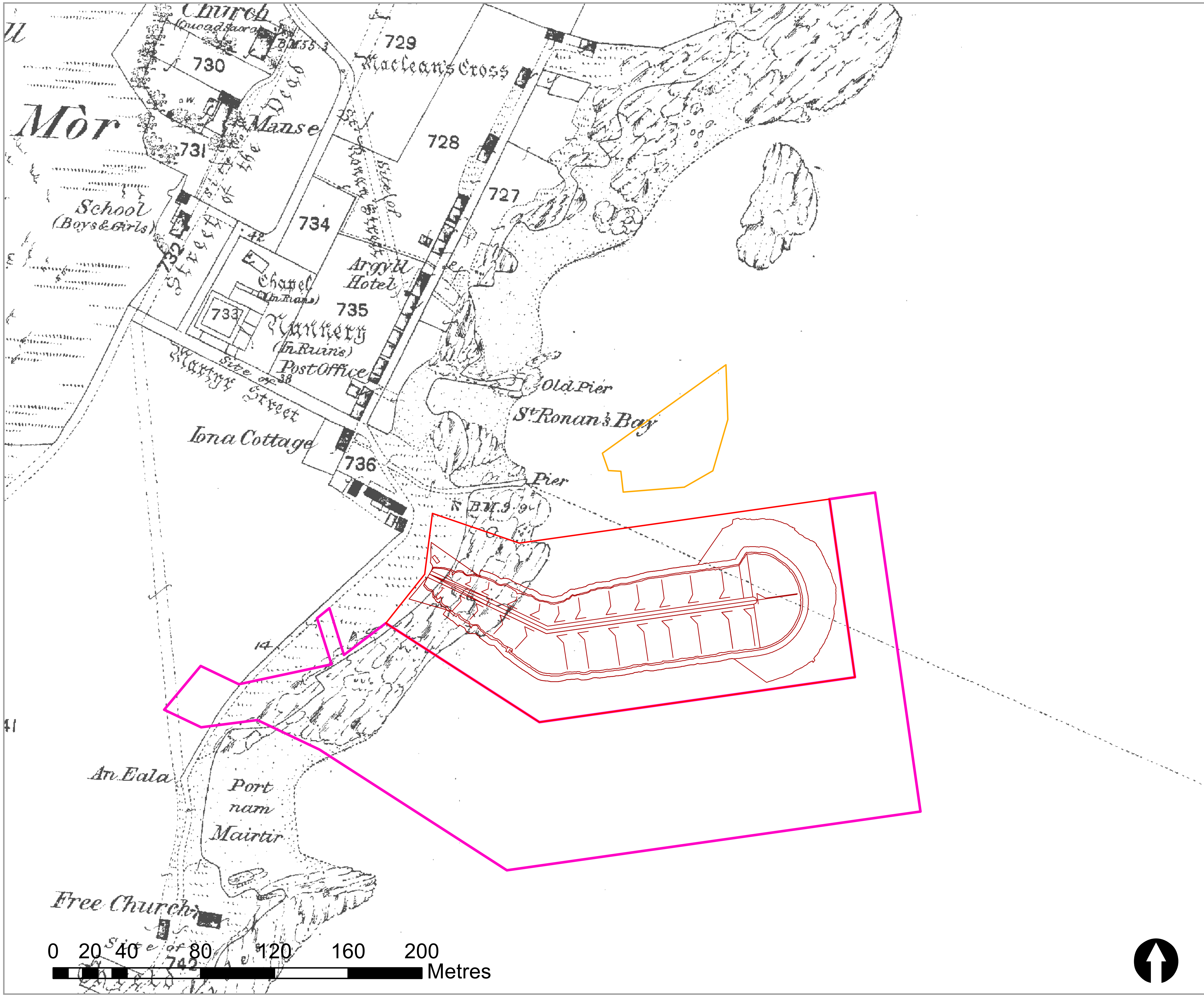

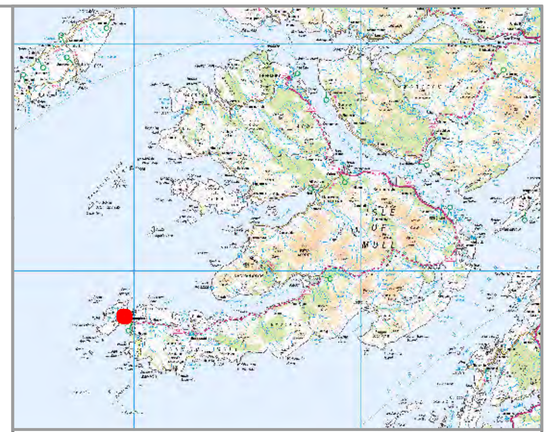

Legend

- Site Boundary
- Dredge Area
- Proposed Breakwater
- Temporary Working Areas

rev	ammendments	drawn	date

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FIGURE 5
ORDNANCE SURVEY (1875)

Project Number	Sheet Size	Drawing Scale
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Drawing Number	Datum
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Drawn by	Status	Revision
RJC	FINAL	--

Checked By	Approved By	Date
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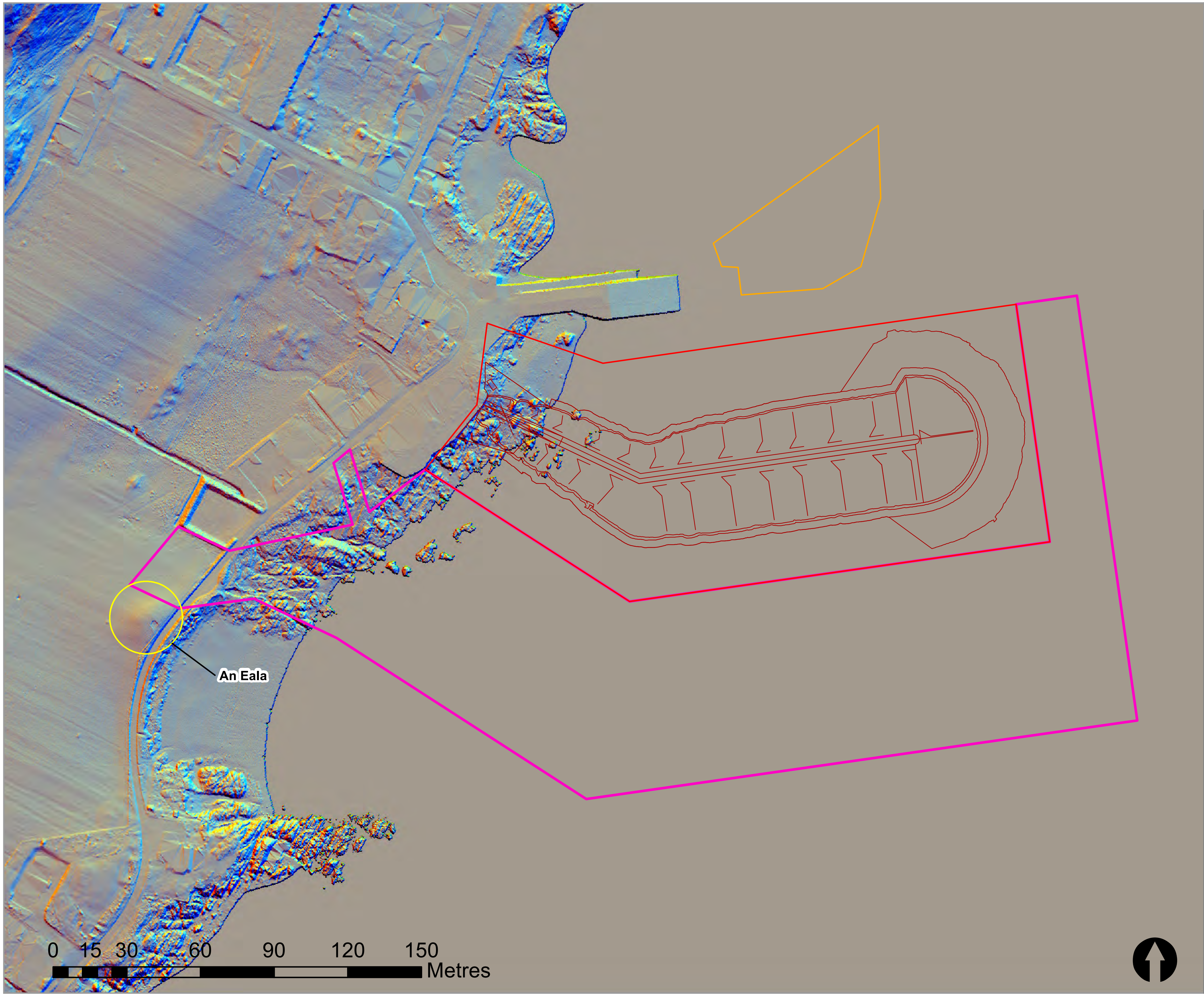

Legend

- Site Boundary
- Temporary Working Areas
- Dredge Area
- Proposed Breakwater

rev	ammendments	drawn	date

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FIGURE 6
LIDAR DATA (MULTI-DIRECTIONAL HILLSHADING)

Project Number	Sheet Size	Drawing Scale
--	A3	1:1500

Drawing Number	Datum
--	OSGB

Drawn by	Status	Revision
RJC	FINAL	--

Checked By	Approved By	Date
MF	MF	16/11/22

PLATES

Plate 1: Existing jetty seen from the south

Plate 2: Existing jetty seen from the north

Plate 3: Existing jetty seen from ferry

Plate 4: The Abbey seen from jetty

Plate 5: The Abbey seen from area immediately to the south of the jetty

Plate 6: View across Martyrs Bay to the Abbey, Baile Mor and the existing jetty.

Plate 7: View south over Martyrs Bay from the jetty

Plate 8: View from the grounds of the nunnery towards the jetty, showing limited visibility

Plate 9: View towards the jetty from road adjacent to the Nunnery

Plate 10: The jetty seen from in front of cottages to its north

APPENDICES

Appendix 1

Statements of Significance

Property in Care (PIC) ID: PIC076
Designations: Listed Building (LB12310 Category A)
Taken into State care: 1999 (Leased)
Last reviewed: 2018

STATEMENT OF SIGNIFICANCE

IONA ABBEY

We continually revise our Statements of Significance, so they may vary in length, format and level of detail. While every effort is made to keep them up to date, they should not be considered a definitive or final assessment of our properties.

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HISTORIC ENVIRONMENT SCOTLAND
STATEMENT OF SIGNIFICANCE

IONA ABBEY

CONTENTS

1 Summary

1.1 Introduction

Iona Abbey is one of the oldest and most important religious centres in Western Europe. The abbey was a focal point for the spread of Christianity throughout Scotland, with a monastic community first founded here by St. Columba (Colum Cille) around 563, when Iona was part of the Kingdom of Dal Riata. The abbey is located on a small island in the Southern Hebrides, a short distance off the south-west tip of Mull.

The Property in Care (PIC) consists of the Benedictine Abbey, which was rebuilt in the 20th century from its medieval ruins, and the wider site around it, which contains the early Christian monastery associated with Columba. In addition, a very significant number of carved stones, principally High Crosses and West Highland Grave slabs, are collected within the site museum or remain outside in their original locations.

Contemporary with the Benedictine Abbey's foundation, an Augustinian Nunnery was founded on Iona. It is also in the care of HES and there are significant physical remains to be seen; it was not comprehensively rebuilt, as was the abbey, and so, while ruinous, gives a good idea of the original architecture of both early 13th century foundations. While it is of course an integral part of the islands medieval religious identity, the Nunnery is currently assessed in a separate Statement of Significance, along with St Ronan's Church and MacLean's Cross. These two Statements will be more fully integrated at a future date, but in the meantime they should be read together to obtain a fuller picture of HES-managed sites on Iona.

After the Reformation the abbey became increasingly ruinous and in time became an attraction for early tourists. Conservation of the site began in the late 19th century with the foundation of the Iona Cathedral Trust whose mission was to restore the abbey for worship. During the mid-20th century The Iona Community[1] (IC), an ecumenical group, spearheaded a major rebuilding project which saw the complete rebuilding and conversion of the cloisters for use as a residential ecumenical centre.

A large part of the island came into the ownership of the National Trust for Scotland in 1980. Their aim is to preserve of the peace and tranquillity of the island, enable access, and to work with the crofting and farming community to retain the traditional agricultural nature of the island.

[1] The Iona Community (IC) refers to the ecumenical group founded in Glasgow and Iona in 1938, as oppose to the local people of Iona.

The abbey, and the area of the earlier Columban monastery, came into the care of Historic Environment Scotland's predecessor body in 1999. HES has a lease of the abbey from the Iona Cathedral Trust and in turn lets the abbey to the IC. HES is responsible for upkeep, conservation, and visitor-facing matters. In 2013 the museum was upgraded and a major re-display undertaken; this was informed by the work of the Iona Research Group http://ionaresearchgroup.arts.gla.ac.uk/index.php/about/ who continue to make very significant contributions towards the understanding of the site.

1.2 Statement of significance

Iona and its abbey, inextricably linked to St Columba, are recognised by people around the world as a special, sacred place. It has a universally acknowledged spiritual presence, which together with the heritage of sanctity contribute to a numinous and sublime quality perceived by most visitors. This sets it apart from other properties in care. The following bullet points outline the most important aspects which contribute to Iona's cultural significance:

- Iona Abbey has had an important spiritual, cultural and political influence on Scotland (and sometimes further afield) for many centuries, from the time of Columba to the era of the Lords of the Isles.

- The legacy of St Columba can still be tangibly felt when visiting the site. The tiny shrine chapel (though extensively rebuilt) holds the greatest cultural significance of any of the buildings on Iona. It was created to contain Columba's relics which were the richest treasure of the monastery. It is probably the oldest church building in Scotland. Radiocarbon dating has confirmed that a structure atop Tòrr an Aba dates from Columba's time and thus is likely to be his writing hut.

- Iona contains the largest and most important collection of early sacred sculpture of any British monastery. This includes the spectacular high crosses such as St Martin's which has stood in its original position outside the monastery for 1250 years. The *Lapis Echodi* inscribed stone may be the oldest surviving memorial to a king in Britain. Eochaid Buide, king of Dal Riata died c 629.

- Iona was a major centre of literacy, the introduction of which revolutionised life in Scotland, especially in relation to governance. The Iona chronicles dating from 630-720 are amongst the oldest post-Roman chronicles in Europe and it is now widely accepted that the Book of Kells, the finest

Gospel book of the western European church, was produced on Iona around 800.

- Adomnán's *Life of Columba,* written on Iona c 690, is a prime evidential resource which provides unique insights into the reality of the monastery and the island during his own lifetime and places associated with Columba. Another Adomnán work, *De Locis Sanctis,* is an account of Christianity's sacred places, including Jerusalem. It provides a framework for understanding how the planning and development of Iona and its liturgical landscape was conceived as a reflection of the heavenly Jerusalem.

- The site exhibits the best preserved and most complex physical remains of an early monastery in Britain; it is therefore of immense research value. The vallum, the shrine chapel, Sràid nam Marbh, Torr an Aba and the high crosses represent extraordinary, in-situ evidence of the reality of the Columban monastery.

- The Benedictine Abbey is the largest and most elaborate ecclesiastical foundation in the West Highlands and Islands. Its design features express particularly the importance of pilgrimage in the planning of the site. Contemporary with the abbey, the Nunnery is one of only two Augustinian nunneries in Scotland and is one of the best-preserved medieval convents in Britain. Its presence evidences the importance of women's participation in religious life and especially pilgrimage. For further details see *HES Statement of Significance, Iona Nunnery, St Ronan's Church and MacLean's Cross.*

- Reilig Odhrain is of considerable importance as the burial place of the monastic communities, and of some kings. In later medieval times it was the popular burial place of the best men of the clans, their graves covered by more than 100 beautifully carved slabs. Today it retains significance as the last resting place of people of national and local importance such as the burial here of John Smith, leader of the Labour Party, in 1994.

- The patronage of the Gaelic-Norse lords and then the Lords of the Isles has led to the presence of a large and important collection of carved stones at the abbey, although it is difficult to know for certain which of the later graveslabs were produced here. The later medieval graveslabs can illuminate many aspects of life and society amongst the clergy and warrior elites of the West Highlands.

- Iona is also significant as a place of pilgrimage. Since the time of Columba's death people have come from afar and walked along Sràid nam Marbh, following in the footsteps of saints and hoping their prayers would be answered. Pilgrimage is a continuing tradition in the life of the island.

- The various phases of conservation and restoration at the abbey, particularly in the 19th and early 20th century, are testament to the continuing significance of Iona. In particular the circumstances around the creation of the Iona Cathedral Trust and the rebuilding work by Rev. George Macleod are of considerable social significance, particularly in regard to the development of so-called Celtic spirituality.

2 Assessment of values

2.1 Background

Iona Abbey is located on the north-east side of the small island of Iona in the Inner Hebrides, 1 mile west of Fionnphort on the south-west coast of Mull; the majority of visitors access the island by way of the Cal Mac ferry which plies across the Sound of Iona between Fionnphort and the landing at Iona village. The island is only 3 miles long and 1 mile east-west, with the highest hill (100m) at Dun I to the west of the abbey, and with Dun Bhuirg and its Iron Age hillfort overlooking the good natural harbours near Port Ban on the west side. Iona is a relatively modern name for the island, based on a misreading of its Latin name.

Iona may have had a reputation as a place of spiritual significance before Columba arrived there, and this may have been part of the attraction. The Greek historian Plutarch (c. 46–120) wrote of an expedition by the Roman fleet to the west coast of Scotland, during which they visited an island which was the retreat of holy men. This is likely to be the circumnavigation of Scotland which the Roman general Agricola ordered after the defeat of the Caledonian tribes at the battle of Mons Graupius in AD 84.

The abbey site can be characterised in four main phases:

<u>500s – 1100s The early Christian monastery</u>

Iona was powerfully associated with St Columba during his lifetime and posthumously as a saint with an international reputation. The key features comprise:

Vallum bank and ditch - the impressive upstanding remains of the west circuit of the early monastic enclosure, which has a long and multi-phase history going back at least 2000 years in places. At least two concentric enclosures existed which would have delineated different zones of sanctity within the monastery. Archaeological survey indicates the inner and outer vallum developed during the 7th and 8th centuries. The full extent enclosed exceeds 20 hectares, one of the largest Christian sites in Scotland. It appears that at least part of the vallum pre-dates the Columban settlement: part of its west side has been radio carbon dated to 0AD indicating a pre-existing Iron Age site; other pre-historic and later enclosures/structures are indicated within the vallum.

Shrine Chapel – only the lowest courses of this tiny building survive from the original reliquary chapel probably constructed in the mid-700s and likely to be the earliest surviving fragment of a Scottish church. During the mid-1400s it was incorporated into the fabric of the cloister; the chapel was rebuilt to the present pattern in 1962. Its original function was probably to house the relics of St Columba, and as such was by far the most important structure at the abbey, harking back to the tomb of Christ in Jerusalem. Its west front contains a key surviving diagnostic feature, being projecting stone 'antae' located at both corners of the west façade. The building was exposed in 1874 during R Rowand Anderson's restoration programme, and found to contain a pair of above-ground stone cists. A new raised floor was built over these in the rebuilding of 1962.

Sràid nam Marbh*,* the 'Street of the Dead' processional way – only the south part of this is early medieval, the north part being a later medieval deviation bringing the road to the Benedictine bakehouse. It originally linked the landings close to the modern village, to the monastery, with many crosses marking its route. Only the 70m length through Reilig Odhrain towards St Martin's Cross is original, dating back to the 600s. It originally terminated at the forecourt in front of the early church and latterly the shrine chapel.

Tòrr an Aba – 'hill of the abbot' facing the likely west end of the early church, is traditionally associated with the elevated place where Columba had a writing hut and from where he could see what was going on in his monastery, as well as ships crossing the Sound. The hilltop was excavated in the 1960s, when evidence of a timber and wattle structure was found. Recent re-examination of excavated material and radio-carbon dating (540 – 650) has confirmed this structure dates to Columba's time and thus the traditional attribution of his writing hut to this location may well be correct.

Reilig Odhrain cemetery – the name alluding both to Odhran who was traditionally a cousin and contemporary of Columba, as well as the Reilig component which refers to a place of burial. This was the original burial ground for the early monastery which grew up outside the inner sanctum, separated from the abbey core by the inner vallum ditch. Most of the early cross marked stones and grave markers come from here, along with St Oran's cross which probably stood beside the Street in the now-empty cross base still visible. The later chapel here was probably built on the site of an early Christian funerary chapel.

Several important traditions pertain to Reilig Odhrain. Dean Donald Munro writing in 1549 described seeing three tombs like small chapels in the Reilig Odhrain cemetery, possibly in a row north – S, each inscribed on the gable front - The Tombs of the Scottish Kings, The Tombs of the Irish Kings, and The Tombs of the Norwegian Kings. No trace of these survives, and indeed they were no longer visible when Pennant visited in 1772, by which time he could only see some indeterminate remains of a possible structure labelled ‘the ridge of the kings’, along with many West Highland slabs. It seems unlikely that Munro simply invented this description, although exactly what he saw remains a puzzle. There may have been a group of early Irish-style gabled tombs. Although some early medieval kings from home and abroad were buried here, along with numerous local kings (clan chiefs), the oft-repeated statement that many kings of Scots were buried here is considered to be a fiction, promoted by later medieval chroniclers and by the likes of William Shakespeare (Macbeth). It may be that the later Benedictines of Iona added the Latin inscriptions to a group of older tombs to ‘sex-up’ their offer. The popularity of Iona as a burial place for the great families declined following the forfeiture of the Macdonald Lords in 1493.

Pennant (1772) records the top of a box-like early Christian cross base (RCAHMS Argyll 4 no 99) as being in Reilig Odhrain just north-west of St Oran’s chapel. This has an important folk tradition, attached to it, possibly lasting over 1000 years, for the practice of divination whereby visitors would turn ‘noble globes of white marble’ in a sunwise direction a prescribed number of rotations. This base was known as the *clach-bràth* in Gaelic, and was in situ until the 19^{th} century. The socket in this base is 0.6m wide, which is wide enough to have supported St Oran’s Cross.

High crosses and other features in the forecourt of the later church and in the site museum; and the substantial body of other crosses, cross slabs and grave markers in the site museum and in local Collections storage. Above all the early Christian period is represented by the (now rebuilt) shrine chapel at the west front – the single most important building, which from its creation around 750 became the central focus of the place. The well, the bullaun (prayer) stones, and the trough known as ‘the cradle of the north wind’ (losaid na gaoithe tuath), are all likely to have early Christian origins, specific to this location. The well is likely to pre-date the Columban monastery and may have been a predetermining feature in the choice of site of this monastery. It may have played a role in baptism. The high crosses are key markers of the complex and sophisticated theological and liturgical activities at Iona.

1200 – 1600s – The Benedictine monastery

Somerled, in seeking to re-establish the power of Iona made an unsuccessful attempt to get the abbot of Derry, then Columba's successor, to take over the abbacy of Iona. Somerled's son Ranald, persisted in reinvigorating religious life on Iona with the foundation of a new Benedictine house, confirmed in a papal bull of 1203 placing the new monastery under the direct protection of the Pope. Derry and its allies took exception to this usurping of their spiritual power, and invaded the island in 1204 destroying construction work on the new church. But the Benedictines held their ground, building the new monastery in and around the high crosses, ancient vallum and historic buildings already imbued with centuries of sanctity. This probably involved little change of personnel, but rather the instructing of the existing brethren in the ways of the Benedictine rule.

The Benedictine monastery was endowed with lands and churches chiefly on Mull and neighbouring islands, but also stretching from North Uist in the North to Kintyre and Galloway in the South.

The first church that was built for the new order was narrower and about two-thirds the length of the later church, as revealed in the restoration works of P Macgregor Chalmers of the early 1900s. It had central transepts located to the west of the later transepts. The church went through two significant redesigns within the 13th century, and by 1250 the choir had been extended to accommodate an increased number of monks, and raised up over a timber-ceilinged crypt as a focus for the liturgy of the cult of St Columba. A greatly enlarged south transept was begun before the end of that century, although never finished, possibly intended to have been articulated with the crypt and occupying two storeys, similar to that planned for Glasgow Cathedral around the same time. The oldest surviving fabric is in the north side of the church. It was documented in the early 1400s that the buildings were in a poor state, and a major programme of repairs was led by Abbot Dominic (abb 1421-1465). The fine effigies of Dominic and of his successor Abbot John MacKinnon can be seen one each against the north and south walls of the choir. The entire south side was rebuilt in a wider form, the crypt done away with, and a large south choir aisle added. The Shrine Chapel was physically attached to the north-west corner of the west front at this time. The north transept contains a pair of shallow chapels set into the east wall, with a niche in between which contained an important almost life-sized statue, only the feet of which survive in situ. A modern imagining of this statue was commissioned for the niche by HES in 2015 and created by Tim Chalk.

The rebuilding of the abbey church in the mid-15th century shows strong Irish architectural influences, and one Irish master mason – Donald Ó Brolchán - signed his name on a crossing pier. All this was taking place in parallel with the flowering of the Iona and West Highland schools of monumental sculpture, and so there are many similarities between the two. There are numerous design features in the rebuilding which hark back to earlier period, including the round columns in the south choir arcade, but with much excellent quality work including that of the tracery. The influence of central and east Scotland, not only Irish architectural influence, can be seen in the use of spiralled tracery. The removal of the two level east end produced a lofty and impressive choir and presbytery space. The massive central tower, now with its caphouse restored, was also added at this time, one of the most impressive and visible features of the church.

A fascinating frieze of religious and genre scenes are carved into the richly decorated capitals of the south choir arcade. These include a Crucifixion and a Garden of Eden, warlike scenes with figures in dressed like the West Highland warriors, as well as scenes of everyday life, such as the cow-slaughter scene. The love of foliate decoration as well as cusped ogee arches, can be seen across the artistic output of Iona at this time, in the sedilia in the presbytery, in the canopied tomb in St Oran’s, and also on the grave slabs.

The Benedictine cloister - the claustral ranges conform to a standard lay-out, excepting the fact that the cloister is located on the north rather than the usual preferred south side of the church. This may have been necessary due to the location of water courses required for the kitchen and latrine, absent to the south, plus the ground to the south may have been too boggy. It is also possible that there were important pre-existing buildings to the south which had to be avoided, now lost. These ranges survived pre-restoration reasonably well at least at ground floor level, documented in prints and early photos. The east range contained the chapter house with the monk’s dormitory above. There was a night stair down into the north transept, while the latrines were located in a north extension of the dormitory, shared with the abbot’s lodging to the north of the north range. The latter housed the refectory. As usual there was a covered walkway around all four sides, the pent roof supported on pairs of coupled octagonal columns.

There are two external buildings to the north-east of the monastery core, now known as the Michael Chapel and the Infirmary Museum. These are on a significantly different alignment, more true east-west, than the core which they may predate in their origins. The remains of the monastic bakehouse are located west of the west range.

St Oran's Chapel – immediately to the south of the abbey is likely to be on the site of a much older mortuary chapel serving the early monastic community and their burial ground. With the rise of the MacSorley dynasty in the 12th century, and the creation of the first Lord of the Isles, John in 1336, the chapel was rebuilt as the dynastic sepulchre of the MacDonald Lords of the Isles and their chief followers.

The chapel is a plain building except for the late 12th century Irish influenced Romanesque west door with dressing of yellow Carsaig sandstone. Each of the 16 voussoirs of the second order of the stonework of the doorway possibly bears a human or animal head, now unrecognisable due to erosion. The interior features the most highly decorated tomb architecture on Iona, a pair of recessed wall tombs in the south wall. The surviving west tomb has an elaborate hood mould, the ornament similar to that on the MacKinnon cross shaft of 1489, now in the site museum. This grandiose tomb is likely to have been created for a Lord of the Isles, although it could have been appropriated by another family following the Macdonald forfeiture of the Lordship in 1493. The altar at the east end is modern but is built on a medieval footing, with the remains of a piscina east of the south window. It was roofless for 300 years until restored by Ian G Lindsay in 1957.

It is documented that a number of the Lords and family members were buried here. John, 1st Lord of the Isles was buried here in 1387, amid services over eight days and nights led by the abbot and the clergy. Key burials would have taken pride of place nearest the high altar, now represented by heavily worn grave slabs. One of these nearer the west door is of considerable importance, as it exhibits the rod of office of one of the lords. The West Highland slabs now displayed here upright against the walls have been gathered in from the burial ground.

<u>1600s – 1800s – Decline and abandonment</u>

During this period the Benedictine monastery was finally abandoned, entering a new life as a highly evocative ruin, a place of antiquarian curiosity and an inspiration for writers and artists. Greater interest was beginning to be taken in the West Highland grave slabs concentrated in Reilig Odhrain, and in 1858 the finest of these was gathered together in two rows and enclosed by iron railings. Any idea of their original disposition within the burial ground was lost at this time. In the late 1870s the Duke of Argyll was put under pressure to conserve fragile parts of the abbey buildings, the works led by the architect R Rowand Anderson.

Late 1900s to present – restoration and conservation

The degree of ruination of the abbey buildings is reasonably well documented in artists' images, and then photography, from the late 1700s onwards. The restoration work undertaken during the 19th and 20th centuries strongly evokes the feel of the medieval abbey and ancillary ranges and many original or early features have been incorporated into the new work.

The reconstructed external ranges – abbot's house, the so-called infirmary, and the Michael Chapel – give a good impression of the original scale of the Benedictine monastery, as not only being the church and cloister, and highlighting the fact to visitors that there were many satellite places of veneration on the island, not only the abbey.

In 1899 ownership of the abbey passed from the Duke of Argyll to the newly established Iona Cathedral Trust, which was committed to the restoration of the abbey for public worship. The various phases of conservation and restoration were aided by some leading Scottish conservation architects of the time, firstly Thomas Ross and John Honeyman, and then P MacGregor Chalmers. The partially restored church opened for worship in 1905, work on the nave was completed in 1910.

From the late 1930s, reconstruction of the cloister ranges was led by architect Ian Lindsay for the Reverend George MacLeod and the Iona Community. Reroofing and conservation of St Oran's chapel followed in 1957.

During the mid-20th century the abbey became an international centre of ecumenical faith, whilst also developing as a major tourism destination. In 1980 much of the island of Iona was given over to the care of the National Trust for Scotland. In 1999 Historic Environment Scotland's predecessor body, under a lease agreement, took over responsibility for conservation, maintenance and all visitor-facing operations at the abbey and in 2013 completed a major re-display of the very important carved stone collection.

2.1 Evidential values

Thanks to the survival of primary texts produced on Iona, along with an unparalleled survival of archaeological remains, carved stones and Gaelic place-names, the entire island is a rich resource for archaeologists and historians.

The HES sites on Iona offer a truly exceptional evidential resource in their combination of physical (both on and off-site), documentary and intangible resources such as place-name evidence and oral tradition. Most importantly, this is true of the early Christian phases where the survival of primary texts and rare artefacts can be linked with archaeological results to enable a detailed picture of the philosophical, symbolic and design intentions which Columba and his successors had for the place, together with the actuality of the site they constructed and the more workaday aspects of everyday life on the island. This strand of significance is also linked to Iona's importance and influence as a leading religious site which, through its scriptorium, craft and sculpture workshops, was a hugely important cultural centre.

The medieval and post medieval operation of the abbey, and the later phases of restoration and re-presentation as a cultural heritage attraction are also evidenced from a wide variety of sources. Added to this, extensive research over two centuries of many aspects of the island's past enables a much better appraisal of its importance in wider contexts of Scotland, the British Isles and beyond. That said, there is potential for much more research over the whole site and its related artefacts and sources. For instance, the recent (2017) Glasgow University project which revisited excavations undertaken in 1956 - 1963 has applied modern techniques to recover very valuable evidence such as dating of timber from Torr an Aba to Columba's time.

Field evidence and surveys
The work of Sir Henry Dryden (1818−99) assisted by the architect William Galloway in recording the abbey in the 1870s has contributed a unique pre-restoration survey, containing much of archaeological importance. Another valuable early publication is John Drummond's 1881 record of the Sculptured Monuments.

In terms of excavation, archaeology has obscured much as well as contributing much. Sporadic, piecemeal campaigns of excavation took place though the 1950s into the 1970s, although these lacked a coherent research strategy, with no real synthesis of results. Between 1956 and 1963 Charles Thomas then of Edinburgh University excavated 98 small trenches, the most extensive investigations ever at the abbey, but the results were never published.

By contrast, Barber's 1979 excavations carried out in advance of the enlargement of the Reilig Odhrain cemetery, produced significant results regarding the nature of the early monastery. This included excavation of a terminal of the inner ditch of the vallum, its construction radiocarbon dated to around AD600, adjacent to the Sràid nam Marbh -Street of the Dead. A large 18m diameter roundhouse was found just inside the ditch (John Smith is now buried inside it), which may have been the communal *magna* *domus* mentioned by Adomnán. A high number of important artefactual finds were recovered (see below).

Our understanding of the archaeology of the abbey has been significantly advanced by the recent (2016) study of the data from Thomas' excavations, carried out by Glasgow University. This has retrieved data on individual structures, as well as allowing a broad characterisation of the archaeological deposits across the site, which will inform future investigations. The study estimates 58% of the abbey site is undisturbed.

Recovered Artefacts

Evidence from recovered artefacts and ecofacts give a good impression of life on Iona and also demonstrate the craft skills and artistry which made the island a leading cultural centre. Some of the most important recovered collections include evidence of craft activity on a large scale including:

- Fine metalworking – bronze, silver, crucibles and moulds; debris widespread across the site in early deposits, many found in inner ditch terminal near Reilig Odhrain. Finished objects found include shrine fittings and personal ornaments. Recent re-evaluation by Glasgow University of investigations have brought new light to bear on a small cast bronze human head found by Thomas, which was probably made here in the 11th century as a component part of a large decorated reliquary. This allows us to understand that the Céli Dé brethren who occupied Iona immediately before the creation of the Benedictine house, were in the business of manufacturing major liturgical objects
- Glass working - studs with metal inlays, reticella rods for decoration of glassware, and beads; some architectural glass from early Christian buildings.
- Leather working – a purse and decorated shoes. Many well preserved from vallum ditch; shoes particularly valuable as the only closely dated group (c700) from early medieval Ireland and Scotland; they can be related to shoes illustrated in the book of Kells.
- Carpentry and Woodworking – turned bowls and architectural carpentry. The evidence for carpentry found in the vallum is the only such evidence to have survived from a monastic site at this period, some of which can be identified as elements of rectangular timber buildings. It is possible that some of the flat pieces of wood found here could represent shingles, such as those illustrated in the Temptation scene in the Book of Kells.
- Pottery – local and imported, African red slipware c 600, earthenware jar from west Gaul.

