EMEC
THE EUROPEAN MARINE ENERGY CENTRE LTD

Decommissioning Penguin WEC 1 and Mooring Components

Environmental Report and Monitoring Programme

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Document History

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Executive Summary

This programme has been developed as an addendum to the Environmental Report and Environmental Monitoring Programme submitted in July 2018 as part of the overarching marine licence application to deploy and operate a three-device array. The array was planned to be composed of three Penguin devices developed by Wello Oy and owned by Fortum Energy UK through the Horizon 2020 Clean Energy from Ocean Waves (CEFOW) project.

This programme reviews the potential environmental risks associated with the removal of the Penguin WEC 1 from the seabed and the removal of mooring components. The report is based on EMEC's site-wide Environmental Appraisal for the Billia Croo test site and therefore it is recommended that the appraisal in read concurrently to this report. The proposed mitigation and monitoring measures that are planned to be employed during the works are also described within the programme.

1 Introduction

Fortum Energy UK are applying for the marine licence to remove the Penguin device currently located on the seabed at the European Marine Energy Centre's Billia Croo test site, berth 5. The removal work is required following the sinking of the device in March 2019 following a successful testing campaign. This report has been developed to support a marine licence application under the Marine (Scotland) Act 2010.

The work is proposed to take place between May 2020 – September 2020, however the applied for duration for the licence will be until 1 March 2021. Further details regarding the method of removal and schedule for the work are provided in the Project Information Summary and Method Statement. It should be noted the detailed method of the removal work is currently not known. This will be determined upon the selection of a marine contractor; tender process is underway at the time of writing.

2 Environmental Description and Assessment

A detailed Environmental Appraisal[1](REP666) (EA) regarding the potential environmental effects associated with the installation, operation and decommissioning of a range of devices at the Billia Croo test site has been produced. The removal and decommissioning of a rotating mass wave energy device, such as the Penguin WEC 1, is included within the Project Envelope which was assessed during the Environmental Appraisal. Although the exact vessel spread will be determined once the marine contractor for the work has been selected, the types of vessels which are expected to be involved in the works include:

- Multicat
- Small workboat
- Crane barge
- Submersible barge

Further details regarding vessels can be found in the method statement and method statement appendix.

2.1 Intertidal and subtidal benthic ecology

Within the EA, the following potential effects on benthic receptors in the intertidal and subtidal zone have been identified which may be relevant to the proposed removal works. Further details regarding each potential effect pathway/activity is provided in the relevant section of the EA.

Table 1. Potential effects on intertidal and subtidal benthic ecology from proposed decommissioning works

Activity / potential effect pathway	Natural heritage feature	Potential importance
Habitat damage	Benthic species	Potentially important
	Benthic habitats	Potentially important
Smothering by re-settlement of disturbed sediments	Benthic species	Potentially important
	Benthic habitats	Potentially important
Introduction of marine non-native species (MNNS) via vessels	Benthic species	Potentially important
	Benthic habitats	Potentially important

[1] EMEC's Environmental Appraisal for Billia Croo test site is available to download from the EMEC website: http://www.emec.org.uk/services/consents/

During the appraisal process the relevant legislation and site information was reviewed to determine the reasoning for undertaking appraisals. An appraisal of priority marine features (PMFs) and other natural heritage features was undertaken.

The offshore area of the Billia Croo test site is composed of mixed sediments of overlying veneer dominated by brittle stars and starfish. The sediment is fine to coarse sand dominated primarily by infaunal polychaete species. Although sediments will be disturbed and re-suspended during the removal work, these are expected to resettle quickly and in the immediate vicinity of the area of disturbance due to the size of the sediment.

Although the Billia Croo test site is not within a SAC, areas of bedrock boulder and cobble reef are regarded as potential Annex I reef habitats. The decommissioning works will include the removal of the Penguin device and moorings, which will remove hard substrate from the seabed and the associated marine growth, and potentially cause physical damage to benthic species. This will be limited to the direct footprint of decommissioning activities and will not affect the rocky/cobbles habitat near the works.

Offshore the sand habitat is inhabited by infaunal polychaete species primarily, but also nematodes, amphipods, bivalves and echinoderms. The decommissioning works will include the lifting of infrastructure, thus removing hard substrate from the seabed and the associated marine growth, and potentially cause physical damage to benthic species. The area of potential impact relative to the total Billia Croo test site is small, therefore any physical disturbance to benthic species will be localised, and hard substrates in the Billia Croo area and throughout Orkney are largely available for the epifauna to attach to. At berth 5 the sedimentary habitats present at berth 5 may generate sediment re-suspension which can reduce the ability of some benthic species to breathe and feed and can result in species smothering. However, sediment conditions are expected to recover relatively quickly following any works.

There is potential for the introduction of MNNS to the site by a variety of vectors, particularly via the hulls or ballasts of vessels involved in the decommissioning works. MNNS may pose a risk to native benthic species and the widespread proliferation of MNNS could be damaging to the benthic ecology of a large area. These risks should be managed accordingly by adoption of a series of protocols that ensures MNNS are not transported on vessels.

2.2 Hydrodynamic and physical processes

Within the EA, the following potential effects relating to hydrodynamic and physical processes have been identified which may be relevant to the proposed removal works. Further details regarding each potential effect pathway/activity is provided in the relevant section of the EA.

