CEFOW Penguin Array Environmental Report

FINAL

Report to Fortum Energy Ltd

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FINAL	18 July 2018	Final draft for submission

Members of:

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1 INTRODUCTION

1.1 BACKGROUND

Fortum Energy Ltd ('the Developer') is taking part in a European Commission Horizon 2020 project, Clean Energy From Ocean Waves (CEFOW) which aims to deploy an array of three Penguin wave energy converters (WECs), each rated at 1MW capacity, at the European Marine Energy Centre's (EMEC's) Billia Croo test site ('the site'). The Penguin WEC is a floating device that produces energy by converting the movement of the waves to rotational kinetic movement inside the device by using the asymmetric shape of the hull. There is currently one Penguin WEC (WEC 1; see Figure 1.2) deployed at the site which was successfully re-installed in February 2017 and grid connected in March 2017[1]. The first of the additional two devices (WEC 2) is expected to be installed in September 2018 with the second (WEC 3) anticipated to be installed in May 2019 to complete the CEFOW array.

The CEFOW array ('the Project') will be situated in the north-west of the Billia Croo. WEC 2 and WEC 3 will take up station alongside the existing Penguin device at Berth 5 (see Figure 1.1). To allow additional WECs to be installed at Berth 5, the existing export cable will be split using a 4-way subsea electrical smart hub. The CEFOW array is anticipated to be operational up until May 2020, however, to allow some redundancy in the programme the marine licence application will cover the period until 1st March 2021.

This Environmental Report (ER) has been prepared to support the following necessary licence application:

- Marine Licence under Marine (Scotland) Act 2010, Part 4 Marine Licensing.

This ER should be read in parallel with the Project–specific Environmental Monitoring Programme (PEMP) (Aquatera, 2018) which has been produced as part of the wider consent application. The PEMP addresses the environmental effects described in the ER, focusing on areas particularly relevant to the planned installation/construction (WEC 2 and WEC 3), operation and maintenance (O&M) and decommissioning of all devices.

1.2 PROJECT OVERVIEW

The CEFOW array will be deployed at Berth 5 of EMEC's Billia Croo wave energy test site (see Figure 1.1), which is located at approximately 70m water depth. All devices in the CEFOW array will have the same working principle with all moving parts contained inside the hull (see Figure 1.3) to increase the power production rate and reduce investment costs. Each WEC will be moored by a 6-point catenary mooring system, with WEC 1 (already installed) using gravity-based anchors and WEC's 2 and 3 using drag embedment anchors. WECs 2 and 3 have a similar but upgraded shape as shown in Figure 1.4.

[1] The initial installation period was from the summer of 2012 to the summer of 2014. WEC 1 was installed under Marine Licence number 04064/13/0.

Figure 1.1 Proposed CEFOW licence area at Billia Croo wave test site marked in green

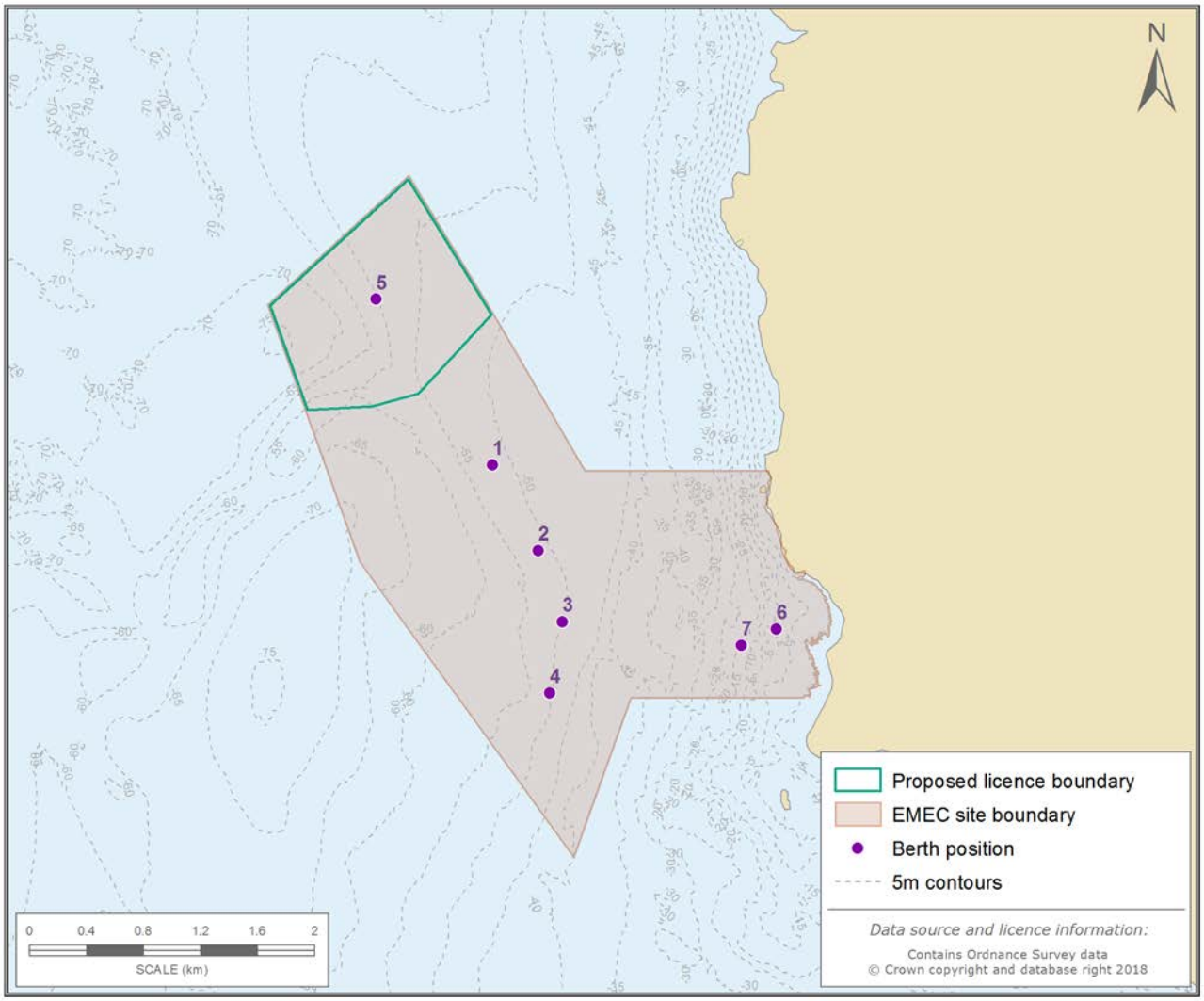


Figure 1.2 Wello's current Penguin WEC 1 (length: 30m, width: 15m, depth: 7m)

Figure 1.3 Operating principle of Penguin: rotating mass (red component) connected with generator

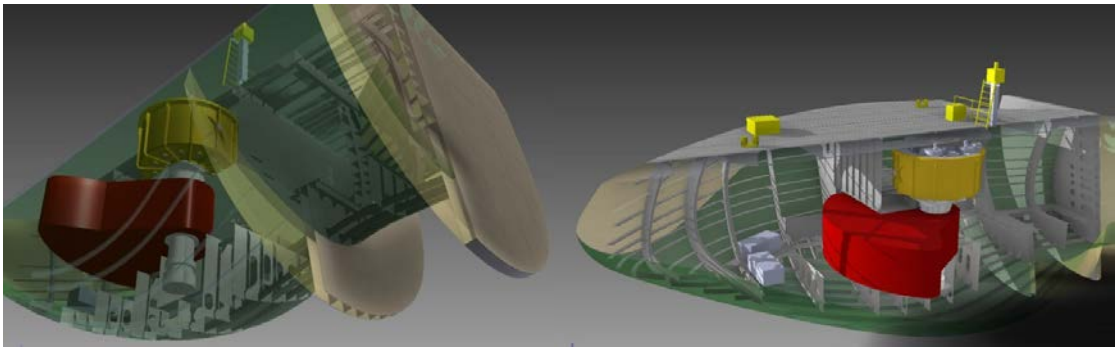


Figure 1.4 Sketch of WEC 2 with the new advanced shape (length: 40m, width: 25m, depth: 8m)

1.3 PROJECT TEAM

The consortium spans the full value chain encompassing a wave converter technology developer (Wello Oy), a marine service providers and a large multinational utility company acting as the operator (Fortum Energy Ltd). Full details about the consortium are provided within the Project Information Summary (Wello, 2018)

1.4 PROJECT SCHEDULE

The anticipated installation, operations, maintenance and decommissioning schedule for the Project is shown in Table 1.1. The anticipated date of installation of WEC 2 and its associated mooring system is September 2018 and for WEC 3 is May-July 2019. The operational period is anticipated to last up to May 2020, however, to allow some redundancy in the programme the marine licence application will cover the period until 1st March 2021. Thereafter, all devices will be completely removed from site.

At all times, onsite works will be subject to EMEC's Permit to Work system, which is managed by EMEC to minimise any potential conflicts and maximise any opportunities that may arise.

Table 1.1 Anticipated installation, operations and decommissioning schedule

Activity	2018		2019				2020				2021			
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Penguin WEC 2														
Installation of drag embedment anchors and mooring lines														
Deployment of 4-way smart electrical hub														
Installation of device														
Operations/Maintenance														
Removal of device														
Penguin WEC 3														
Installation of drag embedment anchors and mooring lines														
Installation of device														
Operations/ Maintenance														
Removal of device														

Activity	2018		2019				2020				2021			
Penguin WEC 1														
Operations/ Maintenance														
Removal of device														

1.5 SCOPE OF ENVIRONMENTAL REPORT

This Environmental Report has been produced to support the following necessary licence application:

- Marine Licence under Marine (Scotland) Act 2010, Part 4 Marine Licensing;

The following activities and operations are considered in this Environmental Report (ER):

- Installation of twelve drag-embedment anchors, studlink chain moorings and associated recovery system for WECs 2 and 3;
- Installation of WECs 2 and 3 onto moorings;
- Installation of umbilical cable from all WECs to 4-way subsea electrical hub and then on to EMEC's subsea connection;
- Commissioning of the WECs;
- Operation, maintenance and monitoring (technical and environmental) activities (WEC 1[2], WEC 2 and WEC 3); and
- Decommissioning (removal) of all equipment outlined above.

1.6 ENVIRONMENTAL REPORT STRUCTURE

The structure of this Environmental Report is as follows:

Section 1: **Introduction** – provides the background to the Project along with an overview of the proposals and details of the project team.

Section 2: **Project description** – provides a technical description of the project components and the planned activities.

Section 3: **Environmental description** – provides a description of the existing environment in addition to that which has been compiled in previous reports.

Section 4: **Assessement of potential environmental interactions** – provides an assessment of the potential environmental interactions (ecological, human and physical) including identification of mitigation measures and the potential for accidental or unplanned events.

[2] WEC 1 is already installed, under Marine Licence number 04064/13/0.

Section 5: **Habitats Regulations Appraisal (HRA)** – this section provides an HRA to determine whether the proposal has the potential to affect Natura sites (i.e. Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Sites of Community Importance (SCIs)).

Section 6: **Supplementary Monitoring Plan** – this section describes the supplementary monitoring activities that will be undertaken as part of the CEFOW project.

Appendix A: **Seabird foraging distances**

Appendix B: **Conservation Objectives**

2 PROJECT DESCRIPTION

2.1 INTRODUCTION

The following sections provide details regarding the Project location, a description of the activities planned during installation, O&M and decommissioning and a description of the technical components of the Project. Further details on the Project components are provided in the Project Information Summary (PIS) (Wello, 2018).

2.2 PROJECT OVERVIEW

The following activities are proposed:

- Construction and installation;
    - Installation of drag embedment anchor support system and moorings for WECs 2 and 3;
    - Installation of Penguin WEC 2 and WEC 3;
    - Installation of 4-way subsea electrical hub and its subsequent connection to EMEC's subsea cable;
    - Connection of Penguin WEC umbilical cables to 4-way subsea electrical hub;
- Operation and maintenance of WEC 1[3], WEC 2 and WEC 3; and
- Decommissioning of electrical hub, three Penguin WECs, moorings and anchors.