The archaeological and early documentary evidence together allows a picture of the economy of the early monastery to emerge – the entire island formed a precinct, with arable production centred on the Machair on the west side. A mill lade still exists which bisected the monastic enclosure to the north of the monastery. A number of millstones from horizontal water mills, used to process cereals, have been found, some re-used as the bases for high crosses. Although significant food production took place on Iona, the early monastery was not self-sufficient, and is likely to have received food rents from abbey lands on Mull and elsewhere. There is evidence of a mixed livestock economy on the island, predominant dairying (butter and cheese). Deer, cattle, pigs, sheep, seals and fish (inc deep sea) well represented on the menu.

2.3 Historical values

The historical value of Iona Abbey lies primarily in its strong connection to Columba and in its role as a key religious and cultural power centre in the British Isles. After the post-Reformation abandonment and gradual ruination of the Abbey, it retained a strong religious and emotional pull becoming a key "heritage" site for Scotland; reverence for its spiritual power growing stronger through the 19^{th} and 20^{th} centuries.

The quantity, quality and variety of evidence available (and the exceptional potential to learn more by further research) accounts for Iona's exceptional ability to demonstrate these themes, coupled with the emotional strength of its ongoing spiritual role. The following paragraphs detail some of these themes, with more detail in a chronological appendix (forthcoming).

Columba and the early foundation

Columba is the first real historical figure in Scotland for whose life we have reliable documentation. He was a member of the kindred of the northern Ui-Neill and therefore of royal blood. He was a priest, poet, musician, scribe and scholar. Before arriving on Iona he had a successful career as a senior churchman in Ireland. He lived in a culture of the written word and there was a strong Gaelic political, cultural and linguistic commonality between Argyll and his home in the north of Ireland.

Columba was granted the island of Iona in 563 by his kinsman King Conall mac-Cognall of Dunadd, to establish what became one of the most important early medieval monasteries in western Europe. Christianity was only established in parts of Scotland at this time, unlike Ireland. His intention was to create the perfect monastic community. Iona would come to be the head of a monastic *familia* that spread across much of the mainland, with the abbot of Iona at its head.

Columba represented the pinnacle of Christian virtues – an example for others to imitate. He died aged around 75 on 9 June 597 in his church at Iona in the early hours of Whit Sunday, blessing the whole island. Buried in a simple grave, body wrapped in white linen, near his church on Iona. One of the most important surviving relics of St Columba is a Psalm book known as the Cathach, traditionally scribed by Columba himself. Depending on its provenance, this may be the earliest surviving Scottish or Irish book.

After Columba's death Iona became a place of pilgrimage with the relics as its focus. The core of the monastery grew around the grave of the founder. Iona became an internationally renowned centre of learning, where kings were sent for their education, including the Saxon King Aldfrith of Northumbria.

A major school and scriptorium existed at Iona, with access to an extensive library. Literacy was essential to monastic life and quickly became essential to secular government. The earliest census of households produced in Dal Riata was in the 700s, possibly with Iona monks seconded as clerks.

In 635, King Oswald of Northumbria, who had been exiled on Iona, gifted the tidal island of Lindisfarne, off the coast of north-east England, as the location for a monastery founded by Iona monk Aidan as a daughter house of Iona. This was a new dawn for Iona, with strengthened royal support in Dal Riata and in Northumbria.

<u>Iona under Adomnán</u>
Adomnán (c 627 - 704) was the ninth abbot of Iona, he was a kinsman of Columba, and like him a native of Donegal. He was influential in contemporary secular and ecclesiastical politics on both sides of the North Channel and wrote the Life of Columba, on which much of our information is based. Church dedications in Pictland in east Scotland and Hebrides show that Adomnán travelled widely for religious and diplomatic purposes; his other writings include Law of the Innocents (advocating protection of non-combatants in time of war); and *De Locis Sanctis* an account of the Holy Places in the life of Christ.

Adomnán describes the buildings of the monastery as including the church, huts of the monks, Columba's hut and his other hut for writing (Tòrr an Abba), scriptorium (and presumably library) guest houses, communal building (kitchen and refectory), some of these clustered around an open space. Outlying buildings included barns and sheds, and a smithy. He also describes that places associated with events in Columba's life were marked with crosses, including one with a millstone base. Coupled with the archaeological evidence detailed above, Iona provides some of the best evidence anywhere for life in an early monastery in Britain.

Religion, Culture and politics

As introduced under Evidential values, the combination of surviving artefacts such as the magnificent sculptured Crosses and surviving contemporary manuscripts such as the Book of Kells, together with the recovered materials of many craft processes mean that Iona can tell a uniquely rich story of monastic life, industry and artistry. The Crosses and other artworks are discussed in the context of the physical and symbolic architecture of Iona in section 2.4. Less tangible aspects of the sites historical importance are its role in religious practice, politics and power brokering in early medieval Britain.

Iona's abbots wielded considerable political influence with important diplomatic roles. The monastery produced a major collection of Canon Law, used throughout Britain and Ireland as well as in France. Relics, of both Columba and Adomnán were taken on ritual journeys to consecrate churches or sanctify laws. In 753 relics of Columba were taken on circuit around Ireland during enactment of Law of Colum Cille (contents unknown) by Domnall, King of Tara. Relics taken to Ireland again in 757 and 778 for similar purpose. To allow this Columba's grave must have been opened and his remains placed within a reliquary chest possibly along with other associated relics. This gives an indicative date for the building of the first Shrine Chapel to house the exhumed relics.

In 807, in response to repeated Viking raids abbot Cellach and some Iona monks moved to found the new abbey at Kells, Co Meath in Ireland. A reduced community was left behind at Iona where Viking raids continued, perhaps prompting the burial of a hoard of 350 silver coins discovered in the vicinity of the later abbot's house. The primacy of the Columban federation was held by the abbot of Kells for next 350 years; it is not known when the Book of Kells left Iona.

In the 11th and 12th centuries a community of Céli Dé, ascetic Irish monks with a strongly eremitical tradition, was resident at the abbey. The chapel site of Cladh an Dìsert (burial ground of the hermitage) 400m north-east of the abbey may be associated with this phase of the monastery.

Pilgrimage

After Columba's death Iona became a prime Scottish site for pilgrimage. The assemblage of crosses, the layout and development of the site (see architectural values below) and the quantities of recovered artefacts contribute to Iona's particular ability to demonstrate this theme. The ongoing and powerful tradition of pilgrimage underlines this aspect.

Later antiquarians and picturesque tourists

Into the 18th and 19th centuries the islanders made use of the ruins of the abbey as quarries and pasture, contributing to an air of neglect which eventually began to be reversed by a growing interest in antiquity and conservation though the 1800s. The islanders had a complex relationship with the site however, as they worshipped in the ruined church, until provided with their new parish church in 1828.

From 1874 to 1875, the 8th Duke of Argyll instructed the consolidation of the church, then in imminent danger of collapse. The project was led by architect R Rowand Anderson, and commissioned by the eminent historian and antiquary west F Skene acting on behalf of the Duke of Argyll. The ongoing story of the restoration of the Abbey and the presentation of its grounds demonstrates both antiquarian and religiously-motivated respect for the site and its history, see Contemporary values.

2.4 Architectural and artistic values

Architecture and site-planning

The architecture of Iona is important for its surviving medieval structures and their later rebuilding and restoration. Primarily though, the whole site is important for our understanding of the Early Christian conception of how the layout and design of the various elements of the site symbolised and represented spiritual and devotional themes and moments, set out in a deliberate and structured manner. Similarly, the carved crosses are understood on several levels as aids to devotion and prayer, conveying particular messages as well as highly sophisticated works of art.

The community's mission was to create nothing less than a new Jerusalem, as a precursor to the (as they believed) imminent Last Judgement, whereby they could prepare themselves for their new life in Heaven. The fact that the community saw themselves as a last bastion against the demons who threatened the world from the great unknown tracts of ocean to the west, made this even more pressing. Recent scholarship suggests that Adomnán's book *On the Holy Places* (690s) was no real attempt at a guidebook to the places associated with the Passion, but rather was a handbook through which they could create, inhabit and explore these places re-created in their own landscape. And this is the key to understanding the physical remains of the early Christian monastery. Understanding for example the Street of the Dead representing the Via Dolorosa in Jerusalem, Columba's shrine as the Tomb of Christ, the church forecourt area as a Paradiso where you prepared yourself for the entry to heaven, and their church as the Temple/Heaven. This allows an imagining of processional activity with carefully structured movement through the ritual landscape, the chanting of psalms and prayers, and the devotional and exegetical role played by the complex iconographic programmes carved on the high crosses.

High Crosses and other carved stones

The most tangible surviving evidence of the rich cultural and political standing of Iona are its High Crosses. Apart from the challenge of winning and transporting the stone, these are some of the earliest and most ambitious carvings in Scotland. Added to this are the fine early medieval metalwork and illuminated manuscripts produced on Iona. Much of this was ground-breaking, experimental and innovative. Another important aspect of Iona's sculpture collection is the collection of West Highland grave slabs. These date from the 1300s to the 1500s.

The High Crosses, and specifically the ring-headed cross are particularly associated with Iona and with the practice of early Christianity. They are significant on many counts: for their role in technical innovation; for our growing understanding of their symbolic and functional roles within the liturgical landscape of the Abbey; for their individual "biographies"; and for their artistic achievement and iconographic content.

Technicalities of the design: The ring-headed cross has become the universally recognised symbol of the early church in Ireland and Pictland, and there is considerable debate concerning the origin of this, with Iona being a leading contender. St Oran's without a ring but with a unique component structure, is considered to be first of the Iona crosses, exhibiting an innovative and experimental design, with arms too heavy ultimately to be supported. A similar problem and collapse of St John's Cross was tackled early on by the addition of mortice and tenon jointed ring components, clearly borrowed from carpentry. This design was then developed into the familiar monolithic ring design, seen on St Martin's Cross and in the freestanding crosses of Ireland and Pictland. The replica of the St John Cross, cast in concrete in the 1970s is a considerable technical achievement in its own right.

Functional and symbolic understanding: The function of the high crosses was threefold: to commemorate individuals; to mark boundaries, or places and their associations; and as aids to prayer and ascetic meditation. Their placing within the symbolic and physical setting of the abbey was clearly important. By our current understanding, interplay with natural phenomena such as sunlight, and the casting of shadows onto other structures or locations, may have been deliberately planned allowing the crosses to appear active and not static.

Recent research has demonstrated how the symbolism and multi-valent figurative sacred scenes on the high crosses were intended to be read with the movement of the sun, varying with the time of day and the liturgical seasons. The east facing sides of the crosses at Iona being seen by the monks as they left their church after morning worship. The west facing sides being observed during prayer and contemplation of the Passion and Life of Christ when facing east in the accepted direction of veneration.

Understanding the symbolic and physical placing of the Crosses within the evolving Iona landscape is something which deserves further research. However, it seems clear that important messages were conveyed by location and setting. For instance, with the high crosses the west face was the “front”, as Christians pray facing east in expectation of the risen Christ. The east and west faces cast various shadows when in sun, throughout the day. The monks would be aware of the gradual unfolding of the theological programme of each face, allowing them to respond to this through prayer and contemplation. Moreover, the shadow of St John’s Cross is almost burnt onto the west front of the shrine chapel late in the day, while on a summer’s evening the disc with the Virgin and Child at the centre of the St Martin’s cross head is brightly illuminated. In a more general sense, the shadow positions would have figured prominently in the daily lives of the monks, as a constant reminder of the canonical hours of worship.

Individual biographies: The sculpted stones in general and the high crosses in particular have a long and complex history. These histories began with the point of their original commissioning, design, creation and erection, but they have subsequent “lives” and “meanings” which developed and changed over a period of more than 1200 years. This is exemplified in the universal symbol of Iona, the St John’s Cross, the ring-headed cross, a concrete replica of which now stands in its original position facing Columba’s shrine chapel. The original cross was probably created around the mid 700s, and due to unfamiliarity of its carvers with the form the arms quickly collapsed, necessitating a redesign to incorporate the rings. This collapsed one or more times in antiquity, and only the shaft was standing when first recorded in 1699. It suffered a number of attempted reconstructions *in situ*, ending in collapse and damage to the original fragments. It was cast in concrete in 1990, and the original parts re-erected in an aesthetically pleasing reconstruction with modern glass components replacing missing parts, within the stone museum within the reconstructed Infirmary building. Impossible to move again, it forms the fixed point in the new (2013) museum, around which everything else was designed.

Within the body of early carved stones, there are pieces of what may be architectural stonework from a screen or altar rail in an early church, some pieces hitherto having been identified as posts for one or more box shrines (RCAHMS 104). There is also an ex-situ fragment of anta probably from the front of St Columba's shrine (RCAHMS 108). It is possible that more early architectural fragments await discovery and/or identification.

Artistic achievement: The artistry of the high crosses tends to be glossed over, with the focus instead being on interpretation of the symbols, patterns and biblical narrative scenes. Figurative scenes were carefully laid out with hierarchies and relationships, usually framed like pictures or icons. The carving is done in high relief, giving solidity and movement to the figures, and more so when freshly carved around 1250 years ago. Tremendous care was taken in the laying out and design of the non-figurative patterns which were executed with an extraordinary degree of symmetry and precision. The use of bosses and elaborate Celtic spiral work, also characterises the Iona school. It is believed that colour was extensively applied, presumably in a similar palette to that used in the Book of Kells, many surprisingly vivid colours being derived from local plants. The impact of these in colour would have been astonishing.

In general terms the narrative scenes on the more heavily illustrated St Martin's Cross were intended to provide Old Testaments parallels prefiguring the Life and Passion of Christ. The extensive use of 'snake-and-boss' decorative and symbolic patterning on the three surviving early high crosses – St Oran's, St John's, and St Martin's – may be symbolic of healing, rebirth and Resurrection, and is one example of multivalency in the symbolic schemes, whereby in Christianity the serpent is often associated with the Devil and clearly in this case the opposite is true. The Maria Angelorum, Virgin and Child scene which features prominently on St Oran's and St Martin's Cross, is a precocious example of Marian devotion in the western church, and is closely paralleled with the same scene in the Book of Kells. The latter might suggest the original colour scheme applied to this scene on the crosses.

In creating the decoration and scenes on the crosses the carvers were borrowing from Irish, Pictish and Anglo-Saxon art, as well as creating and contributing something entirely new and revolutionary to the art of the period in the Insular world.

Significance of the production and artistry of the West Highland grave slabs – for the MacDonalds and their supporters Finlaggan was the centre of lordly authority, while Iona was their spiritual centre. As the most important place of burial, Iona Abbey still has the largest collection of West Highland Sculpture (WHS), dating from the twelfth to the sixteenth century. This consists of grave-slabs, effigies and commemorative crosses. About 100 slabs survive complete or in fragments. Most were created as grave covers laid flat in the main cemeteries of Reilig Odhrain and the Nunnery. Some covered above-ground stone coffins/sarcophagi, positioned in the open air or else inside churches. Not all were carved here, but some certainly were, as part of an ongoing tradition of specialist stone carving.

Some works can be identified as typologically early, perhaps dating from the 1200s into the 1300s. These include: slabs carved with crosses with 4-circle heads and long shafts; other grave slabs with long shafted crosses (eg 116 and 117); slabs with plant-scrolls the full width of the slab (inc 165, 166, 167 and 185); slabs with narrow panels of plant-scrolls and 13th century looking swords, plus an abbot effigy (200) which could be from the 1200s. Later slabs, especially of the 1400s into the 1500s, may be represented by those featuring ships and swords, without crosses. Some are not simply of one phase, occasionally inscriptions and/or new decoration added (eg 123 and 130) – at time of reuse, or other generations added to grave.

A small number of slabs were identified as the memorials to great ancestral heroes, specifically Ranald (191) and Angus Og d1318 (Aonghas Óg MacDomhnaill 150), and these may have been attributed, adapted or newly created, some time after the event. Although some are undoubtedly memorials to 'the best me of all the Iles' – chiefs of the MacDonalds, MacLeods, MacLeans, Macallisters, and MacKinnons - some may be memorials to rich mercenaries, maybe landless and unmarried younger sons, who had the cash to invest in this form of immortality. To be buried close together here reinforced their bonds of loyalty and kinship – in life and in death. There are only 5 surviving warrior effigies, one MacKinnon, and the rest MacLeans of Mull. These were the most expensive so belong to the upper echelons. Earlier military effigies depict warriors holding upright spears, presumably shortened to fit neatly on the slabs. About half of the slabs feature a sword, which seems to have replaced the earlier long-shafted crosses which had foliate decoration and interlace – continuing a much older decorative tradition.

In 1859 the 8th Duke of Argyll arranged for many of the best stones to be enclosed in two sets of protective railings, known as the 'ridge of the kings' and 'the ridge of the chiefs'.

The restoration of the church should be seen in the context of an early 20th century aesthetic, with bare stone walls and relatively little ornamentation, and this is of course contrary to the aesthetic of the medieval church in its Benedictine heyday, the decoration and detailing of which was intended to assault the senses as a reflection of the glory of God. There are some thoughtful details in the restoration works in the church of MacGregor Chalmers, for example where he found medieval burials under the floor of the nave, these are marked with simple crosses and groups of white quartz pebbles the only objects found with the deceased.

Numerous individuals and groups are commemorated in the church, in recognition of donations to fund various components of the work, for example the Highlanders of Nova Scotia who paid for the large south window of the nave. The modern timber work in the church is of high quality, such as the screen of 1956 and the adjacent minister's seat in the cross at the north transept. The modern stained glass in the church is of high quality, for example the Columba window in the north transept designed by William Wilson in 1965.

A few of the original paired shafts from the cloister arcade have been reconstructed on the west side, a process begun during the Ministry of Works conservation programme in 1921. New columns for the arcade openings were carved from 1959 on, decorated with flowers, birds, and plants. The grassy cloister garth is now dominated by a large bronze sculpture by Jacob Lipchitz entitled 'The Descent of the Spirit' installed in 1959.

Alexander and Euphemia Ritchie re-invented Celtic inspired silversmith and craft work, often based on designs inspired by Iona sculpture and the Book of Kells. Alexander was appointed the official custodian of the abbey in 1900. Their designs are highly sought after, and this silversmithing tradition is alive on Iona today.

The permanent exhibition *Iona Through Time* featuring the redisplay of the early and later medieval carved stone collections, completed in 2013, allows the artistry and sophisticated thinking behind these objects to be appreciated for the first time in centuries. This is located in the Infirmary, where the collection has been displayed since the 1960s, and which had the reconstructed St John's Cross from 1990 still at its core. Indeed this cross literally acted as a fixed point around which the new exhibition was designed. Clever use of space, coupled with jewel-like lighting, allows visitors to engage with and gain an appreciation of the creation and purpose of this sculpture. The stars are the early medieval high crosses, with St Oran's and St Matthew's crosses re-erected with high quality mounting technology, standing alongside St John's in an echo of how these originally stood outside the Columban monastery. Almost of equal importance are the selection of later medieval West Highland graveslabs and crosses, featuring the effigies of Maclean and Mackinnon chiefs in full armour.

Because of its natural beauty and its importance as a religious and historical site, Iona attracted many famous visitors as a key stop on the highland itinerary of early tourists; e.g. Boswell and Johnson; Waler Scott, Worsdworth, Keats and Mendelsson. Queen Victoria arrived on Iona on 19th August 1847 aboard the Royal Yacht. Prince Albert landed while the Queen sketched the abbey from the boat.

2.5 Landscape and aesthetic values

In venturing to Iona, almost all visitors have made an arduous journey, and few are disappointed in what they find. Intuitive, imaginative values, the numinous quality of the landscape.

The sublime is further defined as having the quality of such greatness, magnitude or intensity, whether physical, metaphysical, moral, aesthetic or spiritual, that our ability to perceive or comprehend it is temporarily overwhelmed. This is a common experience when viewing the abbey within its wider landscape setting.

The view east across the Sound from the front of the abbey is of great significance. This was where the monks expected to see the risen Christ appear on the last day. The view is spectacular, and entirely natural and unchanged since Columban times, with progressive bands of green field, shoreline, water, the blood red Mull granite, with a band of higher dark hills behind, then the sky.

Although largely rebuilt and restored, the abbey sits comfortably within the landscape backed by a strip and water then a strip of land on Mull, accurate reconstruction in terms of massing and simplicity of form, use of the same grey and pink stones throughout have created a pleasing uniformity.

The abbey and misinterpreted perceptions of Columba's faith provided the focus for the Celtic Christian Revival which took place between 1870 and 1900, which featured romantic evocations of Iona and its spiritual power. This movement coupled with the nascent conservation movement provides the context and indeed the necessary precursor to the restoration of the abbey. This created a new myth of Columba as romantic Gael, mystical rebel and national cultural icon, which persists to this day. This was to deny the historical reality of the Roman orthodoxy of the early church. This was place concurrent with a more general idealisation of the Highlands and islands and their inhabitants.

Visitors approach the site from the village passing the evocative ruins of the Nunnery, then the medieval parish church of St Ronan's, before arriving at MacLeans's Cross[2], passing the attractive gardens of the hotels, all the while drawn irrevocably to St Oran's with the mass of the abbey behind. This creates a strong impression of a pilgrimage journey, consciously or otherwise, following a prescribed ancient route with numerous satellites along the way. In so doing they are replicating and participating in centuries old ritual action. St Oran's stands within the ancient burial ground, conveying a powerful sense of antiquity. It sits low and natural within the burial ground; some visitors are automatically drawn inside, before reaching the ultimate goal of the abbey church, and usually respond with awe and reverence appropriate to the gloom of this sacred space.

Reilig Odhrain continued to be popular for burial in post-Reformation times, with a weight of Gaelic tradition for the deceased being transported to Iona for burial, landing at Martyr's Bay, before being carried along Sràid nam Marbh to their final rest. The old cemetery contains many important and poignant memorials, for example mass graves of shipwrecks, monuments to unknown sailors washed up during WWI, the attractive memorial to Alexander and Euphemia Ritchie the Celtic silversmiths, as well as memorials to some of the four young men of the island drowned in the Sound at Christmas 1998. Burials occasionally still take place here, as well as in the modern cemetery extension where Labour leader John Smith was buried in 1994. His grave is a place of pilgrimage, often with stones and flowers laid on top.

From the later 1700s the abbey became a popular subject for topographic artists making prints of scenes of the windswept ruins, inspired by visits by writers such as Walter Scott. Many of these contain valuable evidence of the contemporary appearance of the site and its surroundings. These featured in themed books, such as Daniell's *Voyage around Great Britain* vol 3 produced in 1818, helping drive a growing interest in the picturesque qualities of the Highlands and Islands. Also became the inspiration for painters, including the notable David Roberts who painted the ruined chapterhouse in 1829. Highest quality of antiquarian recording by Billings for the *Baronial and Ecclesiastical Antiquities* 1845-52. The culmination of early antiquarian interest came with Drummond's exceptional recording of the carved stones in *Sculpted Monuments of Iona* 1881. Queen Victoria rendered a sketch of the abbey from here boat in 1847, around which time steamers had started to make day trips to Iona from Oban.

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[2] The Nunnery, St Ronan's Chapel and MacLean's Cross are all in the care of HES, for more details see *HES Statement of Significance: Iona Nunnery, St Ronan's Church and Maclean's Cross*

Iona has provided tremendous inspiration for artists, acting as a muse to creativity. The abbey was the subject of numerous prints and watercolours from the 1700s on, with draughtsmen accompanying the antiquarian visitors. Numerous artists have sketched and painted the abbey including Scottish seascape artist William McTaggart, with Scottish Colourists F.C.B. Cadell (1883-1937) making almost annual painting visits starting in 1912, along with S.J. Peploe (1871-1935) and others. Iona continues to inspire leading contemporary artists such as Sean Scully.

2.6 Natural heritage values

The abbey sits on a mid-level raised beach, in an area of mixed maritime grassland/wet maritime grassland, and semi-improved calcareous grassland. A boundary line in the underlying geology runs approximately N-S through the site, with sandstone underlying to the east and gneiss to the west of this line. The hard-packed ground on this boundary line was purposely selected as the solid and reasonably well-drained base for Sràid nam Marbh, as revealed in the 1979 excavations of the inner vallum area.

A number of the plants found here may have had historical uses. Many have well documented medicinal uses and are not naturally found here, suggesting deliberate introduction or else seed dispersal due to introduced livestock or feed.

2.7 Contemporary/use values

Social and community Values

There are two permanent communities on Iona, the island community of about 120 permanent residents, together with the Iona Community (IC) resident in the abbey and at the Macleod Centre nearby, who maintain a small staff all year round, welcoming 100 guests every week from Easter – October. The IC is a world-wide dispersed ecumenical Christian organisation which was founded in 1938 by George MacLeod, then a Church of Scotland parish minister in Glasgow. While the IC is responsible for leading worship in the abbey church and in the Michael Chapel, HES has responsibility for visitor-facing functions, maintenance, and conservation of the buildings.

The island's residents have free access to the HES-managed site, and the abbey is regularly used for concerts and performances.

Gaelic was the principal language spoken on Iona until the end of the 19th century. The HES re-presentation of the abbey features significant Gaelic language content, and with Gaelic training being offered to staff. Gaelic choirs regularly perform in the abbey church.

Spiritual values:
For many, Iona is not just another stop in the tourist agenda, but is a very special destination with a strongly spiritual element. It has a justifiably high profile as a world class spiritual place. Many visitors, not only Christian, feel a pull to Iona, and are rarely disappointed. Rev George MacLeod described Iona as a *thin place - only a tissue paper separating the material from the spiritual*, echoing sentiments expressed 1250 years before by Adomnán in his *Life of Columba*.

The IC provide a continuity of religious community and worship at the abbey, as inheritors of the 1000 year span of medieval religious community. This adds a unique and vital dimension to the life of the abbey, which is appreciated by many visitors and contributes greatly to the special sense of place.

The IC lead services in the abbey church, twice daily from March to October. And this is the venue for a weekly ecumenical Sunday service shared by Bishops House (Episcopal) and the RC House of Prayer establishments on the island.

Reilig Odhrain, the ancient but also modern burial ground, contains many more recent burials of islanders and notable individuals from the 19th century until the present day.

Use Values
Economic: The island is considered to be thriving, with the economy (excepting crofting) being largely driven by tourism, for which the abbey and the natural beauty of the island are principal draws. Visitor numbers to the island are estimated at around 130,000. Around 64,000 visitors are counted to the abbey annually, though more may visit outwith official opening times.
There have been recent national initiatives to promote long-distance pilgrimage, walking and cycling routes including St Columba's Way, from Iona to St Andrews.

Access & Education:
The abbey plays a role in the formal educational life of the small primary school on Iona, as the focus for history projects and outdoor learning. School concerts and church services take place at the abbey. HES has online resources related to the abbey available to visiting school groups, who come from Mull and further afield.

3 Major gaps in understanding

- As well as working on the publication of the results of the Charles Thomas excavations, staff in Glasgow University

Archaeology Department are also working towards the production of a new interdisciplinary Research Framework for Iona. They have created the Iona Research Group, and have instigated a field project, aimed at re-excavation of some of Thomas' trenches where possible important features were revealed.

- Was there a prehistoric settlement on the abbey site, related to part of the west vallum bank, and the south-east enclosure identified by remote sensing?
- Were there multiple early churches and chapels here?
- What was the original extent of the early monastic burial ground of Reilig Odhrain?
- What were the 'Tombs of the Kings' in Reilig Odhrain, and could they have any relationship to the shrine posts found here?
- Do parts of Columba/Iona metalwork reliquaries survive in museum collections at home and abroad?
- Can more data be recovered from other unpublished excavations eg Cruden's work especially around the shrine chapel c. 1950?
- What was the impact on the buildings of the early monastery as a result of the repeated Viking raids?
- What was the relationship between the creation of the Iona high crosses and the Anglo Saxon examples at Bewcastle and Ruthwell?
- The assemblage of skeletal remains needs to be assessed for potential for study.
- What was the appearance of the monastery immediately before the shift to the Benedictine rule?
- To what extent was it a popular place of pilgrimage in the Benedictine period?
- What were Iona's relations with other religious houses in Argyll?
- How many of the West Highland graveslabs were carved on Iona?

4 Associated properties

St Ronan's church Iona, Iona Nunnery, Kildalton Cross, Maclean's Cross, Columba Centre collections store Fionnphort, Saddell Abbey, Oronsay Priory, Ardchattan Abbey (the 4 other religious houses in Argyll all supported by the clan chiefs like Iona Abbey), Finlaggan; Clonmacnois, Co Offaly, Ireland; Glendalough Co Wicklow; Bewcastle and Ruthwell crosses; Nigg cross slab.

5 Keywords

Columba, Adomnán, monastery, vallum, Insular, Book of Kells, shrine chapel, pilgrimage, high crosses, Benedictine, clan MacDonald, Iona Community.

Bibliography

Campbell, east & Maldonado, A 2016 Russell Trust Excavations on Iona led by **Charles Thomas, 1956-63.** Glasgow University.
Fowler, east & Fowler, PJ 1988, 'Excavations on Tòrr an Aba, Iona, Argyll', **Proc Soc Antiq Scot** 118: 181-201.
MacArthur, east 2001 Columba's Island. Polygon: Edinburgh
RCAHMS 1982 Argyll vol 4: Iona. HMSO.
Ritchie, A 1997 Iona. Batsford: London.
Yeoman, P & Scott, north 2013 Iona Abbey and Nunnery Official Souvenir Guide. HS.

Appendix 1 – Timeline

- Mesolithic hunter-gatherers - Iona settled in early prehistoric times, flint tools and debris are routinely found in excavations, some dating back more than 5000 yrs.
- c 1000 BC - burial under cairn at Blàr Buidhe, just south-west of St Columba Hotel, the oldest upstanding remains on the island.
- c 100 BC – hill fort constructed by Iron Age community at Dùn Bhuirg, near the island's west coast.
- 40 BC – AD 220 – radiocarbon date from beneath west vallum bank at Cnoc nan Carnan, shows that at least part of the vallum enclosure is prehistoric in origin.
- c AD 500 – ruling dynasties of the Dal Riata Co Antrim and Argyll kindreds, closely related across the North Channel, Gaelic society developing in parallel.
- 521 – birth of Columba (Latin for dove) Gartan, Co Donegal, member of the kindred of the northern Ui-Neill and therefore of royal blood.
- 563 - Columba arrived in Dal Riata (Argyll) with 12 companions from Ireland, having already had 20 year career as controversial churchman in Ireland.
- Mid to later 6th cent – confederation of dependent monasteries founded nearby and eventually further afield.
- 574 – Columba is said to have participated in enkingment of Áedán mac Gabráin as king of Dalriada, probably at Dunaad, one of the earliest such ceremonies in Europe. The historicity of this event is debated.
- 585-89 – Columba founds and stays at monastery at Durrow, Ireland.
- 9 June 597 - St Columba dies aged 75 in his church at Iona.
- 600s - Iona became a place of pilgrimage with the relics of St Columba as its focus.
- 635 – King Oswald of Northumbria gifts the tidal island of Lindisfarne as the location for a monastery founded by Iona monk Aidan as a daughter house of Iona.
- 635-51 – Aidan rules Northumbrian church from Lindisfarne.
- 679–704 – Adomnán (b. c 627/8) rules as 9th abbot of Iona.
- c692 - Adomnán completes the life of St Columba.

- 700s - Iona became a leading centre of Insular Art, the most tangible surviving evidence of the rich cultural and political standing of Iona are its High Crosses created by a school of carvers on Iona.
- 715 -17 – removal of Iona control of Iona-founded monasteries from Pictish eastern heartland by King Nechtan.
- By c740 - under Abbot Cú Chuimne the monastery produced a large, influential and widely-used collection of canon law ***Collectio canonum Hibernensis***
- 731 – Bede writes in his *History* inferring that C's body still buried
- 736 – Brutal assault on Argyll by Pictish king Óengus son of Fergus (d761) of Fortrui. Devastation of Dunaad.
- 741 – 'Good the day when Óengus took Alba..' a turning point in Scottish history. Óengus returned to Argyll in force. Crushes the Dal Riata and establishes direct rule of the territory, including Iona, under Pictish yoke.
- c750 – Columba's grave opened to provide access to relics. First shrine chapel built
- 753 – relics taken on circuit around Ireland during enactment of Law of Colum Cille (contents unknown) by Domnall, King of Tara. Relics taken to Ireland again in 757 and 778.
- c795 – Book of Kells completed in Iona scriptorium. First Viking raid.
- 802 – Viking raid, Iona burnt.
- 806 – Viking raid, 68 of the community killed.
- 807 – abbot Cellach and some Iona monks move to found the new abbey at Kells, Co Meath in Ireland, which remained the political head of the Columban monastic federation for next 350 years.
- 814/5 – Dunkeld founded taking power from Iona as centre of the Church. Some of Columba's relics moved there.
- 825 – Viking raid, murder of abbot Blathmac.
- 847 – Dal Riata dynasty takes political control of Pictland under king Cináed mac Alpín (Kenneth MacAlpin). Creating single kingdom of Alba, king of Scots and Picts, built a new church at Dunkeld honouring the relics.
- 878 – further and final division of relics between Kells and Dunkeld, with a shrine going to Ireland. Shift of patronage also to Irish kings, eventually resulting in decline of Iona's importance from which it did not recover until the Benedictine re-founding.
- 986 Christmas night – Viking raid, Danes from Dublin, abbot and 15 monks killed, at White Strand of the monks (Tra' Bàn nam Manach) at north end.
- By 10th cent – Norse living in Scotland & Ireland converting to Christianity
- 10th and 11th centuries - Columban abbots continued to be appointed until the end of the 12th century, although few details are known about the form and development of the community at this time.
- 1098 - Magnus Barelegs, King of Norway, visited Iona while establishing his royal authority over the Western Isles, causes the door

of the shrine chapel to be sealed up allegedly due to dread of the power contained therein.