Table 2. Potential effects on hydrodynamic and physical processes from proposed decommissioning works

Activity / potential effect pathway	Natural heritage feature	Potential importance
Changes to sedimentary processes (suspended sediment, sediment transport pathways and subsequent deposition)	Seabed	Potentially important
	Water column	Not important
	Coastline	Potentially important

During the appraisal process the relevant legislation and site information was reviewed to determine the reasoning for undertaking appraisals. An appraisal of protected sites and other natural heritage features was undertaken.

Sediment suspension will be limited to the device vicinity whilst seabed change will be small in scale and recover its original state in the medium term of months to years. There may be temporary, highly localised change in seabed character due to buried sediment layers being disrupted/displaced during the lifting operation, however this disturbance will also recover over the medium term of months to years.

It has been determined that increased suspended sediment within the water column due to removal operation is unlikely to be transported to the North-West Orkney Nature Conservation Marine Protected Area due to test site being a distance of 9.8km from the MPA. There is expected to be very little sediment transport in a north-south direction as a result of low current speeds, incident wave angle and lack of mobile sediments.

Billia Croo is located across both the Breck Ness to Noup Head (ID 200237) and Tor Ness to Breck Ness coastal water bodies (ID 200231). The condition of these surface water bodies has been historically high, with future predictions of it remaining so (from 2027 onwards). The decommissioning of devices is considered unlikely to adversely impact upon the water quality of these coastal water bodies, due to the temporary nature of removal works, the low volumes of increased suspended sediment, and the high natural variability of the site.

In summary, any changes to the hydrodynamic regime and coastal environment, are regarded as not important to the extent that they will mostly be immeasurable.

2.3 Fish and shellfish

Within the EA, the following potential effects relating to fish and shellfish have been identified which may be relevant to the proposed removal works. Further details regarding each potential effect pathway/activity is provided in the relevant section of the EA.

Table 3. Potential effects on fish and shellfish from proposed decommissioning works

Activity / potential effect pathway	Natural heritage feature	Potential importance
Decommissioning vessel transits and manoeuvring leading to disturbance	Diadromous fish	Not important
	Marine fish	
	Marine shellfish	
Underwater noise from lifting operation and vessels leading to auditory injury, death or disturbance	Diadromous fish	Potentially important
	Marine fish	Potentially important
	Marine shellfish	Not important
Increased suspended sediment/turbidity	Diadromous fish	Not important
	Marine fish	Potentially important
	Marine shellfish	Potentially important
Smothering due to re-settlement of sediments	Diadromous fish	Not important
	Marine fish	Potentially important
	Marine shellfish	Potentially important
Benthic habitat loss/damage	Diadromous fish	Not important
	Marine fish	Potentially important

Activity / potential effect pathway	Natural heritage feature	Potential importance
	Marine shellfish	Potentially important
Introduction of marine non-native species (MNNS) via vessels	Diadromous fish	Not important
	Marine fish	Potentially important
	Marine shellfish	Potentially important
	Marine fish	
	Marine shellfish	

During the appraisal process the relevant legislation and site information was reviewed to determine the reasoning for undertaking appraisals. An appraisal of qualifying features of European sites, protected features of MPAs, PMFs and other natural heritage features was undertaken.

It is possible that Atlantic salmon from the Thurso SAC will pass through Billia Croo, but it is not anticipated this is with any frequency and connectivity is difficult to establish due to the distances involved and current lack of knowledge regarding migratory routes.

Billia Croo is recorded as a nursery and spawning ground for the sandeel which is a protected feature of the North-West Orkney NCMPA. Given the localised nature and small scale of predicted seabed disturbance the potential for significant impacts to sandeel from the NCMPA is unlikely. Therefore, it is concluded there is no significant risk of hindering the achievement of the conservation objectives of the NCMPA and no further assessment is required.

Atlantic salmon, sea trout and European eel are all encountered in Orkney waters, these species are all included on the PMF list. The potential impacts identified as important for diadromous fish were underwater noise, EMF and barrier effects. The Billia Croo area already has vessel use and is considered naturally noisy due to the hydrodynamic regime. The additional noise emitted due presence of vessels and lifting operations is expected to be minimal, therefore it is not considered that underwater noise will be important to diadromous fish species present at Billia Croo. EMF is not relevant to this proposal as no cable works or energisation of cables will be conducted. Barrier impacts are also considered unlikely to impact diadromous fish at a population level given the scale of the removal works. Any potential impacts to diadromous fish species are not considered important at a population level.

In terms of marine fish, the Billia Croo site does not support the spawning for any gadoid species therefore it is expected that gadoid species will be encountered at Billia Croo but the area does not represent a high-density nursery or spawning area. Cod may be sensitive to noise produced during the decommissioning activity however due to the scale of the site and operation such an impact is not expected to have population level effects. The suspended sediment that may be encountered during the removal works is expected to have minimal effect on gadoid species present at the site due to the mobile nature of the species and limited spatial and temporal extent of the area affected. As benthopelagic species gadoids do associate with the seabed, however they don't interact exclusively with it. The small area of seabed disturbed, in terms of hydrodynamic and sediment processes, during the works is not expected to cause population level effects. It is not considered that gadoid species will be impacted by any MNNS that may enter the test site as gadoids don't tend to have exclusive interactions with specific areas of habitat and are therefore free to move away from any potential negative impacts as a result of MNNS. Impacts determined to be potentially important will not have any population level effects on gadoid species.

