Shetland Tidal Array Decommissioning Environmental Monitoring and Mitigation Plan (T1-3)

Version 1.0

Document control

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1.0	08/02/2023	First version, produced to support application for a Marine Licence.

Notice

Contents

1 Non-technical summary

Nova Innovation has produced this Decommissioning Environmental Monitoring and Mitigation Plan (DEMMP) to set out the measures that will be taken to ensure that the decommissioning of the three geared M100 turbines in the "Shetland Tidal Array" in the Bluemull Sound, Shetland will not result in harm to the marine environment.

This DEMMP sits alongside the Project Environmental Monitoring Plan (PEMP)[1] already in place for the Shetland Tidal Array. The PEMP describes the methods and techniques used to monitor and proactively manage the environmental effects of the project during operational and maintenance phases of the Shetland Tidal Array (including moving turbines within the array).

Decommissioning will involve complete removal of each of the three M100 turbines (T1, T2 and T3) in turn. The turbine nacelle, substructure and cable will be removed from the seabed and taken to shore for recycling or disposal. The three M100-D direct drive turbines (T4, T5 and T6) and associated infrastructure (subsea hub and cables) in the Shetland Tidal Array will not be decommissioned and will remain *in situ* on the seabed.

Full details of the equipment to be decommissioned, and the vessels and equipment that will be used in decommissioning operations are provided in a Decommissioning Schedule and Method Statement, with a summary provided in this document.

Most of the procedures and stages to decommission the three M100 turbine involve routine tasks and operations carried out at the Shetland Tidal Array since 2016 under the existing Project licences, which include:

1. Shetland Islands Council Works Licence 2022/015/WL, issued by Shetland Island Council (SIC) under the Zetland County Council Act 1974 for offshore works associated with the Shetland Tidal Array.
2. Marine Licence MS-00009110 issued by Marine Scotland Licensing Operations Team (MS-LOT) under the Marine (Scotland) Act 2020, Part 4 for construction and operation of the Shetland Tidal Array. This licence also covers routine maintenance and moving turbines within the array.

Nova's previous experience of similar operations and the modular nature of the turbines means that small work vessels can be used and work will be carried out safely and efficiently. Decommissioning the three turbines and cables is expected to be completed over one vessel mobilisation, lasting approximately two weeks.

The activity is not expected to result in any adverse harm to the marine environment, but additional precautionary measures that will be taken are set out in this document, which has been informed by an Environmental and Protected Species Risk Assessment for the decommissioning works. Details of the post-decommissioning monitoring that will be carried out to ensure and demonstrate that all project infrastructure has been removed from the seabed are also provided in this document.

[1] Nova Innovation (2022). Shetland Tidal Array Project Environmental Monitoring Plan (PEMP). Version 6.0. Approved by MS-LOT 07/07/2022.

2 Summary of decommissioning works

2.1 The proposed activities

The Shetland Tidal Array currently comprises six 100 kW tidal turbines (T1 to T6), a subsea hub and associated cables, located in Bluemull Sound, Shetland. The proposed activities will involve the complete removal from the seabed of the following infrastructure associated with the three geared M100 turbines (T1, T2 and T3):

1. Turbine nacelle and rotor.
2. Gravity-base substructure.
3. Power export cable.

Full technical details of the proposed decommissioning activities and methodologies are set out in a Decommissioning Schedule and Method Statement[2] provided in support of Nova's application for a Marine Licence to decommission the three M100 turbines and cables.

The decommissioning works are expected to be fully completed over one vessel mobilisation lasting approximately two weeks, in April-June 2023. Weather conditions or vessel availability may affect this planned schedule.

Decommissioning will only involve the removal of T1, T2 and T3 and associated export cables. T4, T5 and T6 and associated infrastructure (subsea hub and cables) will not be decommissioned and will remain *in situ* on the seabed.

2.2 Location

The Shetland Tidal Array is located in the Bluemull Sound, between the Shetland Islands of Yell and Unst. The array site is east of the Ness of Cullivoe. Figure 2-1 shows the location of the tidal array lease area and cable corridor.

At the time of writing, the Shetland Tidal Array comprises the three M100 (geared) turbines (T1, T2 and T3) and three M100-D (direct drive) turbines (T4, T5 and T6). A subsea hub with export cable has also been installed, connected via jumper cables to the fifth and sixth M100-D turbines. In total there are five export cables back to the landfall at Cullivoe Pier. Figure 2-2 shows the "as-installed" positions of the turbines and cables in the array.

[2] Nova Innovation (2023). Shetland Tidal Array Decommissioning Schedule and Method Statement (T1-3).