- 1164 – Somerled, king of the Isles invites an Irish reforming abbot to Iona, but dies the same year at battle of Renfrew. He is buried on Iona and establishes the abbey as the spiritual home of his mighty MacDonald dynasty.
- c1200 – Benedictine Abbey and Augustinian nunnery founded by Ranald, king of the Isles, son of Somerled. Established with extensive lands chiefly in Mull, Colonsay, Canna, and Coll, from which rents usually paid to the monks in kind – oatmeal, cheese and salt beef.
- 1204 - building site attacked and badly damaged by two NI Bishops along with abbots of Derry and Armagh, seeking to retain primacy over Columban *familia.* Newly strained relations between Iona and the Columban church in Ireland. The Columban familia in Ireland and their political allies, the Cenél nEógain, strongly resented that Iona Abbey became Benedictine. The Columban familia in Ireland would not accept the loss of its connections with and influence over Columba's own foundation.
- c1247 – abbot of Iona acknowledged Bishop of Dunkeld as his superior, before ecclesiastical authority formally transferred from Diocese of the Isles.
- 1266 – Treaty of Perth cedes the Western Isles, including Iona, to the realm of the Scottish king, Alexander III. Although under the control of the church in Trondheim until later 15th cent (diocese of Sodor, Norway). Scottish kings were able to influence the appointment of abbots and a special relationship developed with the bishops of Dunkeld.
- c1420 – Donald, Lord of the Isles donated gold and silver to make a new reliquary for the hand of St Columba, presumed to be the principle relic owned by the abbey by this time.
- 1430s -70s – rebuilding takes a number of decades. South side of the church widened along its length, and removal of the rotting floor above the crypt thus gaining impressive height for the east end. New aisle built on south side of choir with an arcade of 3 pointed arches, capitals decorated, and one inscribed with the name of the Irish master mason c 1460. Effigies of Abbot Dominic (d. c 1465) and Abbot John MacKinnon in choir. South choir aisle capitals, angels weighing souls with devil depressing one side of scales.
- 1493 - the end of the Lordship of the Isles came when John Macdonald II forfeited his estates and titles to James IV of Scotland, and thus the end of the Macdonald patronage of the abbey.
- 1499 – became seat of the bishopric of the Isles.
- 16th century - Bishop John Campbell appointed Commendator in 1499 when the abbacy and the bishopric of the isles were brought together by Papal decree. Monastic life continued albeit in a reduced form. The Reformation of 1560 had limited impact; two of the recent bishop-Commendators had been Protestant sympathisers, and by this time the number of monks was small. Some of them were allowed to carry on

living in the secularised abbey buildings. The monastery was much reduced by this time and so the Reformation probably had little impact.

- 1587 – island, monastery and its estates bestowed on Hector Maclean of Duart (held from the Marquis of Argyll).
- 1609 - At a court held on Iona, Highland chiefs put their signature to the nine 'Statutes of Iona', for James VI/I requiring, amongst other measures, that Highland chiefs send their heirs to Lowland Scotland to be taught in English-speaking Protestant schools. The statutes are often considered to be the first in a series of government measures aimed at the break-up of traditional Gaelic culture and tradition.
- 1635 - repairs carried out to the church, under a scheme supported by Charles I, when it was made Cathedral of the Isles for a few years.
- 1690s – Iona and old abbey and nunnery lands in the Hebrides and west coast passed to Campbell Earl of Argyll. Visited by author Martin Martin.
- 1773 – visited by Boswell and Johnson
- 1810 – visited by Walter Scott
- 1829 – On August 7, visited by composer Felix Mendelssohn, whose trip to Staffa and Fingal's Cave helped inspire Hebrides Overture.
- 1833 – visited by Wordsworth, composed four sonnets.
- 1854 – Society of Antiquaries of Scotland urge 8th Duke of Argyll to take steps to preserve the abbey, nunnery and Reilig Odhrain, due to damage caused by digging up the graveslabs, and the poor state of preservation.
- 1858 – 8th Duke has finest slabs in Reilig Odhrain placed in railed enclosures, 'Ridge of the Kings' and 'Ridge of the Chiefs'.
- 1860s – opening of the two hotels
- 1874 – Sir Henry Dryden carrying out measured surveys at the abbey.
- 1874-76 consolidation of ruins by R Rowand Anderson
- 1899 – 8th Duke of Argyll, under pressure to preserve the church, gifts abbey ruins to newly formed Iona Cathedral Trust, so 'that the Cathedral shall be re-roofed and restored'.
- 1902-05 church restoration for Iona Cathedral Trustees by T Ross and J Honeyman – choir, transepts and crossing.
- 1908-10 nave restoration by P MacGregor Chalmers, funded by Woman's Guilds in the Church of Scotland, mobilised by Helen Campbell of Blythswood.
- 1921-26 – repairs by HM Office of Works on behalf of Iona Cathedral Trust, chiefly in the cloister and in St Oran's chapel, where the masonry was consolidated and the floor relaid.
- 1938 - George MacLeod, then a parish minister in Govan, Glasgow, recognised the widening gap between the Church and the real lives of his parishioners. MacLeod founded the Iona Community and using designs by Ian G Lindsay rebuilt the cloister and constructed a new west range. Not without controversy in the wider Church of Scotland and on the island, where the parish minister and the local population had no involvement in the project. Puts unemployed men from Govan

together with trainee ministers to work on rebuilding the abbey, although soon broadened to include others.

- 1938-65 – restoration of the monastic buildings for the Iona Community by I G Lindsay. Despite shortages, some voluntary work carried on through WWII.
- 1952 –the Queen visits Iona with the Duke of Edinburgh, just six months after ascending to the throne.
- 1962 – shrine chapel rebuilt
- 1979 – after three centuries of ownership, island sold by the Argyll Estates for death duties. Bought for the nation by the Hugh Fraser Foundation and placed in the care of NTS. Ownership of the abbey retained by Iona Cathedral Trust.
- 1982 – publication of RCAHMS Argyll 4 Iona volume.
- May 1994 - Labour Party leader John Smith was buried in the modern extension to the burial ground of Reilig Odhrain.
- 1999 - Iona Abbey into care of HS, with repair and conservation of the church and claustral ranges still housing the Iona Community.
- 2013 – major HS redisplay project and opening of refurbished site museum.

Property in Care (PIC) ID:	PIC077 & PIC091
Designations:	Scheduled Monument (SM90350) & (SM90173)
Taken into State care:	1999 (Leased) & 1956 (Guardianship)
Last reviewed:	2005

HISTORIC ENVIRONMENT SCOTLAND

STATEMENT OF SIGNIFICANCE

IONA NUNNERY & MACLEAN'S CROSS, IONA

We continually revise our Statements of Significance, so they may vary in length, format and level of detail. While every effort is made to keep them up to date, they should not be considered a definitive or final assessment of our properties.

Historic Environment Scotland – Scottish Charity No. SC045925
Principal Office: Longmore House, Salisbury Place, Edinburgh EH9 1SH

IONA NUNNERY AND MACLEAN'S CROSS

BRIEF DESCRIPTION

Iona Nunnery comprises the ruins of an early 13th century Augustinian nunnery dedicated to St Mary the Virgin, one of only two Augustinian nunneries in Scotland and one of the best-preserved examples of a medieval convent in Britain. Founded c.1203 probably by Ranald, Lord of the Isles, the nunnery is contemporary with the adjacent abbey[1], and stands on the north edge of Baile Mòr, overlooking St Ronan's Bay.

The complex follows a conventional quadrangular plan with a church and to the south. Only part of the church and south range stand to any height.

To the east of the nunnery stands St Ronan's Chapel, a 12-th or 13-th century building that served as the island's parish church until the 17th century. Like the nunnery, the church is built of pink granite and dark grey rubble. The building has a modern roof and is used to store an extensive collection of sculptured stones, including part of the Iona collection of medieval effigies and graveslabs carved in the West Highland tradition.

MacLean's Cross stands on a rubble base in or near its original position on the west side of the road between the abbey and the nunnery. The tall decorated shaft and cross, formed from a single thin slab of chlorite schist, topped with a disc head with reduced lateral arms. It is a product of the Iona School of carvers and probably dates to 15th century.

CHARACTER OF THE MONUMENT

Historical Overview

- Burials from Cladh Ronain may date to the first Christian occupation of Iona between 6th and 8th century.
- First church built on the site of St Ronan's Church c.8th century.
- 12th century: the medieval chapel of St Ronans is built directly over the footprint of the earlier church.
- 1203: Somerled's son Ranald (Raghnall) establishes a house of Augustinian canonesses at Cladh Ronain, and makes his sister Beathag the first prioress.
- In the 15th century, alterations are made to the conventual buildings, a wooden gallery is created at the W end of the nave, and the cloister garth is enlarged.
- In the 15th century, the MacLeans of Duart commissions a freestanding cross for the roadside between the abbey and nunnery, it is very similar to one erected at this period by Duncan MacMillan at Kilmory Knap chapel.
- 1569: Mary, Queen of Scots, grants the title of prioress and the nunnery to Marion MacLean, the last prioress.

[1] This document should be read in conjunction with the Statement of Significance for Iona Abbey

- 1574: Prioress Marion MacLean passes the nunnery and its lands to Hector MacLean of Duart.
- The possessions of the MacLeans of Duart, including Iona Abbey and the nunnery, pass to the Duke of Argyll.
- From the mid 17th century St Ronan's Church is no longer used as a parish church, although Cladh Ronain remains a burial ground for women and children until the 18th century.
- c.1830: Vaulting within the chancel collapses, leaving the church entirely roofless.
- 1874-75: Repairs at the nunnery are directed by the renowned architect Robert Rowand Anderson for the 4th Duke of Argyll.
- c.1890s: The Duke gifts Iona abbey and nunnery to the Iona Cathedral Trustees.
- 1917: Further repairs within the nunnery church.
- 1922: Iona Cathedral Trustees undertake restoration works on the sacristy and north chapel of the church.
- 1923 Further repairs carried out within the church. Work within St Ronan's Chapel reveals a gold finger ring, two fragments of a gold fillet, and a piece of gold wire.
- 1993 Excavations by AOC within St Ronan's Chapel reveal an earlier structure and evidence of an early Christian burial.
- 1995: AOC conduct geophysical survey, recording what may be the remains of a road surface to the north-east of the nunnery.

Archaeological Overview

- The condition and extent of the buildings are documented through accounts published by travellers and antiquarians, including Martin Martin (1694), Thomas Pennant (1779), Johnson and Boswell (1774) and Sir Walter Scott (1810). In the late 19th century several antiquarians published descriptions of the nunnery in varying degrees of detail, such as Skene's (1875) historical overview of the abbey and nunnery and the survey of the ruins by MacGibbon and Ross (1896-97).

- The earliest recorded archaeological discoveries made at the nunnery are the finds uncovered during repair works in 1922 and 1923. Four silver spoons and a gold fillet are found beneath the floor of the nunnery church. Fragments of linen cloth adhering to the spoons indicated that they had been wrapped and then buried. The fillet, found in two parts, comprises a long thin piece of beaten gold bearing an elaborate plant scroll pattern. These articles appear to have been hidden at an unknown date, as one of the silver spoons found within the nunnery church retained traces of roughly woven linen, presumably a bag or covering. The spoons are of fine workmanship and A O Curle considered them to be of 15th or 16th century date, based on stylistic similarities to English and Continental spoons. Curle suggests an earlier date for the gold fillets, possibly 13th or 14th century.

- In 1992 excavations within St Ronan's Chapel demonstrated the site's long history as a place of burial and worship. Three broad phases of activity were defined. Between the mid- 6th and 12th centuries the site served as a burial ground, perhaps dating to the first period of missionary activity on the island. Unfortunately, there was a lack of dating evidence and the human remains were unsuitable for radiocarbon dating. Between the 8th and 12th centuries a small rectangular stone building, with lime-washed clay-bonded walls was erected in the burial ground, overlying a number of burials. Finally, in the 12th or 13th century, this building was demolished and the present St Ronan's Chapel erected directly over its footprint.

- A large number of later burials were recovered from within St Ronan's Chapel and the immediate area around it. The overwhelming majority of these burials were female or children, confirming traditional accounts that the site was reserved for women and children long after the church went out of use.

- A geophysical survey carried out in 1995 by AOC Archaeology Ltd traced a curvilinear anomaly interpreted as a road.

Artistic/Architectural Overview

- The convent of St Mary the Virgin is one of the best examples of a small medieval convent in Britain, and is the only surviving house of Augustinian nuns in Scotland (the second house was in Perth). Although ruinous since the Reformation, the convent preserves its original 13th-century layout, although some changes to the church and the E and S ranges were made in the 15th century.

- In plan, the convent follows the conventional form of many other religious houses, its church being situated N of the cloister with domestic ranges on the E, S and W enclosing a central garth (enlarged in the 15th century). Although mostly reduced to footings, parts of the church and the gables of the S range stand to a substantial height.

- The W and N walls of the church stand to their original height, while the aisle chapel was restored in the 1920s. The church comprises an undivided nave and chancel, although there was almost certainly a timber screen between them. An aisle runs about two-thirds of the length of the nave. The nave arcade capitals show a range of carving, including animals and stylised plant decoration. The small chapel at the E end of the nave aisle is covered by a fine rib-vault, a smaller version of the vault that covered the chancel prior to its collapse in the 1830s. Along the W wall of the nave are six sculptured corbels, evidence of a 15th-century enlargement of the convent church by the insertion of a gallery. The corbels bear a variety of decoration, including the Annunciation, an angel, and a human face.

- Enlarged in the 15th century, the E range comprises three ground floor chambers, including the chapter-house with stone benches around its walls. Comparison with other religious houses indicates that the upper floor of the E range probably housed the dormitory. The S range housed the refectory, a large chamber subsequently adapted for domestic use by the insertion of an upper floor. Within the Refectory is a possible *sheila-na-gig* carving (a female fertility symbol), although the sculpture is heavily worn. Almost nothing survives of the W range, the majority of it lies beneath the modern road that skirts the nunnery. Only the inner wall remains standing, and it is possible the range contained guest accommodation and the convent's public entrance.

- St Ronan's Chapel, a small rectangular building constructed of the same pink granite rubble and dark grey Torridonian stone, stands to the NW of the nunnery and survives to wallhead height. In the 1950s (renewed in 1990s by John Renshaw for the Iona Cathedral Trust), the Ministry of Works installed an inverted glass roof (as at Kilmory) with the intention of using the ruin as a stone store. The collection is significant, comprising fragments of early Christian crosses and late medieval West Highland graveslabs, several of which bear inscriptions and effigies, carved in the style of the Iona 'school'. Many of these slabs appear to commemorate nuns and noblewomen.

- MacLean's Cross is a product of the Iona School of carving – it is decorated on both faces, the front of the cross faces W and has a representation of the Crucified Saviour clothed in a long robe on the disc head and fleur-de-lis on the upper right-hand arm, the left arm had a chalice, now lost. The shaft has a continuous mesh of ornament of intertwined plant stems. The rear of the cross is decorated largely with intertwined foliaceous ornament but at the top of the shaft is a pair of animals and on the right arm there has been an angel. A panel at the foot of the shaft bears an inscription in Lombardic capitals that is no longer legible.

<u>Social Overview</u>

- The lack of any formal evaluation makes it difficult to assess the nunnery's present social significance.

- Iona's built and natural heritage attracts a large number of visitors each year.

- Although the nunnery has no direct association with St Columba, it is one part of the island's heritage, widely stated by many writers as occupying a special place in the national consciousness.

<u>Spiritual Overview</u>

- No formal studies have been carried out to gauge the nunnery's present spiritual significance. However, the island remains an important place of pilgrimage, contemplation and worship for Christians around the world. This is demonstrated by a religious group for women around the world taking a close interest in plans for the nunnery's conservation.

- As a former convent, the monument is likely to retain some religious associations, particularly as Cladh Ronain remained in use as a burial ground for women and children until the 18th century.

Aesthetic Overview

- Iona's unspoilt character cannot be stressed highly enough as it provides a stunning backdrop for the built heritage, and gives visitors a sense of the nunnery's original setting.

- The nunnery ruins themselves are particularly attractive, constructed of pink and grey masonry.

- The pleasant cloister garth offers visitors a peaceful and contemplative space in which to admire the ruins.

What are the major gaps in understanding of the property?

- Our knowledge of the nunnery's history is very limited and patchy, particularly the role of the convent after the Reformation.

- The level of survival of the W range, most of which lies beneath the modern road, has never been tested.

- The lack of firm dates from the early Christian phases beneath St Ronan's Church limits our understanding of the site's early history.

ASSESSMENT OF SIGNIFICANCE

Key points

- Iona Nunnery is one of the best-preserved medieval nunneries in Britain, and one of only two houses of Augustinian nuns established in Scotland.
- Iona Nunnery forms part of an internationally-renowned group of monuments set within an almost wholly unspoilt landscape, attracting what is thought to be in excess of 100,000 visitors each year.
- The nunnery is built adjacent to an early Christian burial ground, which may be as old as the primary phase of missionary activity on Iona, forming a link between the early monastery and the later convent.
- Architectural details throughout the nunnery are of high quality indicating its importance and significance. The convent church possessed one of the few rib-vaults in the Western Highlands.
- The 15th century enlargements suggest the nunnery continued to flourish in the later Middle Ages, a time when many religious houses were declining.
- St Ronan's Church, adjacent to the nunnery, occupies the site of an early Christian church possibly dating from the 8th century, itself built on the site of an earlier burial ground. It houses an excellent collection of late medieval West Highland style graveslabs, all the work of masons of the Iona School of carving. Iona was instrumental in the creation of a distinctive West

Highland style of carving, one of the most important cultural developments in late medieval Scotland.

- Several famous travellers have visited the monument since the Reformation, including Martin Martin, James Boswell and Dr Samuel Johnson, Sir Walter Scott, Prince Albert and Felix Mendelssohn.
- Prince Albert's visit in 1847 helped create an interest in the island as a fashionable holiday destination, much in the same way as Victoria and Albert's travels through the Highlands did.
- MacLean's Cross is one of a significant group of 15th-century carved stones produced by the Iona School of carvers.

Associated Properties

Iona Abbey (early monastery of similar date to the early burials found at St Ronan's Chapel: medieval abbey re-founded 1203 by Reginald, Lord of the Isles. Iona abbey possesses one of the finest collections of West Highland sculpture, including slabs from the nunnery burial ground); **Paisley Abbey** (also founded by Reginald/Ranald); St Leonard's nunnery, Perth (only other recorded foundation of Augustinian nuns in Scotland); Duart Castle (the last prioress and convent passed their lands to the heritage of Hector MacLean of Duart in 1574); St Bothan's nunnery (near the of parish church at Abbey of Bathans); North Berwick Nunnery.

Keywords St Ronan; Earl Ragnall/Ranald/Reginald; Bethoc/Beathag/Beatrice; MacLean, Duke of Argyll, convent; Augustinian nuns; sheila-na-gig; corbel; cloister; chapter-house; refectory; rib-vault, late medieval graveslab

Appendix 2

HER Gazetteer

WOSASPIN	SITE NAME	SITETYPE
210	Maclean's Cross, Iona / Mclean's Cross	Cross
211	St Oran's Chapel and Reilig Odhrain, Iona	Chapel; Burial-ground; Cross-slab; Well
212	Tobar a' Cheathain, Iona	Well
213	St Mary's Chapel, Iona	Chapel
214	Cladh nan Druineach, Iona	Enclosure; Burial-ground (possible)
215	Iona Nunnery, Iona	Nunnery
216	Martyr Street, Iona	Road
217	Sraid nam Marbh, Iona	Road
218	Main Street, Iona	Road
219	St Ronan's Street, Iona	Road
220	'Threld', Iona	Village
221	Iona Abbey, Iona	Coin Hoard
222	Blar Buidhe, Iona	Cairn; Corn-drying Kiln (possible)
224	St Ronan's Church, Iona / Teampull Ronaig / Cladh Ronain	Church; Burial-ground; Hoard; Gold Objects; Museum
235	An Eala, Iona	Long Cists; Mound
236	Cill Chainnich, Iona / St Cainneach's Chapel / Cladh Chainnich	Chapel; Burial-ground
240	St Brandon's Cross, Iona	Cross
242	St Adamnan's Cross, Iona / Port a'Chroisein	Cross
243	Iona, Early Christian Monastery	Monastic Settlement; Battle Site or Skirmish
244	Iona Monastery, Torr an Aba / Tor an Aba / Tor Abb / Dum Ni Manich	'Cell'; Building; Cross-base
245	Iona Monastery, Vallum	Enclosure; Sanctuary Marker
245	Iona Monastery, Vallum	Enclosure; Sanctuary Marker
246	Iona Monastery, St Columba's Shrine	Shrine
247	Iona, St Martin's Cross	Cross
248	St John's Cross, Iona	Cross
249	St Matthew's Cross, Iona	Cross
250	St Oran's Cross, Iona	Cross
251	Iona	Burial
252	Reilig Odhrain, Iona	Ditches
253	Reilig Odhrain, Iona	Post-holes; Pits; Enclosure; Cross-base; Corn-drying Kiln; Structure
254	Reilig Odhrain, Iona	Fint Working Site; Scraper; Debitage
258	Iona Abbey / Iona, St Mary's Cathedral	Abbey
258	Iona Abbey / Iona, St Mary's Cathedral	Abbey
258	Iona Abbey / Iona, St Mary's Cathedral	Abbey
258	Iona Abbey / Iona, St Mary's Cathedral	Abbey
261	Tigh-an-Easbuig, Iona / Tigh an Easbuig	Building
12195	Iona, Chapel and Burial-ground / St Ronan's Church	Chapel; Burial-ground

WOSASPIN	SITE NAME	SITETYPE
13558	Iona Abbey	Midden
13559	Sruth a' Mhuilinn, Iona	Mill (possible)
20992	Iona Church / Iona Kirk / Telford Church / Iona Parish Church	Church
20993	Iona Manse / Telford Manse	Manse
21928	Iona Abbey Museum / St Mary's Abbey Museum / Abbey Museum / Infirmary	Museum
21929	Iona Abbey, Michael Chapel	Chapel
43378	Iona, Blair Buidhe	Structure; Enclosure
43380	Iona, Port Nam Mairtir	Memorial
43616	Caol Ithe, Iona	Farmstead
45963	Iona, Maol	Rig
46066	Iona, Pier	Pier
46272	Iona, Abbey	Crosses; Cross-slabs
46273	Iona, Nunnery	Cross; Cross-slabs
46274	Iona, St Oran's Chapel and Reilig Odhrain	Crosses; Cross-slabs
46275	Iona, St Ronan's Church / Nunnery Museum	Crosses; Cross-slabs; Shrine
46278	Iona, St Columba Hotel / Carraig Bheig	Cross-slab
46290	Iona, Iona Nunnery	Sheela-na-gig
46525	Fionnphort, St Columba Centre	Museum; Cross-inscribed Stone; Inscribed Stone
51959	Iona, Iona Abbey, Abbot's House / Abbots House; St Mary's Cathedral; St Mary's Abbey	Abbey
55222	Iona, Baile Mor, Glebe Field	Structure
59899	Oran Cottage	Midden; Pottery; Lithics

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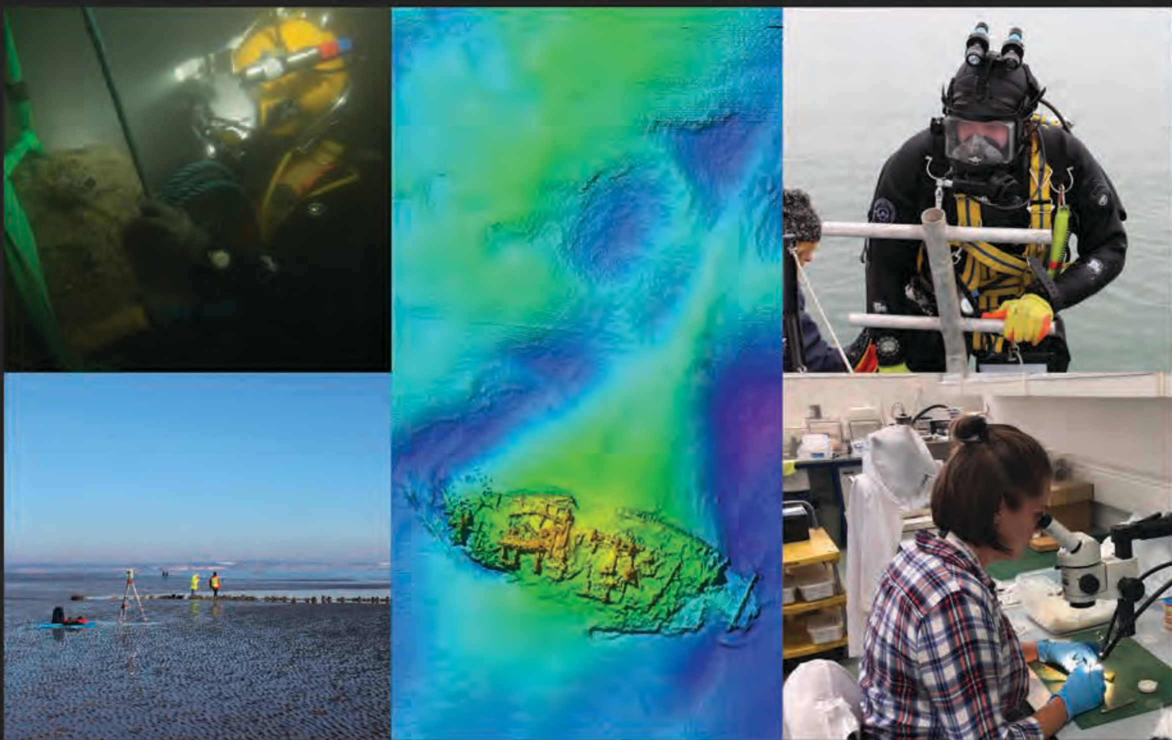
APPENDIX 16.2

Archaeological Assessment of Hydrographic Data

Iona and Fionnphort



Archaeological Assessment of Hydrographic Data

MSDS Marine

2021/MSDS21180/1

Iona and Fionnphort

Archaeological Assessment of Hydrographic Data

Project Name	Iona and Fionnphort – Archaeological Assessment of Hydrographic Data
Client	RPS Ltd
MSDS Marine Project Number	MSDS21180
Author and contact details	Mark James mark@msdsmarine.co.uk 07917 703 176
Origination date	27/07/2021
Reviser (s)	Mark James
Date of last revision	09/08/2021
Quality Assurance Approval	Sally Evans
Version number:	1.1
Summary of changes	Addressing client comments

Contents

Figures

List of Abbreviations

AEZ	Archaeological Exclusion Zone
Aspect	Aspect Land and Hydrographic Surveys Ltd
CD	Chart Datum
EIA	Environmental Impact Assessment
IHO	International Hydrographic Organisation
kHz	Kilohertz
m	Meters
MSDS Marine	MSDS Marine Ltd
PAD	Protocol for Archaeological Discoveries
RPS	RPS Ltd
RTK	Real Time Kinematic
UKHO	United Kingdom Hydrographic Office
Wrecksite	Wrecksite.EU

1.0 Introduction

1.0.1 MSDS Marine Ltd (MSDS Marine) were commissioned by RPS Ltd (RPS) to undertake an archaeological assessment of hydrographic data collected in advance of a marine licence application for development works at Iona and Fionnphort, Scotland (Figure 1). The assessment is being undertaken to inform the Environmental Impact Assessment (EIA) process.

1.0.2 Broadly, the development seeks to undertake ferry berthing improvements at each end of the ferry route between Iona and Fionnphort to the following proposed specifications;

Iona

1.0.3 The development at Iona proposes to construct a rock-armour breakwater c.50 m south of the existing slipway and covering an area c. 6,000 m^2. Alongside the existing slipway and extending c.30 m past to the east twelve piles are proposed. To the north-east of the existing slipway an area c.3,400 m^2 is proposed to be dredged to 3.0 m below Chart Datum (CD). See Figure 2.

Fionnphort

1.0.1 The development at Fionnphort propose to construct a rock-armour breakwater c.30 m to the south-west and extending north-east past the existing slipway and covering an area c.8,000m^2. Alongside the south-eastern edge of the proposed breakwater are nine proposed pile locations in association with a gangway. To the north of the existing slipway an area c.12,700 m^2 is proposed to be dredged to 3.0 m below CD. See Figure 3.

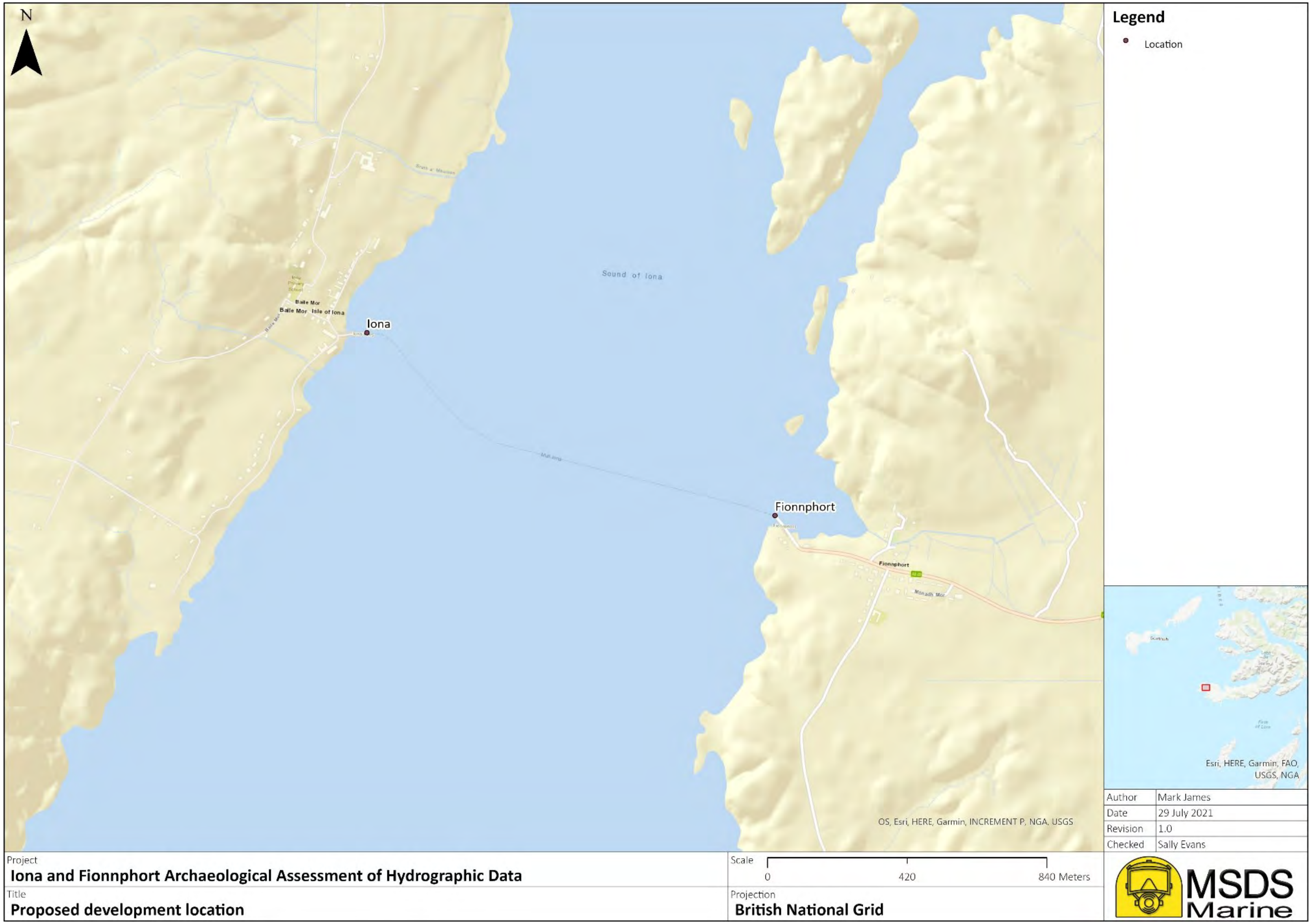


Figure 1: Proposed development location

Figure 2: Proposed development location, Iona

Figure 3: Proposed development location, Fionnphort

2.0 Aims and Objectives

2.0.1 The principle aim of the archaeological review of hydrographic data is to establish the presence of potentially significant archaeological material on the seabed. The identification of material allows for strategies to be recommended to mitigate against any negative effects that may be caused by the development process.

2.0.2 The objectives of the archaeological interpretation can be summarised as follows:

- To establish the presence of anthropogenic material of archaeological potential;
- to interpret the identified anomalies as to their potential to be of archaeological significance; and
- to recommend mitigation strategies for the anomalies appropriate to their archaeological potential.

3.0 Method

3.1 Data Available

3.1.1 Data were collected by Aspect Land and Hydrographic Surveys Ltd (Aspect) during November 2020, mobilising the sensors detailed in Table 1 below[1]. The data collection was specified to meet, or exceed, the International Hydrographic Organisation (IHO) Special Order Standard[2]. The IHO Special Order states that 100% coverage of the survey area must be achieved enabling the detection of cubic features greater than 1 m. The specification was achieved and exceeded. The final data density was better than 0.25 m across the majority of the survey area. Coverage is presented in Figure 4.

Sensor type	Sensor
Position and motion	Trimble Applanix POS MV
RTK Corrections	Base station
Multibeam Echosounder	R2Sonic 2022 @ 400 kHz

Table 1: Mobilised survey sensors

3.1.2 The archaeological assessment of hydrographic data uses the most recent, and highest resolution data which was that collected by Aspect in 2020. However, survey data from previous years was provided to the specifications in Table 2.

Year	Project reference	Resolution
2014	A5314 Iona	0.3 m
2015	A5469 Fionnphort	0.3 m
2017	A6099 Iona and Fionnphort	0.5 m
2020	A7482 Sound of Iona	0.5 m

Table 2: Previous survey specifications

3.1.3 The 2020 data were provided to MSDS Marine as un-gridded points files, with navigation and tidal corrections applied. Previous years data were provided gridded to the values in Table 2.

3.1.4 All data were supplied relative to British National Grid (OSGB36).

[1] Aspect Land and Hydrographic Surveys Ltd, 2020. *Topographic, Multibeam Bathymetric Survey. Sound of Iona, Argyll.* A report for Argyll and Bute Council. Report Ref: A7482.
[2] International Hydrographic Organisation, 2020. *IHO Standards for Hydrographic Survey*. IHO Publication No. 44, 6th Edition.