With regards to clupeids, both herring and sprat have some commercial value and Billia Croo is recorded as overlapping with the spawning area for both. Herring is also recorded

as a PMF and both species are recognised as having ecological value as a food source for other fish, bird and mammal species. Clupeid species are considered sensitive to sound however due to localised nature of underwater noise expected from the works and the relatively noisy natural environment means that no impacts are expected. Clupeids are pelagic species and therefore do not have a heavy reliance on the seabed for most of their existence, only limited disturbance of the seabed is expected during the removal work therefore the works are not considered to be a threat to clupeid species. Herring and sprat feed pelagically and could therefore be at risk to changes in the water column as a result of suspended sediment and changes to hydrodynamic regime, however due to scale of the planned works this is not expected. Due to the short-term nature of the testing programme for the Penguin device, the potential for Fish Aggregation Device (FAD) effects is expected to be limited and no population level impact are predicted. No impacts on clupeid species are expected to be important at a population level.

Due to the sediment conditions at Billia Croo site being medium to course sand and the occurrence of bedrock conditions, it is believed that the site does not offer favourable habitat for sandeels. Therefore, as sandeels are not expected to heavily rely on this area, no impacts are regarded as important for this species at a population level.

Elasmobranch species with the potential to be encountered at Billia Croo include common skate, spurdog, spotted ray, tope and thornback ray. Understanding of elasmobranch hearing is limited, but general understanding is that they have low sensitivity with a narrow range of hearing. Elasmobranch species are also not considered to be particularly sensitive to changes in sedimentary and hydrodynamic regime given their mobile and wide-ranging nature. Billia Croo is not known to overlap with key spawning habitat of any elasmobranch species therefore the impact by smothering is considered to be low, as the dynamic conditions at the site will rapidly disperse sediment in the water column.

In terms of the marine shellfish, a variety of crustacean species are encountered at Billia Croo. Several commercially important species such as brown crab, velvet crab and lobster. European spiny lobster may also be found at Billia Croo and is featured on the PMF list. Crustacean species likely to be encountered at Billia Croo are considered to have relatively low sensitivity to increases in suspended sediment and smothering. As Penguin device has been introduced to the habitat, this could be seen as currently as a positive impact that will be lost with the removal, however the scale of loss of habitat relative to entire site is considered to be minimal. It is expected that a range of mollusc species will be encountered at Billia Croo. By virtue of their mobility molluscs are generally considered of low tolerance to suspended sediment and smothering. However, given the small scale of the planned works and predicted impacts this is not considered important at a population level.

2.4 Basking shark

Within the EA, the following potential effects relating to basking shark have been identified which may be relevant to the proposed removal works. Further details regarding each potential effect pathway/activity is provided in the relevant section of the EA.

Table 4. Potential effects on basking shark from proposed decommissioning works

Activity / potential effect pathway	Natural heritage feature	Potential importance
Decommissioning vessel(s) presence, transiting and manoeuvring leading to disturbance	Basking sharks	Potentially important
Underwater noise from removal methods leading to disturbance	Basking sharks	Potentially important

Activity / potential effect pathway	Natural heritage feature	Potential importance
Increased suspended sediment/turbidity leading to disturbance	Basking sharks	Not important

During the appraisal process the relevant legislation and site information was reviewed to determine the reasoning for undertaking appraisals. A Basking Shark Licence will be required from the Scottish Government for any activities which will disturb, injure or kill basking sharks.

During the EA is was determined that there is no connectivity and no impact pathway to negatively impact basking shark features of the Sea of Hebrides pMPA or at any other protected sites with this species listed as a qualifying feature.

Basking sharks may be sensitive to vessel presence and associated activities, including the transiting and manoeuvring of vessels. The species has been known to vacate areas where vessels are present by either diving or swimming away and it is as yet unknown whether this is caused by the physical obstruction of feeding habitat or vessel noise. Disturbance reactions have the potential to impact upon the health of individuals if feeding is halted, or lower reproductive fitness if the disturbance halts courtship or mating behaviours. Elasmobranchs are generally sensitive to vibrational noise, or the kinetic component of sound, rather than sound pressure (the component most mammalian species hear). The noise expected to be generated during the removal operation is not expected to be within the hearing sensitivity range for basking shark.

2.5 Cetaceans

Within the EA, the following potential effects relating to cetaceans have been identified which may be relevant to the proposed removal works. Further details regarding each potential effect pathway/activity is provided in the relevant section of the EA.

Table 5. Potential effects on cetaceans from proposed decommissioning works

Activity / potential effect pathway	Natural heritage feature	Potential importance
Underwater noise and presence of decommissioning vessel(s), including transiting and manoeuvring, leading to disturbance	Cetacean species	Potentially important
Underwater noise from removal leading to disturbance or auditory injury	Cetacean species	Potentially important
Increased suspended sediment/turbidity leading to disturbance	Cetacean species	Not important

During the appraisal process the relevant legislation and site information was reviewed to determine the reasoning for undertaking appraisals.