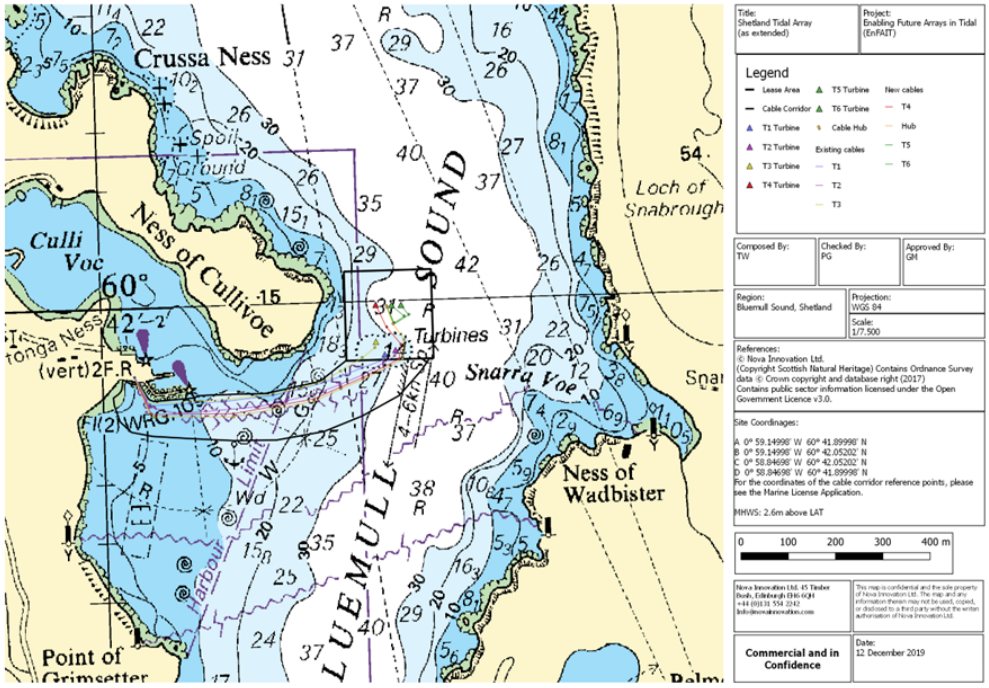


Figure 2-1: Project Location showing boundary of lease area and cable corridor

Source: Copyright © Nova Innovation 2023; Admiralty Chart

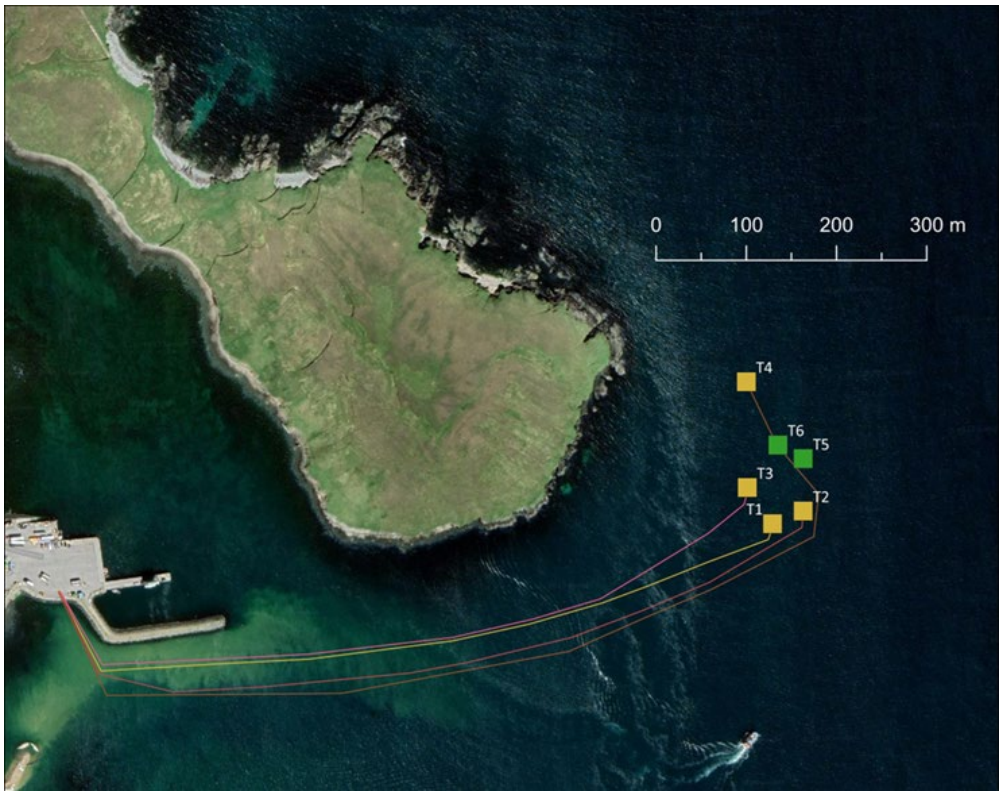


Figure 2-2: Shetland Tidal Array installed layout, including six turbines and five export cables.

Source: Copyright © Nova Innovation 2023

2.3 Overview of the decommissioning process

Recovery and removal of each of the three M100 turbines from the seabed in Bluemull Sound will take place in a series of carefully managed steps, as follows:

1. The nacelle is physically unlatched, electrically isolated, and lifted by the vessel from the turbine foundation to the surface. The cable is then disconnected at the surface and temporarily wet-stowed on the seabed while the nacelle is recovered to shore.
2. A lifting beam is lowered from the vessel and attached to the gravity-base substructure, which is lifted by the vessel and removed to shore.
3. The cable is recovered separately by the vessel, spooled onto a drum and taken to shore. Any cable protection is also removed with the cable.
4. The shore end of the cable is cut and pulled through the intertidal zone via the spool on the vessel.

Once onshore all components will be recycled, repurposed or disposed of in accordance with relevant recycling and waste disposal procedures.

All parts of the array will be removed from the seabed during decommissioning. The seabed and surrounding locality will return to their natural state with no permanent impact from the devices. The offshore site will be surveyed to confirm all equipment has been removed.

Full technical details of the proposed decommissioning activities and methodologies are set out in a Decommissioning Schedule and Method Statement[3] provided in support of Nova's application for a Marine Licence to decommission the three M100 turbines and cables.

The decommissioning works are expected to be fully completed over one vessel mobilisation lasting approximately two weeks, in April-June 2023. Weather conditions or vessel availability may affect this planned schedule.

[3] Nova Innovation (2023). Shetland Tidal Array Decommissioning Schedule and Method Statement (T1-3).

3 Potential environmental effects of decommissioning

An Environmental and Protected Species Risk Assessment for the decommissioning works[4] considered the potential environmental effects of the proposed activities. In addition to assessing general effects of decommissioning the three turbines and cables on the marine environment, this assessment also considered the potential for effects on the following:

- Priority Marine Features (PMF).
- Marine Natura sites including Special Areas of Conservation (SAC) and Special Protection Areas (SPA).
- Nature Conservation Marine Protected Areas (MPA).
- Protected species, including Nationally Protected Species (NPS) and European Protected Species (EPS).

The conclusions of this assessment are provided in Table 3-1, with an indication of whether mitigation measures are required to avoid adverse environmental effects. Full details of mitigation measures are provided in the next section.

Table 3-1 Summary of an Environmental and Protected Species Risk Assessment for decommissioning the three M100 turbines in the Shetland Tidal Array.

Potential effects of decommissioning	Assessment of likely effects and overview of mitigation measures
Mammals	
Disturbance to marine mammals due to physical presence of vessel and decommissioning activity.	Potential for minor, short-term disturbance to marine mammals if present at the site during decommissioning. However, only a single small Multicat vessel will be on site during decommissioning and Bluemull Sound is an active channel for shipping, with the Project site located next to a busy port (Cullivoe). Any additional vessel disturbance as a result of the proposed activities is unlikely to surpass normal background levels. Works are expected to be completed over a two-week period in April-June 2023 so any disturbance will be short-term and temporary in nature. While decommissioning is currently planned to be carried out during the breeding and pupping/calving season for some species, including harbour seal and harbour porpoise, the long-running environmental monitoring programme carried out at the Shetland Tidal Array indicates that Bluemull Sound is not a critical or important habitat for these species and that similar ongoing activity at the site since 2016 has not resulted in significant disturbance to adults or juveniles. Precautionary mitigation measures will ensure that there will not be any significant disturbance to EPS, so the project will not be detrimental to the maintenance of the populations of relevant EPS at a favourable conservation status in their natural range. Precautionary measures will also ensure against disturbance to any juvenile marine mammals and mothers if present in the site. Measures will prevent adverse effect on the harbour seal feature of the Yell Sound Coast SAC and marine mammal PMFs.

[4] Nova Innovation (2023). Shetland Tidal Array Decommissioning Environmental and Protected Species Risk Assessment.

Potential effects of decommissioning	Assessment of likely effects and overview of mitigation measures
Disturbance to marine mammals due to underwater noise and vibration generated by decommissioning activity.	Recovery of the turbines and export cables from the seabed will not require any noisy activities such as drilling and involves simple lifting of infrastructure from the seabed. Similar activities have been carried out throughout the construction and operational phases of the Shetland Tidal Array since 2016. The temporary and short duration of the decommissioning activities, the lack of any noisy marine works and the use of a small Multicat vessel mean the potential for disturbance to marine mammals by noise or vibration generated by decommissioning is negligible. No further mitigation is required.
Disturbance to otter during intertidal cable recovery operations.	These works will be limited to retrieving the shore end of each cable, so will be very spatially and temporally restricted. This, combined with the fact that the cable landfall is in the Cullivoe harbour area, which is already busy with significant activity means that retrieving the shore end of each cable is highly unlikely to disturb otter. No further mitigation is required.
Marine birds	
Disturbance to marine birds due to physical presence of vessel and decommissioning activity.	Potential for minor, short-term disturbance to marine birds if present at the site during decommissioning. However, only a single Multicat vessel will be on site during decommissioning and Bluemull Sound is an active channel for shipping, with the Project site located next to a busy port (Cullivoe). Any additional vessel disturbance as a result of the proposed activities is unlikely to surpass normal background levels. Works are expected to be completed over a two-week period in April-June 2023 so any disturbance will be short-term and temporary in nature. While decommissioning is currently planned to be carried out during the breeding season for many species, including some that are PMFs or features of protected sites (e.g., SPAs and the Fetlar to Haroldswick MPA), the long-running environmental monitoring programme carried out at the Shetland Tidal Array indicates that Bluemull Sound is not a critical or important foraging habitat for any of these species and that similar ongoing activity at the site since 2016 has not resulted in significant disturbance to birds. Any minor disturbance is not expected to affect the integrity or conservation status of these populations. Precautionary mitigation measures will ensure that there will not be any significant disturbance if large numbers of newly fledged birds are present at the site during decommissioning.
Benthic habitats and species	
Damage and loss of benthic habitat during decommissioning.	Removal of infrastructure from the seabed including turbine substructures and cables will result in localised disturbance to benthic habitats and species. Turbines and cables will have become colonised by epifaunal species typical of the area, so this habitat will be lost during decommissioning. However, the highly tide swept nature of the seabed and availability of hard substrate in the area means that areas of seabed under the old footprint of the decommissioned equipment will quickly become recolonised resulting in no net loss of biodiversity. No Priority Marine Features (including maerl or horse mussel) have been identified in any surveys at the Project site. Surveys have been undertaken routinely at the site during all offshore operations since 2016. A drop-down video survey will be carried out after decommissioning to confirm that all equipment and infrastructure has been removed from the seabed. No further mitigation is required.