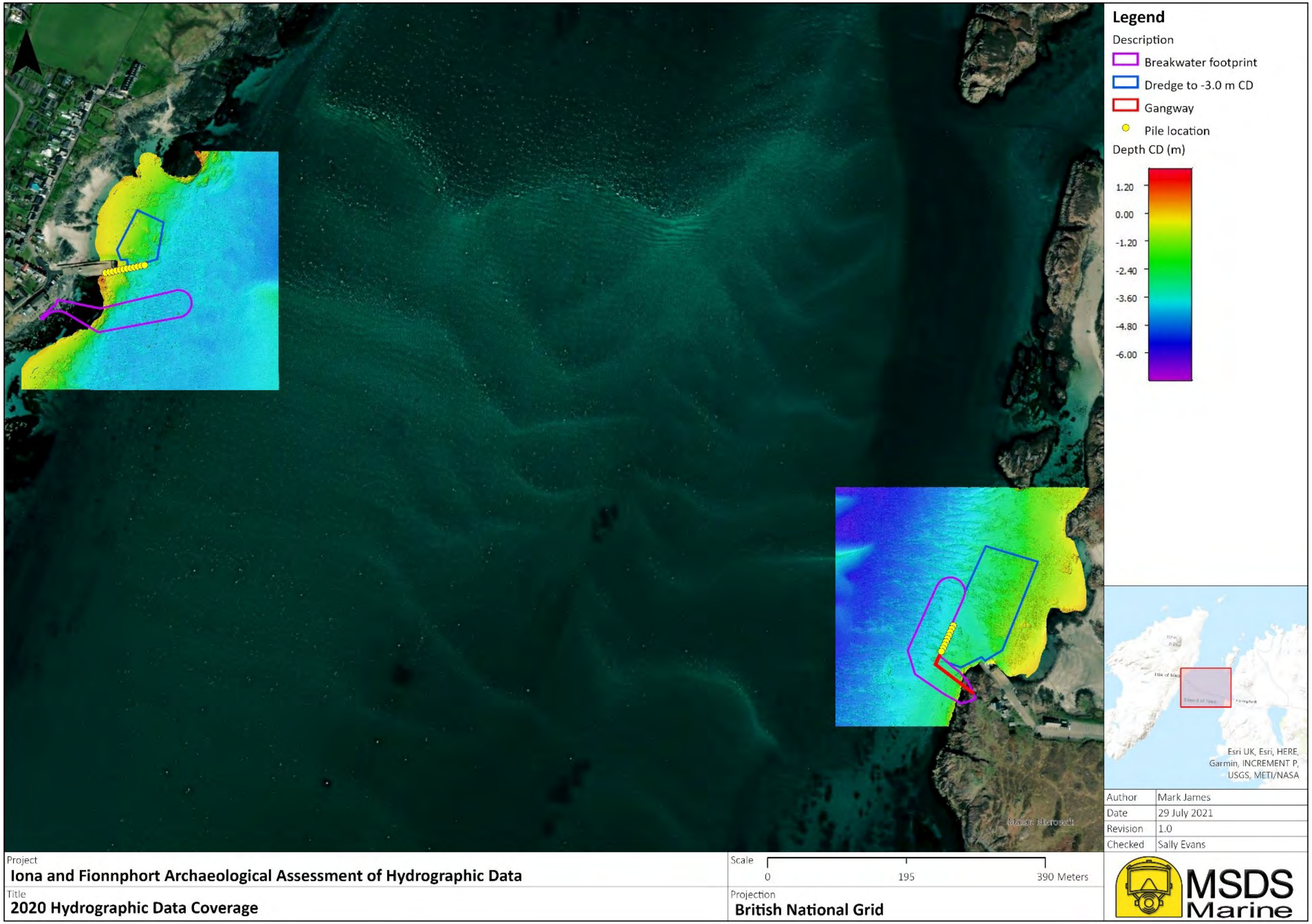


Figure 4: 2020 Hydrographic data coverage

3.2 Archaeological Assessment

3.2.1 The archaeological assessment was undertaken by a qualified and experienced marine archaeologist with a background in geophysical and hydrographic data acquisition, processing, and interpretation.

3.2.2 The assessment considered the provided 2020 data extents around the proposed development areas, the data included a suitable buffer. Data from previous years were assessed to ensure no features were hidden by the movement of sediment, and where they extended past the extents of the 2020 data to contextualise the area.

Hydrographic Data Assessment

3.2.3 Following delivery of the required datasets, an initial review was undertaken to gain an understanding of the geological and topographic make-up of the survey area. Within the extent of the survey area, the potential for variation in the seabed is high and can affect the interpretation of anomalies.

3.2.4 The datasets were reviewed on a 10 m x 10 m grid basis and all anomalies of potential anthropogenic origin identified and recorded. Records include at a minimum (where appropriate) an image of the anomaly, dimensions, and a description. An archaeological potential was assigned to the anomaly following the criteria outlined in Table 3 below.

Potential	Criteria
Low	An anomaly potentially of anthropogenic origin but that is unlikely to be of archaeological significance – Examples may include discarded modern debris such as rope, cable, chain, or fishing gear; small, isolated anomalies with no wider context; or features that appear geological in origin but may have the potential to be anthropogenic.
Medium	An anomaly believed to be of anthropogenic origin but that would require further investigation to establish its archaeological significance – Examples may include larger unidentifiable debris or clusters of debris, unidentifiable structures, or large magnetic anomalies.
High	An anomaly almost certainly of anthropogenic origin and with a high potential of being of archaeological significance – high potential anomalies tend to be the remains of wrecks, the suspected remains of wrecks, or known structures of archaeological significance.

Table 3: Criteria for the assessment of potential

3.2.5 Anomalies assessed as having archaeological potential were compiled into a gazetteer and a shapefile created for further assessment alongside known features such as wrecks, mooring buoys, third party assets such as cables and pipelines and other seabed structures. Satellite imagery was also viewed as due to the water clarity in the Sound of Iona seabed features were visible within this data.

3.2.6 The data was assessed in this way to ensure that anomalies were not unnecessarily identified as having archaeological potential when the origination can be identified.

3.2.7 The interpretation of hydrographic data is, by its very nature, subjective; however, with experience and by analysing the form, size, and characteristics of an anomaly a reasonable degree of certainty as to the origin of an anomaly can be achieved.

3.2.8 Measurements can be taken in hydrographic processing software, and whilst largely accurate, discrepancies can be noted due to a number of factors. Where there is uncertainty as to the potential of an anomaly, or its origin, a precautionary approach is always taken to ensure the most appropriate and robust mitigation for the historic environment.

3.2.9 It should be noted that there may be instances where an anomaly may exist on the seabed but not be visible in the geophysical data. This may be due to being covered by sediment, being obscured from the line of sight of the sonar, or outwith the capabilities or specification of the survey.

3.3 Mitigation

3.3.1 To ensure the most appropriate and robust mitigation for the historic environment without unnecessarily impacting the development, mitigation recommendations were determined on an anomaly-by-anomaly basis and considered all available data including: potential significance, size, seabed type, seabed dynamics, the development type and potential negative impact. Mitigation strategies were based on the criteria in Table 4.

Potential	Criteria
Low	No archaeological significance interpreted. Maintain an operational awareness of the anomaly's location, and reporting through an agreed protocol for archaeological discoveries (Annex B) should material of potential archaeological significance be encountered.
Medium	Avoidance of the anomaly's position and where appropriate an archaeological exclusion zone may be recommended. Ground truthing of the anomaly through the use of divers or an ROV would establish the archaeological potential.
High	Archaeological exclusion zones will be recommended based on the size of the anomaly, any outlying debris and the seabed dynamics as interpreted from the hydrographic data.

Table 4: Mitigation criteria

4.0 Results

4.0.1 A total of ten anomalies of potential anthropogenic origin were identified within the survey extents. Seven anomalies in relation to Fionnphort, one of which is in the proposed development footprint, and three in relation to Iona, none of which are in the development footprint. The anomalies are categorised by potential in Table 5 and the locations presented in Figure 5.

Potential	Iona development footprint	Fionnphort development footprint	Iona wider area	Fionnphort wider area	Total
Low	0	1	3	6	10
Medium	0	0	0	0	0
High	0	0	0	0	0
Total	**0**	**1**	**3**	**6**	**10**

Table 5: Distribution of anomalies by potential

4.0.2 All the identified anomalies were identified as of low archaeological potential. Low potential anomalies are discussed further in Section 4.1.

4.1 Low Potential Anomalies

4.1.1 Ten anomalies were identified as of low archaeological potential within the assessment extents, one of which falls within the development footprint. The anomalies are broken down into the following categories, Table 6.

Category	Iona development footprint	Fionnphort development footprint	Iona wider area	Fionnphort wider area
Potential debris	0	0	2	2
Likely geological	0	1	1	2
Linear feature	0	0	0	2

Table 6: Low potential anomaly categories

4.1.2 The anomalies identified as of low archaeological potential are mixture of small features often potentially geological in form, or likely representing modern debris. Each anomaly was reviewed and established to be of low archaeological potential.

4.1.3 Low potential anomalies have been assessed against all available evidence and are deemed to be unlikely to be of archaeological significance and as such will not be discussed further within the results section of this report. The distribution of low potential anomalies is shown in Figure 6 and Figure 7.

4.1.4 Further information regarding mitigation can be found in Section 6.0, and a gazetteer of low potential anomalies, including positions and dimensions can be found in Annex A – Gazetteer of Archaeological Anomalies.

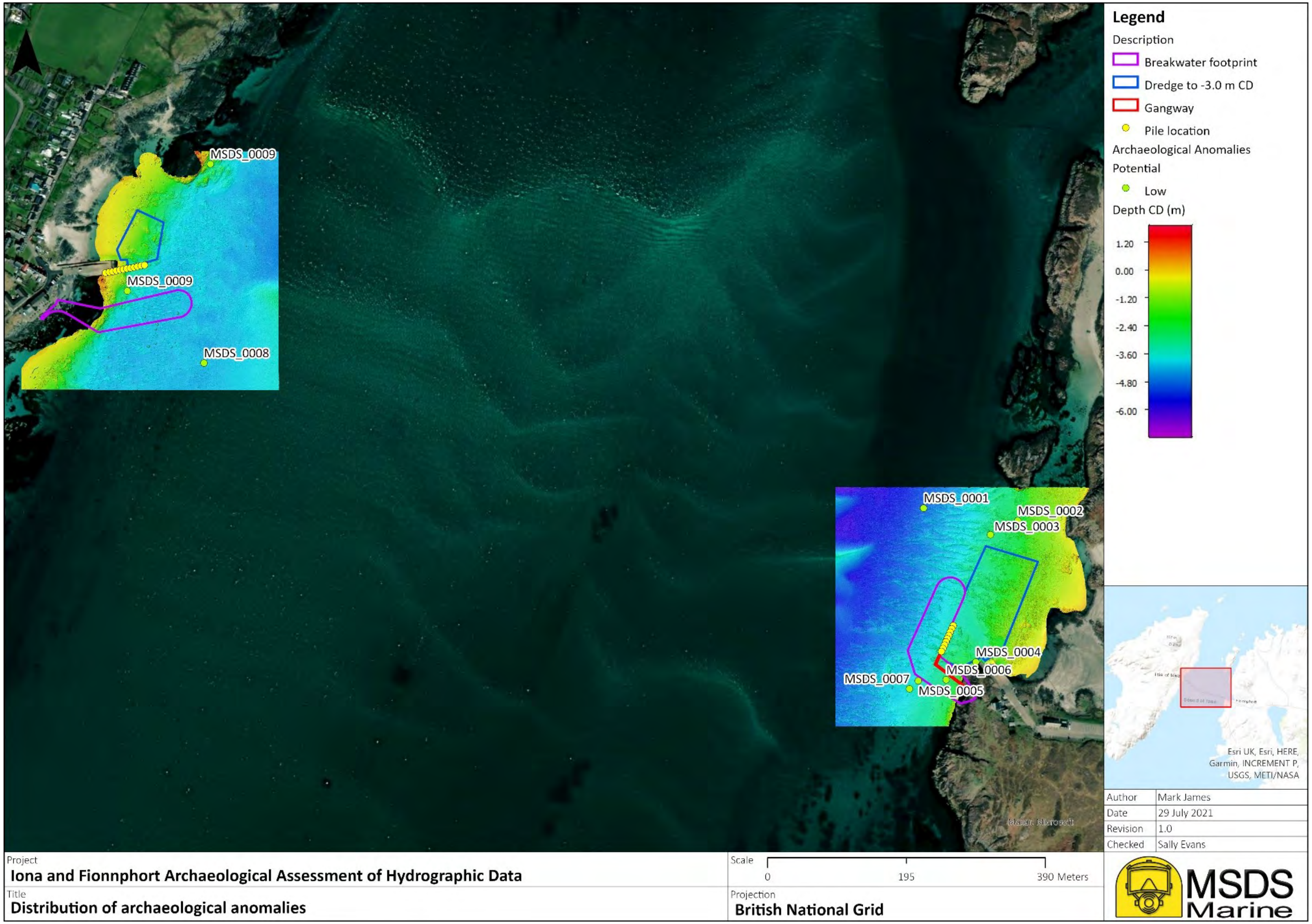


Figure 5: Distribution of archaeological anomalies

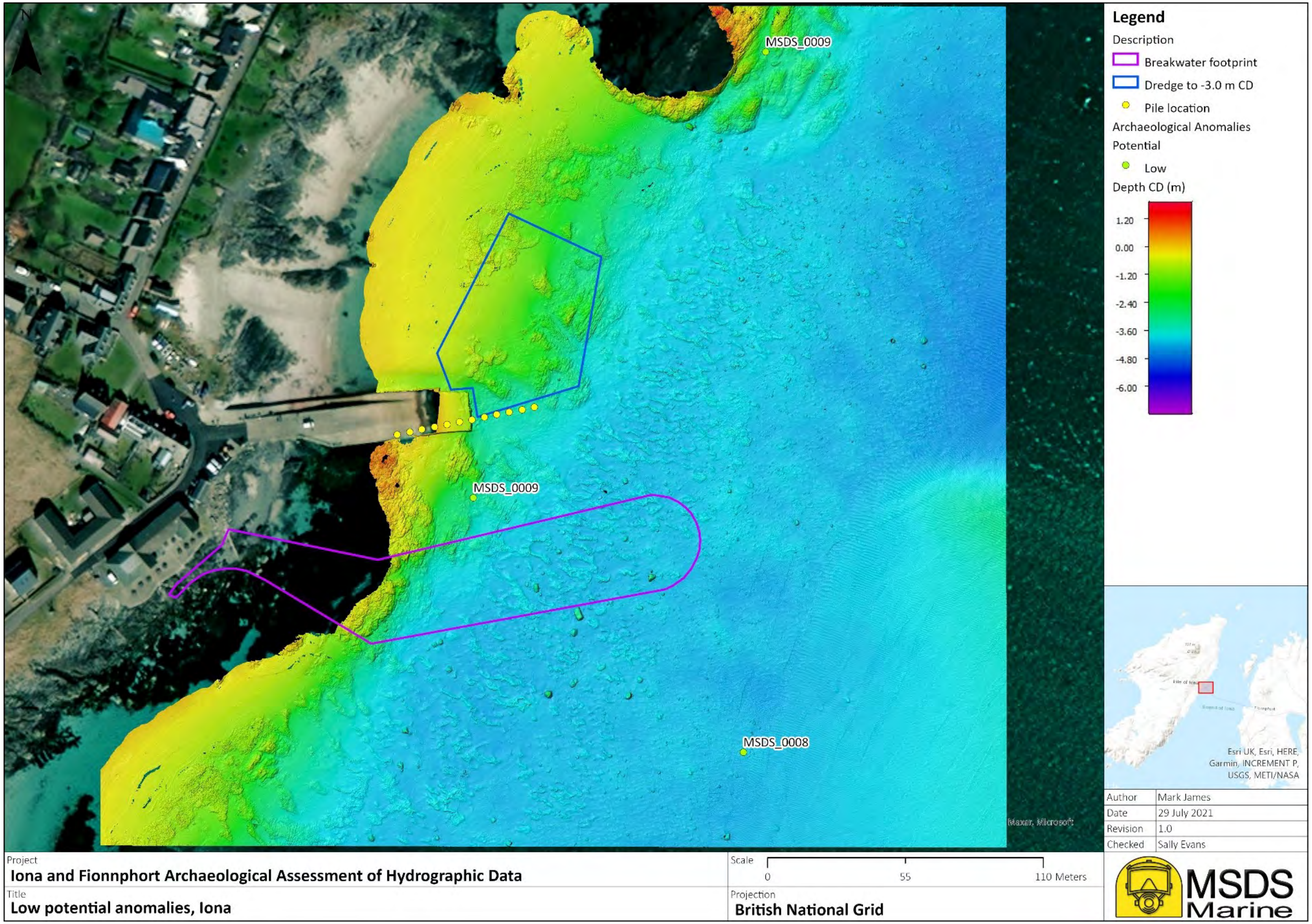


Figure 6: Low potential anomalies, Iona

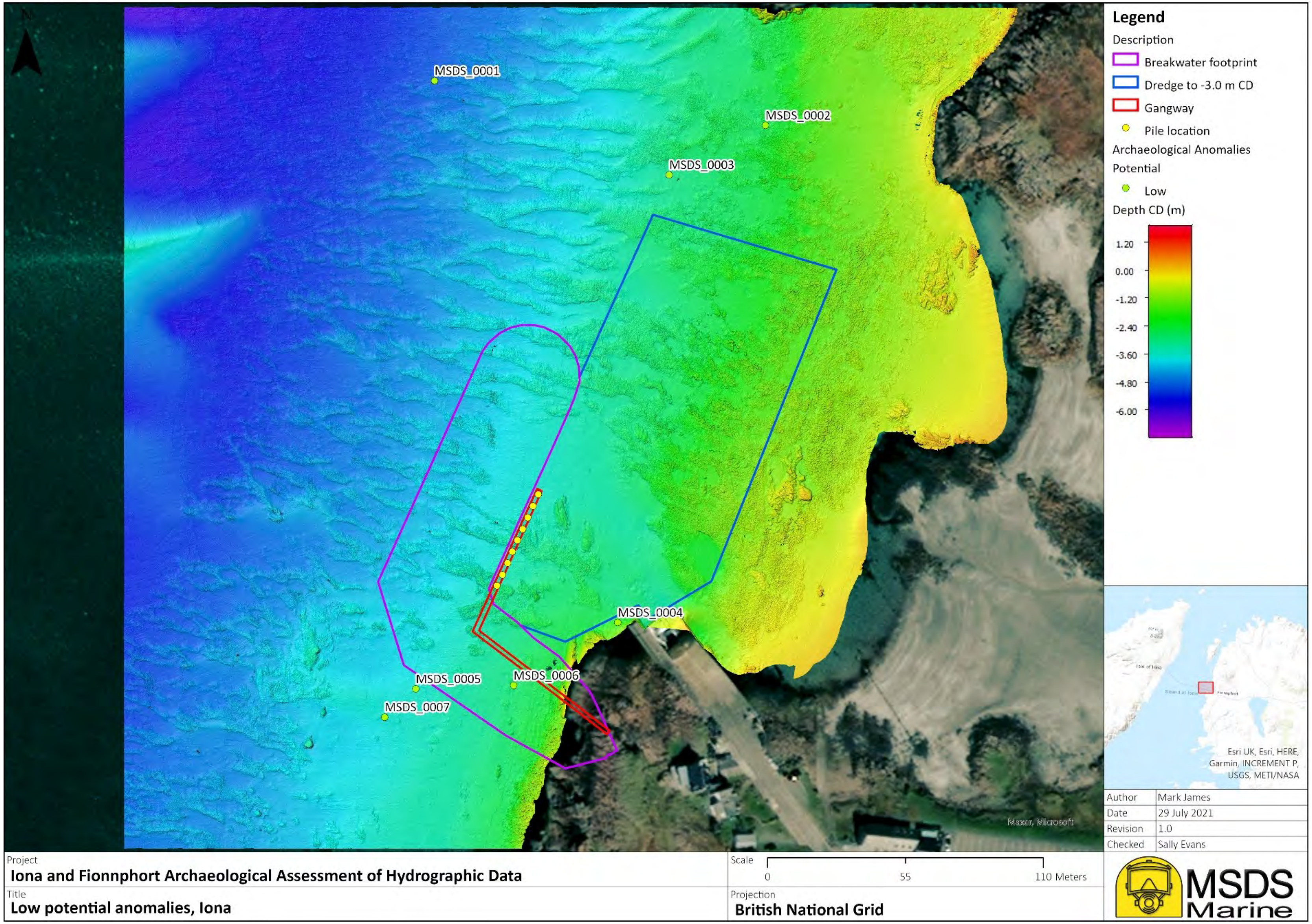


Figure 7: Low potential anomalies, Fionnphort

5.0 United Kingdom Hydrographic Office and Wrecksite Data

5.0.1 United Kingdom Hydrographic Office (UKHO) and Wrecksite.EU (Wrecksite) data were obtained for the Sound of Iona for the cross correlation of anomalies identified within the hydrographic data. No records were present in either dataset within the Sound of Iona area.

6.0 Mitigation

6.1 Low Potential Anomalies

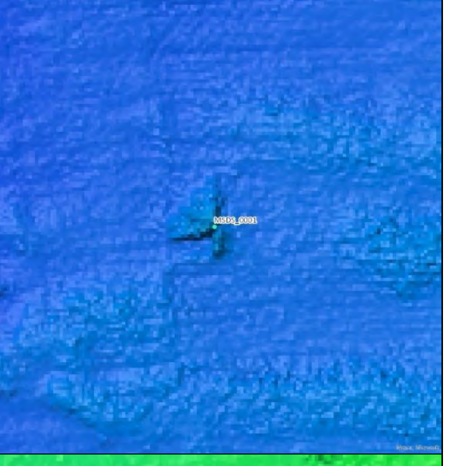
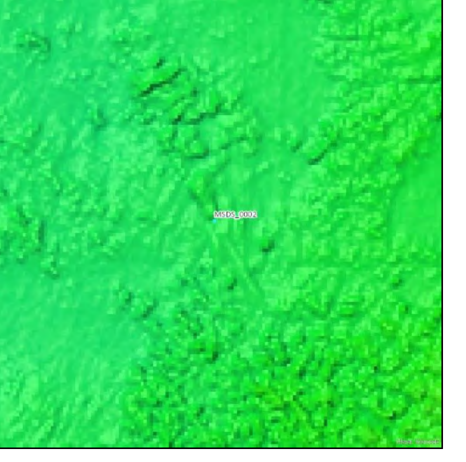
6.1.1 Low potential anomalies have been identified as potentially anthropogenic in origin but unlikely to be of archaeological significance and no exclusion zones are recommended for these anomalies. Should material of potential archaeological significance be identified during the course of pre-development and development works they should be reported under an appropriate Protocol for Archaeological Discoveries (PAD) such as that included as Annex B, which is based on the Crown Estate's *Protocol for Archaeological Discoveries: Offshore Renewables Projects*[3].

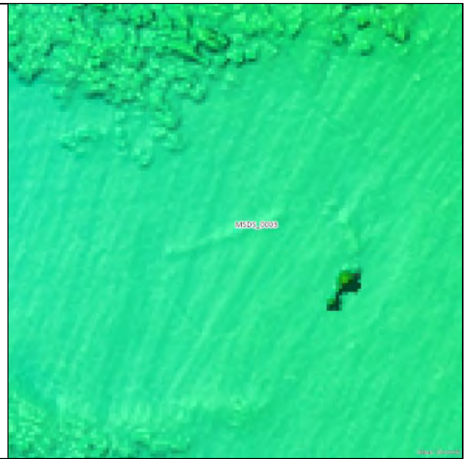
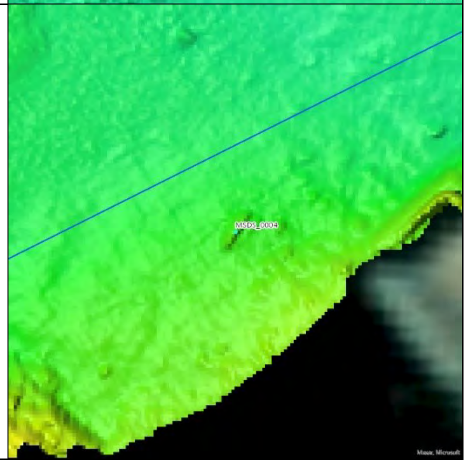
6.2 Archaeological Exclusion Zones

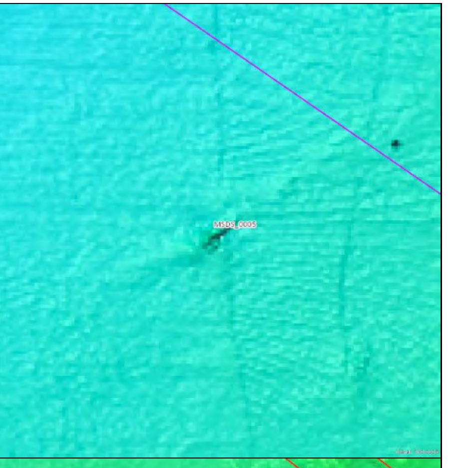
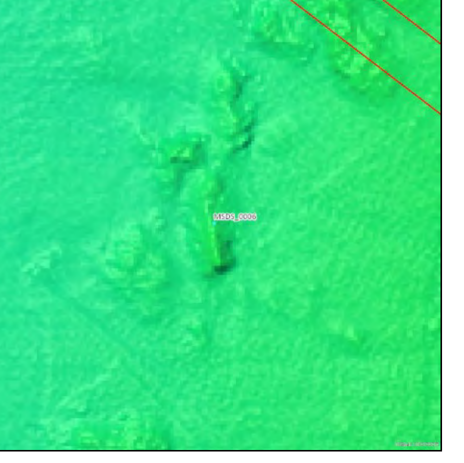
6.2.1 No Archaeological Exclusion Zones (AEZs) are recommended within the development footprint or within the extents of the 2020 hydrographic data.

[3] The Crown Estate, 2014. *Protocol for Archaeological Discoveries: Offshore Renewables Projects.* Wessex Archaeology, Salisbury.

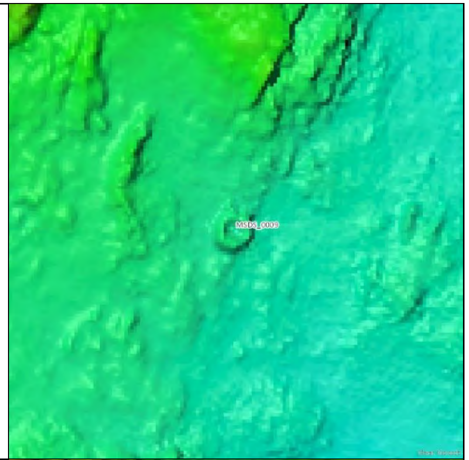
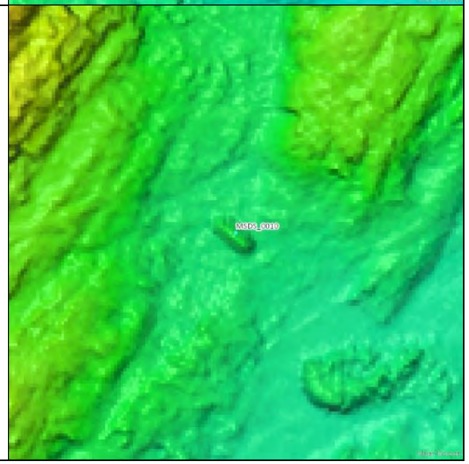
7.0 Annex A – Gazetteer of Archaeological Anomalies

ID	Potential	Length (m)	Width (m)	Description	X (OSGB36)	Y (OSGB36)	Image
MSDS_0001	Low	2.4	1.1	Likely geological	129815.9	723665.1	
MSDS_0002	Low	7.1	0.3	Linear feature	129947.9	723647.3	

MSDS_0003	Low	4.3	0.3	Linear feature	129909.5	723627.6	
MSDS_0004	Low	1.5	0.4	Potential debris	129889.0	723449.0	

MSDS_0005	Low	2.4	1.2	Potential debris	129808.4	723422.5	
MSDS_0006	Low	2.4	0.4	Likely geological	129847.4	723423.9	

MSDS_0007	Low	3.1	2.1	Likely geological	129796.0	723411.3	
MSDS_0008	Low	2.3	1.1	Likely geological	128805.3	723868.6	

MSDS_0009	Low	1.3	1.3	Potential debris	128697.6	723970.1	
MSDS_0010	Low	1.4	0.7	Potential debris	128814.3	724148.0	

8.0 Annex B – Protocol for Archaeological Discoveries

8.1 Purpose of the document

8.1.1 This annex sets out the procedure for reporting discoveries of potential archaeological interest made offshore of the Mean High Water Springs (MHWS) level during the course of activities associated with the Proposed Development.

8.1.2 Any archaeological finds made by project staff are important because they may shed light on past human use of the landscape, sea, and seabed. The information that such discoveries bring to light can help archaeologists to better understand what happened in the past, and therefore to better protect those aspects of our history and prehistory that should be conserved on behalf of future generations.

8.1.3 The aim of the Offshore Protocol for Archaeological Discoveries (PAD) is to reduce any adverse effects of the development upon the historic environment by enabling people working on the project to report their finds in a manner that is both convenient to their every-day work and effective with regard to curatorial requirements. The use of the PAD also allows legal obligations under certain Acts to be met (see Sections 8.6 and 9 for details).

8.1.4 The client will ensure their obligations are met by using the protocol set out within this document which ensures the reporting of potential archaeological finds, cessation of activities while the find is reviewed, and curatorial advice being sought on mitigation where necessary (where confirmed archaeological features or finds are identified).

8.2 Protocol Details and Version

8.2.1 The Protocol that will be used is based on the *Protocol for Archaeological Discoveries for Offshore Renewables Projects* introduced by The Crown Estate (The Crown Estate 2014).

8.3 Operations of the Protocol

Overview of the PAD

8.3.1 The PAD has been designed to allow Developers to report unexpected finds of archaeological interest made on the seabed or in the intertidal zone during the course of offshore construction works. A series of actions is defined for such cases, summarised below and in Table 7.

8.3.2 The PAD anticipates discoveries being made by **Project Staff** who report to the **Site Champion** (for example the Vessel Master or Client Representative) on their vessel; who then completes a series of steps including stopping work and reporting the find to the **Nominated Contact** (typically an archaeological advisor such as a Retained Archaeologist[4] or Archaeological

[4] Conditions of consent can often refer to the need for an Archaeological Written Scheme of Investigation (WSI), to be produced in line with key guidance including The Crown Estate (2010) *Model Clauses for Archaeological Written Schemes of Investigation.* The WSI will typically contain details of an archaeological consultant contracted as a 'Retained Archaeologist' who may in many cases play the role of the Nominated Contact under the PAD.

Consultant) and the Developer's Project Manager. The Nominated Contact will provide specialist advice and technical support services relating to the identification of the find[5].

8.3.3 The Nominated Contact will liaise with the Developer's Project Manager and the Archaeological Curator, along with any additional relevant stakeholders depending on the nature of the find, and planned activities within the area. If the find or feature is determined to be of archaeological interest then suitable mitigation measures will be devised in consultation with the Archaeological Curator.

8.3.4 The Nominated Contact, along with the Developer's Project Manager and contractors shall draw to the attention of all relevant staff the potential for archaeological material to be found in the course of survey, construction and installation work and inform them of the possible importance of such finds.

8.3.5 Personnel working on the project will be briefed on the Protocol for Archaeological Discoveries and copies of this Protocol will be available onboard the installation vessels and on all sites.

[5] Note, the Crown Estate (2014) *Protocol for Archaeological Discoveries* includes an additional step whereby the report is passed to the Implementation Service who provide additional support on identification and input into mitigation. This Service is run by an archaeological contractor. However, typically the project's archaeological advisor (e.g. their Retained Archaeologist or Archaeological Contractor), has access to all project datasets and has a strong understanding of the archaeological potential of the area and are therefore often best placed to give this advice. As such there is no need for the inclusion of the additional step of corresponding with the Implementation Service.

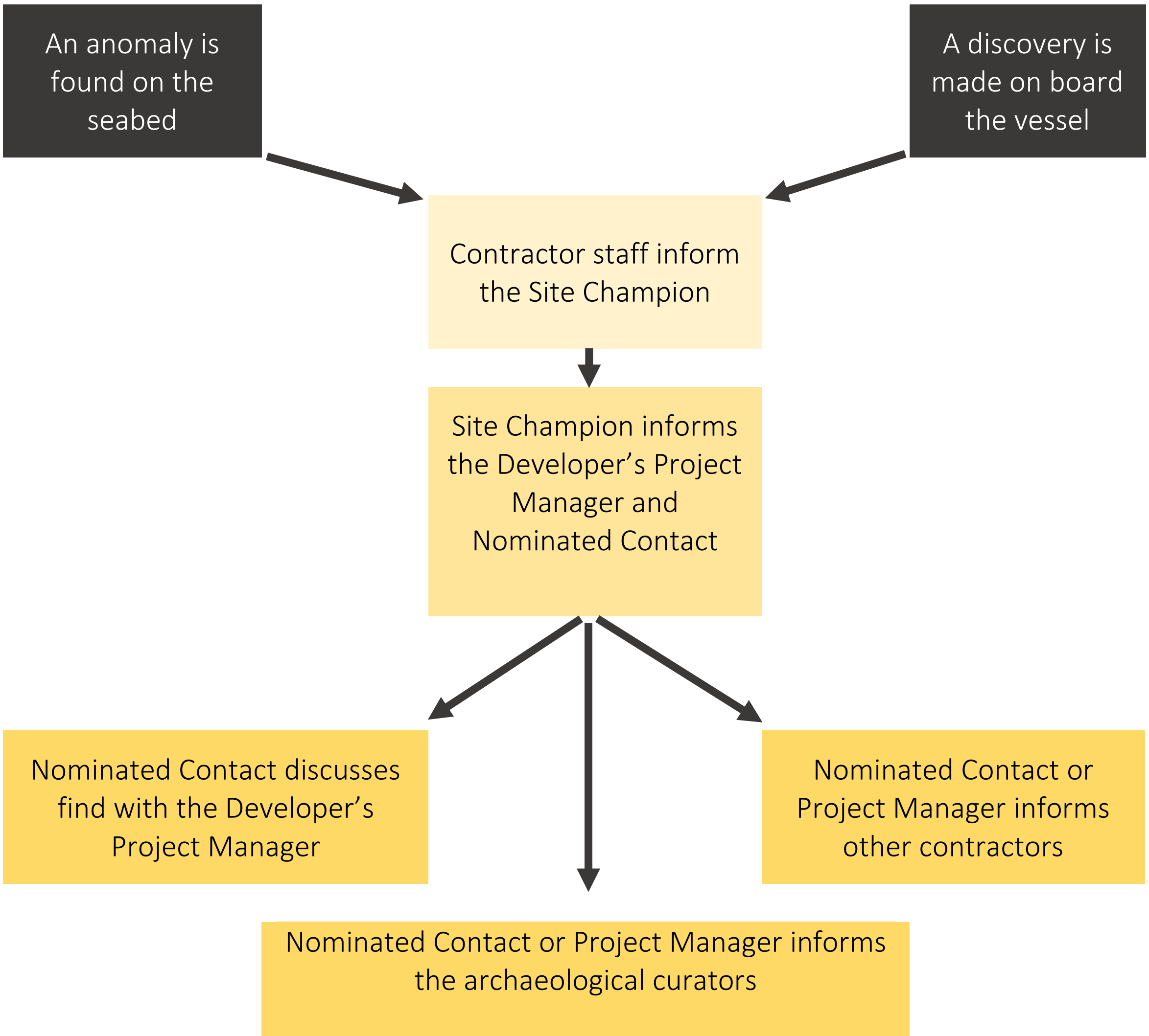


Table 7: Summary of the key roles and chain of communication

8.4 Actions by the Project Staff and Site Champion

8.4.1 Actions required by the Project Staff and Site Champion are set out in Table 8 and are discussed here.

8.4.2 The first step is the recognition of a find of potential archaeological interest. If finds or features are identified by the Project Staff they should then be reported to the Site Champion. The Site Champion will then undertake a series of actions: Stop; Record and Inform, as set out within Table 8. They should ensure works in the vicinity are stopped and a Temporary Archaeological Exclusion Zone (TAEZ) is put in place. They should ensure that the find is recorded in the vessel log, navigational software and within the Preliminary Record Form (see Section 10). The Site Champion should inform the Nominated Contact and Developer's Project Manager and pass over any records. They should also ensure that if any finds have been recovered from the seabed, that they are stored appropriately. Advice on storage is set out within this document and can be sought from the Nominated Contact.