2.3 PROJECT LOCATION

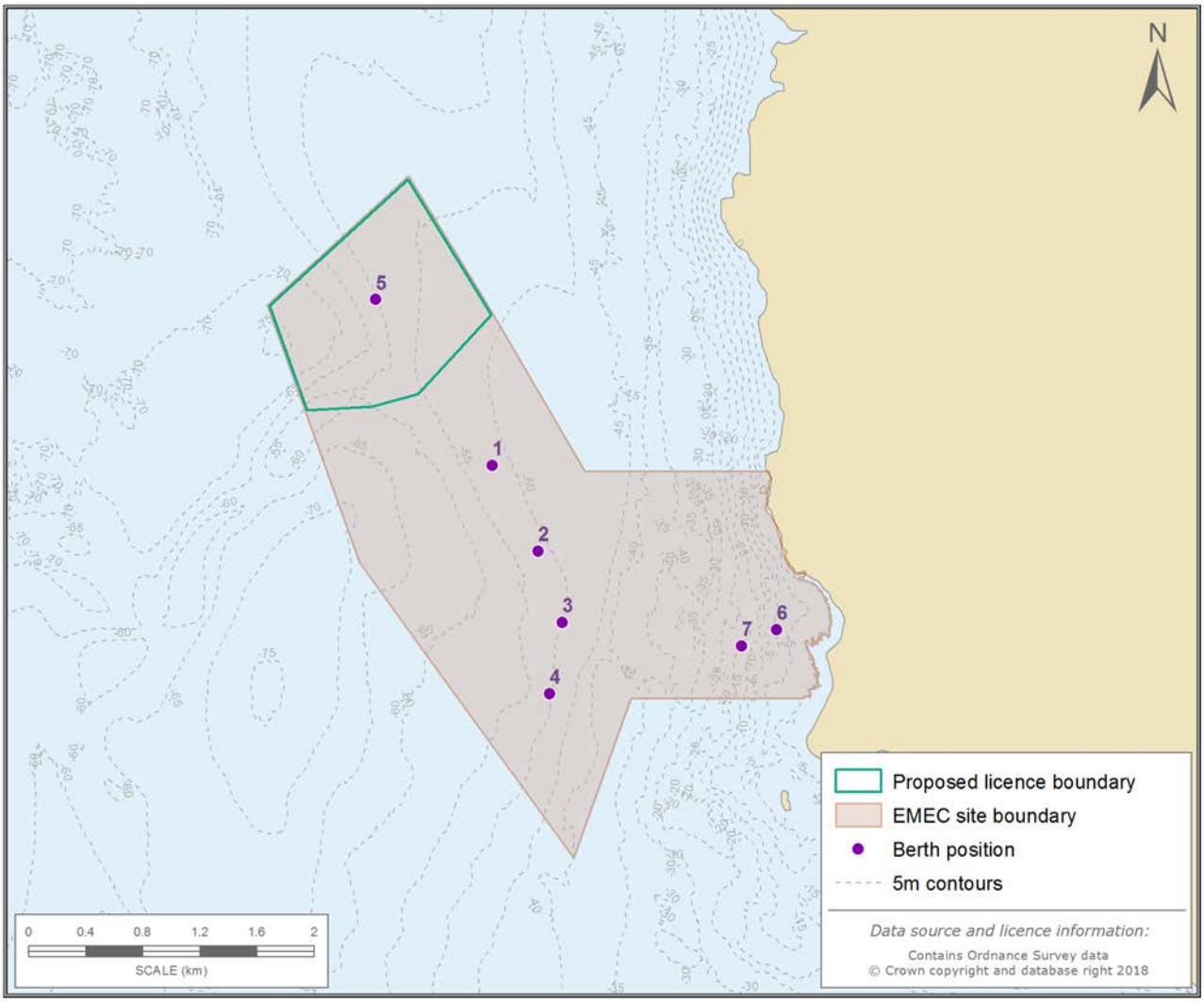
The Penguin devices (WEC 2 and WEC 3) will be installed at Berth 5 within EMEC's Billia Croo wave test site (see Figure 2.1). This is the deep water Berth located in the northwest of the EMEC test site. The licence boundary required for installation of the devices is provided in Table 2.1. The precise location of the devices and anchors (within the licence boundary provided) will be determined prior to anchor installation and will be confirmed with Marine Scotland upon submission of the formal Table of Deposits (Form FEP5). This flexibility in the installation location is required to ensure that no obstructions exist in proximity of the anchoring locations on the seabed. Coordinates will be provided to MS-LOT upon the completion of installation along with a Table of Deposits.

Table 2.1 Coordinates of licence boundary

Point	Latitude	Longitude
NW	58° 59.46'N	003° 25.32'W
N	59° 00.00'N	003° 24.36'W
NE	58° 59.46'N	003° 23.70'W
E	58° 59.16'N	003° 24.24'W
SE	58° 59.10'N	003° 24.60'W
S	58° 59.10'N	003° 25.08'W
SW	58° 59.46'N	003° 25.32'W

[3] WEC 1 is already installed, under Marine Licence number 04064/13/0.

Figure 2.1 Proposed CEFOW licence area at Billia Croo wave test site marked in green



2.4 TECHNICAL DESCRIPTION OF COMPONENTS

A technical description of each of the components to be deployed can be found in the Project Information Summary (PIS) (Wello Oy, 2018).

2.5 OPERATIONAL PLANS AND METHODOLOGIES

2.5.1 Construction and installation

WEC 1 is already installed, under Marine Licence number 04064/13/0, and is held in place by six gravity anchors consisting of steel chain or concrete blocks weighing up to fifty tonnes each. WECs 2 and 3 will be held in place by six drag embedment anchors in a similar orientation to WEC 1 (see Figure 2.6). Initially, installation of vessel moorings will take place over a period of two days to aid in the installation of the drag-embedment anchors. A standard multi-cat type vessel will be required for installation of the anchors, which will be installed at predefined locations on the seabed (see Section 2.3). The anchors will be loaded onto the multicat vessel at Copeland's Dock, Stromness. This is the closest harbour facility to the Billia Croo test site.

The six-point catenary mooring system that will be installed for WEC 2 and WEC 3 will consist of various widths (48mm-76mm) of studlink chain that attach to the anchor. Each mooring line will be around 266m in length with the mooring spread of WEC 2 and WEC 3 being 500m (see PIS (Wello, 2018). Installation of the anchors and moorings for each device is expected to be completed in four days.

The vessel spread required for installation is shown in Table 2.2. Further details of the vessels likely to be used for the deployment are provided in the Vessel Management Plan in the PEMP.

Table 2.2 Vessels utilised for installation

Vessel Type	Task
Multi-cat (x2) (see Figure 2.2)	The vessel will be used to transport and install the anchors and to tow the Penguin devices (WEC 2 and WEC 3) out to the site. The vessel will remain on site whilst the device is installed. A second multi-cat may be used to provide assistance
Workboat (see Figure 2.3)	The workboat is manoeuvrable around the site while the multi-cat is temporarily moored.
Rigid inflatable boat (RIB), or similar (see Figure 2.4)	A RIB will be used to assist with the towing and installation of the device

Figure 2.2 Example multi-cat vessel GM Green Chief

Figure 2.3 Example support vessel – GM Green Quest

Figure 2.4 Example support vessel – rigid inflatable boat (RIB)

Device installation

Technical details of the Penguin device can be found in the Project Information Summary (Wello Oy, 2018). A sketch of the Penguin WEC 2 with a new advanced shape is provided in Figure 2.5.

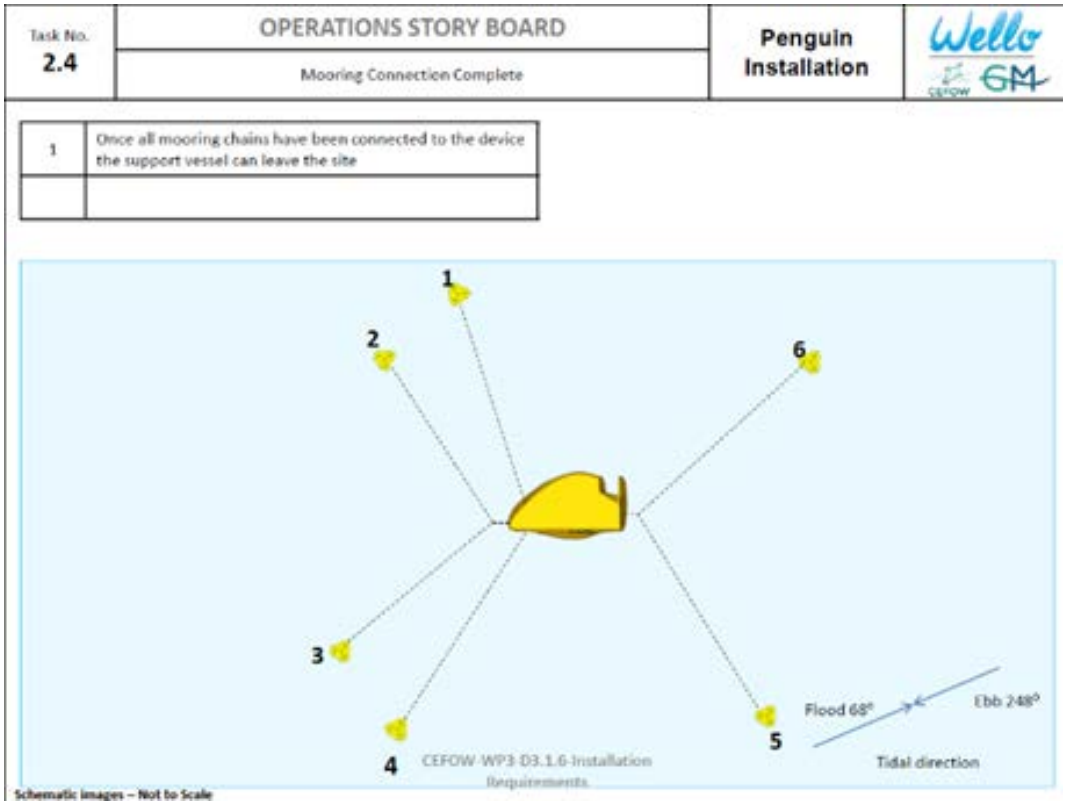
Figure 2.5 Sketch of WEC 2 with the new advanced shape

WECs 2 and 3 will be manufactured in Tallin, Estonia and towed by sea to Orkney where it will be berthed at Hatston Pier (in Kirkwall) or Lyness Pier (in Hoy) in preparation for deployment at Billia Croo. The device is easily deployed due to its ability to be towed behind a standard multi-cat vessel. When the device arrives on site it will be hooked up to the mooring spread. This will be achieved in the following stages:

- Undertake micro-siting onsite and complete connection to buoys;
- Connect to the midline support buoy; and
- Repeat for all mooring legs.

Figure 2.6 shows an indicative mooring spread of the Penguin device. Installation of each Penguin device is expected to take 1 day.

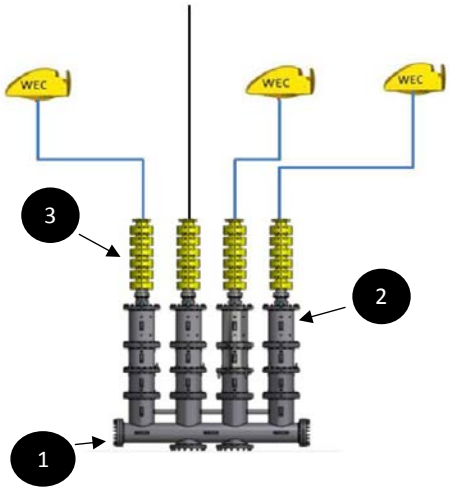
Figure 2.6 Indicative mooring view of Penguin device (not to scale)



Connection of umbilical cable to 4-way subsea electrical hub and then to EMEC's subsea cable

The EMEC electrical cables run from the sub-station at Billia Croo to each Berth location (refer to Figure 2.1). To allow additional WEC devices to be installed at Berth 5 the export cable will be split using a 4-way subsea electrical smart hub as shown in Figure 2.7 below.

Figure 2.7 Schematic of 3 WEC connections (Wello Oy, 2018)



Item No.	Part	Quantity
1	4 - way hub	2
2	MV Dry mate connectors	4
3	Bend stiffeners/ restrictors	4

The hub contains 3 import connections and 1 export connection. The dynamic cable from the WEC devices can be quickly and easily connected to the import connections of the hub via the use of a dry mate connection. Using a 4-way hub then allows multiple WEC devices to be installed exporting power through just the one cable.