Potential effects of decommissioning	Assessment of likely effects and overview of mitigation measures
Increased sedimentation caused by decommissioning.	There is potential for short-term and temporary increases in turbidity and sedimentation as the turbine substructures and cables are recovered from the seabed. However, the highly tide swept nature of the area and hard substrate typical of the project area (including under the footprint of the turbines and cables) means that any sediment levels in the area are expected to be very low and any sediment remobilised during works will quickly disperse. No Priority Marine Features (including maerl or horse mussel) have been identified in previous surveys of the Project site. Surveys have been undertaken routinely at the site during all offshore operations since 2016. Any limited short term effects are highly unlikely to affect the benthic features of the Fetlar to Haroldswick MPA. No further mitigation is required.
Accidental damage to benthic habitats by objects dropped during decommissioning.	Nova's decommissioning programme has been carefully planned to ensure that all works will be carried out in a manner that is safe and responsible. Contingency has been incorporated into all steps of the decommissioning process to safeguard against dropped objects. In the extremely unlikely event that any objects are dropped to the seabed, all material will be safely and fully retrieved. Benthic habitats at the Project site are typical of the tide swept conditions, so would be expected to recover quickly from any such events. No Priority Marine Features (including maerl or horse mussel) have been identified in previous surveys of the Project site. Surveys have been undertaken routinely at the site during all offshore operations since 2016. Standard dropped objects procedures would be followed, as per the requirements of Marine Licence MS-00009110. No further mitigation is required.
Accidental spread of Invasive Non-native Species (INNS) by vessels during decommissioning.	Vessels engaged in decommissioning could inadvertently introduce INNS to Bluemull Sound and the surrounding area. However, the vessels to be used in decommissioning will be based in the Northern Isles and operated by reputable companies with ISO 14001:2015 environmental management systems accreditation, sound environmental policies[5] and their own biosecurity good practice measures. Nova also has a biosecurity plan in place for the Shetland Tidal Array, provided in Annex A to this document. No further mitigation is required.
Accidental spread of Invasive Non-native Species (INNS) due to contaminated equipment used during decommissioning.	Equipment to be used in decommissioning could be contaminated with INNS and risk inadvertent introduction to Bluemull Sound. Temporary moorings (e.g., chains) and other specialist equipment used during decommissioning will be sourced from Shetland or pressure washed / air dried prior to use in Bluemull Sound. Vessel operators for decommissioning will be reputable companies with ISO 14001:2015 environmental management systems accreditation, sound environmental policies and their own biosecurity good practice measures. Nova also has a biosecurity plan in place for the Shetland Tidal Array, provided in Annex A to this document. No further mitigation is required.

[5] For example, see Leask Marine (2019). Environmental Policy Statement. https://www.leaskmarine.com/about/company-policy-statements/

Potential effects of decommissioning	Assessment of likely effects and overview of mitigation measures
Accidental spread of Invasive Non-native Species (INNS) due to contaminated project infrastructure during decommissioning.	Turbines and cables will have become colonised by epifaunal species typical of the area, so there is a risk that this may include INNS. Visual inspections will be carried out when turbines and cables are removed from the water. Laminated "pest ID cards", held on site at Cullivoe will assist staff carrying out the inspections in identifying particularly invasive non-natives. Biological material is removed as standard from turbine nacelles and substructures (on Cullivoe or Belmont Pier), to avoid dangerous handling conditions. If inspections identify INNS, care will be taken to avoid contaminated material entering the marine environment. Any INNS identified will be reported to Shetland Islands Council, Marine Scotland and NatureScot. Nova also has a biosecurity plan in place for the Shetland Tidal Array, provided in Annex A to this document. No further mitigation is required.
General	
General risk of pollution through debris, waste material or chemicals entering the water during decommissioning.	No chemicals or fuel are stored on site or on vessels engaged in decommissioning. All debris or waste material (including that below MHWS) will be removed from the site at Cullivoe and disposed of responsibly. Only contractors with ISO 14001:2015 environmental management systems accreditation to be used in marine operations. No further mitigation is required.
Unexpected pollution or breaches of environmental obligations.	Any accidental pollution or breaches will be reported to Marine Scotland within 24 hours. A copy of the Shetland Pollution Contingency Plan is kept on site at Cullivoe and onboard all vessels engaged in Works. Measures in the Plan would be followed as appropriate. No further mitigation is required.

4 Environmental monitoring and mitigation

4.1 Mitigations measures

Nova is committed to best environmental practice and avoiding adverse environmental effects in all aspects of its business. Nova takes a hierarchical approach to prioritising actions to manage environmental risk, as follows:

1. Eliminate risks to the environment where possible, for example by design changes, elimination of an operation, or selection of a different working methodology.
2. Reduce the potential impact of those risks to the environment that cannot be eliminated.
3. Reduce the likelihood of those risks to the environment happening that cannot be eliminated.

Table 4-1 sets out all of the environmental mitigation and good practice measures that will be followed during the decommissioning works at the Shetland Tidal Array, based on this hierarchical approach.

Table 4-1 Environmental mitigation and good practice management measures for the decommissioning works.

Mitigation or good practice measure	Purpose and effectiveness
All personnel will adhere to the Scottish Marine Wildlife Watching Code during all offshore decommissioning works. Vigilance will be maintained for cetaceans, seal pups or large numbers of newly fledged birds in proximity to the works. Copies of the code will be onboard all vessels engaged in Works and included in site briefings.	**Purpose: to minimise or prevent disturbance to marine mammals and birds during decommissioning.** Expected to be effective. Nova's long-running environmental monitoring programme indicates low numbers of birds and mammals in Bluemull Sound so presence of mammals or large numbers of birds would be unusual/noticeable. Measure is expected to be effective at preventing general disturbance to all species. Will also prevent disturbance that could constitute significant disturbance to EPS or features of SPAs or SACs, thus avoiding impacts on the FCS of populations of these species. Will also prevent adverse effects through disturbance on marine bird and mammal Priority Marine Features.
No drilling or piling to be carried out during decommissioning, avoiding significant underwater noise or vibrations.	**Purpose: to minimise or prevent disturbance to marine wildlife during decommissioning.** Expected to be effective. The lack of activities generating noise and vibrations will ensure any disturbance to wildlife including EPS, the otter or harbour seal feature of the Yell Sound Coast SAC and mammal Priority Marine Features is minimised.
Use of a small workboat for all offshore decommissioning works.	**Purpose: to minimise or prevent disturbance to marine wildlife during decommissioning.** Expected to be effective. The use of a small boat, similar to those that operate in the area will minimise any additional disturbance caused by the short term and temporary decommissioning works.