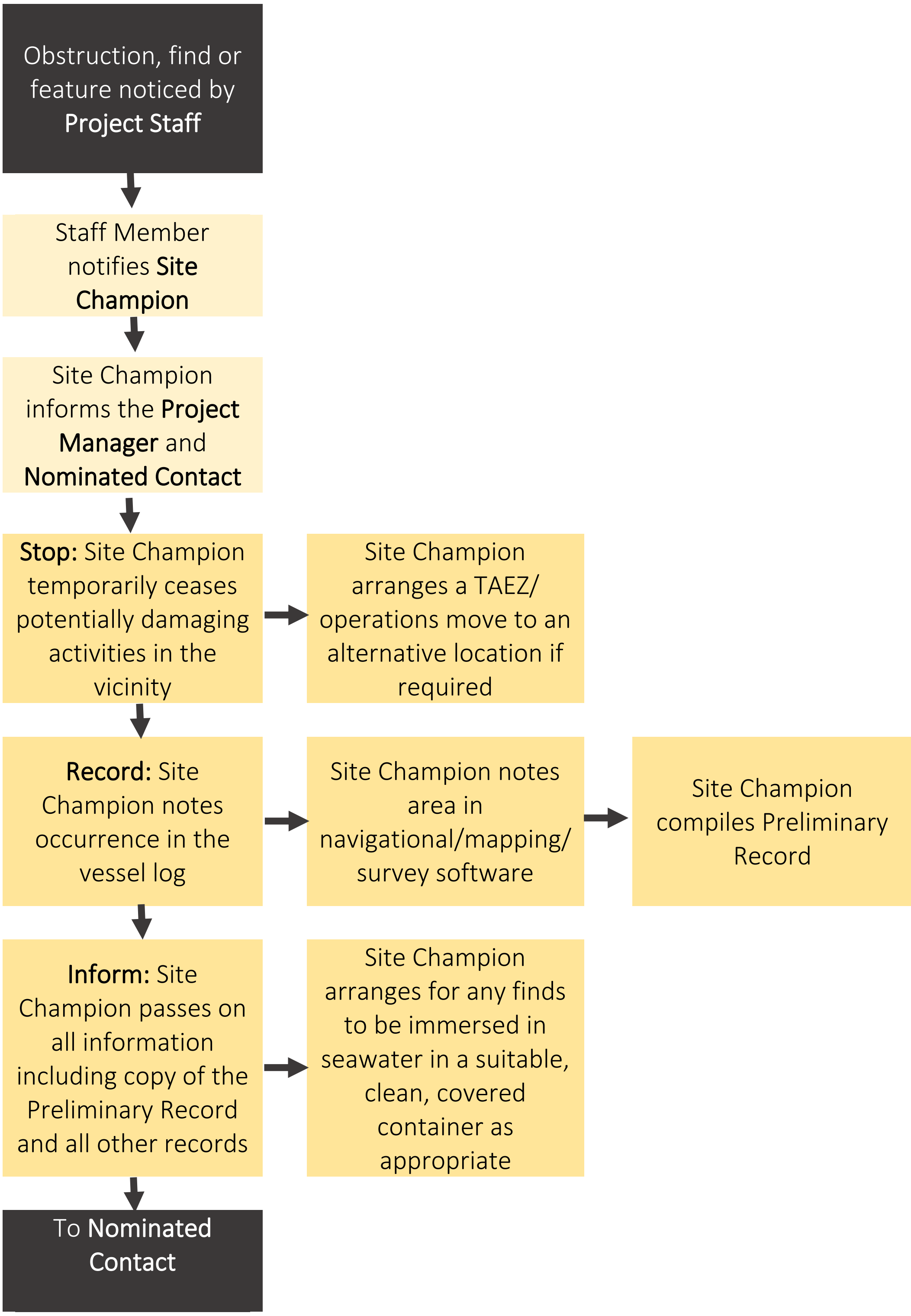


Table 8: Actions by the Project Staff and Site Champion

8.5 Actions by the Nominated Contact

8.5.1 Actions required by the Nominated Contact are set out in Table 9. The Nominated Contact will confirm the details laid out in the Preliminary Record with the Site Champion and then discuss with the Developer's Project Manager and pass on the details of the discovery. The Project Manager will inform any other vessels working in the area of the exclusion zone.

8.5.2 The Nominated contact will then review the discovery in order to determine whether it is of low or high archaeological potential. Low potential finds may be isolated finds (including anchors) or peat deposits that do not contain prehistoric archaeological remains. **High potential finds include finds that predate 1800 AD, finds that relate to an aircraft, multiple finds from the same area, reports indicating the presence of a wreck or other structural remains, or peat or other fine-grained sediments that contain worked flint, charcoal, or bone.**

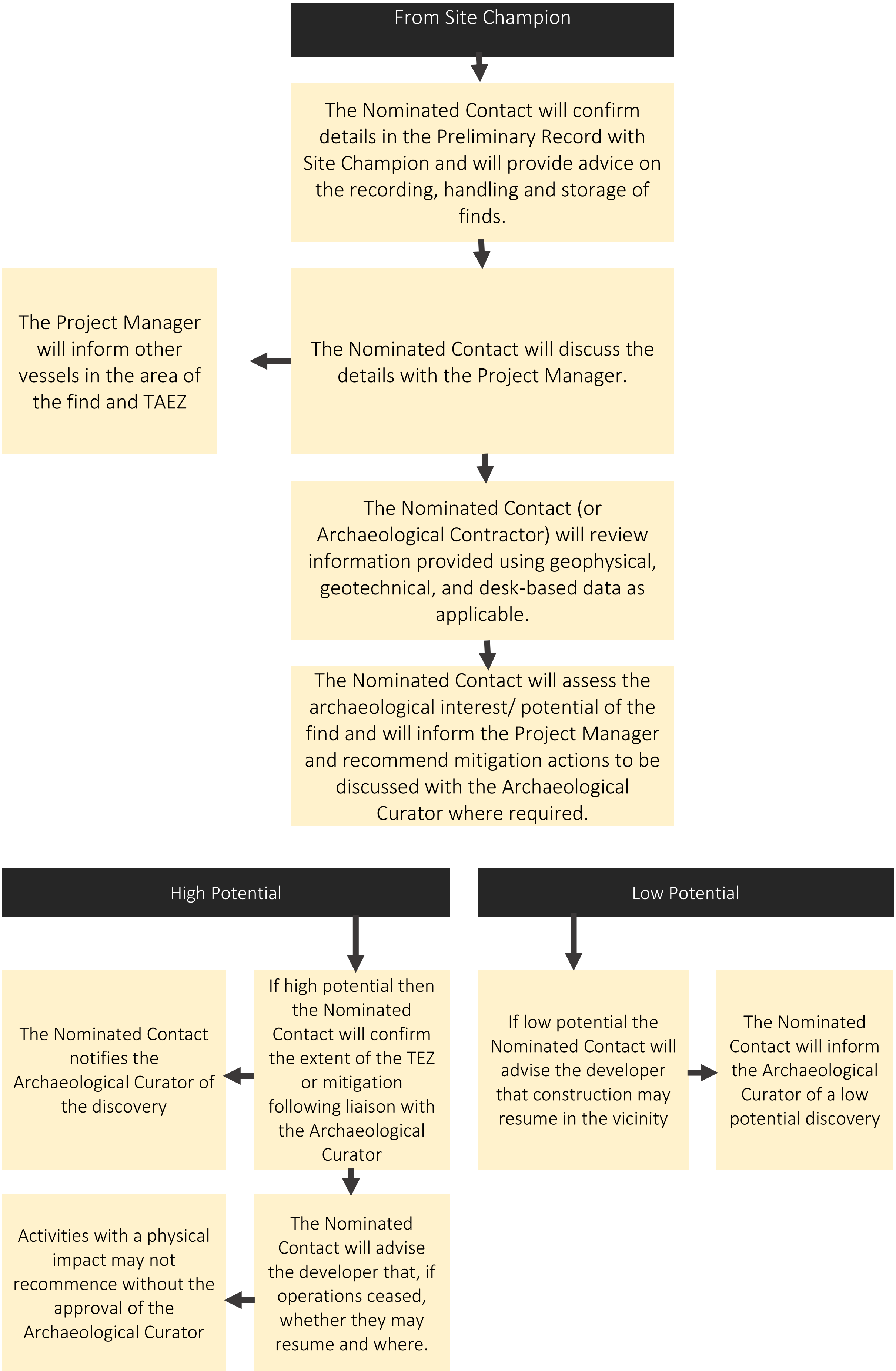
8.5.3 Once the potential has been established, the Nominated Contact will inform the Developer's Project Manager of this.

8.5.4 For reports that are deemed low potential, the Nominated Contact will generally advise that isolated finds be moved to wet storage and request an 'as found' record and an 'as left' record with photos and positions. The Nominated Contact should be contacted prior to moving any find using the PAD process.

8.5.5 For reports that are deemed high potential, the Nominated Contact (or archaeological contractor as necessary) will conduct a review of geophysical data and recommend the extent of the exclusion zone. They may also recommend other mitigation such as further archaeological investigation. Mitigation strategies will be devised in liaison with the Developer's Project Manager and the Archaeological Curator. The Nominated Contact will also advise when and where operations can continue. Physical impacts may not occur within exclusion zones without the approval of the Archaeological Curator.

8.5.6 The Nominated Contact will then make arrangements for any finds which have been recovered to be held in the possession of the developer. They will also produce a summary record and provide this to relevant stakeholders. A summary record will include advice on the identification of finds and the character of their seabed locations, an assessment of the archaeological potential of the report which will include the rationale for the conclusion reached, and advice on actions to be taken in respect of the discovery, including any recovered finds.

8.5.7 Any further actions taken are the responsibility of the developer, and are to be agreed with the Regulator and Archaeological Curator with the assistance of the Nominated Contact.


From Site Champion
The Nominated Contact will confirm details in the Preliminary Record with Site Champion and will provide advice on the recording, handling and storage of finds.
The Nominated Contact will discuss the details with the Project Manager.
The Project Manager will inform other vessels in the area of the find and TAEZ
The Nominated Contact (or Archaeological Contractor) will review information provided using geophysical, geotechnical, and desk-based data as applicable.
The Nominated Contact will assess the archaeological interest/ potential of the find and will inform the Project Manager and recommend mitigation actions to be discussed with the Archaeological Curator where required.
High Potential
Low Potential
If high potential then the Nominated Contact will confirm the extent of the TEZ or mitigation following liaison with the Archaeological Curator
The Nominated Contact notifies the Archaeological Curator of the discovery
The Nominated Contact will advise the developer that, if operations ceased, whether they may resume and where.
Activities with a physical impact may not recommence without the approval of the Archaeological Curator
If low potential the Nominated Contact will advise the developer that construction may resume in the vicinity
The Nominated Contact will inform the Archaeological Curator of a low potential discovery

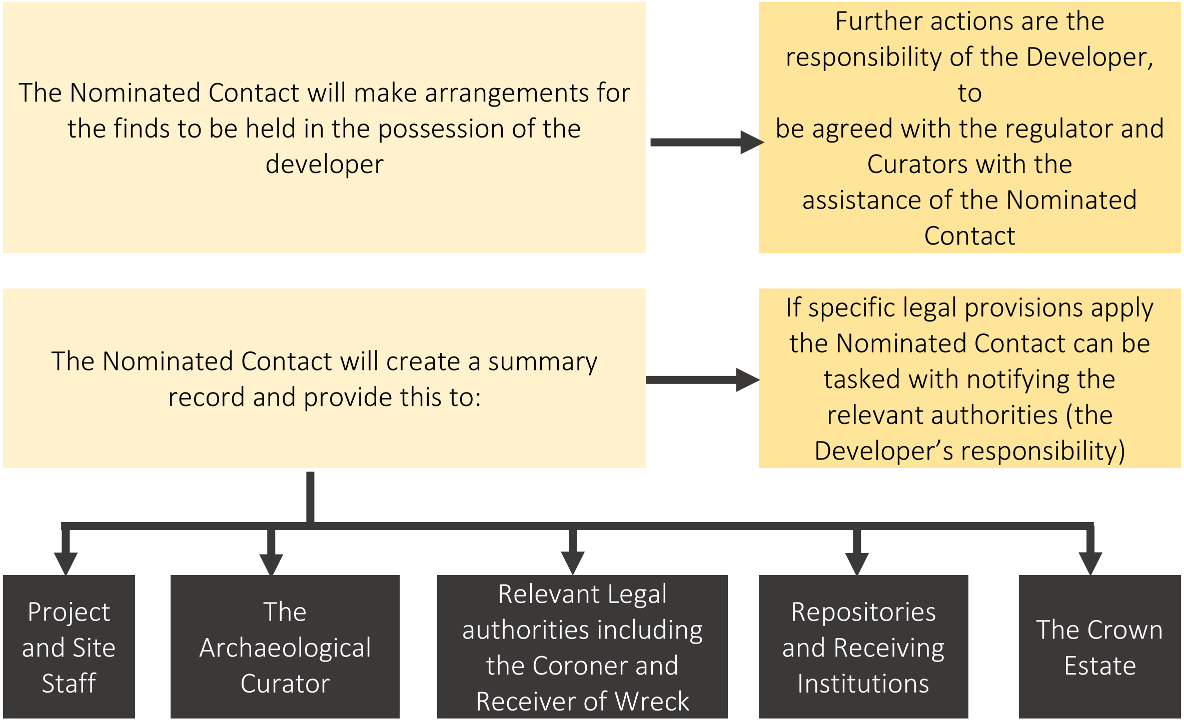


Table 9 Actions by the Nominated Contact

8.6 Legal Implications

8.6.1 It should be noted that if the wreck of an aircraft is encountered it can be automatically protected as a protected place under the terms of the Protection of Military Remains Act 1986 and it is an offence to tamper with, damage, or move the wreck or to remove items.

8.6.2 Furthermore, all items of 'wreck' are reportable to the Receiver of Wreck under the terms of the Merchant Shipping Act 1995. Reporting discoveries, anomalies and finds via the PAD will be sufficient to meet the requirements of the Act.

8.6.3 Other acts may apply in certain situations, depending on the nature of the find. Reporting under the PAD will result in advice from the Nominated Contacts in regards to specific legal requirements for different types of find. Specific Acts of relevance to different finds are detailed in Section 9 of this document.

9.0 Guidelines for Identifying and Handling Finds

9.1.1 The following guideline can be used to identify any discovered material and must be referred to when planning appropriate handling and storage. Advice on the identification of finds has been provided following the accepted advice provided by The Crown Estate in their Protocol for Archaeological Discoveries (2014).

9.1.2 Archaeological material can come in a variety of sizes, shapes, and materials. Materials can degrade in different ways so it is important that they are handled with care and that the appropriate handling and storage techniques are applied.

9.1.3 Finds are vulnerable to deterioration at all times, whether they are recovered or not. Fragile material, such as wood, can be damaged by the force of passing machinery. It is crucial that all finds be treated carefully, and interfered with as little as possible.

9.1.4 Leaving finds in situ is the best way to manage them. Once a find is recovered to the surface, it requires conservation which can be difficult and expensive to administer.

9.2 General advice for finds handling and storage:

- ⊕ Handle all finds carefully
- ⊕ Photograph all sides of a find with a scale
- ⊕ Take close up photographs of any markings, glazing, or imagery
- ⊕ Keep finds wet and ensure the water is changed regularly if biological growth is detected
- ⊕ Keep finds cool and ideally in the dark
- ⊕ Keep finds in protective containers where possible
- ⊕ Label any finds
- ⊕ Contact MSDS for advice on finds storage
- ⊗ Do not attempt to clean the find by removing any sediment build up, concretion, or marine life
- ⊗ Do not allow finds to dry out
- ⊗ Do not handle finds more than necessary

9.3 Metal

9.3.1 Metal is likely to survive in the marine environment, though it may corrode when in water or form concretions of material (a hard mass of material which typically has a mineral matrix, commonly formed around ferrous objects in particular). Typical metal finds might include ingots, ballast, coins, ornaments, tools, weapons, aircraft or ship parts, and personal items. If potential unexploded ordnance (UXO) is encountered this should be dealt with under a UXO protocol.

9.3.2 The Crown Estate (2014) Guidance for the identification of metals is as follows:

Iron and Steel

9.3.3 The potential range and date of iron and steel objects is so wide that it is difficult to provide general guidance. In broad terms, iron and steel objects which are covered by a thick amorphous concrete-like coating ('concretion') are likely to be of archaeological interest and should be reported. Pieces of metal sheet and structure may indicate a wreck and should be reported. Specific operational measures are likely to apply in respect of ordnance (cannonballs, bullets, shells) which should take precedence over archaeological requirements. However, discoveries of ordnance may be of archaeological interest, and they should be reported.

Other Metals

9.3.4 Items made of thin, tinned or painted metal sheet are unlikely to be of archaeological interest. Aluminium objects may indicate aircraft wreckage from World War Two, especially if two or more pieces of aluminium are fixed together by rivets. All occurrences should be reported' and remains of this nature may be subject to the Protection of Military Remains Act 1986. 'Copper and copper alloy (bronze, brass) objects might indicate a wreck, or they may be very old. All occurrences should be reported. Precious metal objects and coins are definitely of archaeological interest because they are relatively easy to date. All occurrences should be reported' (The Crown Estate 2014: 19)

Actions to take:

9.3.5 If possible, do not recover metal. It can be difficult and expensive to conserve and some types of site, such as aircraft, can be covered by specific legislation which prohibits recovery without appropriate licences.

9.3.6 For metals which are lifted, lifting should be carried out carefully and the find should be photographed. All metals should be stored in cool seawater. Different metals should not be stored together. The shape of the concretion can be used to identify the item and as such concretions should not be removed. If the find is too large to cover in seawater, wrap it in soaked material and keep wet. Some metal products e.g. lead, pewter and copper salts can be toxic, so handle with gloves or wash hands thoroughly after contact.

9.3.7 Metals can sometimes be identified the colour of their corrosion. Table 10 below aims to help identify the type of metal used;

Metal	Corrosion
Gold	No corrosion
Silver	White, waxy layers that turn lilac in the light
Copper/Copper Alloy e.g., Bronze	Dark red/purple/green/blue
Iron/Steel	Black or rusty with a crust of concretion.
Lead	Grey or white crystals
Pewter/Tin/Lead Alloy	Grey surface, possibly crystalline, soft or friable
Aluminium	Little corrosion

Table 10 Guidance on the identification of metals

9.4 Ceramics

9.4.1 Pottery can be made from china, porcelain, terracotta, earthenware and other clay-based materials. Typical finds might include crockery, ornaments, clay pipes, lamps, containers and tableware.

9.4.2 Any fragment of pottery is potentially of interest, especially if it is a large fragment. Items which look like modern crockery can be discarded, but if the item has an unusual shape, glaze or fabric it should be reported (The Crown Estate 2014: 19). Additionally, clay pipes should be reported.

Actions to take:

9.4.3 Photograph finds with a scale, especially if they have any glazing or markings. Store in saltwater.

9.5 Ceramic Building Material

9.5.1 Ceramic building material can be in the form of bricks, building blocks, mudbricks, and tile. Bricks and tile can appear unusually shaped. Ceramic building material can be evidence of a ship, or submerged settlement.

9.5.2 Bricks with modern proportions and v-shaped hollows ('frogs') are of no archaeological interest. Unfrogged, 'small', 'thin' or otherwise unusual bricks may date back to Medieval or even Roman times and should be reported (The Crown Estate 2014: 19). Occurrences of tile should also be reported.

Actions to take:

9.5.3 Photograph finds with a scale, especially if they have any glazing or markings on them. Store in saltwater.

9.6 Stone

9.6.1 Stone has been used by humans for thousands of years and it very durable underwater, making it a common find. There are different types of stone: quartz, limestone, marble, granite, obsidian, slate, sandstone, and flint. Typical finds might include ballast, anchors, millstones building material, shot, carvings, tools, sculptures, whetstones, flint or stone tools and other personal items.

9.6.2 Small to medium size stones that are shaped, polished and/or pierced may be prehistoric axes. All occurrences should be reported. Objects such as axe heads or knife blades made from flint are likely to be of prehistoric date and should be reported. Large blocks of stone that have been pierced or shaped may have been used as anchors or weights for fishing nets. All occurrences should be reported. The recovery of numerous stones may indicate the ballast mound of a wreck, or a navigational cairn. All occurrences should be reported (The Crown Estate 2014: 19).

Actions to take:

9.6.3 Photograph with a scale and then store in water or wrap in soaked towelling.

9.7 Skeletal Material and Faunal Remains

9.7.1 Skeletal finds and faunal remains can come in the form of bone, ivory, tooth, antler, baleen, tortoiseshell, tusk, or shell. Typical finds might include human, or animal remains, personal items such as combs or jewellery, carvings, and tool handles.

9.7.2 Discoveries of animal bone, teeth and tusks are of archaeological interest because they may date to periods when the seabed formed dry land and should be reported. Such bones, teeth, tusks etc. may have signs of damage, breaking or cutting that can be directly attributed to human activity. Large quantities of animal bone may indicate a wreck (the remains of cargo or provisions) and should be reported. Human bone is definitely of archaeological interest, and may, if buried and found within territorial waters, be subject to the provisions of the Burial Act 1857. Alternatively, it may be subject to the Protection of Military Remains Act 1986. Any suspected human bone should be reported and treated with discretion and respect.

9.7.3 Objects made out of bone – such as combs, harpoon points or decorative items – can be very old and are definitely of archaeological interest. All occurrences should be reported (The Crown Estate 2014: 19).

Actions to take:

9.7.4 Skeletal finds are vulnerable to environment change, so if any are recovered, ensure they are photographed with a scale and then immediately submerged in seawater and sealed in a suitable container. Change the water if biological growth occurs e.g. algae mould.

9.8 Wood

9.8.1 Wooden finds could be evidence of a wrecked vessel. Typical wooden finds might include small personal items e.g. tools and bottle corks, or larger finds e.g. ships timbers, furniture, chests, barrels, dwelling posts, and wattle panels.

9.8.2 Light coloured wood, or wood that floats easily, is probably modern and is unlikely to be of archaeological interest. 'Roundwood' with bark – such as branches – is unlikely to be of archaeological interest, although it may provide paleo-environmental evidence. However, roundwood that has clearly been shaped or made into a point should be reported. Pieces of wood that have been shaped or jointed may be of archaeological interest, especially if fixed with wooden pegs, bolts, or nails – all occurrences should be reported. Objects made out of dark, waterlogged wood – such as bowls, handles, shafts and so on – can be very old and are definitely of archaeological interest. All occurrences should be reported (The Crown Estate 2014: 19).

Actions to take:

9.8.3 Timber finds are often very fragile and so must be lifted with care. Photograph with a scale. Do not allow the wood to dry out and ensure that it has sufficient support to stop it falling apart and submerge it in seawater. Keep the find in a cool and dark area. Change the water if biological growth is detected e.g. algae or mould. If the find is too large to store in water, try to keep it damp and cool in a darkened area.

9.9 Peat and Clay

9.9.1 Peat is black or brown fibrous soil that formed when sea level was so low that the seabed formed marshy land, for example on the banks of a river or estuary. Peat is made up of plant remains, and also contains microscopic remains that can provide information about the environment at the time it was formed. This information helps us to understand the kind of landscape that our predecessors inhabited, and about how their landscape changed. It can also provide information about rising sea-level and coastline change, which are important to understanding processes that are affecting us today. Prehistoric structures (such as wooden trackways) and artefacts are often found within or near peat, because our predecessors used the many resources that these marshy areas contained. As these areas were waterlogged and have continued to be waterlogged because the sea has risen, 'organic' artefacts made of wood, leather, textile and so on often survive together with the stone and pottery which are found on 'dry' sites.

9.9.2 Fine-grained sediments such as silts and clays are often found at the same places as peat. These fine-grained sediments also contain the microscopic remains that can provide information about past environments and sea level change. Any discoveries of such material would be of archaeological interest, and their occurrence should be reported (The Crown Estate 2014: 20).

Actions to take:

9.9.3 Any sediments collected should be stored in a sealed container with seawater and keep cool. Do not try to break apart the deposits.

9.10 Fibre and Textiles

9.10.1 Fibrous finds are unlikely to survive in marine conditions, but occasionally they do. Typical fibrous finds might include ropes and rigging, weaving, sailcloth, sacks, clothing, basketry, fishing nets etc.

Actions to take:

9.10.2 Due to the incredibly fragile nature, once any fibrous or textile find has been recovered it must be dealt with quickly. Take photographs with a scale, but do not use flash. Carefully place it in a sealed container. Try to keep it out of the light. If possible, keep the find in its original burial deposit i.e. the sediment it was found in, and seawater. This will help to protect the material.

9.11 Plastic, Rubber etc.

9.11.1 In most cases, rubber, plastic, Bakelite and similar modern materials are not of archaeological interest and can be disregarded. One exception is where such materials are found in the same area as aluminium objects and structures, which may indicate aircraft wreckage from World War Two. Such material should be reported (The Crown Estate 2014: 14) and should not be removed from the site.

Actions to take:

9.11.2 Do not bend or clean any plastic or rubber finds. Photograph the find with a scale and then store in seawater in a cool and dark area.

9.12 Resinous or Mineral Substance

9.12.1 These materials include amber, jet, coal, or bitumen. Typical finds might include ornaments, jewellery, beads, sealants, or caulking materials, all of which would be of archaeological interest and should be reported.

Actions to take:

9.12.2 These finds might appear stable, but if they are not stored properly, they may begin to deteriorate. Photograph a find with a scale, and then keep stored in seawater.

9.13 Glass

9.13.1 Glass artefacts are found on the seabed. Finds may include bottles, beads, panes of glass from ship's windows. Unless obviously modern (beer bottles etc) glass finds should be reported, particularly where it occurs alongside other finds as this may represent a wreck site.

9.13.2 Glass is likely to survive in marine conditions, but it does degrade; glass deterioration is usually categorised by leaching, with causes an iridescent pattern to form on the glass, it looks somewhat like an oil slick. It can also begin to flake away.

Actions to take:

9.13.3 Photograph with a scale before packing carefully to avoid breakage. Ensure it is covered in cool seawater in the dark.

10.0 Preliminary Record Form

10.0.1 Preliminary Record Form: Discoveries on the seabed/ on board a vessel/ within a core

Protocol for Archaeological Discoveries	
Preliminary Record Form: Discoveries on the seabed/ on board/ in the intertidal zone / on land	
Company Name	
Vessel/ Team Name	
Site / Sea Area Name	
Date	
Time of compiling information	
Name of compiler (Site Champion)	
Name of finder (if different from above)	

Time at which discovery was encountered			
Vessel position at time when anomaly was encountered			
Latitude		Longitude	
Datum (if different from WGS84)			
Original position of the anomaly on the seabed, if known			
Notes on likely accuracy on position stated above:			
How accurate is the position?			
Is the position the original position or has the material been moved by operations?			
Details of circumstances that led to the discovery			
Description of the find / anomaly			
Apparent size /extent of the anomaly			
Details of any find(s) recovered			
Details of any photographs, drawings of other records made of the find(s) e.g. location figure			
Details of treatment or storage of find(s)			
Date and time Nominated Contact informed			
General notes			
If discovered on the seabed:			

Derived from e.g. Obstacle Avoidance Sonar, Cable Tensiometer?			
Apparent size/ extent of anomaly (length, width, height above seabed)			
Extent of deviation/ route development			
Signed		Date	

APPENDIX 18.1

Scottish Greenhouse Gas Statistics 2021

SCOTTISH GREENHOUSE GAS STATISTICS 2021

18.1 Scottish Greenhouse Gas Statistics 2021

18.1.1 Source emissions

A measure of the actual emissions or removals in Scotland including international aviation and shipping. This measure can be used for UK and international comparisons.

There was 41.6 MtCO2e in 2021.

- Down 49.2% from 1990.
- Down 2.4% from 2020.

18.1.2 Emissions for reporting against targets

The Committee for Climate Change (CCC) recommended a new method of reporting emissions for the purposes of monitoring performance against targets for the June 2020, and future, publications. This is known as the GHG Account.

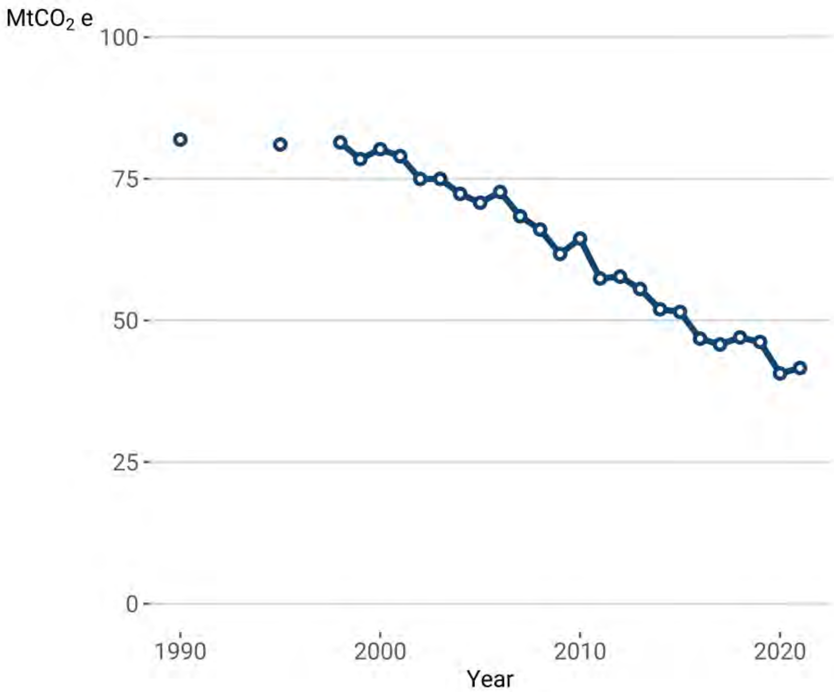
On this adjusted basis, the GHG account reduced by 49.9% between the baseline period and 2021.

The Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 specifies a target reduction of 51.0% reduction over the same period. Therefore, the interim target for 2021 has not been met.

18.1.3 Key trends – Source Emissions

Between 1990 and 2021, there was a 49.2% reduction in estimated emissions, a 41.6 MtCO2e decrease as shown in Figure 0.1.

Figure 0.1: Scottish Greenhouse Gas Emissions, 1990 to 2021. Values in MtCO2e



(Source: Scottish Greenhouse Gas Statistics 2021)

The most significant contribution from this overall reduction came from:

- Reduction in Energy Supply emissions (such as power stations) (-16.8 MtCO2e; 77.6 per cent reduction)
- 'Land Use, Land Use Change and Forestry' (LULUCF) reducing its net emissions over the period, reducing by 5.7 MtCO2e since 1990.
- Reduction in Waste Management emissions (such as Landfill) (-5.0 MtCO2e; a 76.2 per cent reduction)
- Reduction in Business emissions (-4.2 MtCO2e; a 35.3 per cent reduction)
- Reduction in Domestic transport emissions (-2.6 MtCO2e; a 19.3 per cent reduction) Introduction to Greenhouse Gases

This publication uses the results of the Scottish Greenhouse Gas Inventory for 1990-2021 which is compiled in line with international guidance from the Intergovernmental Panel on Climate Change (IPCC). The data is reported by source sector, such as energy supply, and greenhouse gas, such as carbon dioxide.

"Scottish Greenhouse Gas Emissions 2021" includes data on two categorisations of greenhouse gas emissions.

- Estimated net source emissions. These are sometimes referred to as "territorial" emissions, as they are produced within a country's territory or economic sphere.
- GHG account. These are net source emissions which have been adjusted to remove the effect of successive revisions to the data over time.

The publication does not include any information on consumption-based emission estimates, which refers to GHG emissions associated with the spending of Scottish residents on goods and services wherever in the world these emissions arise together with emissions directly generated by Scottish households, through private heating and motoring.

The table below shows how to use the different categorisations of statistics on greenhouse gas emissions.

Table 0.1: Guidance on the use of Estimated Source Emissions and GHG Account

	Estimated Source Emissions	GHG Account
Use for reporting progress against Scotland's Climate Change Targets	×	✓
Can be compared with EU countries	✓	×
Can be compared with UK[1]	✓	×
Includes International Aviation and Shipping	✓	✓

[1] Direct comparisons between Scotland and the UK can be made by adding up the results for the four Devolved Administrations separately. The UK figure in this case would exclude offshore emissions.

	Estimated Source Emissions	GHG Account
Includes North Sea Oil & Gas	×	×
Data on individual GHG	✓	×
Data on sectoral emissions	✓	×
Base Year	1990	Baseline Period (Variable)

18.1.4 Which Greenhouse Gases are Reported on and how do they contribute to Global Warming?

The basket of greenhouse gases consists of carbon dioxide, methane, nitrous oxide, and the four F-gases (hydrofluorocarbons- HFCs, perfluorocarbons – PFCs, sulphur hexafluoride- SF_6 and nitrogen trifluoride- NF_3).

These gases are weighted by Global Warming Potential (GWP), so that total greenhouse gas emissions can be reported on a consistent basis. The GWP for each gas is defined as its warming influence relative to that of carbon dioxide over a 100-year period. Greenhouse gas emissions are then presented in carbon dioxide equivalent (CO_2e) units. In the case of some of the F-gases, the global warming potential is listed as being within a range of values, due to the gases existing as a variety of isotopes with differing GWPs.

Table 0.2: List of GHG and their contribution to Scotland's net GHG emissions, 2021

Name of GHG	Chemical Formula	Global Warming Potential (GWP) (Conversion Factor to Carbon Dioxide Equivalent)	Contribution to Scotland's Net Greenhouse Gas Emissions, 2020 (in $MtCO_2e$)	Percentage of Scotland's Net Greenhouse Gas Emissions, 2020 (in $MtCO_2e$)
Carbon dioxide	CO_2	1	27.5	66.0%
Methane	CH_4	28	10.2	22.4%
Nitrous oxide	N_2O	265	3.0	7.2%
F-gases 2, of which….			0.9	2.2%
• Hydrofluorocarbons	HFC	4 -12,400	0.8	2.0%
• Perfluorocarbons	PFC	6,630-11,100	0.1	0.1%
• Sulphur hexafluoride	SF_6	23,500	0.0	0.1%
• Nitrogen trifluoride	NF_3	16,100	0.0	0.0%

Name of GHG	Chemical Formula	Global Warming Potential (GWP) (Conversion Factor to Carbon Dioxide Equivalent)	Contribution to Scotland's Net Greenhouse Gas Emissions, 2020 (in $MtCO_2e$)	Percentage of Scotland's Net Greenhouse Gas Emissions, 2020 (in $MtCO_2e$)
Total Net Greenhouse Gases			41.6	100.0%

The above GWPs are based on international reporting standards, as set by the IPCC.