The option currently being considered for connecting the 4-way electrical hub with EMEC's subsea cable termination box is:

- Isolate and apply circuit main earth at the onshore substation;
- Lift the export cable onto the vessel deck and prepare for testing/termination;
- Test cable first, and safe padlock the electrical works;
- Splice the cable and fit the dry-mateable connector to 4-way hub; and
- Deploy cable.

As the cable is double armoured, extra protection is not required. When hoisting and lowering cables, extra care will to be taken to prevent kinks and other damage.

The final task is to carry out a post installation ROV survey. This will include the recording of the precise position of the termination box as laid and demobilisation of all associated equipment. It is anticipated that the installation of the anchors will be completed in four days, the electrical connection in two days, and connecting the Penguin device will be completed within one day. The Penguin device can be installed in conditions of Hs <1.5m.

2.5.2 Operations and maintenance

The device has been designed so that regular maintenance is not required. However, it is anticipated that during testing, maintenance and inspection will be required approximately once a month. This will essentially involve using a RIB or small workboat to transfer personnel onto the device where maintenance and inspection will be conducted within the hull. Maintenance will only be carried out in calm sea conditions (with a wave height less than ~1m Hs to ensure safe access to the device).

Technical monitoring of the device will be undertaken regularly by ROV and diver inspections. In addition, inspections will be done after every severe storm especially during the first years of the Project.

Planned and unplanned onsite maintenance is expected throughout 2018, 2019 and early in 2020 (detailed in Table 2.3). However, WECs may be removed to Hatston or Lyness Pier and subsequently reinstalled where repairs cannot be made at sea.

Table 2.3 Planned and unplanned visits to the CEFOW array

Visit Type	Planned / unplanned	Frequency	Max Hs
On board inspection	Planned	2 times	0.5m
Public relation visits	Planned	2-6 times	0.5m
Inspection of mooring lines and anchors with ROV and divers	Planned	Every two months: Approx. 18 times	1.0m
Removal and re-installation upon significant damage	Unplanned	-	1.0m

Retrieval of the device will follow the reverse of the installation method as presented here. Each Penguin device will be detached from its moorings and subsea-cable and towed back to port. The device will then be redeployed utilising the same method of installation as outlined in Section 2.5.1.

2.5.3 Decommissioning

Decommissioning will involve the retrieval of each Penguin device (WEC 1, WEC 2 and WEC 3) and will be a reverse of the installation procedures outlined in Section 2.5.1. Each Penguin device, its mooring lines and anchors are planned to be removed from site by May 2020, however there may be a requirement to extend the deployment period to March 2021, but no site infrastructure will remain after this period.

When Wello departed the testing Berth at Billia Croo in the summer of 2014 there were a number of items left on the seabed. These include:

- 6x clump weights (exact location within Berth 5 area currently unknown) (24t in air, 14t submerged).
- 3x roll plates:
  - Roll plate 1 (Lower Roll plate) – Deposited on seabed in 2012 – shackles may be damaged (Approx 122t dry / 75t wet)
  - Roll plate 2 (Upper Role plate) – Deposited on the seabed 2012 – shackles may be damaged Approx 122t dry / 75t wet).
  - Note: Originally Roll plate 1 was suspended approximately 14m below Roll plate 1 with three chains through the slots on Roll Plate 2.
  - When Roll plate 1 was deposited, it was replaced with a bundle of chain, which is now still partially threaded through Roll Plate 2 centre.
  - Roll plate 3 – was deposited 2013 (1X Approx 138t dry / 92t wet).
- Approximately 150m of umbilical cable.

Wello are committed to works to remove these items from the seabed and to clear the EMEC Berth for the next occupant.

Wello will submit a Draft Decommissioning Plan for the CEFOW array, to accompany the Marine Licence application, which will include these items.

3 ENVIRONMENTAL DESCRIPTION

3.1 INTRODUCTION

A detailed Environmental Description (REP096-04-03) for the Billia Croo test site has been produced (Aurora Environmental and Finn, 2009). This document should be read in parallel with this ER; particularly in reference to the following topics:

- Seascape (section 2.1);
- Coastal habitats (littoral) (section 2.2);
- Seabed conditions (section 2.3.2);
- Sublittoral habitats (section 2.3.3);
- Fish and shellfish (section 2.5);
- Birds and shore birds (section 2.6);
- Marine mammals (section 2.7);
- Conservation (section 2.8);
- Other sea users (section 2.9); and
- Key seasonal environmental sensitivities (section 3).

Additionally, an Environmental Report for the Penguin WEC 1 device was issued to Marine Scotland in 2011 (Aquatera, 2011). The aim of this section is to update the relevant baseline information from the previous Environmental Report (Aquatera, 2011) for the proposed deployment location (see Figure 2.1) that has become available through ongoing monitoring activities.

3.2 SEABED CONDITIONS

This section of the Environmental Report describes the existing knowledge of seabed conditions within Berth 5 (see Figure 2.1) and discusses the pre-deployment survey requirements.

3.2.1 Existing knowledge of seabed conditions

EMEC's Billia Croo Environmental Description details seabed sediments within section 2.3.2 (Aurora Environmental and Finn, 2009). Seabed sediments for the Billia Croo licenced area were surveyed by the International Centre for Island Technology (ICIT) in 2002.

The seabed in the vicinity of test Berth 5 is relatively diverse and characterised by a number of different features. The test Berth site itself is situated on the edge of a sedimentary ridge which has built up over the bedrock. This sedimentary feature is linked to the ebb tide current which flows out of Hoy Sound (0.5km to the south) and forms an eddy to the east as the main current flows north-westwards out of Hoy Mouth. A coastal rock platform lies to the east of the test Berth. To the west of the test Berth, in deeper water, there is another rocky platform, one of a number across the seabed to the west of Orkney. In addition, there are further linear rock features at the site, which may be related to a volcanic intrusion or dyke on the seabed. It could also be the remains of glacial moraine debris, left by a retreating glacier during the previous ice period.

The sediment, based upon previous observations in the area, is formed by medium and coarse-grained sand of a mixed rock and shell-based origin. The sediment is rippled on the surface and is therefore likely to be mobile during high current and storm wave conditions.

The seabed fauna in the area is not particularly rich, in part due to the relatively high seabed mobility and the relatively low nutrient inputs in the sediments.

A pre-deployment ROV survey will be completed before WEC 2 and WEC 3 are installed. This survey will provide localised seabed conditions for each drag embedment anchor. The results of the survey will be reported in an Environmental Monitoring Report (EMR).

3.3 MARINE BIRDS

An overview of marine and shore bird interests at the Billia Croo test site is provided in EMEC's Billia Croo Environmental Description (Aurora Environmental and Finn, 2009). The coastal waters around Orkney provide important habitat for breeding seabird populations many of which nest on the cliffs around much of Orkney's coastline.

This section of the Environmental Report provides a summary of existing knowledge of marine birds (see Figure 2.1), based on the findings of EMEC's Wildlife Observations Programme (Marine Scotland, 2018).

The EMEC Wildlife Observations Programme gathered bird and marine mammal observation data at the Billia Croo wave test site and surrounding area from March 2009 to December 2015. Land-based visual observations were undertaken each week from a nearby cliff-top vantage point at Black Craig. The hemispherical survey area covered the entire Billia Croo test site.

A review of survey data from March 2009 to March 2011 identifies the most frequently recorded species and can assist in understanding the spatial and temporal distribution of species at the test site (Robbins, 2012). It should be noted that a summary of EMEC Wildlife Observations from March 2013 to March 2014 provides an overview of the monthly wildlife sighting counts for each species (Marine Scotland, 2014). The preliminary findings of the 2013-2014 data, in terms of the most frequently observed species present at Billia Croo are consistent with Robbins (2012), however no detailed analysis was undertaken in the 2014 report regarding the spatial distribution of sightings within the survey area. Most recently, data from the EMEC Wildlife Observations Programme was analysed in a study investigating the possible displacement of marine wildlife from the Billia Croo test site (Long, 2017). In-depth spatial analyses for four species of marine birds (common guillemot, black guillemot, Atlantic puffin and Northern gannet) along with three species groups (auks, divers and gulls) were undertaken. A summary of the main findings of Robbins (2012) and Long (2017) is presented here.

The species most frequently observed in the deeper offshore waters within which Berth 5 is located, were Northern fulmar *Fulmarus glacialis*, Northern gannet *Morus bassanus,* black-legged kittiwake *Rissa tridactyla* and common guillemot *Uria aalge* (Robbins, 2012). All of these species were widely distributed throughout the survey area however there were differences in the spatial and temporal distributions of these species. Peak numbers of Northern fulmars were present in December during the winter period. Numbers decrease until September with two small increases in May and August which coincides with the onset of egg laying and then the fledging period. The majority of observations of Northern fulmar were of resting birds. The greatest concentration of Northern gannets was observed off of Breck Ness at the southern end of the Billia Croo test site, where many birds were observed actively foraging. Highest densities of Northern gannet are present between August and October with far fewer birds present during the winter months between December and March (Long, 2017). Most observations of black-legged kittiwake occurred in April/May with numbers decreasing over the summer months which may be as a result of the abandonment of

breeding colonies following failed breeding attempts. Although widely distributed throughout the survey area, the distribution of common guillemot showed a clear concentration of observations in the central part of the survey area with highest densities generally 1-2km west to south-west of the Black Craig cliffs with numbers showing a significant seasonal pattern with numbers increasing rapidly during spring to a peak in June after which numbers rapidly decline by early July when all chicks have left the breeding colonies and gone to sea. Lowest numbers are present in August with numbers rising slightly and remaining relatively constant between October and January (Long, 2017).

Elsewhere within the survey area, the most numerous species observed was European shag *Phalacrocorax aristotelis*, with a clear spatial concentration of observations at the southern part of the Billia Croo test site, off of Breck Ness. Although European shag is a year-round resident species, there was seasonal variation in the observations with the greatest numbers recorded during November following which there was a sharp decline in numbers at the beginning of the year with numbers increasing in March with a peak in early June during the breeding season. Sightings of *Larus spp.* including common gull *Larus canus*, great black-backed gull *Larus marinus* and herring gull *Larus argentatus* were also concentrated around Breck Ness with most records of resting birds, with birds present year round.

Another year-round resident species that occurred predominantly in the southern part of the Billia Croo test site was common eider *Somateria mollissima,* with all sightings of this species in the area of Breck Ness. The highest numbers were recorded in February after which the numbers rapidly decreased until June, increasing again after July. This pattern is consistent with the eider breeding season when females incubate eggs on land and males congregate offshore during moulting.

Black guillemot *Cepphus grylle,* another year-round resident species also showed significant spatial variation within the survey area with most records located within 2km of the coastline. Peak densities are found in March with numbers slowly declining to a low during September to December with a rapid rise in numbers through to March (Long, 2017). Two other auk species were observed more frequently during the spring and summer months these were Atlantic puffin *Fratercula arctica* and razorbill *Alca torda*. Highest densities of Atlantic puffin are present between April and August located predominantly within the inner grid cells west of the cliffs of Black Craig, with a smaller cluster west of Breck Ness (long, 2017).
Three migratory species which are present in Orkney waters only during the breeding season period are great skua *Stercorarius skua*, Arctic skua *Stercorarius parasiticus* and Arctic tern *Sterna paradisaea.* Observations of all three species were distributed widely across the survey area.

A less frequently observed species recorded within the survey area was red-throated diver *Gavia stellata* with the greatest number of sightings in spring and winter. In addition, low numbers of Manx shearwater *Puffinus puffinus* and European storm-petrel *Hydrobates pelagicus* and very low numbers of Leach's storm-petrel *Oceanodroma leucorhoa* were observed during the EMEC Wildlife Observations Programme (Marine Scotland, 2018) relatively infrequently therefore these species are not considered further.

3.4 MARINE MAMMALS

An overview of marine mammal interests at the Billia Croo test site is provided in EMEC's Billia Croo Environmental Description (Aurora Environmental and Finn, 2009). The waters around Orkney provide important habitat for marine mammal populations including cetaceans and pinnipeds. In particular, Orkney holds internationally important concentrations of grey seal *Halichoerus grypus* and harbour (common) seal *Phoca vitulina*.