Mitigation or good practice measure	Purpose and effectiveness
A pre-decommissioning drop-down survey will be conducted to confirm the condition of turbines and cables.	**Purpose: to ensure that decommissioning can be carried out in an environmentally responsible manner.** Expected to be effective. If any issues or hazards that could risk safe and responsible decommissioning are identified, works will be rescheduled until such time as issues or hazards have been rectified.
The pre-decommissioning drop-down survey will confirm that benthic habitats or species on the recommended Priority Marine Features (PMF) continue to be absent from the site.	**Purpose: to avoid damage to sensitive benthic habitats including PMF during decommissioning.** Expected to be effective. All previous surveys show that benthic habitats throughout the site are typical of tide swept areas with no PMFs present. In the unlikely event that any PMF is identified, MS-LOT and NatureScot will be notified and the need for further mitigation measures agreed.
A drop-down video survey of the seabed will be carried out after decommissioning to confirm that all equipment and infrastructure has been removed from the seabed.	**Purpose: to ensure benthic habitats return to their natural state following decommissioning.** Expected to be effective. The tide swept nature of the seabed and availability of hard substrate means that areas of seabed under the footprint of the decommissioned equipment will quickly become recolonised resulting in no net loss of biodiversity.
All lifting equipment used in decommissioning will be appropriately certified and all lifts and offshore operations risk assessed to minimise the risk of dropped objects during deployment and retrieval.	**Purpose: to avoid damage to benthic habitats during decommissioning through accidentally dropped objects.** Expected to be effective. Nova has been safely carrying out similar operations at the site since 2016 with no dropped objects. MS-LOT will be notified within 24 hours in the event of a dropped object event.
Northern Isles-based vessels used for marine operations, to minimise potential for transfer of Invasive Non Native Species (INNS).	**Purpose: to prevent accidental spread of INNS as a result of decommissioning.** Expected to be effective. Decommissioning vessel operators will be reputable companies with ISO 14001:2015 environmental management systems accreditation, sound environmental policies and their own biosecurity good practice measures.
All decommissioning equipment to be used below MHWS will be free from biofouling. Temporary moorings (e.g., chains) will either be sourced from Shetland or will be pressure washed or air dried prior to use in Bluemull Sound.	**Purpose: to prevent accidental spread of INNS as a result of decommissioning.** Expected to be effective. Decommissioning vessel operators will be reputable companies with ISO 14001:2015 environmental management systems accreditation, sound environmental policies and their own biosecurity good practice measures.

Mitigation or good practice measure	Purpose and effectiveness
Visual inspections for INNS will be carried out when turbines and substructures are removed from the water, following standard procedures in Nova's Biosecurity Plan (see Annex A). Laminated INNS ID cards to be used during inspections, with copies also kept on board vessels.	**Purpose: to prevent accidental spread of INNS as a result of decommissioning.** Expected to be effective. Biological material is removed as standard (on Cullivoe or Belmont Pier), to avoid dangerous handling conditions. If inspections identify INNS, care will be taken to avoid contaminated material entering the marine environment. Any INNS identified will be reported to Shetland Islands Council, Marine Scotland and NatureScot.
All debris or waste material (including that below MHWS) will be removed from the site at Cullivoe or Belmont and disposed of responsibly (recycled where possible).	**Purpose: to prevent damage to, or contamination of, the environment by debris or waste generated during decommissioning.** Expected to be effective. Once onshore all material will be repurposed, recycled or disposed of in accordance with waste disposal and recycling procedures.
No chemicals or fuel storage on site or on vessels engaged in decommissioning.	**Purpose: to prevent contamination of the environment through accidental spills or leaks.** Expected to be effective. If situation changes, materials will be stored appropriately including use of bunding if necessary.
Copy of Shetland Contingency Plan kept on site at Cullivoe and onboard all vessels engaged in Works. Measures in the Plan to be followed as appropriate.	**Purpose: to ensure appropriate and timely action in the event of an accidental spill.** Expected to be effective. All procedures in the plan are pre-determined and agreed. Any accidental pollution or breaches to be reported to Marine Scotland within 24 hours.

This table is held alongside all Project consent documentation in site files at Cullivoe and in Nova's offices and included in the operational documentation provided to offshore contractors working on behalf of Nova. All relevant operational procedures relating to environmental protection and best practice are included as standard in site briefings for Nova personnel and sub-contractors.

4.2 Monitoring

4.2.1 Purpose and objectives

Prior to decommissioning commencing, a drop-down video survey will be conducted of all M100 turbines (nacelles, substructures and cables) to inspect that their condition is suitable for decommissioning to proceed. If any issues or hazards that could risk safe and responsible decommissioning are identified, works will be rescheduled until such time as issues or hazards have been rectified.

The pre-decommissioning drop-down video survey will also confirm that sensitive benthic habitats or species, including those on the recommended Priority Marine Features (PMF) continue to be absent from the site. All previous surveys at the site have shown that benthic habitats throughout the site are typical of tide swept areas with no PMFs present. In the unlikely event that any PMF is identified, MS-LOT and NatureScot will be notified and the need for further mitigation measures agreed.

When removal of the three M100 turbines and cables from below MHWS has been completed, a second drop-down video survey of the seabed will be carried out. This survey will cover the seabed footprints of the three decommissioned turbines and export cables, as well as a buffer of around 5 m. The survey will confirm that all equipment and infrastructure has been removed from the seabed.

4.2.2 Methods

Drop-down video cameras will be deployed on an umbilical from a surface vessel during high water slack tides (when the building ebb tide will be running to the north, away from the existing machines). A series of survey transects will be carried out, with survey tracks separated by 5 - 10m. Closer or additional tracks will be used if required to achieve sufficient coverage.

4.2.3 Analysis and reporting

Drop-down video will be interpreted in real-time. Laminated identification reference cards (provided in Annex B) are held on site at Cullivoe to assist staff carrying out the surveys in identifying any horse mussel (*Modiolus modiolus*) reef, maerl beds or other priority marine features, including Annex I reef habitat. These will be included in all pre-survey briefings.

Video will also be recorded to enable further detailed analysis and scrutiny of footage by suitably qualified experts able to identify species or habitats to the appropriate biotope, if necessary, for example to inform a post-decommissioning report for MS-LOT and BEIS.

Results from the post-decommissioning drop-down survey will be provided in a decommissioning report that will be prepared and submitted to MS-LOT and BEIS.

Annex A Shetland Tidal Array Biosecurity Plan

Summary of Biosecurity Risk of Shetland Tidal Array

a. This Biosecurity Plan for Nova Innovation's Shetland Tidal Array has assessed the risk of introducing non-native species from outside of the Shetland regional area as very low. This is because:
   - all vessels used in operations are local to the Northern Isles;
   - vessels not based in Shetland are operated by reputable companies with their own environmental policy statements and good practice procedures;
   - turbines and sub-structures are transported to Shetland overland;
   - measures are in place to minimise biofouling of epibiota on turbines and substructures.

b. The overall risk of activities contributing to the further spread of non-native species already present in Shetland has been assessed as low. This is because:
   - although the turbines and substructures within the array provide an artificial habitat for colonisation, significant similar habitat is already present in Bluemull Sound due to aquaculture sites;
   - the tide-swept nature of the Shetland Tidal Array site is likely to limit the settlement of non-native species larvae.

c. This plan has identified a series of mitigation measures, mostly relating to monitoring and surveillance and good biofouling management to ensure that the overall biosecurity risk of the Shetland Tidal Array is low.

A.1 Introduction

A.1.1 Development name

Shetland Tidal Array, Bluemull Sound, Shetland.

A.1.2 Description of operation

At full build-out the current phase of the Shetland Tidal Array will comprise six 100kW Nova M100 turbines. During 2019/2020, three additional turbines will be added to the existing three-turbine array. A subsea cable hub will be deployed, along with inter-array cabling between the three new turbines and an additional export cable from the subsea hub to Cullivoe Pier. Following a period of operation, the three additional turbines within the array will be reconfigured to inform the sector's understanding for optimal array design and turbine layout as part of the Horizon 2020 EnFAIT project.

A.1.3 Site location

The Shetland Tidal Array is situated in Bluemull Sound, between the islands of Unst and Yell, indicated in Figure A1. The Project is located in a water depth of 30 to 40m offshore from the west coast of the Ness of Cullivoe, a narrow 1 km long headland to the north-east of Yell.

Figure A1 Location of the Shetland Tidal Array (indicated by yellow star).

Bluemull Sound is an active channel for shipping and the Shetland Tidal Array site is located less than 1km from a busy, multiuse harbour at Cullivoe, comprising a pier and small boat marina. In 2017, Cullivoe was the 12th largest whitefish landing port in the UK [6]. It is also used as a base by a number of aquaculture operators (mussels and salmon). The small marina currently provides berthing facilities for 14 boats, with plans to expand these facilities along with those at Cullivoe Pier.