18.1.5 Reporting of the Baseline Period and 1990

A single 1990 Base Year is used for all estimated source emissions. This year is referred to as "1990" in charts, tables and text.

A different baseline is used for the reporting progress against Scotland's Climate Change Targets, using the GHG account. This is referred to as "Baseline Period" when referring to changes over time in the charts, tables and text.

The Baseline Period for reporting against Climate Change Targets is:

- 1990 for carbon dioxide carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N2O).
- 1995 for Fluorinated gases (F gases)[2]: hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6), nitrogen trifluoride (NF_3).

[2] The Kyoto Protocol allows Parties flexibility to choose either 1990 or 1995 as the base year for the industrial gases. Using a 1995 base year is in line with the approach adopted by the UK Government and many EU Member States.

18.1.6 Categories

For the purpose of reporting, GHG emissions are allocated into the following sections:

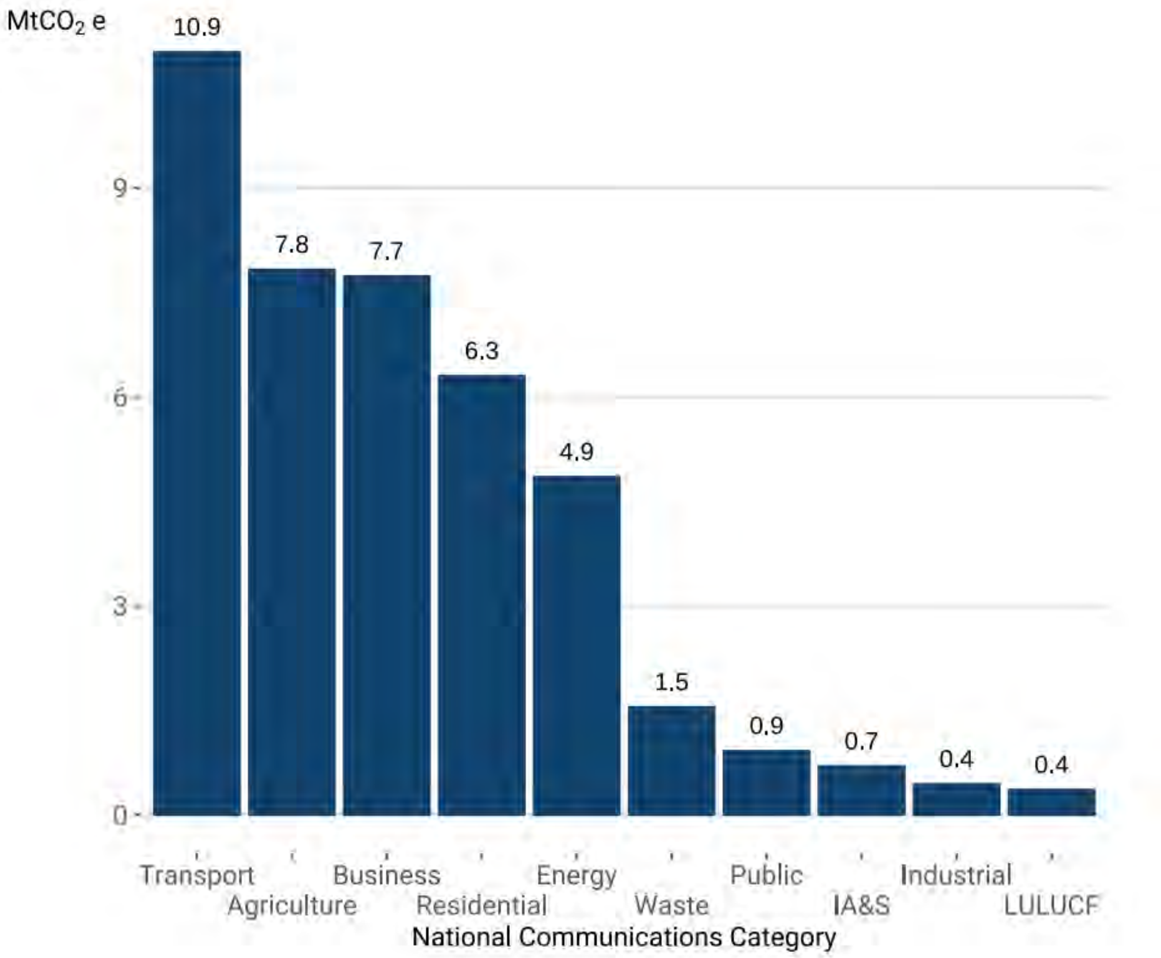
- Energy Supply: Emissions from fuel combustion for electricity and other energy production sources, and fugitive emissions from fuels (such as from mining or onshore oil and gas extraction activities). North Sea oil & gas emissions are not allocated to Scotland[3].
- Business: Emissions from fuel combustion and product use in industrial and commercial sectors, and F gas emissions from refrigeration and air conditioning in all sectors. Includes industrial off-road machinery
- Industrial Processes: Emissions resulting from industrial processes, except for those associated with fuel combustion which are included in the Business sector.
- Transport (excluding International Aviation and Shipping): Emissions from domestic aviation, road transport, railways, domestic navigation, fishing and aircraft support vehicles.
- International Aviation and Shipping: This category is called "Exports" in some inventories. Includes emissions from international aviation and shipping.
- Public: Emissions from combustion of fuel in public sector buildings.
- Residential: Emissions from fuel combustion for heating/cooling and garden machinery and fluorinated gases released from aerosols/metered dose inhalers.
- Agriculture: Emissions from livestock, agricultural soils (excluding carbon stock changes which are included in the LULUCF sector), stationary combustion sources and off-road machinery.
- Waste Management: Emissions from waste disposed of to landfill sites, waste incineration, and the treatment of wastewater.
- Land Use, Land Use Change and Forestry (LULUCF)– Emissions/removals of CO_2 from changes in the carbon stock in forestland, cropland, grassland, wetlands, settlements and harvested wood products, and of other greenhouse gases from drainage (excl. croplands and intensive grasslands) and rewetting of soils, nitrogen mineralisation associated with loss and gain of soil organic matter, and fires. Because the impact of biomass harvest on carbon stocks in ecosystems is included in this sector, any emissions of CO_2 from burning biomass (regardless of the country of origin) are excluded from other sectors to avoid double counting them.

[3] Emissions of GHGs from offshore oil and gas exploration and production are classified within the Greenhouse Gas Inventory as "Unallocated" emissions and not attributed to any of the devolved administrations.

18.2 Results – Net Sources of Scottish Greenhouse Gas Emissions

In 2021, Domestic transport (excluding International Aviation and Shipping) (10.9 $MtCO_2e$) was the largest source of net emissions, followed by Agriculture (7.8 $MtCO_2e$), Business (7.7 $MtCO_2e$), Residential (6.3 $MtCO_2e$) and Energy Supply (4.9 $MtCO_2e$). Figure 0.2 and Table 0.3 show these results.

Figure 0.2: Sources of Scottish Greenhouse Gas Emissions, 2021. Values in MtCO2e



(Source: Scottish Greenhouse Gas Statistics 2021)

Table 0.3: Scottish Greenhouse Gas Emissions by Gas and by National Communications Category, 2021. Values in $MtCO_2e$

NC Category	Carbon Dioxide	Methane	Nitrous Oxide	Fluorinated gases	Total
Agriculture	1.2	4.6	2.0	0.0	7.8
Business	6.8	0.0	0.1	0.8	7.7
Energy Supply	4.4	0.4	0.0	0.0	4.9
Industrial processes	0.4	0.0	0.0	0.0	0.4
International aviation and shipping	0.7	0.0	0.0	0.0	0.7
Land use, land use change and forestry	-4.0	3.7	0.7	0.0	0.4

NC Category	Carbon Dioxide	Methane	Nitrous Oxide	Fluorinated gases	Total
Public	0.9	0.0	0.0	0.0	0.9
Residential	6.1	0.1	0.0	0.1	6.3
Transport	10.8	0.0	0.1	0.0	10.9
Waste Management	0.0	1.4	0.1	0.0	1.5
Grand Total	27.5	10.2	3.0	0.9	41.6

18.2.1.1 Main Points

Carbon dioxide was the main greenhouse gas emitted or removed in most sectors, with the exceptions of the Agriculture and Waste Management sectors.

Methane was the main net gas emitted in the agriculture (4.6 $MtCO_2e$), followed by nitrous oxide (2.0 $MtCO_2e$) and carbon dioxide (1.2 $MtCO_2e$).

Almost all emissions in the Waste Management sector were emitted in the form of methane (1.2 $MtCO_2e$).

All sectors exhibit a general downwards trend between 1990 and 2021:

- Energy Supply emissions have seen the largest decrease in GHG emissions (-16.8 $MtCO_2e$, a reduction of 77.6%) followed by LULUCF (-5.7 $MtCO_2e$, a reduction of 94.1%), Waste Management (- 5.0 MtCO2e, a reduction of 76.2 per cent), and Business (-4.2 MtCO2e, a reduction of 35.3 per cent).
- This is as a result of the change in electricity supply sector, with renewables on the increase, and fossil fuels and nuclear energy decreasing.

Overall, the gigawatt-hours of electricity generated in Scotland decreased by 7.0 per cent between 2020 and 2021. Renewables were the single largest source of electricity generated in Scotland in 2021 at 57.0 per cent, followed by nuclear generation at 29.8 per cent with fossil fuel generation making up only 10.9 per cent of total electricity generation.

18.2.1.2 Total Emissions

Overall, there has been a 40.3 MtCO2e (49.2 per cent) decrease in net emissions between 1990 and 2021. Total emissions have increased by 1.0 MtCO2e (2.4 per cent) between 2020 and 2021.

18.2.1.3 Land Use, Land Use Change and Forestry (LULUCF)

LULUCF is a net source of GHG emissions in Scotland in 2021, emitting 0.4 MtCO2e of net emissions. In 1990 net emissions were 6.0 MtCO2e. In the periods 2011-2014, and 2016-2017, LULUCF exhibited net removals of greenhouse gases in Scotland.

For each sub-sector of the land use sector in 2021, that the net total includes some significant emissions sources, and equally significant ‘sinks’ which remove carbon dioxide from the atmosphere. Forestry and the related 17 ‘harvested wood products’ categories are net sinks of GHG emissions in 2021, removing a net amount of GHG emissions of 7.3 MtCO2e and 1.7 MtCO2e respectively. All other land use types are net sources of greenhouse gas emissions, with croplands, grassland, settlements and wetland showing substantial net emissions to the atmosphere.

18.2.1.4 Domestic transport

Domestic Transport has consistently been a large part of Scotland's emissions. This sector showed dramatic reduction in emissions associated with the COVID-19 lockdown in 2020 (-2.6 MtCO2e) but have rebounded in the latest year by 1.1 MtCO2e.

18.2.1.5 Energy supply

Energy Supply was historically the biggest contribution to emissions, but has seen large changes over the period covered by these statistics, reducing from 21.7 18 MtCO2e in 1990 to 4.9 MtCO2e in 2021 (77.6 per cent reduction). Overall emissions reductions in this sector are mainly due to reductions in emissions from power stations and the complete cessation of coal use for electricity generation in Scotland.

Between 2020 and 2021 Energy Supply emissions decreased by 0.5 MtCO2e (9.2 per cent decrease). This decrease was driven by a decrease in CO2 emissions from power stations.

EfW emissions have historically been very low and only reached a notable level from 2019 when these emissions equalled 0.3 MtCO2e. Emissions have stayed at this level since, but we expect future increases in these emissions as more plants, currently under construction, begin operation. In 2021, EfW plants contributed 19 per cent of total emissions from electricity generation.

18.2.1.6 Business

This sector has seen a 4.2 MtCO2e (35.3 per cent) fall in emissions between 1990 and 2021. Much of this decrease occurred between 1990 and 1995 – linked to a decline in emissions from manufacturing and the iron and steel industry over this time period. There was a further smaller reduction between 2008 and 2009 (-1.0 MtCO2e), coinciding with the recession. Between 2020 and 2021 there was a reduction of 0.2 MtCO2e in total emissions from business.

18.2.1.7 Agriculture

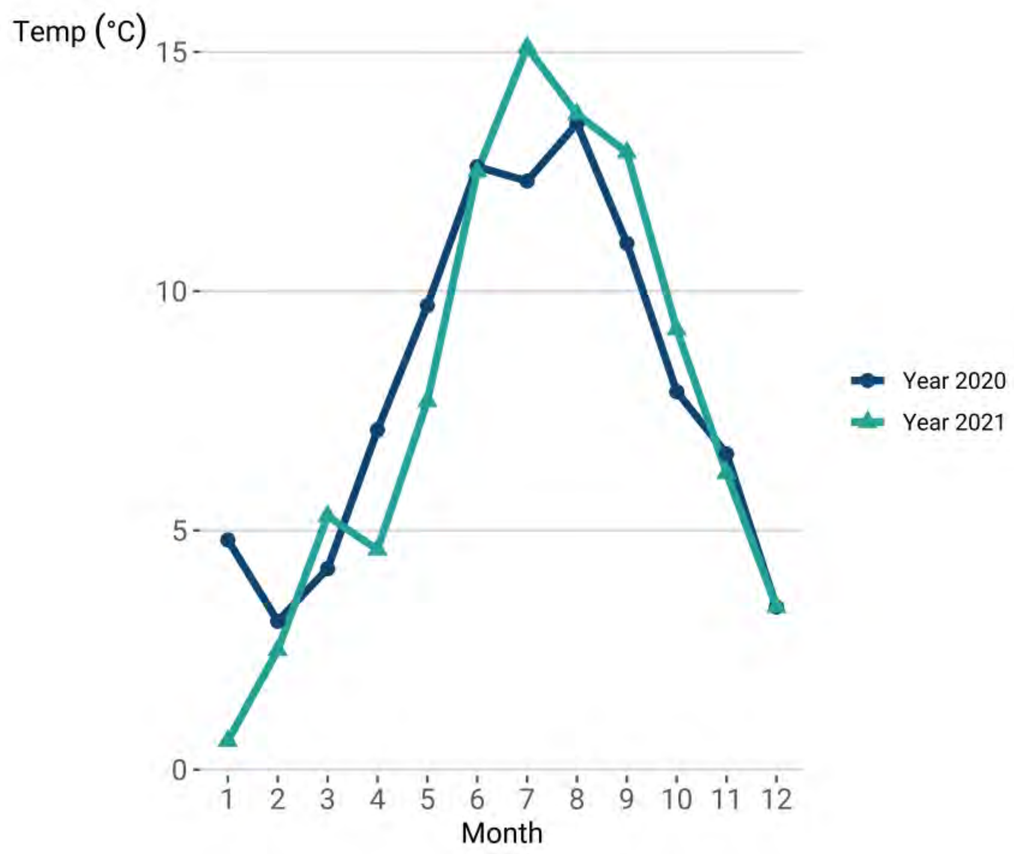
This sector has seen a 0.9 MtCO2e (10.8 per cent) fall in emissions between 1990 and 2021. Between 2020 and 2021 there was an increase of 0.1 MtCO2e (1.9 per cent).

18.2.1.8 Residential

The residential sector is dominated by direct fuel combustion for home heating in households. There has been a reduction of 21.0 per cent between 1990 and 2021. This long-term decrease is mainly due to a switch from less efficient solid and liquid fuels to natural gas for heating, and improvements in energy efficiency.

Residential emissions increased between 2020 and 2021 from 5.9 MtCO2e to 6.3 MtCO2e (+7.2 per cent). This change in emissions was caused by relatively colder temperatures in January, February and April 2021, resulting in more fuel being used for domestic heating.

Figure 0.3: Mean air temperature by month, Scotland. 2020 and 2021. Values in °C



(Data Obtained from Met Office[4])

18.2.1.9 International aviation and shipping

International aviation was affected dramatically during the early part of the COVID-19 restrictions with international shipping affected to a lesser degree.

- Between 1990 and 2021, international aviation and shipping decreased by 0.6 MtCO2e (47.3 per cent).
- Between 2020 and 2021 international aviation and shipping emissions decreased by a further 0.1 MtCO2e (15.2 per cent decrease).

18.2.1.10 Waste management

Waste management emissions are dominated by methane emissions. Emissions from Waste Management have been relatively static over recent years, with a value of 1.5 MtCO2e for 2021, with no significant change from 2020.

However, between 1990 and 2021 emissions reduced by 5.0 MtCO2e (76.2 per cent). This decrease is largely due to the progressive introduction of methane capture and oxidation systems within landfill management.

[4] Source Met Office: http://www.metoffice.gov.uk/pub/data/weather/uk/climate/datasets/Tmean/date/Scotland.txt

18.2.1.11 Public

The main source of emissions from this sector is the use of natural gas for heating public buildings.

- There was a 1.3 MtCO2e (59.5 per cent) fall in emissions from public sector buildings between 1990 and 2021.
- Emissions over the last few years have been relatively flat, with a value of 0.9-1.0 MtCO2e between 2014 and 2021.

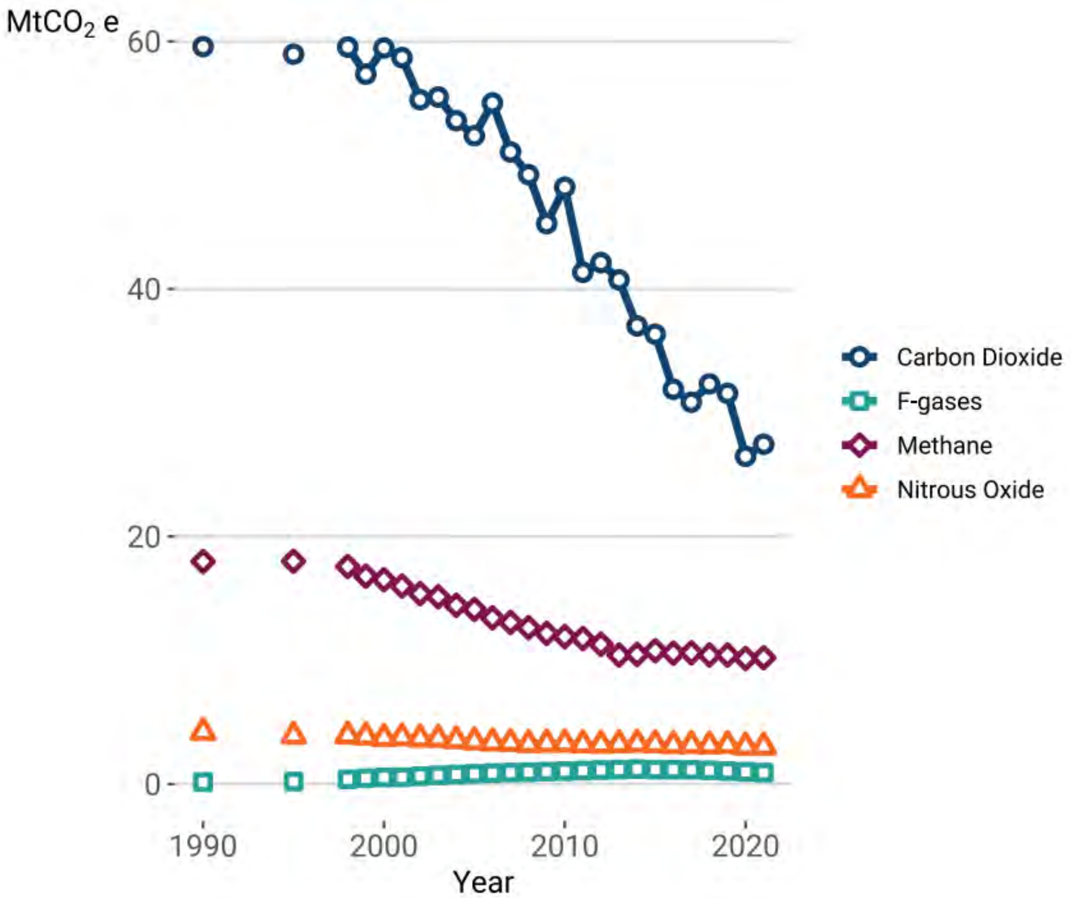
18.2.1.12 Industrial processes

This sector has seen a 1.4 MtCO2e (76.4 per cent) decrease from 1990 to 2021. Values have been relatively stable in recent years, with 2021 having a value of 0.4 MtCO2e. Most of the decrease in the sector happened between 1990 and 1995 and was associated with decreased emissions in the Nitric acid production industry and from a process known as sintering – a process associated with the iron and steel industry.

18.2.1.13 Emissions by type of gas

Figure 0.4 shows the trends in emissions, broken down by gas from 1990 to 2021.

Figure 0.4: Scottish Greenhouse Gas Emissions, by Gas, 1990-2021. Values in MtCO2e



(Source: Scottish Greenhouse Gas Statistics 2021)

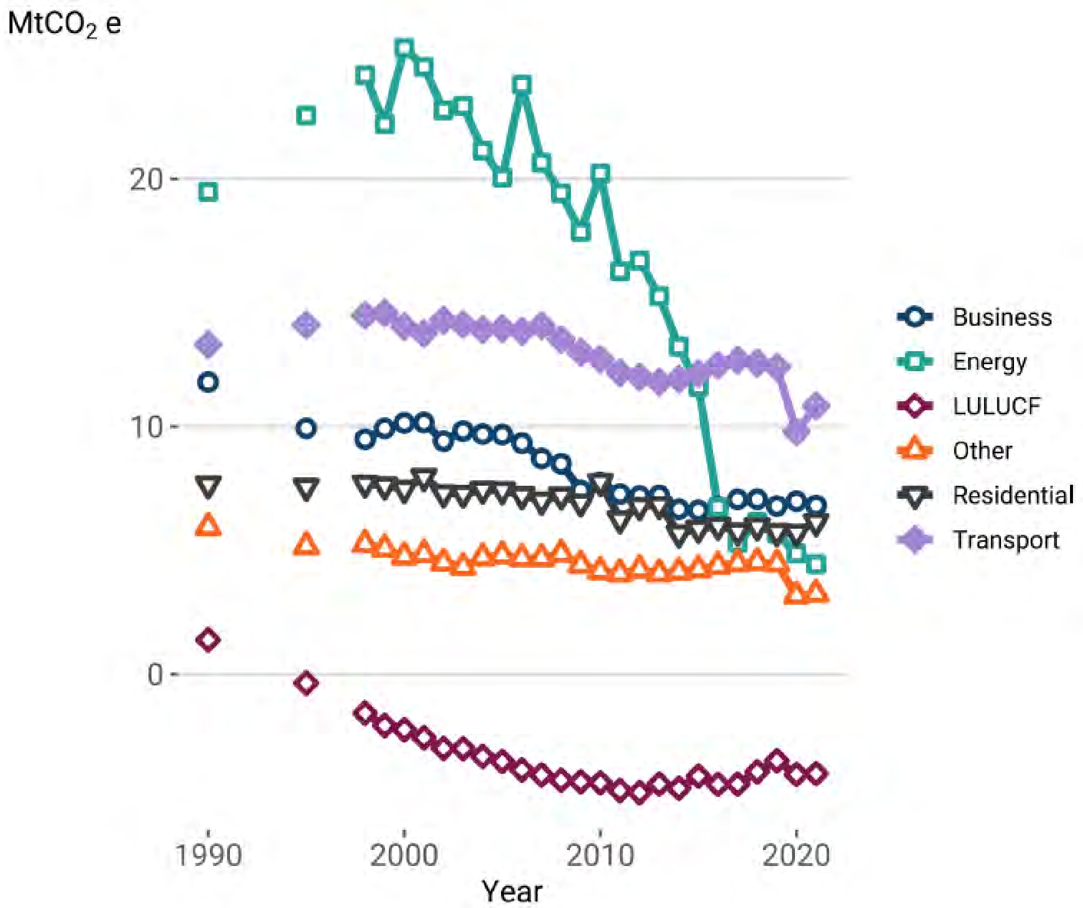
Carbon dioxide is by far the largest contributor to Scottish greenhouse gas emissions in all years (66.0 per cent of all emissions in 2021) and is the most 22 volatile series of all gases – largely driven by changes in energy supply emissions and to a lesser extent, emissions from the residential and business categories.

Methane is the second most common greenhouse gas in 2021 (24.5 per cent of all net emissions) followed by nitrous oxide (7.2 per cent) and F-gases making up the remainder (2.2 per cent).

Carbon dioxide has seen the largest reduction from 1990 to 2021 (32.1 MtCO2e reduction). There have also been reductions in both methane (7.8 MtCO2e reduction) and nitrous oxide (1.2 MtCO2e reduction). Emissions from fluorinated gases showed a large increase from 1990 to 2013 but have been declining since 2016. Although they remain small in absolute terms, driven by the introduction of hydrofluorocarbons (HFCs) from 1995 onwards. These HFCs replace chlorofluorocarbons (CFCs) which were banned by the Montreal Protocol due to their impact on the ozone layer.

18.2.1.14 Carbon dioxide (CO2)

Figure 0.5: Carbon Dioxide (CO2) Emissions by National Communications Category, 1990 to 2021. Values in MtCO2e

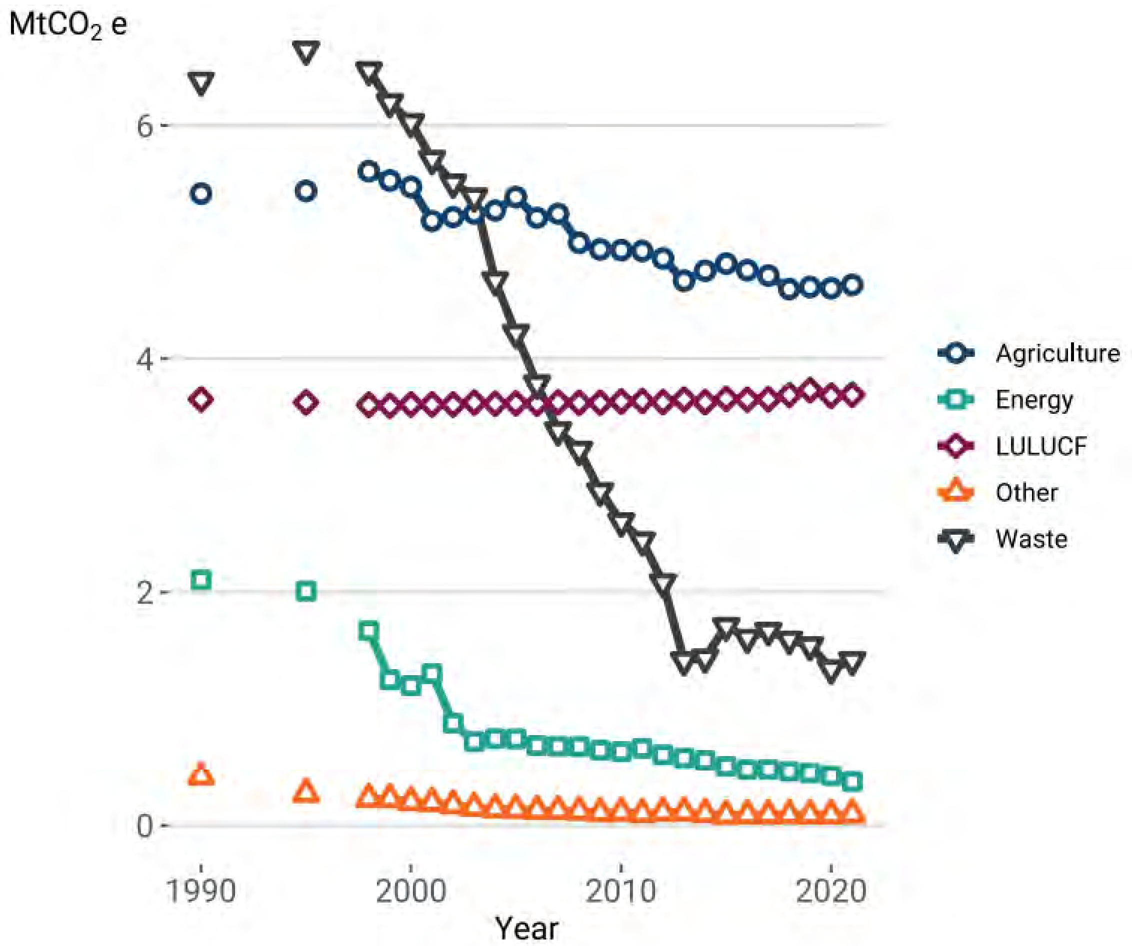


(Source: Scottish Greenhouse Gas Statistics 2021)

- Figure 0.5 shows that Energy Supply is a key source of carbon dioxide emissions in all years between 1990 and 2015, after which the change in fuels used in electricity generation substantially reduces CO2 emissions from this source. Change in energy supply emissions is the main driver of changes in total carbon dioxide emissions. Emissions from this category have been volatile, with the highest emissions occurring between 1995 and 2003, and a spike in 2006, related to a greater use of coal in that year. •
- Transport (excluding international) is the next most common source of carbon dioxide emissions across the entire time-series. In 2015 Transport became the highest source of emissions for the first time in the time series.
- Despite revisions to total greenhouse gases for the LULUCF sector, it has become a much greater net CO2 sink for Scotland over the period. In 1990 it emitted 1.4 MtCO2 of net CO2 emissions. From 1995, this sector became a net-CO2 sink, reaching a maximum in 2012 when it acted to sequestrate 4.8 MtCO2.

Since that time, this net CO2 sink has been generally reducing to its current (2021) level where it reached net CO2 emissions of -4.0 MtCO2 These 24 trends reflect forestry planting activities in the early 1990s reaching maturity and gradually reducing its potential to remove CO2.Methane (CH4)

Figure 0.6: Methane (CH4) Emissions by National Communications Category 1990 to 2021. Values in MtCO2e

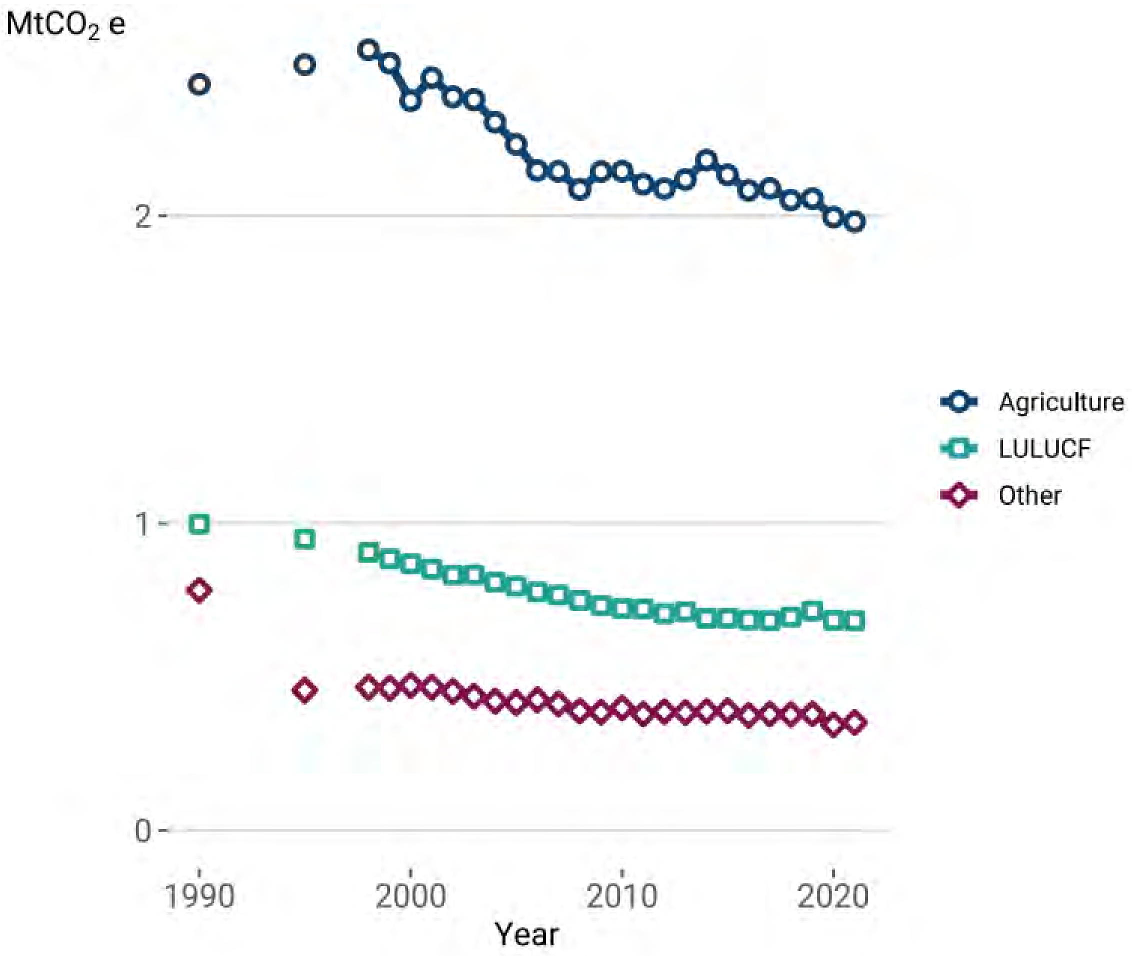


(Source: Scottish Greenhouse Gas Statistics 2021)

- Methane emissions from Waste Management have fallen by 5.0 MtCO2e between 1990 and 2021 (a 77.9 per cent reduction). This is largely due to the progressive introduction of methane capture and oxidation systems within landfill management.
- In the Energy Supply sector, methane emissions have fallen by 1.7 MtCO2e between 1990 and 2021 (a 82.1 per cent reduction), partly due to reductions in emissions from sources such as coal mining.
- Methane emissions in the Agriculture sector have fallen by 0.8 MtCO2e between 1990 and 2021 (a 14.5 per cent reduction). This is mainly due to a decrease in livestock numbers (particularly cattle and sheep).
- Land Use emissions of methane have risen very slightly over the entire time series.