During the EA process it was concluded that whilst there is some potential for connectivity with the Southern Trench, North East Lewis and Sea of Hebrides pMPAs, this is considered very limited in magnitude and activities at Billia Croo are not anticipated to impact upon the conservation objectives of this site or its cetacean protected features. There is no connectivity with any of the SACs sites with cetacean features. For this reason, there is no

Likely Significant Effect to bottlenose dolphin as a qualifying feature of the Moray Firth SAC, nor to harbour porpoise as a qualifying feature of the Inner Hebrides and the Minches SCI or Skerries and Causeway SAC.

All cetacean species are collectively listed as European Protected Species (EPS). Harbour porpoise and bottlenose dolphin are additionally listed singularly as species-specific EPS. As noise specialists, cetacean species are particularly vulnerable to noise-related disturbances. Both odontocete (i.e. toothed whales) and mysticetes (i.e. baleen whales) use sound for communication, the development of social bonds, and predator aversion. Odontocetes additionally use sound for foraging and to gather information about their environment. Vessel-related disturbance is caused by continuous sound emissions from vessel engines which are above ambient levels. Ambient noise pressure at Billia Croo has been measured as falling roughly between 65-72 dB re 1 µPa2 Hz-1 for emissions within the 500 Hz – 1 kHz third octave band. A range of vessels may be used during the proposed removal works, however, noise produced from the largest vessels may generate source pressure levels between 165-180 dB re 1 µPa at 1 m. Although there are multiple reasons why the vessel noise could be masked, there remains the potential that some animals may experience some level of disturbance during vessel activities.

Information regarding noise produced during the type of removal work has not be recorded. However, similar work, anchor block placements have been recorded to generate maximum sound pressure levels of 167 re 1 µPa at 1 m (pk-pk), whilst the installation of the mooring chains may reach up to 173 re 1 µPa at 1 m (pk-pk), which both roughly equate to RMS values near 21 dB re 1 µPa at 1 m, respectively. The majority of decommissioning methods would not exceed the criteria for injury to cetaceans; rather, they are more likely to exceed the thresholds for disturbance.

It is considered that the potential disturbance impacts from noise emissions from vessels and removal works will not be detrimental to the maintenance of the populations or the Favourable Conservation Statuses of relevant identified cetacean species across their natural range.

2.6 Pinnipeds

Within the EA, the following potential effects relating to pinnipeds have been identified which may be relevant to the proposed removal works. Further details regarding each potential effect pathway/activity is provided in the relevant section of the EA.

Table 6. Potential effects on pinnipeds from proposed decommissioning works

Activity / potential effect pathway	Natural heritage feature	Potential importance
Underwater noise and presence of decommissioning vessel(s), including transiting and manoeuvring, leading to disturbance	Grey and harbour seals	Potentially important.
Underwater noise from removal works leading to disturbance or auditory injury	Grey and harbour seals	Potentially important
Increased suspended sediment/turbidity leading to disturbance	Grey and harbour seals	Not important

During the appraisal process the relevant legislation and site information was reviewed to determine the reasoning for undertaking appraisals.

Given that the Billia Croo area is not directly overlapping or immediately adjacent to any seal haul-outs or SSSIs, the EA was strictly limited to disturbance to such sites from vessel movements. Vessel Management Plan which will ensure vessel traffic transiting to and from the site and anchoring away from the site will not lead to disturbance to seals at any designated haul-outs, the nearest of which are located 2.5 km and 4 km from Billia Croo. The following figure provides an overview of designated seal haul outs in close proximity to proposed vessel routes.

The closest European site, the Faray and Holm of Faray SAC, is located 38.5 km east-northeast of Billia Croo, whilst the Sanday SAC is situated 49.3 km east-northeast of Billia Croo. Both sites are additionally designated as SSSIs for seal qualifying features. The Billia Croo test site is not directly connected with, or necessary to site or conservation management of, any SAC in the UK. However, there is potential connectivity with the Sanday and Faray and Holm of Faray SACs.