A.1.4 Biosecurity plan period

The Biosecurity Plan covers the period 1 May 2019 to 2035 with regular reviews as appropriate. This Site Biosecurity Plan will be supplemented with Operation Biosecurity Plans, as necessary, for any specific activities that fall out with those considered within this plan. None are currently anticipated but this will be kept under review.

A.1.5 Responsible persons for biosecurity management

a. Management of Biosecurity Plan and overview of biosecurity: Kate Smith, Nova Environmental Manager.
b. Management of biosecurity operations on site: Tom Wills, Nova Offshore Manager (or delegated operations manager for a particular task).

A.2 Environmental factors affecting biosecurity

A.2.1 Salinity and environmental conditions

Bluemull Sound is a fully saline site. A number of small burns and land run-off enter the Sound but tidal currents and mixing mean that any effects on salinity are very localized and unlikely to extend beyond the intertidal zone.

[6] Napier I (2017). Shetland Fisheries Statistics 2017. Report produced by the University of the Highlands and Islands, pp35.

A.2.2 Seabed habitat

The seabed in Bluemull Sound at the Shetland Tidal Array site is rocky with little overlying sediment due to tidal scour. The array is located in an area of strong tidal streams which can reach velocities exceeding 3 m/s. This habitat typically supports a community of foliose seaweeds and encrusting animals typical of such tide-swept conditions, with sparse faunal communities dominating in the deeper, most tide-swept parts of the site.

A.2.3 Artificial habitat and biofouling

Although the Shetland Tidal Array provides artificial habitat for potential colonisation by non-native species, significant similar habitat is already present in Bluemull Sound due to aquaculture sites. The species and taxa most commonly observed to colonize the surfaces of structures in the Shetland Tidal Array are mussels, barnacles and kelp[7].

A.2.4 Non-native species present in Shetland

The northerly location of Shetland and lower water temperatures compared to the mainland UK may inhibit the spread of certain non-native species from the south. Despite this, a number of marine non-native species have been recorded around Shetland, detailed in Table A1, compiled from a variety of sources[8] [9] [10]. The known locations of these species in Shetland are detailed, along with an indication of the likelihood that the Shetland Tidal Array could contribute to their spread within Shetland.

Table A1 Non-native species already recorded in Shetland and relevant to the Shetland Tidal Array.

Species	Records in Shetland	Habitat details and relevance to Shetland Tidal Array
Fragile green sponge fingers, *Codium fragile ssp. Fragile*	Throughout Shetland	Occurs on rock from the mid to lower shore and shallow subtidal. Not relevant to STA, depth and tide-swept nature of site make colonisation unlikely.
Japanese weed, *Dasysiphonia japonica*	Throughout Shetland	Lower intertidal species. Not relevant to STA, depth and tide-swept nature of site make colonisation unlikely.
Hook weed, *Bonnemaisonia hamifera*	Throughout Shetland	Not relevant to STA, already widespread throughout Shetland. GBNNS consider environmental & economic threat is low.
Harpoon weed, *Asparagopsis armata*	Throughout Shetland	Not relevant to STA, already widespread throughout Shetland. GBNNS consider environmental & economic threat is low.
Wireweed, *Sargassum muticum*	West coast of mainland	Occurs on rock, cobbles and boulders from the mid to lower shore and shallow subtidal. Not relevant to STA, depth makes colonisation unlikely.

[7] Vezza R (2019). An anti-biofouling strategy for operators: A systems approach for the tidal energy industry. Ph.D. thesis, University of Edinburgh, University of Exeter and University of Strathclyde.

[8] Collin SB, MacIver K & Shucksmith R. (2015). A Biosecurity Plan for the Shetland Islands, pp66.

[9] Collin SB, Tweddle JF & Shucksmith RJ (2015). Rapid assessment of marine non-native species in the Shetland Islands, Scotland. BioInvasions Records 4: 147-155.

[10] Shelmerdine RL, Mount B & Shucksmith RJ (2017). The most northerly record of feral Pacific oyster *Crassostrea gigas* (Thunberg, 1793) in the British Isles. BioInvasions Records 6(1): 57–60.

Species	Records in Shetland	Habitat details and relevance to Shetland Tidal Array
Orange-tipped sea squirt, *Corella eumyota*	Yell	Occurs in shallow waters in harbours, marinas and on manmade structures. Could colonise structures of STA, maintain surveillance.
Bryozoan, *Schizoporella japonica*	Throughout Shetland	Widespread throughout Shetland on manmade structures Not relevant to STA, already widespread. GBNNS consider environmental & economic threat is low.
Bryozoan, *Fenestrulina delicia*	Sullom Voe	Only a single record in Shetland. Unlikely to colonise STA. GBNNS consider environmental & economic threat is low.
Bryozoan, *Bugula simplex*	Lerwick	Colonises marinas, harbours and boat hulls. Could colonise structures of STA, maintain surveillance. GBNNS consider environmental & economic threat is low.
Orange-striped anemone, *Diadumene lineata*	The Vadills, Mainland	Only a single historical record in Shetland Vadills (coastal lagoons) from 2003. Unlikely to colonise STA.
Darwin barnacle, *Austrominius modestus*	Throughout Shetland	Not relevant to STA, already widespread throughout Shetland. GBNNS consider environmental & economic threat is low.
Japanese skeleton shrimp, *Caprella mutica*	Throughout Shetland	Found in areas of human activity on natural and artificial substrata. Limited dispersal potential. Could colonise structures of STA, maintain surveillance.
Pacific oyster, *Crassostrea gigas*	Sandsound Voe, Mainland	Only two specimens found in Shetland in 2016, on mussel lines. Unlikely to colonise STA due to tide-swept conditions.

A number of other non-native species could potentially be present in the waters around Shetland, without having been formally recorded. Of likely pertinence are those species recorded in Orkney since the spread in distribution of non-native species generally follows a south to north pattern. A number of non-natives not yet recorded in Shetland were recorded in a recent rapid assessment survey of Orkney in 2017. As with species detailed in the table above, not all of these non-native species will be of environmental or economic concern, but it is good practice to maintain watching brief over these and other non-native species not yet record in Shetland.

A.3 Vessels using the site and engaged in operations

Local multi-category ('multicat') workboat vessels of the type shown in Figure A2, and small workboats are utilised for all operations associated with the Shetland Tidal Array, including deployments, retrievals and maintenance.

All vessels used in operations are based in the Northern Isles. Those not based in Shetland itself are operated by reputable companies with sound environmental policies and good practice procedures. Turbines and substructures are shipped to site overland via lorry and northern isles freight service.

Figure A2 Representative vessel utilised for Shetland Tidal Array operations. *Source Leask Marine*.

A.4 Site activities which risk introducing or spreading non-native species

The nature of biosecurity risks for the Shetland Tidal Array, associated activities and mitigation measures are detailed in Table A2.

Table A2 Activities associated with the Shetland Tidal Array, biosecurity risk and mitigation measures.

Activity and nature of risk	Mitigation measures	Risk level
Use of vessels for site operations: Risk of introducing or spreading non-native species	- Turbines and substructures are shipped to Shetland by road. - Northern Isles-based vessels used for marine operations. - The operators used for provision of multicat vessels follow their own biosecurity good practice, under an environmental policy statement[11]. - An 'Operations Biosecurity Plan' will be produced for use of any vessels not based in Northern Isles (not currently anticipated).	Very low to low
Installation of turbines, substructures, cables and offshore hub: Risk of introducing or spreading species, provision of artificial habitat for colonisation	- Turbines, substructures, cables and hub not previously deployed subsea elsewhere. - Temporary moorings (e.g., chains) used during deployment will be sourced from Shetland or pressure washed / air dried prior to use in Bluemull Sound. - An anti-fouling strategy is in place involving use of anti-fouling coatings on turbines, substructures and hub. - Visual inspections when turbines or substructures removed from water - contingency action will be taken if necessary.	Low to medium

As detailed in Table B2, the introduction of artificial habitat to Bluemull Sound could provide new habitat for colonisation by non-native species. However, the risk that this would contribute significantly to the further spread of species already present in Shetland is considered low, for a number of reasons:

[11] Leask Marine (2019). Environmental Policy Statement. See https://www.leaskmarine.com/about/company-policy-statements/

a. In general, the sheltered habitats of marinas, ports and harbours seems to favour the establishment of non-native species, over habitats in more wave or tide-exposed conditions such as Bluemull Sound.
b. In a recent rapid assessment of non-native species in Orkney, whilst a number of non-natives species were found to be colonising structures in harbour and marinas, none were found on marine renewable energy devices sampled.
c. Devices are periodically removed from the water for maintenance, during which any biofouling is removed.
d. Additional mitigation and good biosecurity measures will be applied to the STA, detailed in the next section.