This section of the Environmental Report provides a summary of existing knowledge of marine mammals within the wider Billia Croo site area, based on the findings of EMEC's Wildlife Observations Programme (Marine Scotland, 2018).

As noted above (Section 3.3) the EMEC Wildlife Observations Programme gathered bird and marine mammal observation data at the Billia Croo wave test site and surrounding area from March 2009 to December 2015. Land-based visual observations were undertaken each week from a nearby cliff-top vantage point at Black Craig. The hemispherical survey area covered the entire Billia Croo test site.

A review of survey data from March 2009 to March 2011 identifies the most frequently recorded species and can assist in understanding the spatial and temporal distribution of species at the test site (Robbins, 2012). It should be noted that a summary of EMEC Wildlife Observations from March 2013 to March 2014 provides an overview of the monthly wildlife sighting counts for each species (Marine Scotland, 2014). The preliminary findings, in terms of grey seals and harbour porpoise being the most frequently recorded species is consistent with Robbins (2012), however the number of harbour seals recorded in the Billia Croo site dropped from 42 during the 2009-2011 data gathering period to just seven over the April 2013 to March 2014 recording period as reported in Marine Scotland (2014). This reduction in the number of harbour seal counts is consistent with the wider Orkney area which has seen a decline of 85% between 1997 and 2016 (Special Committee on Seals (SCOS), 2017; see Section 3.4.2 for further details). No detailed analysis has been undertaken regarding the spatial distribution of sightings within the survey area for data gathered in 2013/2014 (Marine Scotland, 2014). A summary of the findings of Robbins (2012) is presented here.

A wide variety of marine mammals have been observed at the Billia Croo wave test site, since observations began in 2009. The most frequently recorded species at the Billia Croo site are grey seal, harbour seal and harbour porpoise *Phocena phocena*. Other less frequently recorded species of cetacean include minke whale *Balaenoptera acutorostrata*, Risso's dolphin *Grampus griseus* and white-sided dolphin *Lagenorhynchus obliquidens*. Bottlenose dolphin *Tursiops truncates* (a qualifying feature of the Moray Firth SAC (approximately 125km by sea southeast), see Section 5 HRA) are very infrequently recorded at the site with only one record of four individuals in April 2013 from all the gathered data (Marine Scotland, 2018). Large baleen whales are also very infrequently observed at the site with with only one sighting of a humpback whale *Megaptera novaeangliae* in September 2013 (Marine Scotland, 2018).

Only three species of marine mammal were observed in sufficient numbers during the 2009-2011 data gathering period to enable statistical analysis to be carried out (Robbins, 2012). These were grey seal, harbour seal and harbour porpoise.

3.4.1 Seals

The total number of seals sighted during the 2009-2011 observation period was 470, 9% of which were harbour seals, 66% of which were grey seals and 25% of which were unable to be identified to species level (Robbins, 2012).

Spatial distribution maps of marine mammal species are not provided in Robins (2012) due to the relatively low numbers of individuals sighted during the observation period. However, the general spatial distribution of seal species throughout the Billia Croo site followed that of birds species, with sightings concentrated along the coastline between the Blackcraig observation tower and Breck Ness, away from the deeper water areas around Berth 5. The model used in Robins (2012) predicts an increasing abundance of seals towards the southeastern extent of the site.

Taken together, both seal species, which are year-round residents at the site, were shown to follow a seasonal pattern with numbers increasing until around August and then gradually decreasing again. However, the different breeding pheneology of these species means there are typically higher concentrations of each species depending on the time of year. Harbour seals breed in the summer months giving birth on land and then spending the majority of the pupping season at sea with their pups. Grey seals pup during the autumn with the peak during autumn and winter.

3.4.2 Designated seal haul-out sites

The harbour seal population in Orkney has seen a decline of 85% between 1997 and 2016, as highlighted by the SCOS (2017). In 2016, a complete survey of the harbour seal population in Orkney and the north coast was completed. A total of 1,349 harbour seals were counted compared with 1,938 in 2013, 3,000 in 2008-2009 and 8,800 in 1997. These latest results suggest that the Orkney harbour seal population has seen a rapid decline in population since 1997 and this is continuing.

Although declines have been reported in certain areas (Orkney, Shetland, Firth of Tay) in Scotland, the declines are not universal, and increases in population have been observed on the west coast of Scotland and England. Consequently, the SACs within the wider area are in unfavourable condition (as assessed through site condition monitoring) and overall the conservation status for harbour seals at a UK level has been assessed as 'unfavourable-inadequate'. The Potential Biological Removal (PBR) for harbour seals in Orkney has also recently been reduced to 11 (for 2017) (Scottish Government, 2018), indicating that there is concern that the death of 11 individuals outwith 'natural causes' may lead to the population becoming unsustainable.

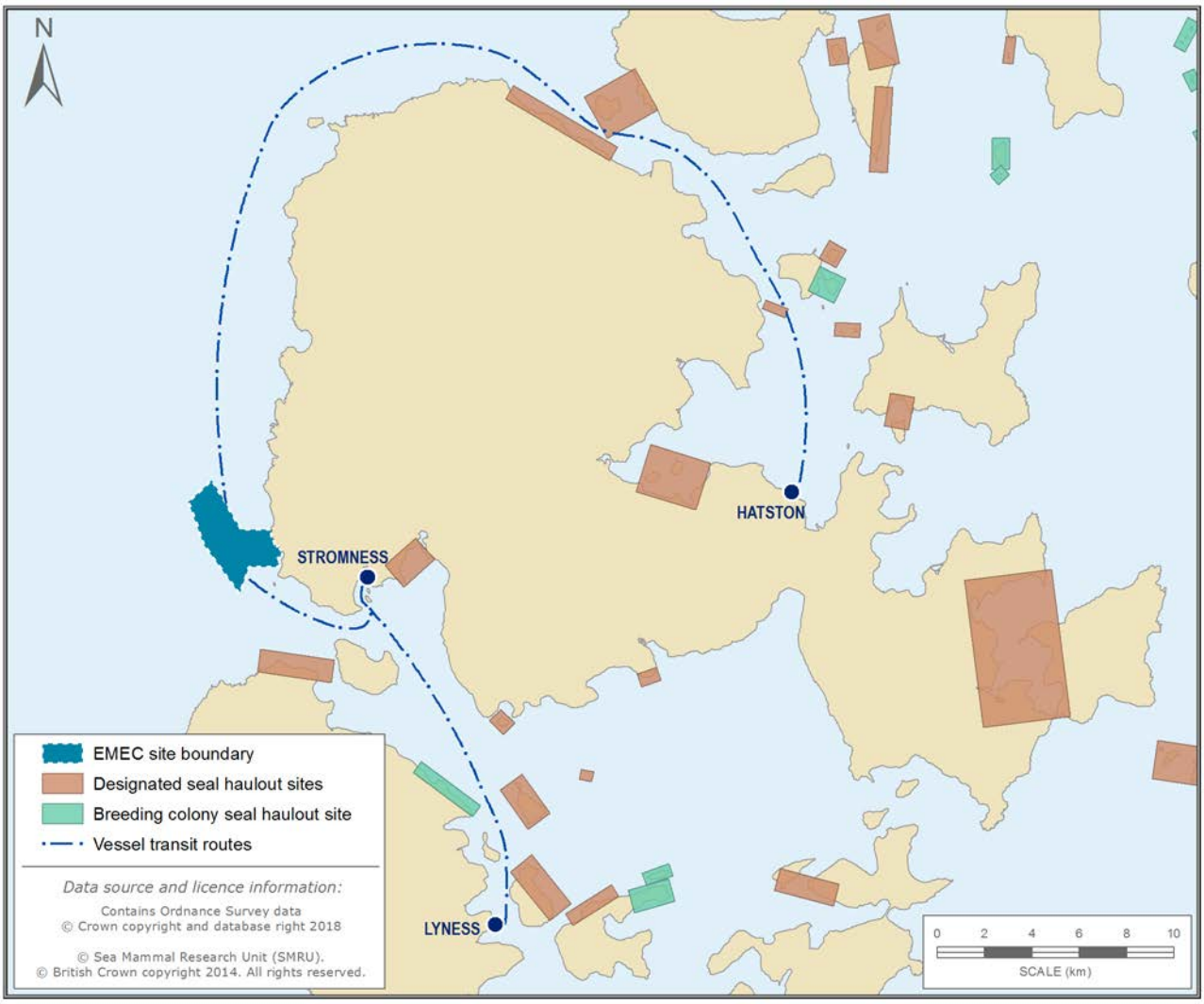
Under Section 117 of the Marine (Scotland) Act 2010, Scottish Ministers have been permitted to designate specific seal haul-out sites to provide additional protection for seals from intentional or reckless harassment. There are no designated seal haul-out sites on the west coast of Orkney Mainland. However, when vessels are transiting to and from site, there are several designated haul-out sites situated in close proximity to the potential transiting routes, these are detailed in Table 3.1 and shown in Figure 3.1.

Note that only those considered relevant to the proposals due to their proximity to vessel transit routes are described within Table 3.1.

Table 3.1 Designated seal haul-out sites in close proximity to vessel transiting routes

Site Name	Site ID	Location	Description
Selwick	NOO-006	North Hoy	Rocky coastline between Muckle Head and Middle Skerry and associated rocky outcrops.
Eynhallow and Westside	N00-001	Between Mainland and Rousay	The rocky coastline of the intertidal island of Eynhallow and a small section of the southern coast of Rousay.
Costa and Burgar	N00-016	North Mainland opposite from Eynhallow	Entire rocky coastline and associated rocky outcrops from Costa Head to approximately 1.5km west of Aiker Ness.
Holm of Rendall	NOO-022	East of Rendall north Mainland	Two small tidal islets off the coast of Rendall.
Sweyn Holm	N00-027	North east of Gairsay	Intertidal sandbanks of Sweyn Holm.
Taing Skerry and Grass Holm	N00-019	Wide Firth, west of Shapinsay	Rocky coastline of Taing Skerry and Grass Holm with small areas of intertidal sandbank on Grass Holm.
Gairsay	BC-028	Off Mainland east of Tingwall	Breeding colony seal haul-out encompassing the southeast of Gairsay and including tidal sandbanks at the bays of Millburn and Rusness.

Figure 3.1 Designated seal haul-out sites in the vicinity of the site and vessel transit routes



3.4.3 Harbour porpoise

A total of 397 harbour porpoise were observed at the Billia Croo site during the 2009-2011 observation period and, again, the model used in Robins (2012) predicts a greater abundance in the southeastern part of the site, away from the Berth 5 area. Harbour porpoise were found to show a significant seasonal pattern with a peak in the number of encounters between May and August.

3.5 PROTECTED SITES

An overview of protected sites at and in the vicinity of the Billia Croo test site is provided in EMEC's Billia Croo Environmental Description (Aurora Environmental and Finn, 2009).

There are a number of protected sites which are considered relevant to the Project and which are described in the following sections.

Specifically, this section details the following:

- Natura sites;
  - o Special Areas of Conservation (SACs)
  - o Special Protection Areas (SPAs)
  - o Sites of Community Importance (SCIs)
- Sites of Special Scientific Interest (SSSI); and
- Marine Protected Areas (MPAs).

3.5.1 Natura sites

Special Areas of Conservation (SACs)

As this Project has no land-based operations, only those SACs with an offshore marine feature are deemed relevant. A number of SACs in the wider Orkney and North Sea region include:

- Faray and Holm of Faray SAC (48km northeast by sea);
- Sanday SAC (63km northeast ny sea); and
- Moray Firth SAC (123km southeast by sea).

The HRA (see Section 5 HRA) concluded that there are no SACs with potential conncectivity to the site. Faray and Holm of Faray and Sanday SACs are designated for breeding grey seals and harbour seals respectively. A foraging distance of 20km is recommended by SNH (*pers. comm.*) for use as the appropriate criteria for grey seals during the breeding season and of 50km for harbour seals and so both of these sites are not considered relevant. Similarly, the low frequency of sightings of bottlenose dolphin at the site and in the north coast of Scotland in general means the Moray Firth SAC has little potential for connectivity with the Billia Croo site (see Section 5 HRA).

Special Protection Areas (SPAs)

All of the SPAs considered relevant to this Project are shown in Table 3.2 along with a complete list of their qualifying features. These sites were identified through the HRA screening process and a full explanation of the possible connections between each of the qualifying features and the Project are presented within the HRA (see Section 5).