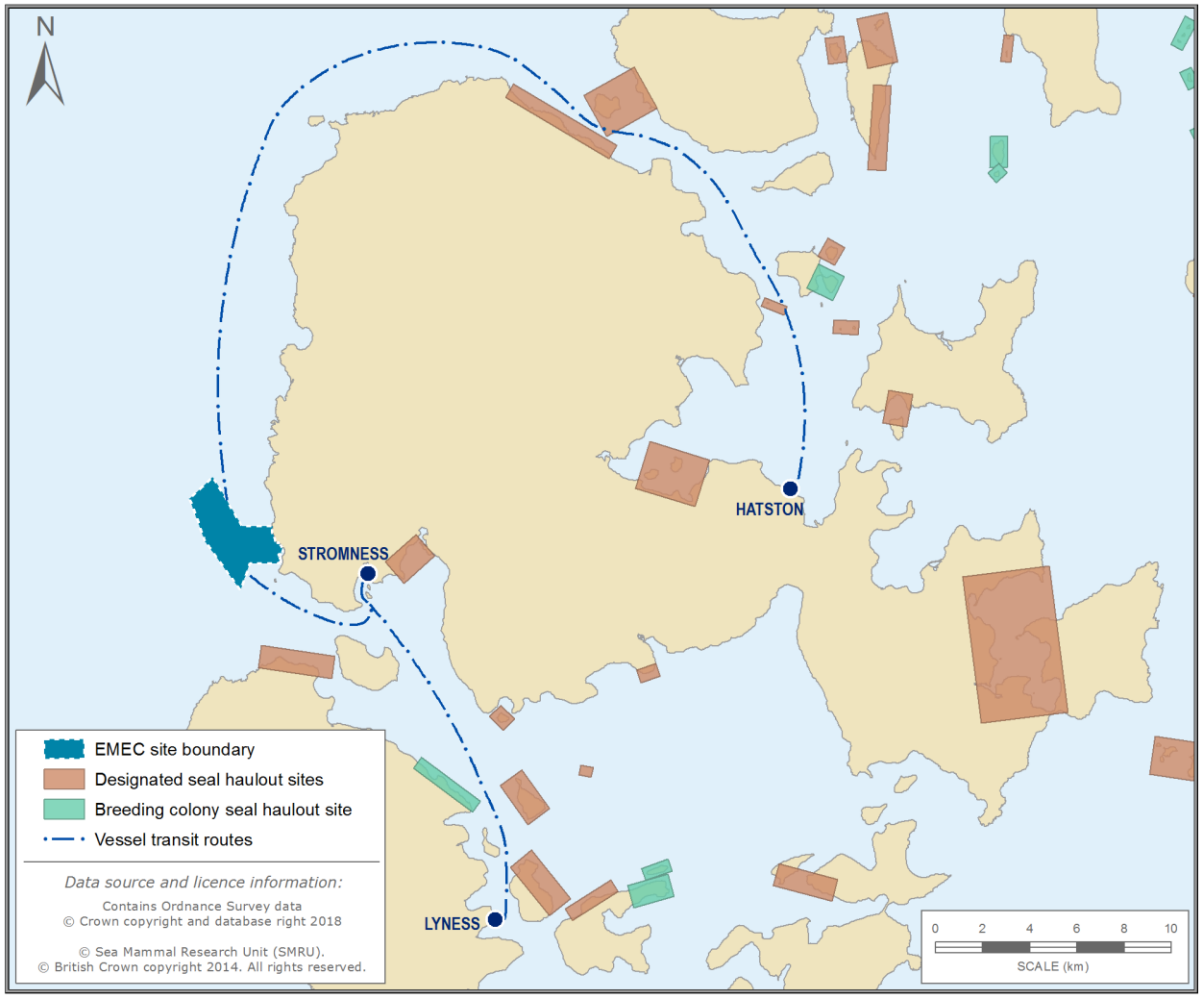

Figure 1. Designated seal haul-out sites in the vicinity of the site and vessel transit routes (Source: Aquatera, 2018)

Disturbance of seals by vessel presence appears to be limited to idle or anchored vessels near haul-outs and noise emissions from active vessels. Noises generated by both large and small to medium sized vessels are well within the anticipated range of audibility for

pinnipeds, and thus there is potential for seals within the test site to incur a strong disturbance, given the anticipated sources levels of these vessels. Given their reduced, declining population, noise-related impacts to harbour seals have the greatest potential to generate population-level consequences. Vessels present at Billia Croo are not anticipated to generate sufficient levels of noise to generate a significant disturbance which would impact the conservation of either grey or harbour seals. Disturbance events from vessel activities would be highly constrained to the area comprising the test site and will not impact upon the distribution of grey or harbour seals within their prospective sites. Additionally, vessel disturbance is not anticipated to preclude the free passage of individuals to surrounding habitats of elevated relative importance.

Acoustic measurements for noise emitted during the type of removal work proposed are not recorded, however similar work, such as anchor block placement and mooring chains have. The noise recorded for such methods do not meet the threshold criteria for injury to pinnipeds. However, they have the potential to exceed the thresholds for disturbance. It is not anticipated that methods employed during the removal work would generate any noise-related disturbances on such a scale as to cause detriment to the maintenance or conservation status of either seal species.

2.7 Ornithology

Within the EA, the following potential effects relating to birds have been identified which may be relevant to the proposed removal works. Further details regarding each potential effect pathway/activity is provided in the relevant section of the EA.

Table 7. Potential effects on birds from proposed decommissioning works

Activity / potential effect pathway	Bird natural heritage feature (bird group or species)	Potential importance
Vessel(s) presence, manoeuvring and travelling to/from test site, leading to temporary disturbance and resulting in displacement from feeding /resting habitat. This may impact birds' energy budgets and hence survival and/or reproductive potential leading potentially to population level impacts.	> Auk species (common guillemot, razorbill, Atlantic puffin, black guillemot and little auk) > Diver species > European shag > Duck species	Potentially important
	All other species	Not important
High intensity work lights on project vessels to facilitate night working leading to: Disorientation of nocturnally active birds, especially during conditions of low visibility; Collision by flying birds with surface-piercing elements leading to injury or death.	> Manx shearwater and petrel species > Atlantic puffin > Seaduck species > Migrant land birds	Potentially important
	All other seabird species	Not important

Activity / potential effect pathway	Bird natural heritage feature (bird group or species)	Potential importance
Seabed habitat loss, change and creation of artificial reef leading to: Changes in prey availability. Artificial reef may enhance feeding opportunities.	> Black guillemot > Diver species > European shag > Sea duck species (common eider and long-tailed duck)	Potentially important
	All other species	Not important
Accidental release of contaminants leading to death or reduced fitness through plumage fouling or poisoning.	All species using sea surface or water column	Potentially important

During the appraisal process the relevant legislation and site information was reviewed to determine the reasoning for undertaking appraisals. Detailed appraisal with regard to European sites, SSSIs and other features including a natura appraisal are outlined in the EA.