18.2.1.15 Nitrous oxide (N2O)

Figure 0.7: Nitrous Oxide (N2O) Emissions by National Communications Category, 1990 to 2021. Values in MtCO2e

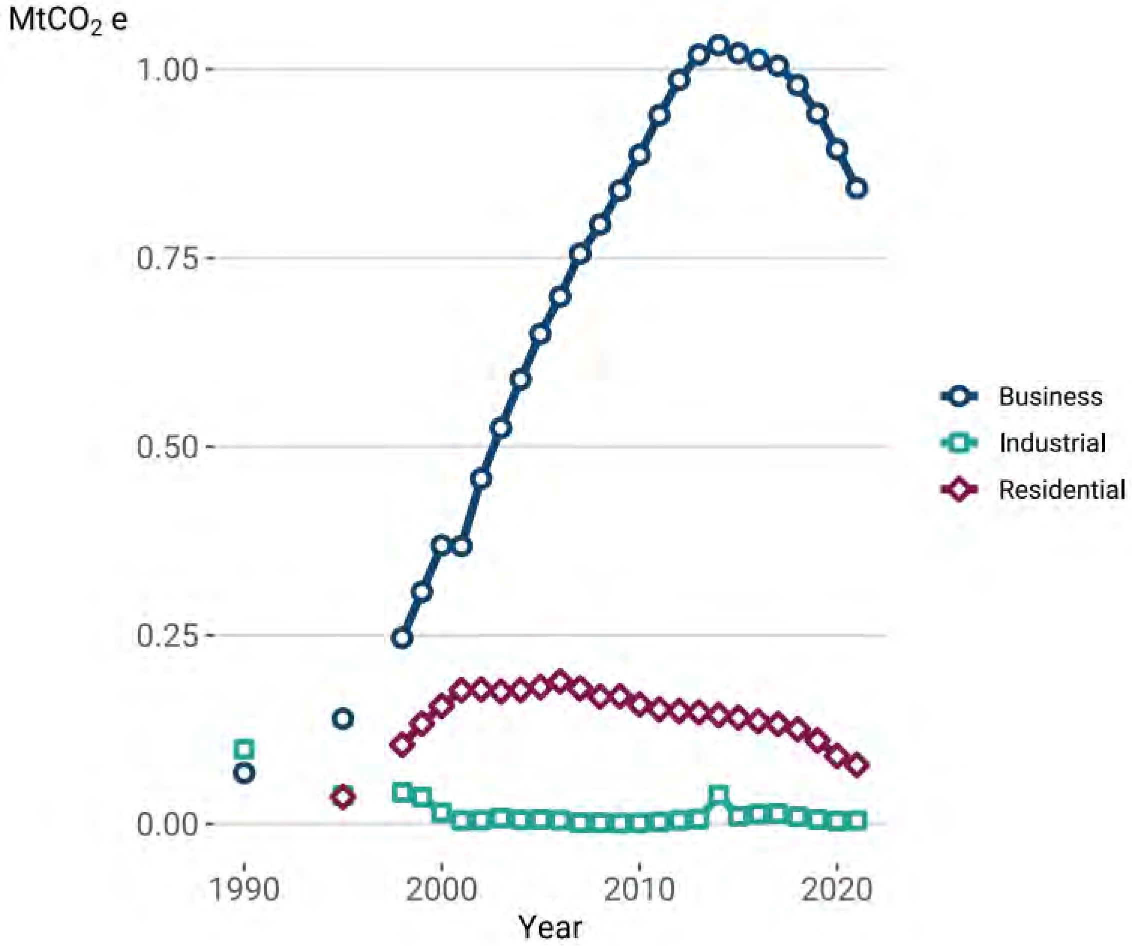


(Source: Scottish Greenhouse Gas Statistics 2021)

- Agriculture is by far the main contributor to emissions of nitrous oxide. These are largely produced by agricultural practices on soils, and to a lesser extent by animal manures. Emissions of nitrous oxide in this sector have fallen by 0.4 MtCO2e between 1990 and 2021 – an 18.4 per cent reduction.
- 'Land Use, Land Use Change and Forestry' fell by 0.3 MtCO2e (31.6 per cent reduction) between 1990 and 2021.

18.2.1.16 Fluorinated gases (F-gases)

Figure 0.8: F-gas Emissions by National Communications Category, 1990 to 2021. Values in MtCO2e



(Source: Scottish Greenhouse Gas Statistics 2021)

- F gases are the most potent greenhouse gases with high global warming potentials but they are emitted in very small quantities. As a result, they contribute less to global warming than the other greenhouse gases in Scotland. (For targets these gases use 1995 as a baseline year rather than 1990)
- There is a sharp increase in HFC gases of 0.9 MtCO2e between 1990 and 2014 (from 0.2 MtCO2e in 1995 to 1.2 MtCO2e in 2014), but have since decreased every year from that peak. This change is almost entirely in the Business sector. This increase is because F gases were introduced to replace chlorofluorocarbons (CFCs), which were used in appliances such as industrial air conditioning units. CFCs were banned under the Montreal Protocol, as they were contributing to the depletion of the ozone layer.
- F gas emissions in the residential sector result from the use of aerosols and asthma inhalers, and represent around 0.1 MtCO2e in 2021.

18.3 Scotland's GHG Account for Assessing Progress Against Statutory Targets

The Committee on Climate Change (CCC) used the term "GHG Account" to refer to their recommended manner of accounting for emissions, which is intended to better separate the impacts on targets of scientific and methodological improvements to the GHG inventory, from those of 'on-the-ground' policy actions.

At the heart of this method is the freezing of inventory methods (the scientific methods used for the measurement and estimation of emissions levels) between the time that target levels are set (or reviewed through independent advice from the CCC) and the time when target outcomes come to be reported. To ensure that the inventory methods used for the purpose of reporting target outcomes do not become too far separated from the best science and evidence, the base inventory will be re-aligned to the most up to date inventory methods at least every 5 years.

In accordance with advice from the Committee on Climate Change, the calendar year 2020 (for which emissions data was first published in June 2020) has been selected as the base inventory for reporting progress to the 2021 interim target.

- The Baseline period uses a 1995 base-year for F-Gas emissions, and 1990 for all other greenhouse gases.
- Where data does not exist for a particular year, revisions are carried over from the previous complete year.
- There has been a 49.9% reduction from baseline levels in 2021 and, as a result, **the statutory emissions reduction target for 2021 has not been achieved.**

18.4 Revisions to the Inventory and Methodology

18.4.1 Compilation of the GHG inventory

Most emission estimates are compiled by combining activity data (such as fuel use) with a suitable emission factor (such as amount of CO2 emitted per unit of fuel used).

Estimates of emissions from the industrial sector are often compiled based on plant-specific emissions data. Emissions from some sectors are based on more complicated models - such as the model used to estimate emissions from landfill, and the model used to estimate the carbon dynamics in soils when trees are planted.

Much of the data on net emissions from 'agriculture' and 'land use, land use change and forestry emissions' are based on modelled data for Scotland, which are consistent with, but not constrained to, the UK totals and thus are known as "bottom up" estimates.

Many of the remaining emissions sources within the inventory have been collated on a "top down" approach where estimates of emissions have been apportioned to Scotland using proportions of energy use in the Department of Business, Energy and Industrial Strategy (BEIS) Publication "Digest of UK Energy Statistics (DUKES)". This approach is prompted by data availability on emissions being more limited at the sub-UK level.

18.4.2 Details of main revisions and interpretation of revisions to the inventory

Revisions to emission inventory estimates reflect the continuous development of scientific understanding of emissive processes, and the improvement to underlying data and methods to generate accurate emission estimates.

18.4.2.1 LULUCF revisions

There was a substantial revision to the LULUCF category in both the baseline period and the latest year – affecting all intervening years. These revisions represent a profound improvement to the underlying data and methodology used to construct emissions estimates for LULUCF emissions.

This improvement is as a result of a new method which uses multiple time-series sources e.g., remote sensing data to arrive at frequently updated probabilistic estimates of land use for each land area.

18.4.2.2 Energy supply

Recalculations are primarily due to revisions to DUKES data in later years and change in activity data for petroleum refining.

18.4.2.3 Business

There were large revisions to the UK inventory due to new bottom-up estimates of offroad machinery fuel use by machinery type, resulting in the reallocation of residual fuel use in other sectors. Integration of new mapping grids for the use of fuels at industrial sites, particularly for gas oil, coal, fuel oil and natural gas use impacts emissions across the time-series. Emissions for later years of the time-series were affected by recalculations in the DUKES activity data.

18.4.2.4 Residential

Large recalculations in 2019 and 2020 due to revisions to the DUKES activity data. Domestic combustion of natural gas was revised for 2019 and 2020 due to updates to the Carbon Emission Factors in the Local Distribution Zone (LDZ) data. Minor recalculations throughout the time series due to revisions to the calorific values in the domestic combustion model.

18.4.2.5 Interpretation of uncertainties in the inventory

In the inventory, there will be uncertainty inherent in any process or calculation that uses sampling, estimation or modelling.

Estimates of greenhouse gases are compiled by a consortium of contractors. The source emissions are based upon a range of data sources, ranging from model-based estimates to point source emission data. Consequently, these estimates are subject to a degree of uncertainty.

The Scottish Government previously commissioned research to overhaul and update the uncertainties model used for the Scottish greenhouse gas inventory. A detailed study was carried out in parallel with the compilation with the 1990-2014 Scottish greenhouse gas inventory to review and improve the uncertainty calculations.

18.4.2.6 Future revisions to the inventory

Every year, greenhouse gas inventories are updated to reflect improvements in the underpinning science, data and modelling which often result in revisions to the entire time series. These revisions also reflect changes to the Intergovernmental Panel on Climate Change (IPCC) guidelines. The Scottish Government is represented at the UK's National Inventory Steering Committee, where improvements to the Scottish and UK inventories are discussed.

Following the recent UNFCCC COP26 meeting in Glasgow, it was confirmed that the greenhouse gas warming potentials used in this release will move to those presented in IPCC Annual Report 5 (AR5) without climate feedback effects. This change is expected to occur in the next edition of this publication and will result in methane moving from a GWP multiplier of 25 to 28, and nitrous oxide reducing from 298 to 265. Other changes to individual isotopes of fluorinated gases will also be made.

18.5 Exclusions, Glossary and References

18.5.1.1 Why are some greenhouse gas emissions not considered in this statistics release?

The methods used to compile the Scottish Greenhouse Gas Inventory are consistent with international reporting and are therefore comparable to the greenhouse gas emission estimates reported by all other EU Member States and other Annex 1 parties8 to the UNFCCC. All countries estimate and submit their greenhouse gas inventory estimates to be consistent with methods set out in international guidance for national inventory methods from the Intergovernmental Panel on Climate Change (IPCC), known as the IPCC (2006) guidelines. The IPCC (2006) guidelines state that national inventories should report on all anthropogenic (human) emissions and removals of greenhouse gas emissions, as a result of human activities within a country's territorial sphere.

However, there are some emissions and removals of carbon dioxide that occur as a result of short-cycle biogenic processes. This biocarbon has only recently been abstracted from the atmosphere before it is then re-released as carbon dioxide. In accordance with the IPCC (2006) guidelines, these emissions and sinks are therefore excluded from the greenhouse gas inventory, as they could lead to double counting. If countries do choose to estimate these biocarbon emissions, they are reported outside of the national inventory total, as a memo item to that country's submission to the UNFCCC. This means that some sources and sinks of greenhouse gases are not included in the Scottish and UK inventory totals.

Examples of reasons for why some sources and sinks of greenhouse gases are not included in the greenhouse gas inventory.

1. Due to short cycle biocarbon (carbon only been recently abstracted from the atmosphere)

- **Carbon dioxide (CO2) emissions from biomass combustion.** For example, this includes CO2 emissions from biomass power stations.
- **Process emissions in food and drink production.** These include CO2 emissions from brewing, fermenting and malting and in the production of food.
- **CO2 emissions from biodegradable waste to landfill.** Emissions are not estimated where they arise from biogenic sources of waste such as food. Fossil-derived organic matter (such as plastic) is assumed to be non-biodegradable and there are no emissions associated with its decomposition.

However, methane (CH4) emissions from biodegradable waste sent to landfill are considered in these greenhouse gas statistics as they are formed by the anaerobic (oxygen-free) decay of organic matter in solid waste disposal sites.

2. Where there has been no anthropogenic influence

- **Natural accumulation and storage of carbon in peatland**. For emissions or removals of peatland to be considered for IPCC reporting, they require humans to alter the peatland – either through wetland drainage, rewetting, peatland extraction or through another land use change. The UK and Scotland has elected to include the IPCC (2006) Wetlands Supplement as part of their inventory reporting from the 1990-2019 vintage of the inventory: http://www.ipcc-nggip.iges.or.jp/home/wetlands.html

3. **Beyond the territorial definitions as prescribed by the IPCC (2006) reporting requirements**

- "Blue carbon". Blue carbon refers to the carbon captured by the world's oceans and coastal ecosystems. The carbon captured by living organisms in oceans is stored in the form of biomass and sediments from mangroves, salt marshes and seagrasses. However, it should be noted that research in underway to being to develop estimates of the environmental changes resulting from changes to coastal wetlands environments.

APPENDIX 19.1

Hazard Identification Record

Grouped Risk Event	Source and/or Pathways	Reasonable worst-case scenario	Navigation & Safety	Biodiversity	Coastal Processes	Water Quality	Flood Risk	Climate Change	Population & Human	Cultural Heritage	Landscape & Visual	Waste	Primary Mitigation	Tertiary Mitigation	Could this lead to a major accident and/or natural disaster with primary and tertiary mitigation in place?	Is the reasonable worst consequence managed to an acceptable level with primary and tertiary mitigation in place?	If no, what secondary mitigation measures recommended?
Major boat/construction vessel collision (either with existing infrastructure, new infrastructure, other vessels or running aground).	Working within existing ferry operation routes and/or leisure areas (e.g., sea kayaking and other water sports).	Death and/or injury to a member of the public or construction worker.	✓	×	×	×	×	×	✓	×	×	×	- Lighting on Breakwater	- Marine liaison officer - AIS coverage - Notices to mariners (Issued by ABC) - Passage planning - Operational planning - Update ALRS and signalling directions - Communication to stakeholders on moving buoyed areas - Safety lighting - Shore-side facility maintenance plan	Yes	No	- Safety boat - Weather forecasting - Operational weather limits - Aids to navigation
Accident to the general public on or near the shoreline (e.g., people swimming etc.)	Working nearby to the shoreline while constructing the Breakwater.	Death and/or injury to a member of the public	✓	×	×	×	×	×	✓	×	×	×	- Lighting on Breakwater - Safety fencing	- Marine liaison officer - AIS coverage - Notices to mariners (Issued by ABC) - Passage planning	Yes	No	- Safety boat - Weather forecasting - Operational weather limits - Aids to navigation

Grouped Risk Event	Source and/or Pathways	Reasonable worst-case scenario	Navigation & Safety	Biodiversity	Coastal Processes	Water Quality	Flood Risk	Climate Change	Population & Human	Cultural Heritage	Landscape & Visual	Waste	Primary Mitigation	Tertiary Mitigation	Could this lead to a major accident and/or natural disaster with primary and tertiary mitigation in place?	Is the reasonable worst consequence managed to an acceptable level with primary and tertiary mitigation in place?	If no, what secondary mitigation measures recommended?
														- Operational planning - Update ALRS and signalling directions - Communication to stakeholders on moving buoyed areas - Safety lighting - Shore-side facility maintenance plan			
Man overboard during construction	Working in a marine setting.	Death and/or injury to a construction worker	✓	×	×	×	×	×	×	×	×	×	N/A	- Marine liaison officer - Passage planning - Shore-side facility maintenance plan	Yes	No	- Weather forecasting - Operational weather limits - Safety boat
Major pollution or sedimentation event affecting nearby designated sites / areas.	Working within, or in close proximity to, an SAC, SPA, SSSI, MPA or NNR.	Severe long-term or permanent detrimental impact on sites and qualifying species / features.	×	✓	✓	✓	×	×	×	×	×	✓	- Use of local materials - Use of clean quarried rock - Incorporation of utilities infrastructure (i.e., sewer network, electricity cables, telecommunication	- Construction Environmental Management Plan (CEMP) which includes pollution prevention measures.	Yes	No	- Availability of pollution response equipment.

Grouped Risk Event	Source and/or Pathways	Reasonable worst-case scenario	Navigation & Safety	Biodiversity	Coastal Processes	Water Quality	Flood Risk	Climate Change	Population & Human	Cultural Heritage	Landscape & Visual	Waste	Primary Mitigation	Tertiary Mitigation	Could this lead to a major accident and/or natural disaster with primary and tertiary mitigation in place?	Is the reasonable worst consequence managed to an acceptable level with primary and tertiary mitigation in place?	If no, what secondary mitigation measures recommended?
													cables, gas pipelines etc.)	- Environmental Management Plan (EMP) - Navigation safety management processes to manage vessel movements. - Shore-side facility maintenance plan			
Major coastal flood event during construction of the Breakwater	Working in a coastal location	Death and or injury to a construction worker.	✓	×	✓	×	✓	✓	✓	×	×	×	N/A	- Use SEPA's Floodline Warning Service to manage risk of flooding to works from extreme tidal events. - Shore-side facility maintenance plan	Yes	Yes	N/A

Grouped Risk Event	Source and/or Pathways	Reasonable worst-case scenario	Navigation & Safety	Biodiversity	Coastal Processes	Water Quality	Flood Risk	Climate Change	Population & Human	Cultural Heritage	Landscape & Visual	Waste	Primary Mitigation	Tertiary Mitigation	Could this lead to a major accident and/or natural disaster with primary and tertiary mitigation in place?	Is the reasonable worst consequence managed to an acceptable level with primary and tertiary mitigation in place?	If no, what secondary mitigation measures recommended?
Scour of the toe of the breakwater leading to movement and/or damage that could cause a health & safety risk	Working in a marine setting with strong tidal influence and wave propagation	Death or injury to a maintenance worker, vessel operator or member of the public	✓	×	✓	×	×	×	✓	×	×	×	- Scour protection on breakwater toe	N/A	Yes	No	- Maintenance dredging to account for any movements of the breakwater

APPENDIX 20.1

Outline Construction Environmental Management Plan (oCEMP)

OUTLINE CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN (OCEMP)

Iona Breakwater Project

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Document status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
F01	oCEMP	Various	Dr Laura McAnallen Richard Bingham	Grace Glasgow	24/02/2023
F02	Final with updated potential dredge deposit location information	Various	Richard Bingham	Grace Glasgow	16/08/2023

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1 INTRODUCTION

1.1 Project Background

Iona is a small island located to the west of the Isle of Mull. The Sound of Iona, which is orientated north-by-northeast to south-by-southwest and is open to the Atlantic Ocean particularly from the southwest, separates the Isle of Iona and the Isle of Mull. At Iona, an existing ferry terminal, comprising a pier and a steep slipway, is located within the small village of Baile Mòr. A small-scale passenger ferry operates from this location between the Iona ferry terminal and the Fionnphort ferry termina, on the Isle of Mull.

As part of the Argyll & Bute Council (ABC) Local Development Plan (LDP)1, a new strategy for Oban, Lorn and the Isles was developed in order to address known infrastructure constraints and improve ferry services.

In 2019, a Feasibility Study was undertaken by Byrne Looby (Byrne Looby, 2019) on behalf of ABC whereby five different options for a rubble mound breakwater, as well as construction methodologies were explored. The Proposed Development builds on Option 1B of the Byrne Looby Feasibility Study (Bryne Looby, 2019) and consists of a new rock armour breakwater and dredging.

1.2 Description of Works

The Proposed Development consists of the construction of a new rock armour breakwater (185m crest length) to the south of the existing slipway. Minor overburden dredging (2,017m^2 area, 1,225m^3 dredge volume) will be required in order to accommodate the new navigation channel requirements. Descriptions of these proposed activities are provided in the sub-sections below and illustrated in Figure 1-1.

[1] Argyll & Bute Local Development Plan - https://www.argyll-bute.gov.uk/ldp

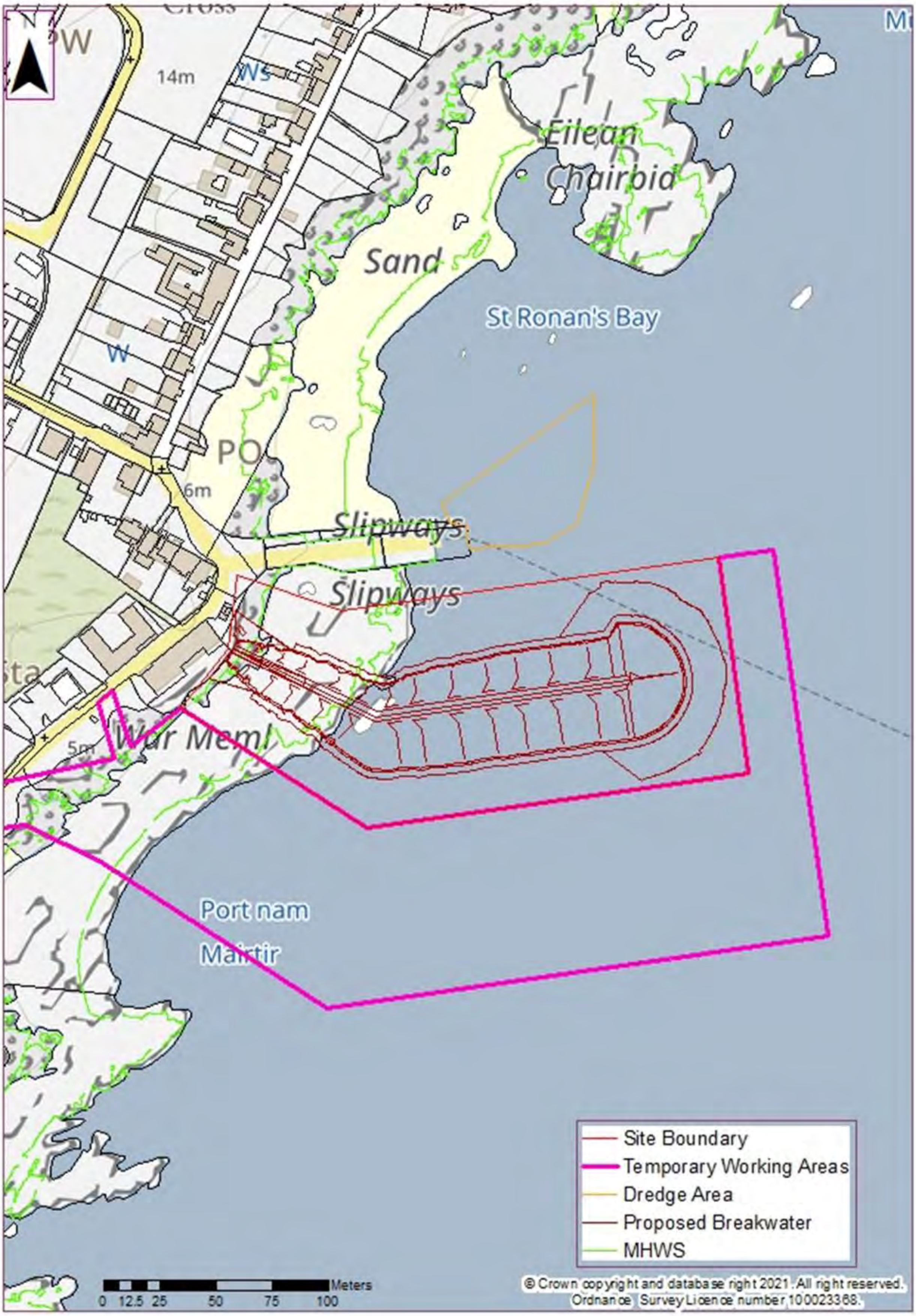

Figure 1-1 Proposed Development overview, site boundary and working areas

1.2.1 Rock Armour Breakwater

The function of the structure is primarily to provide defence from waves propagating from the prevailing southerly direction and provide protection for slipway users and ferry vessels. The breakwater will result in an overall reduction of wave heights at the structure. This will significantly reduce the risks to ferry operators and passengers and vehicles boarding and disembarking the ferry. The reduction in wave height provides a greater grip between the ferry ramp and the slipway deck.

The design details of the rock armour breakwater are listed below:

- The breakwater will be located approximately 70m south of the existing slipway in Iona.
- Crest length of circa 185m.
- 2:1 slope on outer face (non-slipway side) and 1:1.5 on the inner face (slipway side).
- The proposed maximum crest level will be 7.71m CD.
- Due to high flows through the crest during storm conditions, the crest width will be 4m.
- The base of the breakwater will be lined with a tear resistant geotextile membrane with the bedding placed on top of this layer will comprise of a 500mm deep layer of 300-1000kg graded rock.
- The core will be constructed of 1000 – 3000kg graded rock.
- The outer layer will be constructed of 3000-6000kg graded rock.
- A 3m wide and 2.5m high toe will be constructed on each face of 3000-6000kg graded rock. The toe will not be visible as it will be under a layer of sediment. Therefore, an area of sediment will need to be excavated, however this material will be replaced after construction is completed
- At the end of the breakwater, a 5:1 batter will be constructed of 1000-3000kg of graded rock
- The overall footprint of the breakwater is approximately 2.18ha.
- The rock armour breakwater will be constructed of clean quarried rock.
- The estimated volume of rock armour required for the proposed breakwater is 149,812 tonnes.

It is likely that local sources of rock armour will not be suitable, however Glensanda Quarry (Aggregate Industries) in Oban has been identified as a quarry which will be capable of producing rock armour material to a grading sufficient for the application at Iona. The quarry is equipped with marine loading facilities.

1.2.2 Dredging

In order to accommodate the new navigation channel requirements, some dredging works will be required, however these will be minor in nature and comprise overburden dredging only. The approximate dredge area is 2,017m^2. The approximate dredge volume to be removed is 1,225m^3. It is proposed that this is carried out by a backhoe dredger, with the material deposited at the potential location as shown in Figure 1-2.

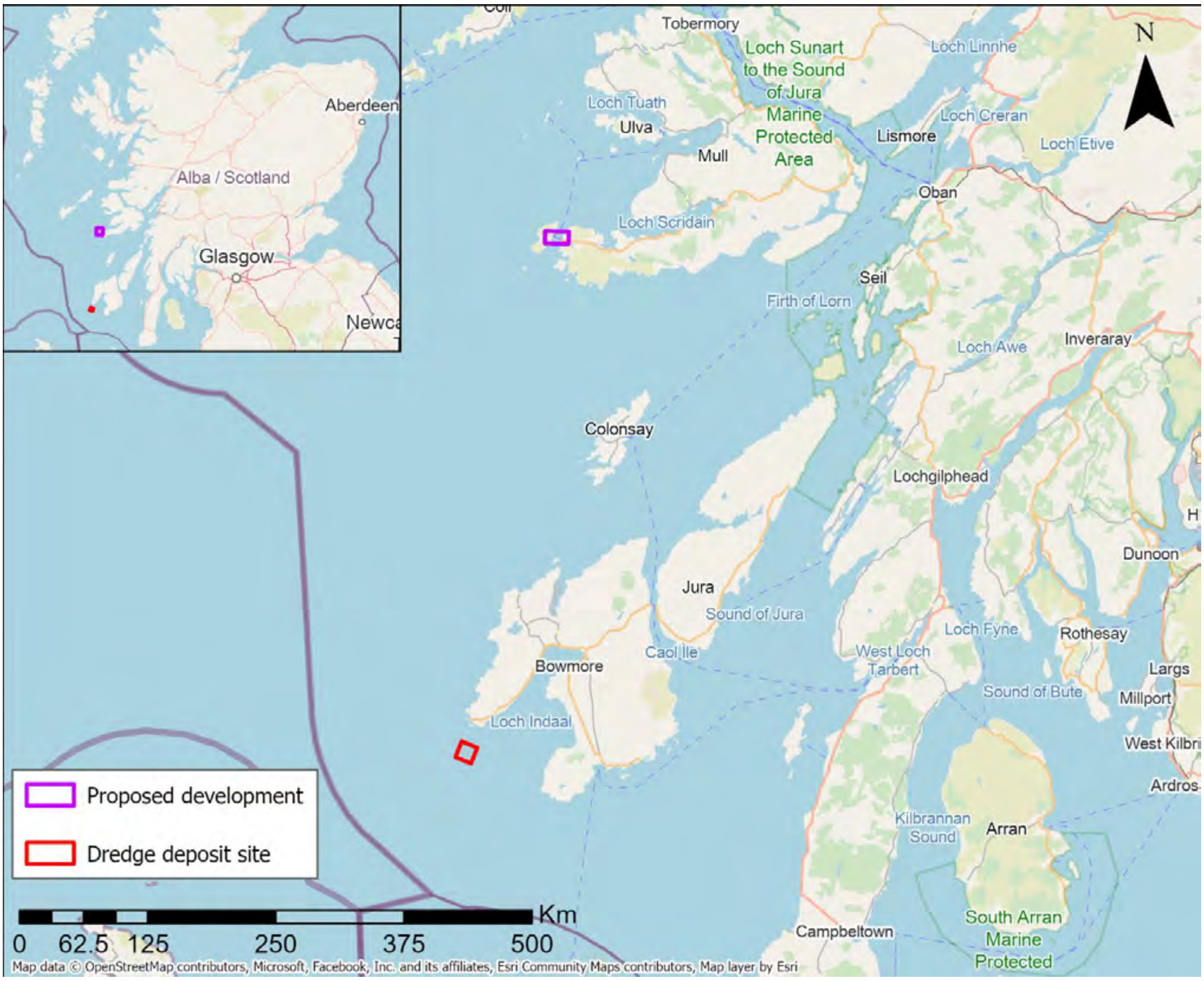

Figure 1-2 Potential dredge deposit location (shown in red)

In November 2020, ABC commissioned Structural Soil Limited to undertake a ground investigation at the Proposed Development site. This included three seabed sediment cores within the dredge area and six grab samples in the vicinity of the breakwater. The sediments were analysed for a suite of chemical parameters and screened against Marine Scotland Revised Action Levels (AL) 1 and 2, in order to identify any contamination which may be present. All samples within the dredge area were below the revised AL1 and AL2 Action Levels.

1.2.3 Other Technical Information relating to the Proposed Development

- Design Life: The design life of the structure is 120 years in accordance with the UK National Annex to BS EN 1990:2002, Category 5.
- Transport of Material to site: Materials are expected to be transported to site by barge and installed from a barge. Transport by road will be minimal – there is no estimated impact on the road transport network.
- Duration of Works: The duration of the works at Iona is estimated to be 52 weeks.

- Dredging: It is expected that dredging work will last for a maximum of 1 week. The dredge pocket will be undertaken prior to breakwater construction.
- Maintenance: Maintenance dredging will be required after construction is complete. The frequency of maintenance dredging will be established as part of the construction contract following the construction of the breakwater. Maintenance of the breakwater will be required as rock armour will move/adjust for a period of time. Defect period is expected to be 104 weeks during which the breakwater will be monitored, and any movement recorded and reported. After this, the breakwater will be inspected as part of the ongoing seabed bathymetric surveys regime. Systematic surveying of the UK's coastal waters is administered by the Maritime and Coastal Agency (MCA) under the Civil Hydrology Programme.
- Services: Mains electric is known to be present well to the north of the site and the proposed works will have no interference with these services.
- Current ferry services: Given that the breakwater is proposed to be located c.70m south of the existing slipway, it is expected that current ferry operations are not likely to be disturbed during the construction phase. Dredging activities are expected to be undertaken overnight, or as arranged with the ferry operator CalMac Ferries Ltd., to minimise any disturbance during this time.

1.2.4 Outline Method Statement

The outline method of construction is likely to be:

1. Undertaking of site dilapidation survey and level surveys as required to show the condition of the surrounding area and roads prior to the start of the works.
2. Site welfare facilities, site compound and storage areas established within the area. The site boundaries on land around the site compound and storage areas shall be defined with Heras fencing. Working area over water shall be marked with indicative safety buoys deployed at approx. 10m centres to delineate.
3. Dredging Works:
    a) Mobilisation of dredging plant to site.
    b) Pre-dredge bathymetric survey.
    c) Removal/relocation of existing private moorings and buoys from within the site boundary, working areas and dredging area and subsequent installation of the mooring at temporary locations nearby.
    d) Dredge pocket to the northeast of the existing Iona slipway. As part of the dredging is along the ferry route, the dredging operations shall be overnight or as arranged with the ferry operator CalMac Ferries Ltd.
    e) Post-dredge bathymetric survey.
4. Construction of Breakwater:
    a) Mobilisation of plant and operations team to site.

b) Rock armour and materials for breakwater delivered to site by barge. Rock armour can be stored below MHWS on the south side of the proposed breakwater.

c) Removal of existing toilet block septic tank outfall pipe with concrete surround.

d) Formation of breakwater footprint.

e) Installation of Geotextile membrane.

f) Installation of secondary rock and primary rock to existing seabed level.

g) Partial reinstatement with new pipe and concrete surround (the section from the septic through the breakwater to where it breaks through the south face only).

h) Installation of inner core & primary rock armour.

i) Installation of beacon access steps.

j) Installation of navigation beacon to crest of breakwater.

k) Reinstatement of breakwater toe to existing seabed level with site won seabed material.

l) Disposal of surplus seabed material in accordance with Marine Dredging Licence.

m) Installation of final length of pipe and concrete protection for the toilet block septic tank outfall to reinstate its original length.

n) Installation of rock armour along shore between existing slipway and south end of existing restaurant.

o) Reinstatement of private moorings and buoys to final, permanent locations.

p) Removal of safety buoys marking out the site.

q) Installation of security gate.

r) As-built surveys.

s) Demobilisation.

t) Submission of Health and Safety File.

1.3 Objectives of the Construction Environmental Management Plan

This document comprises an outline Construction Environmental Management Plan (oCEMP) for the Proposed Development. It is a 'live' document and will be updated as the project progresses, including incorporating the requirements of conditions attached to statutory consents granted in respect of the Proposed Development.

This oCEMP sets out the **minimum requirements** which will be adhered to during the construction phase of the Proposed Development.

ABC is the applicant for the Proposed Development. ABC seeks to achieve the highest possible standards of environmental management during both the construction and operation of the Proposed Development.

2 SUMMARY OF MITIGATION MEASURES

2.1 Mitigation Measures Arising from the EIAR

The EIAR assesses the likely significant impacts arising from the Proposed Development. Where required, mitigation measures are identified and described within individual topic chapters. These are measures which could avoid, prevent, reduce and, where possible, offset likely significant adverse effects upon the environment.

Table 2.1 summarises the mitigation measures and monitoring recommended within the EIAR.