Table 3.2 SPAs considered relevant to the proposed Project

Name of SPA	Relevant Qualifying Species
Auskerry	Storm petrel; Arctic tern
Calf of Eday	Seabird assemblage; Fulmar*; Guillemot*; Kittiwake*; Great black-backed gull*; Cormorant*
Copinsay	Seabird assemblage; Fulmar*; Guillemot*; Kittiwake*; Great blacked-back gull*
Hoy	Seabird assemblage; Great Skua; Peregrine; Red-throated diver; Fulmar*; Kittiwake*; Guillemot*; Puffin*; Arctic Skua*; Great black-backed gull*
Marwick Head	Seabird assemblage; Guillemot; Kittiwake*
North Caithness Cliffs	Seabird assemblage; Common Guillemot; Peregrine; Fulmar*; Kittiwake*; Razorbill*; Puffin*
Rousay	Seabird assemblage; Arctic tern; Fulmar*; Guillemot*; Kittiwake*; Arctic skua*

Name of SPA	Relevant Qualifying Species
St Kilda	Seabird assemblage; Leach's storm petrel; Storm petrel; Great skua; Gannet; Puffin; Manx shearwater*; Razorbill*; Guillemot*; Kittiwake*; Fulmar*
West Westray	Seabird assemblage; Arctic tern; Guillemot; Fulmar*; Kittiwake*; Razorbill*; Arctic skua*

* part of seabird assemblage

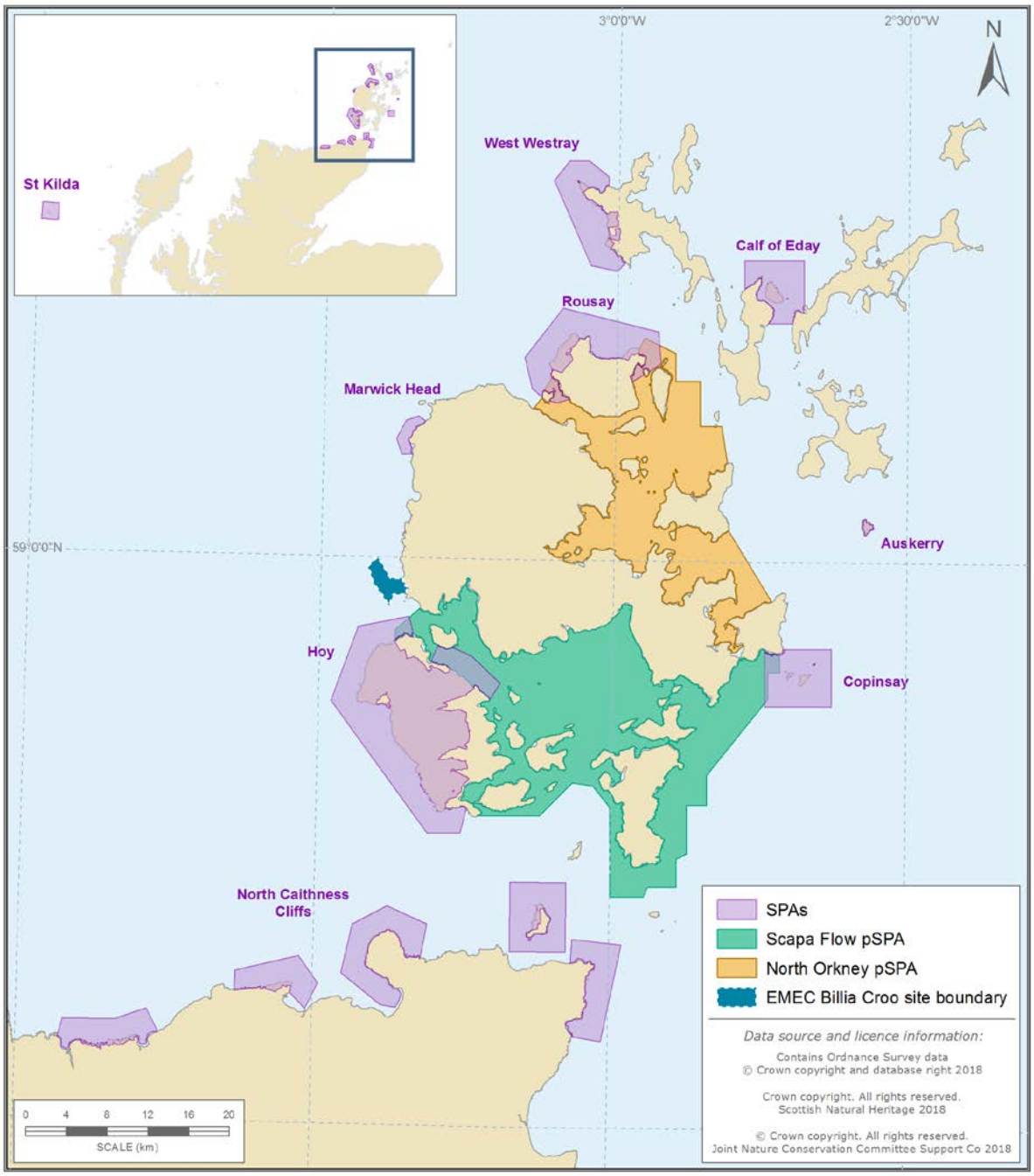
Proposed SPAs

There are two proposed SPAs (pSPAs) within the wider area, Scapa Flow pSPA is located 4.2km to the southeast of the Billia Croo site and North Orkney pSPA is located 27.5km to the Northeast (see Figure 3.2).

Scapa Flow pSPA has been selected to provide protection to a range of marine bird species including wintering and breeding season interests. Wintering season interests include great northern diver *Gavia immer*, black-throated diver *Gavia arctica*, Slavonian grebe *Podiceps auritus*, common eider *Somateria mollissima*, common goldeneye *Bucephala clangula*, long-tailed duck *Clangula hyemalis*, red breasted merganser *Mergus serrator* and European shag *Phalacrocorax aristotelis*. This site is also of importance as a foraging area for breeding red-throated diver *Gavia stellata*. The proposed maintenenance vessel transit route from Stromness to Billia Croo is within the western extent of the Scapa Flow pSPA (see Section 5 HRA).

North Orkney pSPA is located to the north of Mainland Orkney. North Orkney pSPA was selected to provide protection to important wintering grounds used by seven species of inshore wintering waterfowl; these are great northern diver, Slavonian grebe, common eider, long-tailed duck, red-breasted merganser, European shag and velvet scoter *Melanitta fusca*. The inshore area is also selected as an important foraging area for breeding red-throated diver. The vessel transit route for transportation of the Penguin devices, which will be seldom used, transits northwest from Hatston (see Figure 3.1) and therefore is within the North Orkney pSPA (see Section 5 HRA).

Figure 3.2 SPAs and proposed SPAs (Scottish Natural Heritage, 2016)



Sites of Community Importance (SCIs)

SCIs are conservation sites that have been adopted by the European Commission but have not yet been formally designated by the government of each country. The Southern North Sea SCI is at an at sea distance of 493km southeast and so is not considered relevant to the Project (see Section 5).

3.5.2 Sites of Special Scientific Interest

Under the Nature Conservation (Scotland) Act 2004, and the Wildlife and Countryside Act (1981), Sites of Special Scientific Interest (SSSIs) are designated because of a site's natural features. In some instances, biological SSSIs have been designated as they support nationally important colonies of breeding seabirds in other cases earth science SSSIs have been designated as sites most representative of certain geomorphological features which require long-term conservation. There are a number of SSSIs in the surrounding area however as there are no onshore works required for this Project, none of these sites or aspects of their qualifying features would be affected. Therefore, these are not considered further.

3.5.3 Marine Protected Areas

Marine Protected Areas (MPAs) have been designated to help protect nationally important marine wildlife, habitats, geology and undersea landforms. There are a number of MPAs in the wider Orkney area as follows:

- North-west Orkney;
- Wyre and Rousay Sounds; and
- Papa Westray.

None of these sites or their qualifying features have potential to be affected by the Project. Therefore, they are not considered further within this ER.

3.6 OTHER SEA USERS

A vessel traffic analysis and overview of site activity for the EMEC Billia Croo test centre, is described in the Navigational Risk Assessment Update (Anatec Ltd., 2014). There has been no update regarding vessel activity on the site since. The project-specific NRA addendum (Orcades Marine, 2018) utilised site wide vessel traffic analysis for the analysis of navigational risk. These documents should be read in parallel with this ER; particularly in reference to other sea users.

4 ASSESSMENT OF POTENTIAL ENVIRONMENTAL INTERACTIONS

4.1 POTENTIAL IMPACTS

There are a number of potential impacts on the ecological, human and physical environment that may arise as a result of the Project and which need to be considered within this assessment. Potential impacts associated with: the installation of WEC 2 and WEC 3; operation and maintenance of all devices; and the decommissioning of all devices are as follows:

4.1.1 All phases

- Potential disturbance to marine mammals and seabirds from vessel activity at the site;
- Impacts on shipping and navigation in the vicinity of the site;
- Impacts on other sea users as a result of the Project infrastructure; and
- Disruption to commercial fisheries activity.

4.1.2 Installation and decommissioning

- Loss of species or habitat during installation and removal of anchors, moorings and subsea electrical hub;
- Disruption at ports and harbours as a result of increased vessel activity; and
- Impacts on seabed geology and sediments.

4.1.3 O&M

- Displacement of marine mammals, basking sharks and seabirds due to the presence of the array;
- Potential for entanglement of marine megafauna in mooring lines;
- Disturbance of marine mammals and fish due to underwater noise produced from operation of the array;
- Creation of new habitat due to the presence of devices, anchors and moorings; and
- Change in seascape character.

4.2 MITIGATION MEASURES

General mitigation measures which Fortum and Wello will commit to are described in Section 4.2.1. Also refer to Section 6: Supplementary Monitoring Plan which details environmental monitoring activities that are being undertaken by Exeter and Plymouth Universities as part of the Project.

4.2.1 General mitigation measures

- Regular ROV inspections of the moorings and devices will be completed including a search for derelict fishing gear that may have become entangled in the device moorings and which could pose an entanglement risk. Any derelict fishing gear entangled in mooring lines will be removed; and
- A Vessel Management Plan (VMP) has been developed which will be implemented to help ensure a minimum approach distance is adhered to when passing designated seal haul-outs (see VMP in PEMP (Aquatera, 2018)).

Relevant measures from the Scottish Marine Wildlife Watching Code (SMWWC) will be implemented by Fortum, Wello and all marine contractors. These will include:

- Speed will be reduced to 6 knots when any marine mammals or birds are sighted within or near to transit routes, where consistent with crew and navigational safety and the completion of constrained operations;
- A steady speed and course will be maintained where possible if a marine mammal approaches a Project vessel;
- Care will be taken to avoid splitting up groups and mothers and young;
- Minimum approach distances (as stated in the SMWWC) for vessels on approach to marine mammals and birds will be adhered to, although this may be varied according to species and circumstance. Specifics will be agreed with SNH and listed in the CEMD and implemented;
- Sudden unpredictable changes in speed, direction and engine noise will be avoided to prevent/reduce disturbance to any marine mammals or birds in the vicinity;
- Rafts of birds will not be intentionally broken up or flushed; and
- During the seabird breeding season (April to August inclusive) vessel transit corridors will be at least 50m from shore in the vicinity of cliff-nesting seabirds to avoid disturbance.

Good practice measures as detailed in the Alien Invasive Species and the Oil and Gas Industry (IPIECA, 2010) Guidelines for the Control and Management of ships' biofouling to minimise the transfer of invasive aquatic species will be followed. Additionally, the Code of Practice on Non-native Species (Scottish Government, 2012) will be implemented including:

- Maintain a Biofouling Management Plan, which includes details of:
  - o Antifouling paints used;
  - o Biofouling inspections;
  - o Removal of biofouling;
  - o Waste management;
- Removal of any biofouling in the area of its origin before deployment of the Penguin devices at EMEC; and
- Use anti-fouling paints that comply with AFS convention and national legislation suitable for the specific application. The anti-fouling on the device presently (Marine Standard) is conforming to this legislation and convention.

4.3 ASSESSMENT OF LIKELY SIGNIFICANT EFFECT

Table 4.1 provides a description of the potential impacts along with a conclusion of each impact's likely significance of effect and how it will be dealt with in the assessment.