For red-throated divers that occur in the Billia Croo test site there is potential for SPA conservation objectives to be undermined. Specifically, the Hoy SPA breeding red-throated diver qualifying interest and Scapa Flow pSPA breeding red-throated diver qualifying interest. For all qualifying species other than red-throated diver, and despite in some cases potential for connectivity of moderate or high strength between the test site area and at least one or more SPA, it is determined that that there is no potential for the SPA conservation objectives to be undermined. This is due to all but one of these species has been determined to have low or very low vulnerability to wave energy development. The exception is great northern diver, a species which is rated as having moderate vulnerability. Considering the potential for impact pathway and connectivity, and the relatively low abundance of the species at the test site (in the context of SPA and wider population sizes) leads to the conclusion that there is no LSE to for all qualifying species other than red-throated diver at any SPA.

There is potential for disturbance of red-throated diver species from vessel activity. However, the low use of the test site by this species and the wide local availability of alternative habitat in relation to the small scale of proposed works, it is considered that any disturbance would not negatively impact on the conservation objective for either of the two connected SPAs. For Hoy SPA, disturbance in the breeding season could lead to the occasional displacement from foraging areas, this may result in minor losses in foraging time leading to minor reductions in provisioning rates during chick-rearing and could therefore potentially compromise the SPAs conservation objectives. Due to the expected small magnitude of the effects on individuals affected and the wide local availability of alternative habitat it is concluded that the disturbance would not be significant and therefore would not compromise the Hoy SPA or Scapa Flow pSPA conservation objectives and therefore there would be no AESI.

Changes to the characteristics of seabed at Billia Croo as a result of the removal works are not considered to be important and as such it is unlikely there would be significant impacts on diver prey species. Thus, it is unlikely there would be a negative effect on SPA conservation objectives.

Divers have high vulnerability to oil and other marine contaminants; plumage soiling and contaminants ingestion is likely to lead to mortality. However, vessels employed in such works has multiple embedded mitigation measures to prevent incidents occurring, and in the unlikely event of an incident there will be specialist equipment and trained personnel on hand to rapidly contain and clean up any contamination. The very exposed location would mean that any residual contaminants are quickly dispersed and broken down. Provided protocols designed to avoid and deal with incidents are rigorously observed, it is concluded there would be no significant impacts on the populations of diver species and therefore no negative impact on the conservation objectives of the SPA.

The conclusions regarding the potential for the test facility to affect the integrity of these SPAs equally applies to the notified ornithology features of the SSSI designations.

Bird species that commonly use the Billia Croo test site in at least moderate numbers and that are either not qualifying interests or features of the nearby SPAs or SSSIs, or also have substantial regional (Orkney) populations outside of these sites that are relevant for appraisal of potential impacts from the project are black guillemot and European shag.

Low to moderate numbers of European shag were frequently observed using the test site during the breeding season. During the EA it was concluded that parts of Billia Croo and its immediate vicinity has high importance for the regional (Orkney) population of shags in the breeding season. European shags' preference for feeding on the seabed in relatively shallow water (<30 m deep) means that the planned works at test berth 5 is likely to be have low importance as foraging habitat for this species compared to the shallower parts of the test site closer to the coast.

Black guillemots were frequently observed year-round in low numbers during the surveys of the test site. Black guillemots' preference for feeding on the seabed in relatively shallow water (<40 m deep) means that the immediate vicinity around the proposed works at test berth 5 is likely to be have low importance as foraging habitat for this species compared to the shallower parts of the test site.

2.8 Otters

Within the EA, the following potential effects relating to otters have been identified which may be relevant to the proposed removal works. Further details regarding each potential effect pathway/activity is provided in the relevant section of the EA.

Table 8. Potential effects on otters from proposed decommissioning works

Activity/potential effect pathway	Natural heritage feature	Potential importance
Decommissioning vessel(s) presence, transiting and manoeuvring leading to disturbance	Otters	Potentially important
Underwater noise from removal methods and vessels leading to disturbance, auditory injury, or death	Otters	Not important
Habitat loss/damage	Otters	Not important

During the appraisal process the relevant legislation and site information was reviewed to determine the reasoning for undertaking appraisals.

Otters are a EPS, listed on the Scottish Biodiversity List and are also listed as PMFs. Vessel disturbance to otters is likely to be limited, due to minimal spatial and temporal overlap between otters and vessel presence in the Billia Croo area. A range of vessels of varying sizes and draughts will be employed for the work. Given marine habitat use by otters is limited to the nearshore environment where they can target shallow water prey and maintain proximity to their holts, it is unlikely that otters will overlap spatially with vessels involved in the removal work. As such, any disturbance to otters would be limited to a very few number of individuals and will not have population-level repercussions or alter the FCS of this species.

2.9 Commercial fisheries

Within the EA, the following potential effects relating to commercial fisheries have been identified which may be relevant to the proposed removal works. Further details regarding each potential effect pathway/activity is provided in the relevant section of the EA.