The biosecurity risk for the Shetland Tidal Array is likely to be considerably lower than that associated with other activities in the area such as national and international shipping, marinas, recreational boating and aquaculture. The use of local vessels means the risk of introducing non-native species from outside of Shetland is minimal, though they could contribute to the spread of species already present in Shetland. The presence of turbines and substructures in the Sound creates artificial habitat for potential colonisation by non-native species already present in Shetland. However, similar habitat is available on nearby aquaculture installations.

A.5 Biosecurity control measures

The full range of biosecurity control measures to reduce the risk of the Shetland Tidal Array contributing to the spread or introduction of non-native species are listed below:

a. The Site Biosecurity Plan will be reviewed on any changes being made to the Construction Method Statement to ensure its conclusions remain valid.
b. An 'Operations Biosecurity Plan' will be produced, as necessary, for any specific activities that fall outside those described within this plan. None are currently anticipated but this will be kept under review.
c. The Site Biosecurity Plan will be kept under review and updated, as necessary.
d. None of the turbines, substructures, cables or subsea hub will previously be deployed subsea elsewhere.
e. Turbines and substructures are shipped to Shetland by road.
f. Northern Isles-based vessels used for marine operations.
g. The operators used for provision of multicat vessels follow their own biosecurity good practice, under an environmental policy statement[14].
h. Any temporary moorings (e.g., chains) used during deployment will either be sourced from Shetland, or pressure washed or air dried prior to use in Bluemull Sound.
i. An anti-fouling strategy is in place for the project, which includes use of anti-fouling coatings on turbines, substructures and offshore hub.
j. Turbines and substructures will undergo visual inspections when removed from the water. Contingency action will be taken if necessary (see Section A.7).

A.6 Site surveillance and reporting procedures

Turbines and substructures will undergo visual inspections when removed from Bluemull Sound. Any non-native species identified will be reported to Shetland Islands Council, Marine Scotland and Scottish Natural Heritage in the first instance. Records of inspections and any instances of non-native species

will be kept within the site biosecurity logbook, maintained and managed by Nova's Environmental Manager. A hard copy of the biosecurity logbook will be kept on-site at Nova's site office at Cullivoe.

A.7 Contingency plan

Visual inspections will be carried out following removal of turbines or sub-structures from Bluemull Sound. Inspections will take place at either Cullivoe or Belmont Pier. Laminated 'pest ID cards', held on site at Cullivoe will assist staff carrying out the inspections in identifying particularly invasive non-natives. Not all non-native species will require further action, since many are already well-established in Shetland, or have minimal likely environmental or economic impacts.

If visual inspections of turbines and substructures indicate the presence of a non-native species, this will be reported to Shetland Islands Council, Marine Scotland and NatureScot in the first instance, for discussion on whether further action is required.

Biological material is removed as standard when turbines or sub-structures are removed from Bluemull Sound, for health and safety reasons, to avoid dangerous handling conditions. This takes place *in situ* at Belmont or Cullivoe pier usually by pressure washing. If inspections have suggested that invasive non-native species may be present, care will be taken during pressure washing to avoid contaminated material entering the marine environment.

Any contingency action taken will be recorded in the site biosecurity logbook kept in Nova's site office at Cullivoe Pier.

A.8 Location of biosecurity logbook

The Shetland Tidal Array biosecurity logbook will be maintained and managed by Nova Innovation's Environmental Manager. A hard copy will be kept on-site in Nova's Cullivoe office.

A.9 Biosecurity plan review process

This Site Biosecurity Plan will be reviewed and updated if necessary; for example, if the Construction Method Statement is amended at any point (not anticipated). The Plan will be reviewed in May 2021 followed by every two years, or sooner if required. More frequent reviews may be triggered by an identified higher risk, such as change in vessel use or record of an invasive non-native species elsewhere in Shetland, for which containment may be required.

Annex B Priority Habitat Identification Cards

Ref: https://www.nature.scot/snh-commissioned-report-406-descriptions-scottish-priority-marine-features-pmfs

TERRITORIAL WATERS

Broad habitat

HORSE MUSSEL BEDS

Image	Distribution
 Image: Rob Cook	

Feature description

Characteristics - The horse mussel *Modiolus modiolus* occurs in scattered clumps, thin layers or dense raised beds, which can extend up to several hectares in size. Raised beds are formed of horse mussels bound together by a matrix of byssus threads. Silt, organically rich faeces and shells accumulate within the structure and further increase the bed height. Horse mussel beds significantly modify sedimentary habitats and provide hard substratum, refuge and ecological niches for a wide variety of organisms. The beds increase local biodiversity and may provide settling grounds for commercially important bivalves, such as queen scallops.

Environmental preferences - Weak to strong water movement on a variety of mixed substrata. Found at depths of 5-220m.

Scottish distribution - Recorded from sea lochs, embayments and open coast in Shetland, Orkney, off Caithness and down the west coast with scattered records from the Outer Hebrides and Moray Firth. Relatively small, dense beds of horse mussels can also occur on steep rocky surfaces within sea lochs.

Wider distribution - Recorded from the Ards Peninsula, Strangford Lough, off both ends of the Isle of Man, off north-west Anglesey and north of the Llŷn Peninsula, Wales.

Feature status - Scottish waters support 85% of all horse mussel beds in the British Isles which themselves represent most of the habitat within Europe. They are sensitive to physical disturbance and mobile fishing gears may damage and/or remove beds. The extent and quality of habitat has declined since the 1950s with formerly extensive beds in Strangford Lough (N. Ireland) lost as recently as 2007 due to scallop trawling and dredging. The condition of beds in Loch Creran and Loch Duich on the west coast of Scotland has also deteriorated but the cause is currently unknown.

Natural heritage importance	Information sources
EC Habitats Directive Annex I	MarLIN
OSPAR T&D	OSPAR Case Report
Scottish Biodiversity List	UK BAP Habitat Definitions
UK BAP	UK Marine SACs Overview

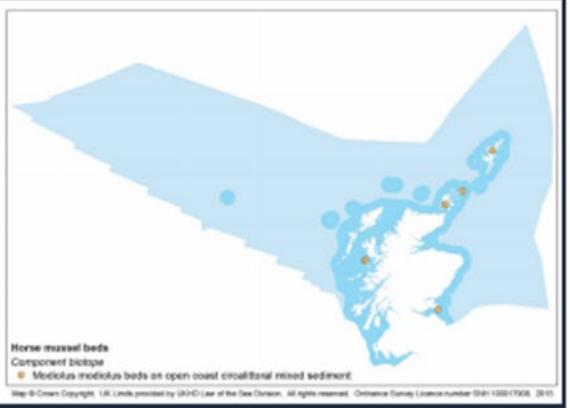
Component biotopes in Scottish waters

Modiolus modiolus beds with hydroids and red seaweeds on tide-swept circalittoral mixed substrata - **SS.SBR.SMus.ModT**.
Modiolus modiolus beds on open coast circalittoral mixed sediment - **SS.SBR.SMus.ModMx**.
Modiolus modiolus beds with fine hydroids and large solitary ascidians on very sheltered circalittoral mixed substrata - **SS.SBR.SMus.ModHAs**.
Modiolus modiolus beds with *Chlamys varia*, sponges, hydroids and bryozoans on slightly tide-swept very sheltered circalittoral mixed substrata - **SS.SBR.SMus.ModCvar**.