Table 4.1 Assessment table which provides a description of the potential impacts of the CEFOW array and the potential for likely significant effects

Potential impact	Phase	Description of impact	Conclusion
Ecological Environment			
Loss of species or habitat during installation and removal of anchors, moorings and subsea electrical hub	Installation & decommissioning	During installation and removal of anchors, moorings and the subsea electrical hub there is potential for disturbance to the seabed which could result in a change or loss of habitat for benthic organisms, or direct impacts on these species from smothering impacts associated with a re-suspension of sediment into the water column.	The installation and removal of the twelve drag embedment anchors for WEC 2 and WEC 3 (approximately 3 tonnes each) and mooring lines is likely to result in a highly localised and temporary loss of habitat around each anchor point. This is also the case for the removal of six gravity-base anchors (WEC 1). The habitat in and around Berth 5 is not particularly diverse due to a lack of nutrient upwelling and the influence of tides in the area. Therefore, the deployment and removal of the anchors and subsea electrical hub is highly unlikely to have a significant effect on benthic organisms or habitats at the site. Therefore, **no likely significant effects are expected** and this impact is not considered further.
Displacement of marine mammals, basking sharks and seabirds due to the presence of the array	Operation	The introduction of new structures into the environment has the potential to displace marine mammals, basking sharks and seabirds from the area which may adversely affect national and international conservation objectives.	The presence of an additional two floating devices with no external moving parts, together with their anchors and moorings, in an established test site is highly unlikely to adversely affect marine mammals, basking shark and seabirds which will still be able to inhabit and pass through the area. While marine mammals and basking shark are known to periodically occur in the area and the Hoy SPA which is located approximately 3 km south has an assemblage of internationally important breeding bird species, it is highly unlikely that the proposals would result in significant adverse displacement effects on any of these species groups. Therefore, **no likely significant effects are expected** and this impact is not considered further.
Potential for entanglement of marine megafauna in mooring lines	Operation	When fully deployed, each Penguin device in the CEFOW array will have six semi-taut catenary mooring lines extending through the water column. There is a perceived risk that large baleen whales could becoming entangled in	The addition of a further twelve semi-taut catenary mooring lines in an established test site in which very large whales eg humpback and fin whales rarely occur (one humpback whale sighting and zero fin whale sightings in six years of observation at EMEC) is unlikely to result in any significant effects. Additionally, the devices are due to be installed for a

Potential impact	Phase	Description of impact	Conclusion
		untaut mooring lines. Additionally, in the event that derelict fishing gear becomes attached to the mooring lines there is a entanglement risk for cetaceans.	relatively short period (one for up to two years and one from summer 2019 to spring 2020) with ROV inspections every two months. Therefore, any derelict fishing gear would be identified and removed so that it does not affect the integrity of the mooring system. This would further reduce the potential for entanglement. Therefore, **no likely significant effects are expected** and this impact is not considered further.
Disturbance of marine mammals and fish due to underwater noise produced from operation of the array	Operation	Marine mammals and, in particular, cetaceans, have highly-developed acoustic sensory systems, which enable them to communicate, navigate, orientate, avoid predators and forage. As a result these species may be vulnerable to changes in background noise levels. Fish generally have less developed hearing anatomy, and are, as a result, much less sensitive to the underwater noise associated with WECs.	A study by Beharie and Side (2012) which measured the sound pressure levels produced by the cooling system of the first Penguin device while it was Berthed at Lyness Pier, Orkney, suggests a sound source level of 140.5 dBrms re 1µPa at 1m. The study concluded that ambient noise levels would be reached within approximately 10m from the device. Therefore, the noise levels produced are well below levels which have potential to cause Temporary or Permanent Threshold Shift (TTS and PTS respectively) in marine mammals. The addition of a further two devices at the designated test site would not produce noise levels which would induce TTS or PTS, with ambient noise levels likely to be reached within approximately 10m from each device. Therefore, **no likely significant effects are expected** and this impact is not considered further.
Potential disturbance to marine mammals and seabirds from vessel activity at the site	All phases	Disturbance from vessels required to install, maintain and remove the array could stem from the physical presence of vessels and from the noise that they produce.	Each device in the array, together with the gravity-based anchors and moorings, will be installed using one or two multi-cat boats, a standard workboat and potentially a RIB. It is anticipated that up to 14 trips to the site will be required to complete the installation of the vessel moorings, drag embedment anchors and additional two WECs, with subsequent visits every two months expected for maintenance purposes. Standard mitigation measures such as the implementation of the Scottish Marine Wildlife Watching Code (SMWWC) would be implemented during the Project activities (see Section 4.2 and the PEMP (Aquatera, 2018)). Disturbance to marine mammals and seabirds from vessel activity would be of a short-term and temporary nature and not far from background levels of disturbance produced by other types of vessels. Therefore, **no likely significant effects are expected** and this impact is not considered further.

Potential impact	Phase	Description of impact	Conclusion
Creation of new habitat due to the presence of devices, anchors and moorings	Operation	The addition of hard structures to the marine environment can provide habitat for sessile marine organisms to cling to and mobile marine organisms (eg fish & benthic invertebrates) to find refuge in eg crevices in the anchor infrastructure.	Due to the relatively short term nature of the array deployment (May 2018-May 2020) any benefits associated with this are likely to be of minor or negligible significance. Therefore, **no likely significant effects are expected** and this impact is not considered further.
Human Environment			
Impacts on shipping and navigation in the vicinity of the site	All phases	Potential impacts on shipping and navigation include: • Potential for collision between WECs/moorings and vessels transitting through EMEC site, due to increased number of collision targets; • Potential for collision between WECs/moorings and vessels working on other projects within the EMEC site; • Potential for collision or fouling upon mooring line by maintenance or intervention vessels; • Potential for collision of vessels operating on site due to further restriction on sea space; and • Potential for Search and Rescue (SAR) vessels to collide with sub-surface objects.	Potential shipping and navigation impacts, including potential risks related to collision of vessels with the additional WEC devices and moorings are discussed in detail in the Project-specific Navigational Risk Assessment Addendum (Orcades Marine, 2018). The NRA addendum identifies additional navigational risks associated with installing WEC 2 and WEC 3 alongside the existing WEC 1 – which are primarily associated with the increased number of collision targets and the further restriction of sea space within the EMEC site. Prevention measures have been proposed to reduce the risk level of these major events to unlikely (Orcades Marine, 2018). Therefore **no likely significant effects are expected**.
Impacts on other sea users as a result of the Project infrastructure	All phases	There is potential for impacts on other sea users, including SAR vessels (including local RNLI vessels) and other sea users inadvertently or deliberately transiting/utilising the Billia Croo site (despite 'area to avoid' charting) , primarily related to collision with WEC devices (sub-sea buoys and cables) and mooring lines. The WECS are visually apparent and show as a good target on radar, however, subsea buoys and cables may	The WEC array is within the boundary of the EMEC Billia Croo test site and close to the west cardinal buoy marking the extreme of the site. Colour and lighting of the array will be in line with regulators guidance and Notice to Mariners issued to ensure other sea users are fully informed about operations and installation locations. SAR authorities will be provided with up-to-date information on the location of subsurface obstructions, for access within buoyed area and clost to the WECs. Prevention measures have been proposed to reduce the risk level of these major events to unlikely (Orcades Marine, 2018). Therefore, **no**

Potential impact	Phase	Description of impact	Conclusion
		not be readily apparent.	**likely significant effects are expected** and this impact is not considered further.
Disruption to commercial fisheries activity	All phases	There is potential for disruption to commercial fisheries activity from an increase in work vessel activity at the site and in Kirkwall and Stromness harbours during all phases of the deployment.	The additional two devices and associated infrastructure will be deployed, and all devices removed, at separate times. Thus limiting vessel activity and therefore any potential impact on commercial fisheries either at harbours or at the site during installation and decommissioning. During the operational period one trip by up to two vessels is anticipated every two months in an established test site which is clearly marked on navigational charts as an 'area to be avoided' (for vessels larger than 5,000grt). Therefore, **no likely significant effects are expected** and this impact is not considered further.
Change in seascape character	Operation	Presence of the CEFOW array will result in a change to the seascape character in the area which could also result in a change of visual amenity.	The CEFOW array consisting of low-lying Penguin devices of relatively small scale within a designated wave test site for an approximately two year period is highly unlike to dramatically change the seascape character of the area and to adversely affect visual amenity to a level that is significant. Therefore, **no likely significant effects are expected** and this impact is not considered further.
Disruption at ports and harbours as a result of increased vessel activity	Installation & decommissioning	Installation, maintenance and removal activities will increase activity at local ports and harbours.	Installation of the anchors and moorings will be carried out by vessels based at Copeland's Dock in Stromness which is a purpose built pier for the marine renewables supply chain. The Penguin devices themselves will be towed from Hatston Pier in Kirkwall, or Lyness Pier on Hoy. This spread of activities and the availability of significant port infrastructure throughout Orkney means the potential for significant effects is very low. Therefore, **no likely significant effects are expected** and this impact is not considered further.
Physical Environment			
Impacts on seabed geology and sediments	Installation and decommissioning	During installation and decommissioning of the Project moorings and anchors there is potential for mobilisation of material into the water column together with changes in sediment concentration and sediment deposition. Also, there are potential effects associated with sediment scour around anchors.	The addition of twelve relatively small scale (approximately 3 tonnes each) drag embedment anchors and studlink chain moorings in an established wave energy test site for a period of up to two years is unlikely to result in significant effects on seabed geology and sediments. Therefore, **no likley significant effects are expected** and this impact is not considered further.

4.4 ACCIDENTAL AND UNPLANNED EVENTS

In addition to the potential impacts associated with the Project that are anticipated to arise from planned activities, there are a number of accidental or unplanned events which may occur during the lifetime of the Project. Whilst the likelihood of such an event occurring is extremely low, the consequences could be significant. It is therefore, important to understand the potential effects of such events and to identify the measures put in place to help ensure that they do not occur as well as to have contingencies in place to action in the unlikely event that they do.

This section addresses the potential accidental and unplanned events associated with the proposed Project. The assessment methodology for evaluating the potential scale and consequence of accidental and unplanned events is as follows:

1. Identification of potential high level events
2. Screening of events for potential environmental interactions
3. Scoring of interactions using EMEC's assessment criteria
4. Grouping of impacts into key issues
5. Identification of mitigation, optimisation and contingency measures
6. Identification of residual impacts

Identification, screening and classification of high level events

Based on previous experience, consultation with key stakeholders, and the outcomes of the project-specific Navigational Risk Assessment (Orcades Marine, 2018), the following accidental and unplanned events were identified as appropriate for further consideration:

- Mooring system failure resulting in a device or floating object becoming errant;
- Support vessel collision with third party vessel; and
- Support vessel or third party vessel (inclusive of SAR) collision with a Penguin WECs or moorings.

Each event has been screened for potential environmental interactions and each potential interaction has been classified (see Table 4.2) as per the impact classification criteria outlined in EMEC EIA guidance for developers (2008), shown in Table 4.3. Impact scores therefore represent the worst case impact should the accidental or unplanned event occur and do not make allowances for the likelihood of a given event occurring (see note below). Each potential interaction was then grouped into a potential 'key issue' (refer to and Table 4.2 and Table 4.3).

Note – the overview provided within this section should be read in parallel with the Project Navigational Risk Assessment (NRA) report which addresses all issues around navigational risk and presents the relevant mitigation measures and any appropriate Emergency Response Plans (ERPs).

Table 4.2 Identification and assessment of unmitigated accidental and unplanned events and identification of 'key issues'

Phase / Activity	Seabed character	Hydrography	Seabed sediment quality	Air quality	Water quality	Climate	Coastal processes	Coastline character	Seabed communities	Intertidal communities	Plankton	Marine fish	Marine birds	Marine mammals	Commercial fishing	Shipping	MOD operations	Oil and gas activities	Cables and pipelines	Local residents	Local supply chain	Local infrastructure	Amenity /leisure	Archaeology	Air traffic	Seascape	Protected habitats	Protected species	Geological areas	Landscape designations	Built heritage
Mooring failure resulting in errant devices/object	B		B		B			B	B	B	B	B	B	B	A	A		A	A	C	D		A			C	B	B		B	
Support vessel collision with 3rd party vessel	B		B		B			B	B	B	B	B	B	B	A	A		A	A	C	D		A			C	B	B		B	
Support vessel/3rd party vessel collision with devices or mooring	B		B		B			B	B	B	B	B	B	B	A	A		A	A	C	D		A			C	B	B		B	

Table 4.3 Key issues around unplanned and accidental events

Ref.	Key issue	Ranking
A	Collisions with the device or vessels	Major
B	Chemical contamination following a collision event or structural failure	Major
C	Impacts of structural debris/lost equipment	Minor
D	Employment opportunities around contingencies and unplanned works	Positive

As shown in Table 4.2, there are two issues which would result in potentially significant effects (defined as moderately negative or greater) which will be addressed further. These are:

- Collisions with the device or vessels; and
- Chemical contamination following a collision event or structural failure.