Table 9. Potential effects on commercial fisheries from proposed decommissioning works

Activity / potential effect pathway	Commercial fisheries feature	Potential importance
Increased suspended sediment	Aquaculture	Potentially important
Snagging risk	Commercial fisheries	Potentially important

It is not considered that any aquaculture developments will be impacted as a result of any activities, therefore no further assessment within the EA was deemed necessary.

Snagging of gear on either operational infrastructure or post decommissioning relics has also been raised as by local fisheries organisations. Although the test site is well established and local fishermen are aware of the site and have a good understanding of the types and locations of devices installed, removal work once completed will return the seabed to pre-installation conditions, therefore further reducing any risk of snagging gear.

2.10 Archaeology

Within the EA, the following potential effects relating to archaeology have been identified which may be relevant to the proposed removal works. Further details regarding each potential effect pathway/activity is provided in the relevant section of the EA.

Table 10. Potential effects on archaeology from proposed decommissioning works

Activity / potential effect pathway	Archaeological feature	Potential importance
Loss of or damage to marine historic environment assets	Known assets	Potentially important
	Unknown assets	Potentially important
	Submerged prehistoric landscapes	Potentially important

During the appraisal process the relevant legislation and site information was reviewed to determine the reasoning for undertaking appraisals.

There are no known historic environment assets in the Project Envelope area. However, there is potential for wreckage to survive in gullies and be buried in any less mobile

sediments from wrecks that would be considered important if they survived. However, the likelihood of survival is considered negligible-low due to the highly dynamic environment and salvage activities conducted at the time a vessel was lost.

3 Mitigation and monitoring programme

3.1 Benthic ecology

The following mitigation and monitoring activities have been identified relating to benthic ecology:

Table 11. Proposed mitigation and monitoring activities associated with benthic ecology for the proposed decommissioning works

Impact	Receptor	Impact pathway	Monitoring/mitigation	Explanation
Change to benthic communities	Benthic species and habitats	Disturbance/loss of habitat	All infrastructure including moorings will be removed during decommissioning. The SEA Wave project, baited and unbaited static camera monitoring campaign and high-definition towed camera array campaign will be completed pre- and post-removal.	Removal of infrastructure and moorings will allow the benthic environment to recover to pre-installation conditions.
	Benthic species and habitats	Marine non-native invasive species	Adopt good practice: > Device/moorings will be removed during decommissioning; > Marine Biosecurity Planning Guidance (SNH, 2014a); > Marine Biosecurity Planning – Identification of best practice: a review (SNH, 2014b); > Guidelines for the control and management of ships' biofouling to minimise the transfer of invasive aquatic species (IMO, 2011); > Code of practice on non-native species (Scottish Government, 2012); > Good practice for water management (IPIECA, 2010).	Guidelines, codes and good practice will be followed to limit impacts on the benthic environment as a result of MNNS.

3.2 Hydrodynamic and physical processes

No mitigation or monitoring activities are planned relating to hydrodynamic and physical processes.

3.3 Fish and shellfish

The following mitigation and monitoring activities have been identified relating to fish and shellfish:

Table 12. Proposed mitigation and monitoring activities associated with fish and shellfish for the proposed decommissioning works

Impact	Receptor	Impact pathway	Mitigation/Monitoring	Explanation
Community composition and changes in behaviour	Diadromous fish, marine fish and crustaceans	Habitat removal and FAD	Monitoring of all introduced infrastructure via the SEA Wave project. Baited and unbaited static camera monitoring campaign will be completed pre- and post-removal.	Monitoring the variety of infrastructure deployed at the site would provide a useful of understanding of when and if FAD occurs and what preferences in terms of infrastructure, seasonality etc there might be.
Change to benthic communities	Mostly low mobility shellfish and benthic species	Introduction of MNNS	Adopt good practice: > All devices moorings will be removed during decommissioning; > Marine Biosecurity Planning Guidance (SNH, 2014a); > Marine Biosecurity Planning – Identification of best practice: a review (SNH, 2014b); > Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species (IMO, 2011); > Code of practice on non-native species (Scottish Government, 2012); > Good practice for water management (IPIECA, 2010).	Guidelines, codes and good practice will be followed to limit impacts on the benthic environment as a result of MNNS.

3.4 Basking shark

The following mitigation and monitoring activities have been identified relating to basking shark:

Table 13. Proposed mitigation and monitoring activities associated with basking shark for the proposed decommissioning works

Impact	Receptor	Impact pathway	Mitigation/Monitoring	Explanation
Disturbance	Basking sharks	Decommissioning vessel presence, transiting and manoeuvring	A VMP which includes a traffic management scheme, will be submitted on selection of the marine contractor.	This mitigation measure should reduce the potential impacts of disturbance from vessel presence and activity onsite.
			Vessel movements and occupancy within the Billia Croo test site will be managed through EMEC's SOPs.	The SOPs limit the number and size of vessels which can utilise the test site simultaneously.
		Underwater noise from foundation/mooring installation methods leading to disturbance	There is no plan to have Marine Mammal Observers (MMO) onboard the vessels involved in the decommissioning works.	