TERRITORIAL WATERS

Component biotope name

***MODIOLUS MODIOLUS* BEDS ON OPEN COAST CIRCALITTORAL MIXED SEDIMENT (SS.SBR.SMus.ModMx)**

Image	Distribution
 Image: Richard Shucksmith	

Feature description

Characteristics - Beds of horse mussels (*Modiolus modiolus*) on or within mixed muddy and gravel sediments in deep water. Clumps of live and dead shells are bound together by byssal threads providing a stabilising effect on the sea bed. The accumulation of silt and mussel faeces upon and around the beds provides a habitat that attracts a rich diversity of organisms, in particular polychaete worms. Venerid bivalves and brittlestars are also commonly present.

Environmental preferences - Typically occurs on current swept, moderately sheltered circalittoral mixed sediment (muddy sand and gravel, with shells and stones) at depths of 40-100m.

Scottish distribution - Recorded from the Northern Isles (Sullom Voe, Shetland and Hoy Sound, Orkney) as well as from the Small Isles on the west coast, and Isle of May on the east.

Wider distribution - There are a number of records in the Irish Sea, with scattered records on the east coast of Ireland, Northern Ireland and England. Records of *M. modiolus* off Norway, in the Kattegat Sea and off the west coast of France may represent examples of this biotope.

Feature status - *M. modiolus* is a long lived species with poor recruitment. Horse mussel beds are sensitive to physical disturbance which can adversely affect bed integrity. Mobile fishing gears may damage or completely remove beds.

Natural heritage importance	Information sources
EC Habitats Directive Annex I (Reefs)	JNCC Marine Habitat Classification
OSPAR T&D	MarLIN
Scottish Biodiversity List	OSPAR Case Report
UK BAP	UK BAP Habitat Definitions

Sub-component biotopes in Scottish waters

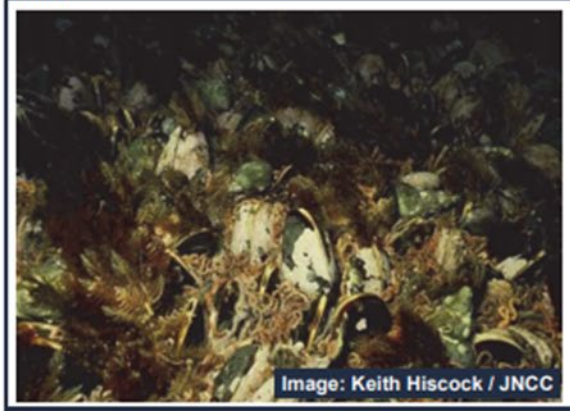
No sub-component biotopes

TERRITORIAL WATERS

Component biotope name

***MODIOLUS MODIOLUS* BEDS WITH HYDROIDS AND RED SEAWEEDS ON TIDE-SWEPT CIRCALITTORAL MIXED SUBSTRATA (SS.SBR.SMus.ModT)**

Image



Distribution

Feature description

Characteristics - In strong currents or tide-swept conditions, the horse mussel (*Modiolus modiolus*) forms raised beds on mixed muddy substrates. The beds are made up of living and dead mussels, bound together with byssus threads, and an accumulation of silt and mussel faeces. In some cases they can be several metres high and many metres long providing refuge for a variety of other organisms. Red seaweeds and sea firs grow on or amongst the horse mussels. Brittlestars are often common in this habitat, along with tube worms, whelks, clams and sea anemones.

Environmental preferences - Typically found on the open coast but also in the tide-swept channels of marine inlets on mixed, muddy substrata (cobbles and pebbles) from 5-50m.

Scottish distribution - Recorded from Shetland (e.g. Basta Voe and Yell Sound), Orkney (Shapinsay Sound), the Caithness coast (Noss Head), the Moray Firth, the Outer Hebrides (Loch Roag) and within sea lochs of the west coast of Scotland (e.g. Loch Carron, Loch Linnhe and Loch Long).

Wider distribution - There are very few records of this biotope outside of Scotland but it has been recorded in the Irish Sea off the north-west Llŷn Peninsula (North Wales) and off Co. Down (Northern Ireland).

Feature status - Supporting the majority of horse mussel beds in the British Isles, Scottish waters are nationally important for this habitat which is sensitive to physical disturbance. Mobile fishing gears may damage or completely remove horse mussel beds.

Natural heritage importance	Information sources
EC Habitats Directive Annex I (Reefs, typical of Large shallow inlets and bays) OSPAR T&D Scottish Biodiversity List UK BAP	JNCC Marine Habitat Classification MarLIN OSPAR Case Report UK BAP Habitat Definitions

Sub-component biotopes in Scottish waters

No sub-component biotopes

TERRITORIAL WATERS

Component biotope name

***MODIOLUS MODIOLUS* BEDS WITH *CHLAMYS VARIA*, SPONGES, HYDROIDS AND BRYOZOANS ON SLIGHTLY TIDE-SWEPT VERY SHELTERED CIRCALITTORAL MIXED SUBSTRATA (SS.SBR.SMus.ModCvar)**

Image

Distribution

Feature description

Characteristics - Beds of horse mussels (*Modiolus modiolus*) on or in gravelly mud sediments. Beds are made up of living and dead mussels, bound together with byssus threads, and an accumulation of silt and mussel faeces. The beds provide refuge and substratum for a variety of other organisms. The variable scallop (*Chlamys varia*) is characteristically present amongst the horse mussels. Brittlestars, feather stars, hermit crabs, spider crabs and whelks are also found in this biotope. Sponges, sea firs, sea mats and sea squirts grow on the mussels.

Environmental preferences - This biotope forms beds on slightly tide-swept, very sheltered circalittoral mixed sediment (pebbles and shells on sandy mud) at depths of 5-220m.

Scottish distribution - Restricted to a small number of sea lochs on the west coast (Loch Fyne, Loch Creran and on Skye), as well as from Orkney and within Bluemull Sound in Shetland. An atypical deep water variant of this biotope has recently been recorded within the Sound of Canna.

Wider distribution - There are only a few records of this biotope outside of Scottish waters, these are primarily in the Irish Sea (Northern Ireland and north-west Wales).

Feature status - This is a rare horse mussel bed biotope and like all biogenic reefs is sensitive to physical disturbance which can adversely affect bed integrity. Mobile fishing gears may damage or completely remove *M. modiolus* beds.

Natural heritage importance	Information sources
EC Habitats Directive Annex I (Reefs, typical of Large shallow inlets and bays) OSPAR T&D Scottish Biodiversity List UK BAP	JNCC Marine Habitat Classification MarLIN OSPAR Case Report UK BAP Habitat Definitions

Sub-component biotopes in Scottish waters

No sub-component biotopes

TERRITORIAL WATERS

Component biotope name

***MODIOLUS MODIOLUS* BEDS WITH FINE HYDROIDS AND LARGE SOLITARY ASCIDIANS ON VERY SHELTERED CIRCALITTORAL MIXED SUBSTRATA (SS.SBR.SMus.ModHAs)**

Image

Distribution

Feature description

Characteristics - In wave sheltered areas, the horse mussel (*Modiolus modiolus*) forms beds or scattered clumps on mixed muddy substrates. The beds or clumps consist of living and dead mussels bound together by byssus threads. They provide refuges and substratum for sea firs, solitary sea squirts and fish species. The beds also support a variety of brittlestars, together with commercially important shellfish (e.g. queen scallops), hermit crabs, spider crabs and whelks.

Environmental preferences - This biotope typically forms on mixed, muddy substrata (cobbles and pebbles) in sheltered conditions with slight tidal movement at depths of 5-30m.

Scottish distribution - Found in sea lochs and voes in Shetland (e.g. Sullom Voe), Orkney (e.g. North Sanday and Shapinsay Sound), the Outer Hebrides (e.g. Loch Roag and Loch Tarbert) and the west coast (e.g. Loch Sunart and Loch Duich).