This section should be read along with the Project-specifc NRA addendum (Orcades Marine, 2018).

Collisions with the device or vessels

This issue was considered to be the most important by local fishing representatives during previous consultation for the first Penguin device and therefore, has been considered further as it is assumed this would still be the key issue now that there is a proposed array of three devices. There are three mechanisms for collision:

- One or more of the Penguin WECs becoming errant and colliding with a passing vessel;
- A third party vessel becoming errant and colliding with the Penguin or mooring on station; and
- A support vessel becoming errant and colliding with a third party vessel or the device on station.

There are a number of project specific factors that will serve to minimise the potential for a collision or other accidental event with the device. These include:

- The device will be marked as per NLB recommendations;
- The device and mooring system will be Third Party Verified;
- All mariners will be notified regarding the presence of the device as per EMEC's Notifications Procedure; and
- Support vessels will be travelling at slow speeds.

In addition, the availability of locally based tugs and other support vessels to respond to any emergencies will help to minimise the risk of collision and the impacts of a collision.

A number of factors will serve to minimise the potential for a collision or other accidental interaction with support vessels including:

- Only vessels appropriate for the task and in good condition will be used;
- The lead contractor will contact the Hydrographical Office, who will then communicate the location and nature of the activities and potential obstruction though the Notices to Mariners;
- Appropriate communications with Marine Services and relevant vessel operators;
- Competent crew familiar with Orkney waters or similar will be utilised where available;
- Vessels will be marked appropriately in accordance with IRPCS requirements;
- Both installation and decommissioning operations are of limited duration and will only be undertaken in fair conditions;
- Detailed method statements will be applied during all phases of the installation;
- Specific task risk assessment and tool box talks will be carried out before crucial tasks;

- The tow tug will be available to assist third party vessels in the event of lost power or control;
- The vessel(s) involved are marked/lit in accordance with COLREGS[4] as appropriate to their activities; and
- Special Project operating procedures will be developed to minimise risk of contact/collision by Project vessels.

It is expected that these measures will reduce the likelihood of an incident still further than that outlined above and it will be perfectly feasible for the device to be installed, monitored, maintained and removed without incident.

It is therefore anticipated that the Project can be undertaken without any collisions arising and thus ***no likely significant effects*** *are expected from this issue.*

Chemical contamination following a collision event or structural failure

The west coast of Orkney can be a hazardous area for shipping. The conditions mean that mechanical failure or human error could quickly lead to an incident. Such an incident could cause chemical contamination with associated environmental implications. Suitable precautions must therefore be taken to avoid accidents in the first instance and also to ensure that, in the unlikely event of their occurrence, an effective response can be mounted.

There is potential for vessel-vessel collision, vessel-device collision, or structural failure of the device to cause the release of pollutants. The quantities of fuels held on the installation support vessels and the device are in the order of single to tens of tonnes. These are relatively small quantities but in the event of a spill, they could lead to localised but serious impacts. The effects that could arise include shoreline smothering and the coating of birds and other marine wildlife. Additionally, other sea users within the wider area may also be affected by any offshore pollution. Coastal use by local residents and visitors may be affected by any shoreline pollution.

A number of factors will serve to minimise the potential for incidents:

- Only vessels appropriate for the task and in good condition will be used;
- Detailed method statements will be applied throughout all phases of the installation;
- Appropriate communications will be maintained throughout the operation;
- Competent crew familiar with Orkney waters or similar will be utilised where available;
- Both installation and decommissioning operations are of limited duration and will only be undertaken in fair conditions;
- Specific task risk assessment and tool box talks will be carried out before crucial tasks;
- All vessels will work to EMEC's operational requirements;
- All vessels will have their own oil spill contingency plans in place;
- Where practicable fuel use and engine exhaust emissions will be minimised; and
- Third party verification of the devices and associated structures.

Based upon these measures it is anticipated that the planned operations can be completed without incident and that in the occurrence of such an unlikely event, intervention would be swift and effective.

[4] Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs)

Since it is expected that the operation can proceed without incident **no likely significant effect** is expected.

Summary of likely significant effects (LSE) for accidental and unplanned events

Ref.	Key issue	Pre-mitigation	Residual impact	Post-mitigation
A	Collisions with the devices or vessels	Major	It is anticipated that all unplanned and accidental events can be avoided through the careful planning, contingency awareness and mitigation measures in place.	No LSE
B	Chemical contamination following a collision event or structural failure	Major		No LSE
C	Impacts of structural debris/lost equipment	Minor	It is anticipated that the proposed activities can be undertaken without incident.	No LSE
D	Employment opportunities around contingencies and unplanned works	Positive	Mitigations reduce likelihood of unplanned works but positive impact remains for contingencies	Remains positive

Accidental and unplanned events have been fully addressed from a navigational and safety standpoint within the Project-specific NRA (Orcades Marine, 2018).

4.5 SUMMARY OF LIKELY SIGNIFICANT EFFECTS

In summary, no likely significant effects have been identified. General mitigation measures (see Section 4.2), such as compliance with the SMWWC during all Project activities, will ensure that the influence of any effect is further reduced beyond current levels. Moreover, an annual monitoring campaign being run by Plymouth and Exeter Universities (see Section 6) is being carried out to investigate the responses of seals, seabirds, fish and seabed organisms to the deployment of single and multiple WECs. Any environmental monitoring reports produced during the Project's operation together with the final reports produced following completion of the Project, will be provided to SNH and Marine Scotland.

An assessment of the potential for accidental and unplanned events such as collision with vessels or the Penguin WECs has also been carried out. A number of mitigation measures have been proposed to ensure this risk is reduced. Fortum Energy Ltd and Wello are committed to adopting these mitigation measures which will ensure the potential for, and risk of, accidental and unplanned events is reduced to acceptable levels.

5 INFORMATION TO INFORM HRA

5.1 INTRODUCTION

This section presents the results of an initial screening process to identify Natura sites and qualifying features that should be considered in relation to Habitats Regulations Appraisal (HRA) for the CEFOW penguin array.

An Appropriate Assessment was carried out by Marine Scotland for the WEC 1 deployment (FKB/Z232) in 2014, concluding the deployment of WEC 1 at Billia Croo would not adversely affect the integrity of Hoy and Marwick Head SPA and qualifying features.

Information has been presented here to inform a Habitats Regulations Appraisal (HRA) for the Penguin array, to determine whether the proposal has the potential to affect Natura sites (i.e. Special Areas of Conservation (SACs), Special Protection Areas (SPAs), proposed SPAs (pSPAs) and Sites of Community Importance (SCIs)).

Vessel transit routes have been screened out of the assessment as the relatively low level of vessel movements and type of vessel activity associated with the Project (see Section 4.3), is not anticipated to result in any likely significant effects in terms of disturbance to species.

5.2 REGULATORY BACKGROUND

In relation to wildlife and nature conservation, two key Directives have been adopted by the European Community, namely Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) and Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (the Birds Directive; formerly 79/409/EEC).

The Habitats Directive requires Member States to take measures to maintain or restore natural habitats and wild species listed in the Annexes to the Directive at a favourable conservation status and to introduce robust protection for those habitats and species of European importance. There is an obligation to contribute to a coherent European ecological network of protected sites by designating SACs for habitats listed in Annex I and for species listed in Annex II. The Birds Directive gives Member States of the European Union the power and responsibility to classify SPAs to protect birds which are rare or vulnerable in Europe, as well as all migratory birds which are regular visitors. Together SACs and SPAs make up the Natura 2000 network of sites.

Scottish Natural Heritage (SNH), on behalf of Scottish Ministers, are in the process of considering responses to a series of public consultations on their proposals to designate a suite of fifteen proposed SPAs (pSPAs) to protect coastal and offshore areas for marine bird interests. There are currently no candidate SACs in Scotland. It is Scottish Government policy to afford the same protection to proposed SPAs and candidate SACs as fully classified sites. There are also a number of Sites of Community Importance (SCIs) in the UK, SCIs are sites that have been adopted by the European Commission but not yet formally designated by the government of each country, as Natura sites, these have also been included in this assessment.

The Habitats and the Birds Directive are transposed into domestic law in Scotland by the 'Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)'; commonly known as the Habitats Regulations. The Habitats Regulations require that an appropriate assessment is carried out by the competent authority if any Natura interests are likely to be significantly affected by a proposed development.

5.3 OVERVIEW OF HABITATS REGULATIONS PROCESS

Where a plan or project could affect a Natura site, the Habitats Regulations require the competent authority to consider the provisions of Regulation 61. This means that the competent authority has a duty to:

- determine whether the proposal is directly connected with or necessary to site management for conservation; and, if not
- determine whether the proposal is likely to have a significant effect (Likely Significant Effect, LSE) on the site either individually or in combination with other plans or projects; and, if so, then
- make an appropriate assessment of the implications (of the proposal) for the site in view of that site's conservation objectives.

This process is now commonly referred to as HRA. HRA applies to any plan or project which has the potential to affect the qualifying features of a Natura site, even when those interests may be at some distance from that site. The competent authority, Marine Scotland, will decide whether an appropriate assessment is necessary and carry it out (with advice provided by SNH) if required. It is the applicant, in this instance Fortum Energy Ltd who is usually required to provide the information to inform HRA.

The approach to HRA follows the three step process as detailed in SNH guidance (SNH, 2010). The information in this HRA is presented in a format to answer the following three questions:

- Step 1: Is the proposal directly connected with or necessary to the conservation management of a Natura site?
- Step 2: Is the proposal likely to have a significant effect (LSE) on the qualifying features of a Natura site either alone or in-combination with other plans or projects?
- Step 3: Can it be ascertained that the proposal will not adversely affect the integrity of a Natura site?

5.4 PROJECT LOCATION

The HRA was undertaken for the Project using the boundary as shown in Figure 2.1.

5.5 SACS

5.5.1 Step one: Is the proposal directly connected with or necessary to the conservation management of the SACs?

No, the proposal is not directly connected with or necessary to site management for the conservation of the SACs and therefore consideration of Step two is required.

5.5.2 Step two: Is the proposal likely to have a significant effect (LSE) on the qualifying features of the SACs either alone or in combination with other plans or projects?

Identification of SACs relevant to the Project

A screening exercise was carried out to identify those SACs, SCIs and candidate SACs with qualifying features that have potential connectivity with the proposed Project[5]. These sites are listed in Table 5.1. The justification for screening out Atlantic salmon *Salmo salar* and freshwater pearl mussel *Margaritifera margaritifera* is provided below.

[5] The vessel transit route from Hatston Pier or Lyness Pier is not considered here, just the proposed Project boundary.

Atlantic salmon

There are no impact pathways from the Project that could possibly affect Atlantic salmon (*Salmo salar*), this species is screened out of the assessment.

Freshwater pearl mussel

Freshwater pearl mussels (*Margaritifera margaritifera*) are not present in the marine environment however Atlantic salmon is their host species so any negative effects on Atlantic salmon have the potential to also affect freshwater pearl mussels which are only found in freshwater rivers.

As there are no impact pathways from the Project that could possibly affect Atlantic salmon, freshwater pearl mussel is also screened out of the assessment.