3.5 Cetaceans

The following mitigation and monitoring activities have been identified relating to cetaceans:

Table 14. Proposed mitigation and monitoring activities associated with cetaceans for the proposed decommissioning works

Impact	Receptor	Impact pathway	Mitigation/Monitoring	Explanation
Disturbance from underwater noise	Cetacean species	Decommissioning vessel(s) transiting and manoeuvring	Vessel movements and occupancy within the Billia Croo test site will be managed through EMEC's SOPs. The SOPs limit the number and size of vessels which can utilise the test site simultaneously.	SOPs will be used as good practice. The SOPs limit the numbers and sizes of vessels which can utilise the test site simultaneously, as well as put in place.

Impact	Receptor	Impact pathway	Mitigation/Monitoring	Explanation
			A VMP, which includes a traffic management scheme, will be submitted on selection of a marine contractor. Its implementation will minimise vessel overlap and provide further mitigation against potential disturbance to cetaceans.	VMP including a traffic management scheme to minimise vessel overlap. This mitigation measure should reduce the potential impacts of cumulative noise from vessel activity onsite.
		Removal methods	There are no plans to have an onboard MMO on vessels involved in the removal works. Through the SEA Wave project, acoustic monitoring equipment will be deployed at the site during the works to understand the produced noise level relative to ambient noise.	

3.6 Pinnipeds

The following mitigation and monitoring activities have been identified relating to pinnipeds:

Table 15. Proposed mitigation and monitoring activities associated with pinnipeds for the proposed decommissioning works

Impact	Receptors	Impact pathway	Mitigation/Monitoring	Explanation
Disturbance from underwater noise	Grey and harbour seals	Installation, decommissioning and maintenance vessel(s)	Vessel movements and occupancy within the Billia Croo test site will be managed through EMEC's SOPs. The SOPs limit the number and size of vessels which can utilise the test site simultaneously.	SOPs will be used as good practice. The SOPs limit the numbers and sizes of vessels which can utilise the test site simultaneously, as well as put in place a traffic management scheme to minimise vessel overlap. This mitigation measure

Impact	Receptors	Impact pathway	Mitigation/Monitoring	Explanation
		transiting and manoeuvring		should reduce the potential impacts of cumulative noise from vessel activity onsite.
			A VMP, which includes a traffic management scheme, will be supplied once the marine contractor for the works has been selected.	Its implementation will minimise vessel overlap and provide further mitigation against noise impacts to seals. This includes limiting vessel speed and providing a conservative buffer zone of 500 m around designated seal haul-outs.
		Foundation/ mooring installation and decommissioning methods	There are no plans to have MMO onboard vessels involved in the removal works.	

3.7 Ornithology

The following mitigation and monitoring activities have been identified relating to ornithology:

Table 16. Proposed mitigation and monitoring activities associated with birds for the proposed decommissioning works

Impact	Receptors	Impact pathway	Mitigation/Monitoring	Explanation
Injury/death	All birds species	Accidental release of contaminants into the marine environment.	Adherence to embedded mitigation in relation to pollution and reporting of incidents of leakage and contamination immediately to the regulator.	The conclusion of very low risk to birds is dependent on the rigorous adherence to the project's embedded mitigation measures. These are aimed at avoiding contamination events occurring and having protocols and equipment ready to deal with any incidents should they occur. Incidents should be reported immediately to the Regulator, as appropriate, and if

Impact	Receptors	Impact pathway	Mitigation/Monitoring	Explanation
				required, boat-based and beach surveys organised to assess if any birds are at risk or have become contaminated.
Disturbance because of lighting	European storm petrel	Lighting	Vessel lighting should be designed to provide sufficient light for purpose but avoid excessive bright lights.	

3.8 Otters

No mitigation or monitoring activities are planned relating to otters.

3.9 Commercial fisheries

The following mitigation and monitoring activities have been identified relating to commercial fisheries:

Table 17. Proposed mitigation and monitoring activities associated with commercial fisheries for the proposed decommissioning works

Impact	Receptors	Impact pathway	Mitigation/Monitoring	Explanation
Damage to vessels and fishing gear	Static and mobile fishing gears	Snagging/ interaction with infrastructure	All devices/assets should be clearly marked and charted. Notice to Mariners will be issued to inform fishing operators of works. On completion of the works, post decommissioning seabed footage will be submitted to EMEC. An approved Decommissioning Programme is in place for the device.	Through Notice to Mariners, all fishing operators should be well aware of activities within the Billia Croo test site and be able to plan accordingly Seabed footage will be used to inform the decommissioning process to ensure the seabed is returned to its condition prior to the commencing A Decommissioning Programme will set out the process of Decommissioning proposed for a project ensuring the seabed is left in a favourable condition as agreed with the regulator.

3.10 Archaeology

No active mitigation or monitoring is planned with regards to archaeology, however, EMEC operates an Archaeological Discoveries SOP (SOP128) to guide EMEC personnel, clients and marine contractors on the method of preserving and recording discoveries.

4 Conclusion

As outlined in Section 2 there a few potentially important impacts that require further consideration due to the scale both spatially and temporally, and location within the offshore part of the test site. Clear mitigation measures have been specified in Section 3, the majority of which will require to be implemented by the marine contractor. Through the European Maritime and Fisheries Fund, the SEA Wave project will be conducting monitoring around the removal work, this work will follow on from the successful monitoring campaign in the Horizon 2020 CEFOW project.

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