Wider distribution - This biotope is only recorded in Scotland.

Feature status - This biotope is unique to Scottish waters and, like the other horse mussel bed biotopes, is sensitive to physical disturbance which can adversely affect bed integrity. Mobile fishing gears may damage or completely remove *M. modiolus* beds.

Natural heritage importance	Information sources
EC Habitats Directive Annex I (Reefs, typical of Large shallow inlets and bays) OSPAR T&D Scottish Biodiversity List UK BAP	JNCC Marine Habitat Classification MarLIN OSPAR Case Report UK BAP Habitat Definitions

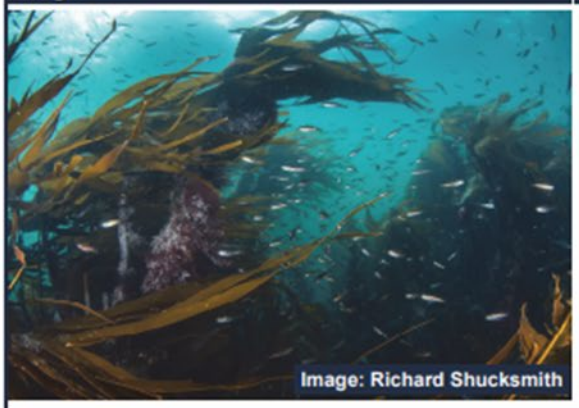
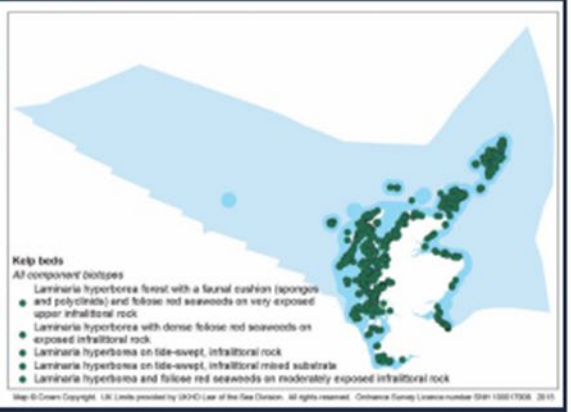
Sub-component biotopes in Scottish waters

No sub-component biotopes

TERRITORIAL WATERS

Broad habitat

KELP BEDS

Image	Distribution
 Image: Richard Shucksmith	

Feature description

Characteristics – Beds of the kelp *Laminaria hyperborea* form as 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 grow 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.

Environmental preferences - 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.

Scottish distribution - Widely recorded around all coasts of the Scottish mainland and islands. The more exposed biotopes are particularly recorded from Atlantic coasts in the west and the north.

Wider distribution - Widely recorded around the coasts of the UK and Ireland, although more exposed biotopes are only found on the west coast of Ireland, off Cornwall and south-west Wales.

Feature status - Scotland holds a significant proportion of the UK records of kelp beds and therefore the habitat is considered to be nationally important. The kelp component may be a target for seaweed harvesting, with potential effects on habitat structure and species diversity. Activities which cause changes in wave exposure or tidal flow could also have effects on this habitat.

Natural heritage importance	Information sources
EC Habitats Directive Annex I (Reefs) Scottish Biodiversity List (IR.MIR.KR.LhypT & IR.MIR.KR.LhypTX only) UK BAP (IR.MIR.KR.LhypT & IR.MIR.KR.LhypTX only)	JNCC Marine Habitat Classification MarLIN

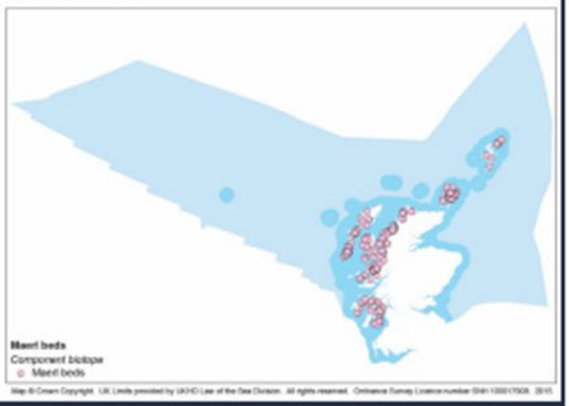
Component biotopes in Scottish waters

Laminaria hyperborea forest with a faunal cushion (sponges and polyclinids) and foliose red seaweeds on very exposed upper infralittoral rock - **IR.HIR.KFaR.LhypFa**.
Laminaria hyperborea with dense foliose red seaweeds on exposed infralittoral rock - **IR.HIR.KFaR.LhypR**, including: **IR.HIR.KFaR.LhypR.Ft** & **IR.HIR.KFaR.LhypR.Pk**.
Laminaria hyperborea on tide-swept, infralittoral rock - **IR.MIR.KR.LhypT**, including: **IR.MIR.KR.LhypT.Ft** & **IR.MIR.KR.LhypT.Pk**.
Laminaria hyperborea on tide-swept infralittoral mixed substrata - **IR.MIR.KR.LhypTX**, including: **IR.MIR.KR.LhypTX.Ft** & **IR.MIR.KR.LhypTX.Pk**.
Laminaria hyperborea and foliose red seaweeds on moderately exposed infralittoral rock - **IR.MIR.KR.Lhyp**, including: **IR.MIR.KR.Lhyp.Ft**; **IR.MIR.KR.Lhyp.Pk**; **IR.MIR.KR.Lhyp;GzFt** & **IR.MIR.KR.Lhyp:GzPk**.

TERRITORIAL WATERS

Broad habitat

MAERL BEDS

Image	Distribution
	

Feature description

Characteristics - Maerl beds are formed by an unusual red seaweed with a hard chalky skeleton that grows as small rounded nodules or short branched twig-like shapes. In high abundance, maerl can form loosely interlocking beds through which water is able to circulate, providing the perfect conditions for the development of diverse communities of plants and animals (on, within or under the beds). Red seaweeds, sea firs, sea urchins, brittlestars, starfish, sea anemones and scallops may colonise the surface. Maerl needs light to grow, so living maerl is restricted to the surface of the beds overlying the chalky skeletons of dead maerl. Three maerl species exist in the British Isles and the relative composition of these within a bed, and the proportion of living / dead maerl within and between beds, varies with factors such as salinity and wave exposure. Maerls are extremely slow growing and extensive beds may be 1000s of years old.

Environmental preferences - Coarse clean sands and gravels either on the open coast or in tide-swept channels to a depth of about 20m. Occasional records from muddier sediments e.g. Loch Torridon.

Scottish distribution - Widespread on the west coast (e.g. Arran, Loch Sween, Sound of Arisaig and Loch Laxford), the Outer Hebrides (e.g. Sound of Barra and Loch nam Madadh) and in tide-swept areas of Orkney (e.g. Wyre and Hoy Sound) and Shetland (e.g. Bluemull Sound).

Wider distribution - Recorded on the south English coast, in Wales, Ireland and Northern Ireland, NW Iceland, NW France, NW Spain and the Canaries. Also known to occur in Sweden and Norway.

Feature status - Scotland has approximately 30% of the maerl beds in north-west Europe and most of the beds in the UK. They are sensitive to physical disturbance, smothering, increased suspended sediment and changes in water flow. Pressures are known to include mobile demersal fishing activity, aquaculture, pollution and extraction (for soil conditioner).

Natural heritage importance	Information sources
EC Habitats Directive Annex I (Subtidal sandbanks)	JNCC Marine Habitat Classification
OSPAR T&D	OSPAR Case Report
Scottish Biodiversity List	UK BAP Habitat Definitions
UK BAP	UK MarineSACs Overview

Component biotopes in Scottish waters

Maerl beds - **SS.SMp.Mrl**, including:**SS.SMp.Mrl.Pcal** (inc. **Pcal.R** & **Pcal.Nmix**); **SS.SMp.Mrl.Lgla**; & **SS.SMp.Mrl.Lcor**.