Table 2.1: Mitigation measures and monitoring recommended within the EIAR

Potential Effects	Summary of Proposed Mitigation
CHAPTER 6: Navigation & Safety	
Ferry or tour boat allision (heavy contact) with the Proposed Development. Dredger flooding whilst engaged in operations. Dredge/construction plant impact with the Proposed Development during construction phase. Recreational or fishing vessel allision with the Proposed Development. Dredge/construction plant collision with recreational/fishing vessel. Tug and tow collision with recreational/fishing vessel. Tug and tow collision with ferry/tour boat. Accident spill during marine works. Heavy lift failure, or failure of lifting gear. Small non-powered craft displaced by the Proposed Development. Ferry or tour boat allision with the breakwater. Small non-powered craft displaced by the breakwater.	• Marine liaison officer – the marine liaison officer provides a point of contact for the marine works, will provide safety information to vessels navigating in the area and coordinate with local authorities during emergency situations. This is just to provide a central point of contact. • AIS coverage – all dredge/construction vessels, including barges to carry AIS (A or B (see Volume III, Appendix 6.1, Section 2.1 for definitions of AIS signals)). • Notices to mariners – issued by Argyll & Bute Council containing details about the construction works. These should be issued prior to any works (or any related activities such as diving or towage movements). • Availability of pollution response equipment – pollution response equipment should be available and carried by the contractors for use at Iona. The equipment should be appropriate for the type and scale of pollution that may occur. • Weather forecasting – a weather forecasting service should be regularly monitored to indicate any periods of upcoming adverse weather conditions. Appropriate actions should then be taken to mitigate any potential situations that may arise. These actions should be documented in the safety management system, detailing the specific weather conditions that will necessitate action(s). • Operational weather limits – including maximum wave and wind limits for construction activities should be detailed in the contractors 'Risk Assessment Method Statement'. • Promulgation of information – information on the proposed development and upcoming operations with associated vessel movements should be provided to local stakeholders. A website page (potentially on the Council's website) for the project, providing information and a method to contact the project would allow any vessels in the area to obtain information. • Aids to navigation, Provision and maintenance of – aids to navigation should be provided after consultation and approval of the NLB. Marine works to be illuminated at night. The aids to navigation must be maintained to provide the availability of the aids to navigation required by the NLB with any out of service periods reported via the Local Aids to Navigation (LATON) system. • Safety boat – the safety boat should be appropriate for the wind and wave conditions in the area. It should be available on site and manned during construction operations in order to provide quick assistance if any incident was to occur. • Passage planning – CalMac should update their passage plan, both during the works and on completion of the works to recognise the altered route. • Operational planning – capital dredging should be scheduled, as far as possible, to avoid disruption to ferry operations. • Review of available powers – Argyll & Bute Council should review their powers in relation to operating the port facility at Iona to determine whether further powers are required to ensure navigational safety. • Update ALRS volume 6 and Sailing Directions – updates to include new structures after completion of the marine works. • Shore side facility maintenance programme – to schedule the maintenance of the site, including the AtoN. • Communications – stakeholders should be informed of the need to move buoyed areas prior to construction and advised of other suitable locations. • Safety - Lighting - it is important that any marine works at night or at times of reduced visibility are sufficiently illuminated in accordance with the Health and Safety Executive (HSE) Approved Code of Practice (ACOP) 'Safety in Docks' (HSE, 2014). The guidance on illumination levels is

Potential Effects	Summary of Proposed Mitigation
	drawn from the 'Safety and Health in Ports' code of practice published by the International Labour Organization; this states that: "On access routes for people, plant and vehicles and in lorry parks and similar areas, the minimum level of illumination should not be less than 10 lux. In operational areas where people and vehicles or plant work together, the minimum level of illumination should not be less than 50 lux". (ILA, 2016). This level of illumination must be balanced alongside the requirements provided in the British Standard Institute (BSI) publication 'Design of Road Lighting' BS5489.
CHAPTER 7: Terrestrial Biodiversity	
Temporary disturbance/ loss of habitat arising from activities within the terrestrial area of the Temporary Work Area (namely the establishment of a work compound and storage of rock).	• Production of an <Redacted> Species Protection Plan (see Volume III, Appendix 7.2) and adherence to all recommendations made within. • Production of a Construction and Environmental Management Plan (CEMP). • An Ecological Clerk of Works (ECoW) will be appointed to monitor the works in respect to <Redacted> activity. • No additional mitigation measures are required for the operational phase of the Proposed Development. The Environmental Management Plan (EMP) will manage the risks of all operational activities, facilities and cargo handled by the port and will include best practice measures to control pollution following standard guidelines such as the Environment Agency Pollution Prevention Guidelines. This will be considered sufficient to limit any potential impacts relating to pollution events.
Temporary disturbance/loss of habitat due to airborne noise and visual disturbance from construction activities.	
Permanent loss of habitat arising from reclamation of seabed during the construction of a new rock armour breakwater to the south of the existing slipway.	
Temporary effects on prey species due to underwater noise arising from construction activities (notably dredging and vessel noise), increased suspended sediment concentrations and sediment deposition.	
Long term increase in disturbance to habitat arising from increased levels of marine activity due to improved ferry services.	
Long term increase in disturbance of habitat due to airborne noise and visual disturbance associated with the increase in terrestrial activity.	
Long term effects on prey species due to noise arising from vessels and potential for pollution events linked with increased levels of marine activity.	
CHAPTER 8: Marine Biodiversity	
Temporary disturbance/ loss of habitat arising from capital and maintenance dredging activity.	• Production of a CEMP - Control of pollution during construction will be set out in a CEMP. This will include best practice measures to prevent accidental spillage of chemicals during construction activities. • Production of an EMP - The EMP will manage the risks of all operational activities, facilities and cargo handled by the port and will include best practice measures to control pollution following standard guidelines such as the Environment Agency Pollution Prevention Guidelines.
Increased suspended sediment concentrations and sediment deposition.	
Resuspension of contaminated sediments.	

Potential Effects	Summary of Proposed Mitigation
Temporary disturbance/loss of habitat arising from the displacement/compaction of the seabed by anchors and jack-up barge spud legs. Permanent habitat loss arising from placement of material on the seabed for the breakwater. Underwater noise. Disturbance and collision risk to marine mammals from increased vessel traffic during construction. Changes in the hydrodynamic regime due to the presence of the breakwater.	• Production of an Invasive and Non-Native Species (INNS) Management Plan - A document detailing how the risk of potential introduction and spread of INNS should be produced. The plan will outline measures to ensure vessels comply with the International Maritime Organization (IMO) ballast water management guidelines, it will consider the origin of vessels and contain standard housekeeping measures for such vessels as well as measures to be adopted if a high alert species is recorded. • Plant, equipment and material (where required) will follow the 'check, clean, dry method'. • The presence of sensitive features onboard the ship's navigation systems will aid the vessel master in placing either anchor or jack-up legs to avoid these sensitive features. • Production of a Seagrass Compensation and Monitoring Plan - to ensure that seagrass habitat is not permanently lost, compensation will be undertaken to ensure that the habitat is restored. An assessment has already been undertaken in the form of the intertidal and subtidal survey, with the extent of biotopes derived. This data will be used to inform the 'Seagrass Compensation and Monitoring Plan'.
CHAPTER 9: Ornithology	
Temporary disturbance/loss of habitat arising from activities within the terrestrial area of the Temporary Work Area (namely the establishment of a work compound and storage of rock). Temporary disturbance/loss of habitat due to airborne noise and visual disturbance from construction activities. Permanent loss of habitat arising from reclamation of seabed during the construction of a new rock armour breakwater to the south of the existing slipway. Temporary effects on prey species due to underwater noise arising from construction activities (notably dredging and vessel noise), increased suspended sediment concentrations and sediment deposition. Long term increase in disturbance to habitat arising from increased levels of marine activity due to improved ferry services. Long term increase in disturbance of habitat due to airborne noise and visual disturbance associated with the increase in terrestrial activity. Long term effects on prey species due to noise arising from vessels and potential for pollution events linked with potential increased levels of marine activity.	• The most highly sensitive IOF are non-breeding populations and therefore measures to reduce disturbance around the nearshore area shall be undertaken as far as is practical during the period between September and April. • Methods to attenuate noise will be utilised, notably the use of sound walls and any modification of drilling rigs that would reduce noise levels. • Works undertaken in the vicinity of roosting birds or near occupied nests of sensitive species will be supervised by a suitably qualified and experienced ECoW to determine if additional measures may be required. • Near-shore vessel-based activities should aim to reduce disturbance to foraging seabirds and waterfowl, particularly if works coincide with the winter period when divers, grebes and sea duck may be present.
CHAPTER 10: Terrestrial Noise & Vibration	

<table>
<tr><th>Potential Effects</th><th>Summary of Proposed Mitigation</th></tr>
<tr><td>Worst case construction noise predictions exceed the 65 dB BS 5228 noise limit at a number of construction noise receptors during day-time hours.</td>
<td rowspan="4">
Mitigation in the form of timely and effective stakeholder consultation should be undertaken. This would ensure that residents are kept informed of on-going and future operations. For example, local residents would be informed by letter drop of proposed works, particularly where these are due to occur outside standard working hours. The letter would include details of proposed cause, start dates and duration of works to be carried out.
In order to minimise the likelihood of complaints, Argyll & Bute Council and affected residents should be kept informed of the works to be carried out and of any proposals for work outside normal hours. All complaints will be recorded by the appointed contractor. The appointed contractor will investigate the circumstances and ensure the necessary corrective measures are taken.
Night-time construction noise impact indicates that there is the potential for significant impact without mitigations. Screening at source of potentially affected receptors would ensure that the BS 5228 noise limit is achieved reducing impact to temporary minor adverse.
Construction mitigation measures will be put in place to ensure construction noise levels are attenuated and reduced where necessary.
Best practice measures will be employed to ensure that construction phase noise levels are reduced to the lowest possible levels.
BS5228:2009+A1:2014 – Noise and vibration control on construction and open sites outlines a range of measures that can be used to reduce the impact of construction phase noise on the nearest noise sensitive receptors. These measures will be applied by the contractor where appropriate during the construction phase of the Proposed Development. Construction best practice measures which will be implemented included below:

Ensuring that mechanical plant and equipment used for the purpose of the works are fitted with effective exhaust silencers and are maintained in good working order
Careful selection of quiet plant and machinery to undertake the required work where available
Machines in intermittent use will be shut down in the intervening periods between work
Ancillary plant such as generators, compressors and pumps will be placed behind existing physical barriers, and the direction of noise emissions from plant including exhausts or engines will be placed away from sensitive locations, in order to cause minimum noise disturbance. Where possible, in potentially sensitive areas, temporary construction barriers or enclosures will be utilised around noisy plant and equipment
Handling of all materials will take place in a manner which minimises noise emissions
Audible warning systems will be switched to the minimum setting required by the Health & Safety Executive

Although recognised that the choice of dredgers is likely to be determined by the engineering requirements and the suitability of available equipment, dredging activities should be planned where possible to reduce the overall source noise level during the works – e.g. limiting night-time works directly adjacent to noise-sensitive properties etc.
Any dredger used for the works will be expected to be fitted with effective engine exhaust silencers, and there will be a requirement placed on the chosen dredger operator to ensure that all engine silencers are effective and reducing engine exhaust noise levels to the lowest reasonably practicable level.
Screening shall be provided nearest to those properties most likely to experience high noise levels from dredging, particularly during more sensitive night-time periods.
</td></tr>
<tr><td>Worst case construction noise predictions exceed the 45 dB BS 5228 noise limit at a number of construction noise receptors during night-time hours.</td></tr>
<tr><td>Unmitigated construction noise daytime predictions in excess of 65 dB would be deemed to have a temporary moderate impact at four receptors of medium sensitivity, and temporary moderate / major impact at one receptor of high sensitivity.</td></tr>
<tr><td>Worst case construction noise predictions exceed the 45 dB night-time BS 5228 noise limit for all construction noise receptors during night-time hours. Unmitigated construction noise night-time predictions in excess of 45 dB would be deemed to be temporary moderate / major adverse impact at all medium and high sensitivity receptors.</td></tr>
<tr><td colspan="2">CHAPTER 11: Water Quality</td></tr>
</table>

Potential Effects	Summary of Proposed Mitigation
There is the potential for increased suspended sediment during the construction works of the breakwater and the dredging process. Any sediment plumes generated during disposal are expected to be limited but may result in a temporary increase in turbidity. The presence of physical alterations within a waterbody has the potential to impact on the hydromorphology of the waterbody. Dredging activities associated with the Proposed Development are likely to produce noise which is likely to disturb species in the area resulting in temporary, localised impact. There is potential for accidental oil/ fuel spillages on site due to increased vessel presence and associated fuel storage.	• SEPAs standing advice for "Construction Activities – Pollution Prevention" should be used. • Mitigation measures required to reduce the potential impacts from noise have been identified and included and the impacts of dredging and suspended solids on general marine life. These measures follow the Joint Nature Conservation Committee recommendations and guidance for minimising risk to marine wildlife (JNCC, 2010). • No losses of concrete (cement) to the waters will be permitted during the works. • Fuel, oil and chemical storage must be sited on an impervious base within a bund and secured. The base and bund walls must be impermeable to the material stored and of adequate capacity. GPP2 shall be implemented to ensure safe storage of oils and chemicals. • The safe operation of refuelling activities shall be in accordance with PPG 7 "Safe Storage – The safe operation of refuelling facilities" (Environment Agency, 2011b). • With regard to potential oil spills during construction, an emergency spill kit and oil spill containment equipment will be located at strategic locations adjacent to the works. • An Oil Spill Contingency Plan which must be adhered to by all staff including those employed to carry out works. Its primary purpose is to set in motion the necessary actions to stop or minimise the discharge and to mitigate its effects. Effective planning will ensure that the necessary actions are taken in a structured, logical and timely manner. • Given that there will be berthing of oil, gas and renewables supply vessels and associated refuelling, a full retention oil separator is recommended to mitigate for the potential impacts of fuel/ oil spillage or leakage. This is recommended to be maintained in accordance with the manufacturer's instructions by experienced personnel. • SEPA's Standing Advice for Construction activities – pollution prevention has been consulted and will be adhered to. • The contractors Environmental Clerk of Works will be required to monitor mitigation measures and auditing of the contractor's environmental controls will be undertaken by the clients representative. • A 'Seagrass Compensation and Monitoring Plan' has been proposed to counter the direct habitat loss predicted to occur as a result of the Proposed Development. This will ensure that the loss of existing seagrass habitat is compensated ensuring no net loss of habitat.
CHAPTER 12: Flood Risk	
The existing slipway and pier are currently at risk of coastal flooding, and this will still be the case with the Proposed Development. Minor local changes to the currents are expected around the breakwater such as an increase in the current velocity around the structure.	• Contractor to sign up to SEPA's Floodline flood warning service in order to get notified when the area is at risk of flooding. • Use the Scottish Flood Forecast by the Scottish Flood Forecasting Service (SFFS), which provides 3-day flood forecasts and is updated daily. • Tidal warning will be the key mitigation measure for the operation of the site. The Floodline Warning Service and the Scottish Flood Forecast as described above can be used.
CHAPTER 13: Coastal Processes	
Scour around the toe of the breakwater. Sediment build up to the northern side of the breakwater (infilling the dredged pocket).	• Scour protection is proposed as part of the operational phase of the Proposed Development to mitigate the impact of scour around the toe of the breakwater during periods of maximum flood velocity which would be expected during a 1 in 1 year 240° storm event during the flood tide. • Maintenance dredging would be required after construction is completed. The frequency of maintenance dredging would be established as part of the construction contract following the construction of the breakwater.
CHAPTER 14: Population & Human Health	
Construction noise is predicted to be within limits set to be protective of health and the environment in most	• Mitigations measures related to noise impacts are included in Chapter 10.

Potential Effects	Summary of Proposed Mitigation
cases. However, when considering a worst-case scenario, Chapter 10 identifies that there is potential for construction noise to exceed limits (both day-time and night-time) at a small number of individual receptors that are located closest to the construction activities, with the receptors most likely to be impacted being non-residential.	• A CEMP will be produced as part of application process. The CEMP will outline how the effects of construction can be managed by good practice and environmental controls which are routinely and successfully applied on other similar development proposals. • The CEMP should also set out a clear plan for managing access to the Sound of Iona during construction. This would include designating safe alternative transport routes and appropriately communicating these to local populations (including through the use of Gaelic materials). • The CEMP should also set out a plan for engagement with the local population. This could include information on timings updates, affects to any services/deliveries/access and a complaints procedure. Engagement should be culturally appropriate, including provision of non-technical information and communication in Gaelic. • Opportunities to include the local population in construction of the Proposed Development can be beneficial for health. Actions to ensure positive outcomes include providing opportunities for training and upskilling as well as prioritisation of hiring for local populations.
Disruption or disturbance to recreation could effect the vulnerable sub-population (dependents with children or people with existing poor physical or mental health).	
There is the potential for construction to affect sea users including sea kayakers and sail boats which are used for leisure boating and recreation in the Sound of Iona. This effect would possibly occur during dredging or when there is other disruption in the construction area. This change would mostly affect residents in the local community.	
CHAPTER 15: Landscape & Visual	
No specific landscape mitigation measures have been proposed as part of the Proposed Development. The design of the Proposed Development has “built-in” mitigation through steps such as optimising the new breakwater height to maintain as low a height as possible and the use of natural rock to form the breakwater. The minimal lighting required for safety has been provided.	
CHAPTER 16: Cultural Heritage	
stripping of topsoil for the compound may result in the disturbance of features associated with An Eala, in particular a revetting wall and possible ditch.	• A reporting protocol has been developed to allow for the reporting and thereby appropriate recovery and recording of any cultural material encountered during the construction phase below the high-water mark. • Potential construction impacts above the high-water mark can be avoided by relocating the compound or be mitigated through a programme of archaeological works. • A programme of archaeological work would offset the physical loss or disturbance of features affected by allowing for them to be recorded appropriately, with reporting to an appropriate level. • Works must be undertaken in line with a Written Scheme of Investigation (WSI) agreed with WoSAS and approved by the Local Planning Authority.
The change in setting of heritage assets including Iona Nunnery, MacLean’s Cross, St Mary’s Abbey and Replica of St John’s Cross.	
Change of appearance / character of Iona Conservation Area.	
CHAPTER 17: Waste	
There is the potential for quantities of materials to be deposited in landfill sites.	• Argyll & Bute Council and their appointed contractor will ensure that all waste materials leaving the site will be transported via road by a registered and licensed carrier and arrive at a licensed / permitted site. Waste will only be disposed or recovered through licenced operators and in accordance with national waste legislation. • Site Waste Management Plan (SWMP). • CEMP. • Construction Phase Monitoring.
The use of non-permitted waste contractors or unlicensed facilities could give rise to inappropriate management of waste and result in environmental impacts/ pollution.	
Excess materials and packaging, over-ordering materials, off-cuts, damaged materials and poor storage during the construction phase.	

Potential Effects	Summary of Proposed Mitigation
The proposed development would support a slight increase in tourism using the ferry service and fishing/commercial vessels using the berthing opportunities which would result in a slight increase in litter and waste generation.	
CHAPTER 18: Greenhouse Gas Assessment	
Potential impacts during the construction phase could include: • Inaccessible construction site due to severe weather events (flooding, snow and ice, storms) restricting working hours and delaying construction; • Health and safety risks to the workforce during severe weather events; • Unsuitable conditions (due to very hot weather or very wet weather, for example) for certain construction activities; and • Damage to construction materials, plant and equipment, including damage, material storage areas and worksites, for example from stormy weather.	• Operational Environmental Management Plan (OEMP) - An OEMP will be developed to guide ongoing operations and maintenance activities during the life-cycle of the Project. The OEMP will also set out the procedures for managing and delivering the specific environmental commitments as per each technical chapter for each receptor over the operational period. • Adherence with the International Convention for the Prevention of Pollution from Ships (MARPOL) - All vessels will adhere to MARPOL requirements. Accordance with this will help to ensure that the potential for release of pollutants is minimised during operations. • Adherence with the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (the 'BWM Convention').
Potential impacts on the Proposed Development during the operational phase include: • Material and asset deterioration due to high temperatures; • Health and safety risks to ferry users; • Damage to access roads from periods of heavy rainfall; and • Flood risk (surface, groundwater, fluvial and snow/ice melt) on the road network and damage to drainage systems with the potential for increased runoff from adjacent land contributing to surface water flooding.	
CHAPTER 19: Risk of Major Accidents & Disasters	
Major boat/construction vessel collision/allision (either with existing infrastructure, new infrastructure, other vessels or running aground).	• Lighting at the end of the Breakwater – to avoid contact between vessels and the breakwater during the operation phase. • Scour protection – to reduce scour around the toe of the breakwater and avoid damage and movement of rock armour. • Type and sources of construction materials – constructing the breakwater from clean quarried local rock should help reduce the risk of pollution during construction phase and reduce transport distances.
Accident to the general public on or near the shoreline.	
Man overboard during construction.	

Potential Effects	Summary of Proposed Mitigation
Major pollution or sedimentation event affecting nearby designated sites. Scour of the toe of the breakwater leading to movement and/or damage that could cause a health & safety risk.	• Utilities infrastructure – avoidance of sewer, telecommunications, gas and electricity infrastructure during construction is key as well as incorporating any existing infrastructure into the project design to avoid any unnecessary risks. • Safety fencing – to keep the general public away from construction areas or areas of potential danger. • Safety Boat – to help avoid collisions between vessels and contact with the shoreline or infrastructure during the construction phase. • Navigational Aids – to help avoid collisions between vessels and contact with the shoreline or infrastructure during both the construction and operation phase. • Safety lighting – to help avoid collisions between vessels and contact with the shoreline or infrastructure during both the construction and operation phase. • AIS coverage – to help avoid collisions between vessels during the construction phase. • Weather forecasts and operational weather limits – to avoid hazardous conditions during construction. • Updating ALRS and signalling directions – to help avoid collisions between vessels and contact with the shoreline or infrastructure during both the construction and operation phase. • Pollution response equipment – to help quickly respond to a major pollution event during the construction phase • SEPA's Floodline Warning Service – to be aware and plan for coastal flood events during the construction phase. This service also includes information on tidal extremes and may also be useful during the operation phase. • ECoW – appointed to monitor the works in respect to biodiversity and species in the area. • Correct and secure storage of fuels, oils and chemicals – must be sited on an impervious base within a bund and secured. The base and bund walls must be impermeable to the material stored and of adequate capacity. • Marine Liaison Officer – to provide a point of contact for the marine works providing safety information to vessels in the area during the construction phase. • Notices to mariners – to provide details of construction activities. • Passage and operational planning – to provide details of altered routes during the construction and operation phase and scheduling construction activities to reduce disruption. • Communicating with stakeholders – to inform locals of movement of buoyed areas during the construction phase. • Navigation safety management process – to help manage vessel movements during the construction phase. • Adherence to a CEMP. • Adherence to an Operational Environmental Management Plan (OEMP). • Adherence to an EMP. • Ensure waste arisings from the construction phase (especially with sediment disposal) are dealt with in a sustainable and legislatively compliant manner. • Oil Spill Contingency Plan – to set in motion the necessary actions to stop or minimise the discharge and to mitigate its effects. • The safe operation of refuelling activities shall be in accordance with PPG 7 "Safe Storage". • Adherence with the International Convention for the Prevention of Pollution from Ships (MARPOL) – to help to ensure that the potential for release of pollutants is minimised during operations. • Adherence to a SWMP. • Construction Phase Monitoring.

3 MANAGEMENT OF ENVIRONMENTAL IMPACT

3.1 Roles and Responsibilities

ABC intends to appoint a Contractor(s) to undertake construction activities. Mitigation measures set out in the oCEMP will form part of the Contract Documents for the construction phase to ensure that the Contractor(s) undertakes works required to implement the mitigation measures.

ABC will appoint a suitably qualified person to the role of Environmental Clerk of Works to monitor the Iona Breakwater Project construction works. The Environmental Clerk of Works will provide monthly reports to ABC, or as deemed necessary. The Environmental Clerk of Works will work closely with the Contractor's site supervisors to monitor activities and ensure that all relevant environmental legislation is complied with and that the requirements of the CEMP are implemented. The Environmental Clerk of Works will have the authority to review method statements, oversee works and instruct action, as appropriate, including the authority to require the temporary cessation of works, where necessary.

3.2 Hours of Working

Where construction activities take place for the development in the vicinity of residential properties, the activities will operate between the hours of 07:00 and 19:00 on Mondays to Fridays, between 07:00 and 13:00 on Saturdays and there will be no activity on Sundays or Bank Holidays in accordance with the requirements of the EIAR. Day-time noise levels should not exceed the threshold limit of 65dB.

Where additional working hours, such as night-time working (23:00 – 07:00) are required, noise levels should remain below the threshold limit of 45dB.

All affected residents and stakeholders shall be notified on receipt of any approved derogations including the rationale for the extended working hours.

3.3 Approach to Community Engagement

ABC are in regular engagement with local community groups and local fishermen. This engagement should continue throughout the duration of the Proposed Development.

3.4 Construction Phase Monitoring

Navigation & Safety:

During the marine works there is a risk of lifting gear failure whilst a load is slung or a heavy load is transferred between vessels, a vessel and the marine works, or rock is placed along the breakwater. The prevailing weather conditions will be the main factor leading to this impact occurring; especially high wind conditions affecting cranes, and large swell causing movement of vessels. Monitoring of weather conditions should be undertaken to track operational weather limits (maximum wind/ wave limits for construction).

Marine Biodiversity:

Permanent habitat loss arising from the placement of material on the seabed for the breakwater is likely to have a significant effect on the seagrass Priority Marine Feature found within the breakwater footprint. As the receptor is being directly affected due to the placement of rock armour, there will be no possibility of being able to mitigate for this loss. A ‘Seagrass Compensation and Monitoring Plan’ is therefore required to assess and reduce the impact where possible.

Noise:

Construction noise monitoring will be undertaken as part of noise control planning at nearby sensitive receptors.

Water Quality:

The contractors Environmental Clerk of Works will undertake regular checks and monitoring of grab samples, while auditing of the contractors’ environmental controls will also be undertaken by the clients representative.

Waste:

Records will be kept for each waste material which leaves the site, whether for reuse on another site, recovery, recycling or disposal. A system will be put in place to record the waste arising on site during the construction phase. The following should be recorded:

- Waste taken off-site for reuse;
- Waste taken off-site for recovery;
- Waste taken off-site for recycling; and
- Waste taken off-site for disposal.

For each movement of waste off-site a signed waste collection docket will be obtained from the waste contractor. This will be carried out for each material type. This system will also be linked with the delivery records. A signed waste acceptance docket will be issued for each movement of waste on-site.

If waste movements are not accounted for, the reasons for this shall be established in order to see if and why the record keeping system has not been maintained. Each material type will be examined in order to see where the largest percentage waste generation is occurring. The waste management methods for each material type will be reviewed in order to highlight how the targets can be achieved.

The contractor will be responsible for conducting an audit of the waste practices at the site during the construction phase of the development.

Upon completion of the construction phase a final report will be prepared summarising the outcomes of waste management processes adopted and the total recycling/ reuse/ recovery figures for the development.

3.5 Environmental Management Plans

3.5.1 <Redacted> Species Protection Plan

The following guidelines will be complied with throughout the construction phase of breakwater to ensure impacts to <Redacted> and their habitats are limited:

- An ECoW should be present on site to oversee enabling works and construction including dredging works; and contribute to all relevant construction method. They should be a suitably experienced individual, whose role would ensure works are carried out in accordance with the CEMP produced for the Proposed Development, ensuring compliance with international and national legislation and planning conditions. Once works are underway, the ECoW would work full time on site providing ecological and pollution control advice and supervision for all relevant mitigation measures;
- No work should be carried out within 30m of any <Redacted> shelter or 200m of any breeding <Redacted> except under license from NatureScot. Should a licence be required for any works, the ECoW will be responsible for ensuring compliance with any licensing conditions;
- No works resulting in large scale noise or vibration such as pile driving or blasting should be undertaken within 100m of any <Redacted> shelter, unless under license from NatureScot;
- Ensure all rubbish and materials will be collected and removed from site on a regular basis to prevent trapping or injury of any wildlife;
- Any excavations, including trenches and trial pits more than 0.5 m deep will be covered in the evening to prevent animals falling in. Where pits and trenches cannot be closed or filled on a nightly basis, ensure that a plank is placed into the excavation so an animal can use this as a means of escape if necessary;
- Any open pipes, whether installed or being stored, should be closed to prevent any animals entering and becoming trapped;
- In the unlikely event of discovering any evidence suggesting <Redacted> presence within the footprint of the works, work must stop immediately and the ECoW should be contacted for advice on how to proceed;
- Night working should be avoided wherever possible. Where this is not possible, lighting should be focussed on the works area(s) and directed away from water and areas of potential <Redacted> foraging. Lighting should be kept to an absolute minimum within 100m from any identified <Redacted>
- Toolbox talks on <Redacted> should be given to all construction staff on site and an emergency procedure protocol given to contractors in the event of encountering an <Redacted> or discovering a new shelter; and
- If <Redacted> or new shelters are recorded during construction, all of the following emergency procedure must be adhered to:
    - All works, in the vicinity of the <Redacted> are to stop immediately and the ECoW contacted;
    - The ECoW will review the situation and install the relevant exclusion zone and timings;

- Should micrositing of works outwith exclusion zones applied to new shelters not be possible, an application to NatureScot will be required;
- Consultation with NatureScot will be undertaken, if required;
- Mitigation measures additional to those already in place may be required;
- Incident, outcomes and recommendations will be recorded; and
- Works will only recommence following advice from the ECoW. In the unlikely event of an <Redacted> being injured or killed, or shelters damaged, the ECoW will be contacted immediately. They will attend the site and make a written and photographic record. This will record the time, location, personnel involved, and the details of the incident. This information will be supplied within 24 hours to NatureScot and the developer.

3.5.2 Invasive Non-Native Species Management Plan

A document detailing how the risk of potential introduction and spread of Invasive and Non-Native Species (INNS) should be produced. The plan will outline measures to ensure vessels comply with the International Maritime Organization (IMO) ballast water management guidelines, it will consider the origin of vessels and contain standard housekeeping measures for such vessels as well as measures to be adopted if a high alert species is recorded.

Plant, equipment and material (where required) will follow the ‘check, clean, dry method’.

3.5.3 Seagrass Compensation and Monitoring Plan

A Seagrass Compensation and Monitoring Plan will be implemented as part of the Proposed Development in order to counter the direct habitat loss predicted to occur. This will ensure that the loss of existing seagrass habitat is compensated ensuring no net loss of habitat. An assessment has already been undertaken in the form of the intertidal and subtidal survey, with the extent of biotopes derived. This data will be used to inform the plan.

order. Machines in intermittent use will also be shut town in the intervening periods between work.

3.5.4 Site Waste Management Plan (SWMP)

Construction waste will be managed as part of a SWMP, prepared and implemented by the appointed contractor for the duration of the construction works. The SWMP will contain procedures for the management of waste and assist with providing a complete audit trail. The SWMP will be a live document and will be subject to revision throughout the course of the construction phase.

The SWMP will:

- Include specific details on the projected waste types and subsequent management;
- Identify and capture the decisions made in the design process to reduce waste generation;
- Identify the methodologies for waste management at each stage of the project;

- Identify how the waste will be dealt with (i.e., disposal, re-use on/off site etc.); and
- Identify potential end markets e.g., reuse, recycling facilities, waste treatment facilities and disposal sites.

The SWMP will specify procedures for:

- On-site segregation of waste at source where practical;
- On-site segregation of waste materials into appropriate categories;
- On-site segregation of non-hazardous waste materials into appropriate categories such as:
  - Metals;
  - Timber.
- On-site segregation of any hazardous waste materials into appropriate categories such as:
  - Any contaminated soils;
  - Waste oil and fuels;
  - Paints, glues, adhesives and other known hazardous substances.

The SWMP will additionally specify:

- Measures to ensure monitoring and updating of records under Duty of Care requirements;
- Measures to avoid over-ordering and generation of surplus waste materials;
- Measures to ensure appropriate staff training and levels of awareness in relation to waste management;
- Measures and procedures to monitor waste flows on site;
- Steps to be taken with materials suppliers to reduce the amount of packaging or to participate in a packaging take-back scheme;
- Implement a 'just in time' materials delivery systems to avoid materials being stockpiled, which increases the risk of their damage and disposal as waste;
- All waste materials will be stored in skips or other suitable receptacles in designated areas of the site. The waste storage area(s) will be assigned, and all construction staff provided with training regarding the waste management procedures on commencement of the project.

All waste leaving the site will be recycled, recovered or reused where possible, with the exception of those waste streams for which appropriate facilities are currently not available.

Waste streams will be collected by an appropriately licensed and permitted private waste contractor, appointed by the contractor for recycling, recovery or disposal at suitably licensed facilities.

3.6 Operational Environmental Management Plan (OEMP)

An OEMP will be developed to guide ongoing operations and maintenance activities during the life-cycle of the Project. The OEMP will also set out the procedures for managing and delivering the specific environmental commitments as per each technical chapter for each receptor over the operational period.

4 SITE SAFETY

4.1 Weather and Working Conditions

4.1.1 Weather Forecasting

The contractor to sign up to SEPA's Floodline flood warning service in order to get notified when the area is at risk of flooding (tidal warning). In addition, the contractor must use the Scottish Flood Forecast by the Scottish Flood Forecasting Service (SFFS), which provides 3-day flood forecasts and is updated daily. Weather forecasting service will be regularly monitored to indicate any periods of upcoming adverse weather conditions. Appropriate actions will then be taken to mitigate any potential situations that may arise. These actions should be documented in the safety management system, detailing the specific weather conditions that will necessitate action(s).

4.1.2 Operational Weather Limits

Operational weather limits will be set to ensure work is not carried out when conditions are considered to be unsafe. These limits will be dictated by maximum wave and wind limits and will be detailed in the contractor's Risk Assessment Method Statement.

4.2 Health & Safety

Safety will be of prime importance during the construction phase of the Proposed Development. The works will be subject to the Health and Safety at Work Act 1974. All aspects of design construction will be reviewed with regard to health and safety and a risk assessment will be carried out.

A Project Supervisor (Design Process) will be appointed by ABC to produce a pre-tender Health and Safety Plan for the project. The Principal Contractor will be responsible for the control and coordination of health and safety during the works and will be appointed as the Project Supervisor (Construction Stage).

All individuals working on the Project will be required to undertake induction procedures. Such will be designed to make individuals aware of all the issues associated with the Project and will include, but not be limited to:

- The terms of the CEMP;
- Marine safety;
- Working hours;
- Access arrangements;
- Health, safety and environmental policy procedures;
- Code of conduct within the site and surrounding area;
- Statutory obligations of individuals on site;
- Public access;
- Lighting requirements;

- Complaints and disciplinary procedures;
- Protection of the water environment;
- Protection of wildlife and habitats;
- Noise; and
- Emergency procedures.

Visitors will not be allowed onto the site unless demonstrating they have undertaken appropriate construction site Health & Safety training and have received formal induction or are accompanied by and authorised person who has completed the induction. All visitors will be required to sign a visitor's book.

5 CONCLUSION

This oCEMP sets out the overall management strategy for the Proposed Development. The oCEMP aims to ensure the management of pre-construction and construction activity is carried out in a planned, structured and considerate manner which minimises the impacts of the works on the local environment, residents and commercial activities in the vicinity of the site. Due to the nature of construction works, there may be unforeseen events which occur at the site and the project team will actively manage any changes and discuss with the relevant authorities, where required. The project team are committed to ensuring that the construction activities to be carried out are pro-actively managed so as to minimise potential impacts.