Table 5.1 Determining potential connectivity of SAC/SCI qualifying features with the proposed Project

SAC/SCI name	Distance by-sea (km)	Qualifying feature	Potential connectivity
Faray and Holm of Faray SAC	48	Grey seal *Halichoerus grypus*	No potential connectivity. A foraging distance of 20km is recommended by SNH (*pers. comm.*) for use as the appropriate connectivity criteria for grey seals during the breeding season. At a distance of 48 km from the Project, this SAC is therefore screened out.
Sanday SAC	63	Common seal *Phoca vitulina*	No potential connectivity. A foraging distance of 50km is recommended by SNH for use as the appropriate connectivity criteria for common seals. At a distance of 63km from the Project, this SAC is therefore screened out.
Moray Firth SAC	123	Bottlenose dolphin *Tursiops truncatus*	No potential connectivity. EMEC's Wildlife Observations Programme recorded only a single record of four bottlenose dolphins at the Billia Croo wave test site in six years of observation from 2009 to 2015 (Marine Scotland, 2018). Thomson *et al*. (2011) notes that "There have been relatively few reports of bottlenose dolphins on the north coast of mainland Scotland or around Orkney and Shetland". With such a low frequency of sighting of this species at Billia Croo, this SAC is therefore screened out.
Southern North Sea SCI	493	Harbour porpoise *Phocoena phocoena*	No potential connectivity. Although this SCI is within the same management unit (North Sea Harbour Porpoise Management Unit) as the proposed development, at a by-sea distance of 493km it is not considered to have connectivity with the proposed development and is screened out.

Conclusion

There are no SACs with potential connectivity to the Project therefore there is no potential for likely significant effects. **Conclude no LSE for the SACs listed in Table 5.1.**

5.6 SPAS AND PROPOSED SPAS

5.6.1 Step one: Is the proposal directly connected with or necessary to the conservation management of the Natura sites?

No, the proposal is not directly connected with or necessary to site management for the conservation of the SPAs or pSPAs and therefore consideration of Step two is required.

5.6.2 Step two: Is the proposal likely to have a significant effect (LSE) on the qualifying features of the SPAs/proposed SPAs either alone or in combination with other plans or projects?

Identification of SPAs relevant to the project

The Project is within foraging range of several species of birds that are qualifying features of SPAs designated to protect breeding seabird populations in the wider area. During the breeding season, many seabird species regularly fly considerable distances on foraging trips from nest sites; therefore SPAs at considerable distances from the Project could have potential connectivity for particular qualifying features.

A screening exercise was carried out to identify those SPAs with qualifying features that have potential connectivity with the proposed Project[6]. The 'Aquatera HRA Screening Tool[7]' was used to identify a long list of SPAs with qualifying features that could potentially be present at the Project site using mean maximum foraging ranges. The foraging distances used in this process are presented in Table 5.2.

SPAs with qualifying features whose mean maximum foraging ranges overlap with the Project site have been taken forward in this screening process as there is the potential for connectivity between the SPAs and the Project. As most seabird species (with the exception of gulls and terns) are unlikely to fly over land for long distances a further step was taken in the screening process for those SPAs where the direct (straight line) distance crossed land. The distance 'by-sea' to the proposed Project was measured and compared with mean maximum foraging ranges for the relevant qualifying features (see Table 5.2).

28 sites were identified as having potential connectivity to the Project based on an overlap with mean maximum forgaing ranges for the relevant qualifying features. Of these, 13 sites have qualifying features with potential connectivity to the proposed Project. Those qualifying features considered to have 'very low vulnerability' to wave energy deployments, as per Furness *et al* (2012), have been screened out of the assessment. In addition, low numbers of Manx shearwater and European storm-petrel and very low numbers of Leach's storm-petrel were observed during the EMEC Wildlife Observations Programme relatively infrequently therefore these species can also be screened out of the assessment. All other species listed in Table 5.2 have been recorded at the Billia Croo test site (see Section 3.3).

The findings of this screening process are presented in Table 5.2. The 13 SPAs with qualifying features where there is potential connectivity due to overlap with mean maximum foraging range are shown in Figure 5.1 and listed in table Table 5.3.

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[6] The vessel transit route from Hatston Pier or Lyness Pier is not considered here, just the proposed Project boundary.

[7] This tool compares the straight line and at sea distances between the proposed development site and the designated sites and compares it with connectivity criteria for each of the species.

Table 5.2 Determining potential connectivity of SPA qualifying features with the Project

SPA	By-sea distance (km)	Straight line distance (km)	Qualifying feature	Distance measurement to use for this species	Mean maximum foraging range (breeding season) (km)	Potential connectivity with the proposed Project
Hoy	5	5	Red-throated diver	Straight line	9	Yes
			Black-legged kittiwake	By-sea	60	No – Very low vulnerability to wave energy developments.
			Great black-backed gull	By-sea	61.1	No – Very low vulnerability to wave energy developments.
			Arctic skua	By-sea	62.5	No – Very low vulnerability to wave energy developments.
			Common guillemot	By-sea	84.2	Yes
			Great skua	Straight line	86.4	No – Very low vulnerability to wave energy developments.
			Atlantic puffin	By-sea	105.4	Yes
			Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.
Marwick Head	11	10	Black-legged kittiwake	By-sea	60	No – Very low vulnerability to wave energy developments.
			Common guillemot	By-sea	84.2	Yes
Rousay	28	22	Arctic tern	Straight line	24.2	Yes
			Arctic skua	Straight line	62.5	No – Very low vulnerability to wave energy developments.
			Common guillemot	By-sea	84.2	Yes
			Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.

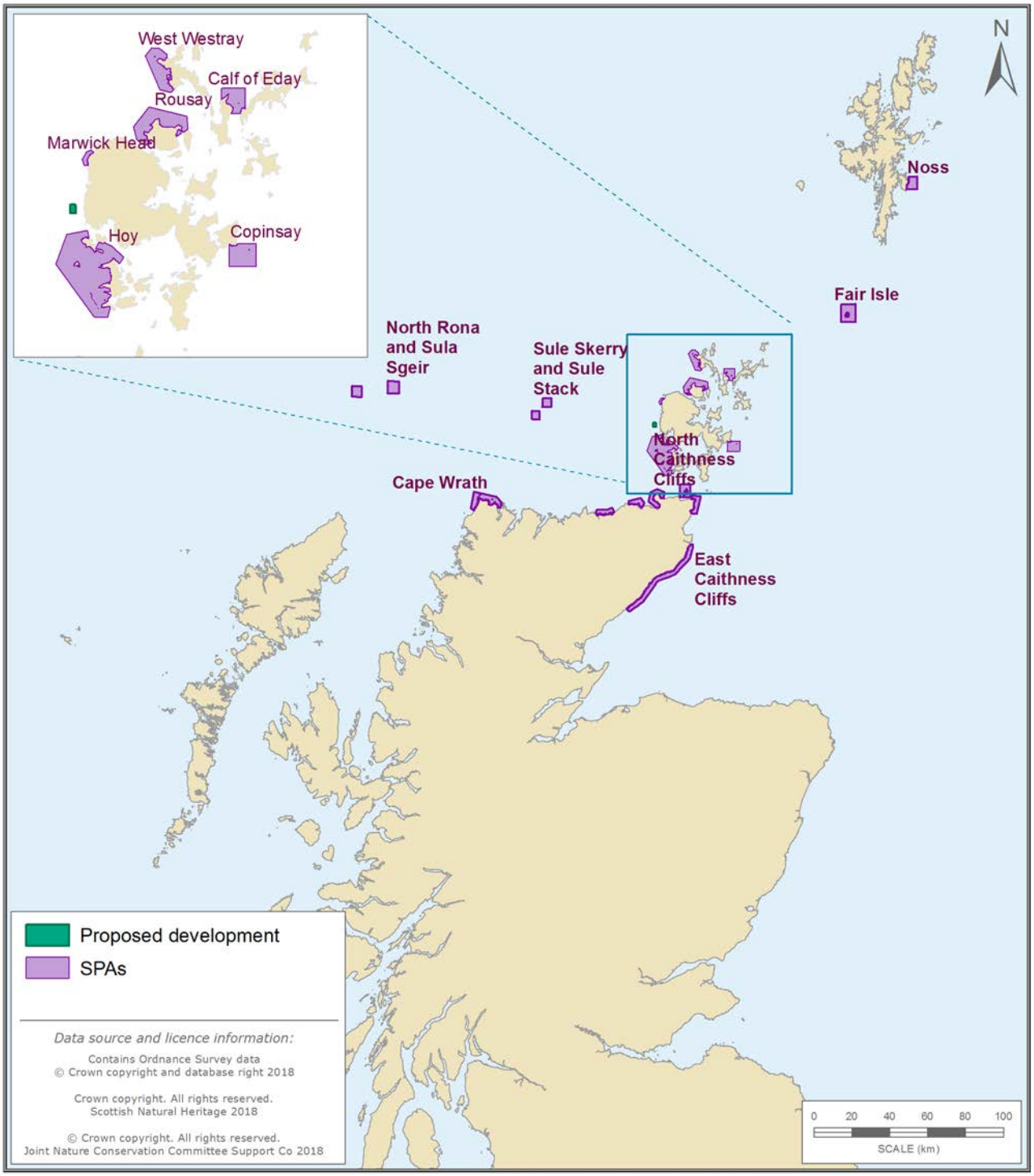
SPA	By-sea distance (km)	Straight line distance (km)	Qualifying feature	Distance measurement to use for this species	Mean maximum foraging range (breeding season) (km)	Potential connectivity with the proposed Project
North Caithness Cliffs	34	33	Razorbill	By-sea	48.5	Yes
			Black-legged kittiwake	By-sea	60	No – Very low vulnerability to wave energy developments.
			Common guillemot	By-sea	84.2	Yes
			Atlantic puffin	By-sea	105.4	Yes
			Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.
West Westray	38	35	Razorbill	By-sea	48.5	Yes
			Black-legged kittiwake	By-sea	60	No – Very low vulnerability to wave energy developments.
			Arctic skua	Straight line	62.5	No – Very low vulnerability to wave energy developments.
			Common guillemot	By-sea	84.2	Yes
			Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.
Copinsay	43	38	Black-legged kittiwake	By-sea	60	No – Very low vulnerability to wave energy developments.
			Great black-backed gull	Straight line	61.1	No – Very low vulnerability to wave energy developments.
			Common guillemot	By-sea	84.2	Yes
			Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.
Calf of Eday	52	44	Black-legged kittiwake	By-sea	60	No – Very low vulnerability to wave energy developments.
			Great black-backed gull	Straight line	61.1	No – Very low vulnerability to wave energy developments.
			Common guillemot	By-sea	84.2	Yes
			Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.

SPA	By-sea distance (km)	Straight line distance (km)	Qualifying feature	Distance measurement to use for this species	Mean maximum foraging range (breeding season) (km)	Potential connectivity with the proposed Project
Auskerry	62	47	European storm-petrel	By-sea	91.7	No – Very low vulnerability to wave energy developments and low numbers observed at the site.
Sule Skerry and Sule Stack	57	54	Common guillemot	By-sea	84.2	Yes
			European storm-petrel	By-sea	91.7	No – Very low vulnerability to wave energy developments and low numbers observed at the site.
			Leach's storm-petrel	By-sea	91.7	No – Very low vulnerability to wave energy developments and very low numbers observed at the site.
			Atlantic puffin	By-sea	105.4	Yes
			Northern gannet	By-sea	229.4	Yes
East Caithness Cliffs	72	65	Common guillemot	By-sea	84.2	Yes
			Atlantic puffin	By-sea	105.4	Yes
			Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.
Cape Wrath	97	89	Atlantic puffin	By-sea	105.4	Yes
			Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.
Fair Isle	126	111	Northern gannet	By-sea	229.4	Yes
			Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.
Handa	136	118	Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.
North Rona and Sula Sgeir	141	135	Northern gannet	By-sea	229.4	Yes
			Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.
Foula	150	140	Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.

SPA	By-sea distance (km)	Straight line distance (km)	Qualifying feature	Distance measurement to use for this species	Mean maximum foraging range (breeding season) (km)	Potential connectivity with the proposed Project
Sumburgh Head	163	150	Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.
Troup, Pennan and Lion's Heads	168	155	Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.
Noss	200	180	Northern gannet	By-sea	229.4	Yes
			Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.
Buchan Ness to Collieston Coast	207	192	Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.
Shiant Isles	218	204	Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.
Fetlar	249	218	Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.
Hermaness, Saxa Vord and Valla Field	257	235	Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.
Fowlsheugh	277	238	Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.
Flannan Isles	268	249	Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.
Rum	325	265	Manx shearwater	By-sea	330	No – Low numbers observes at the site
Forth Islands	368	312	Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.
St Kilda	341	315	Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.
Mingulay and Berneray	366	341	Northern fulmar	By-sea	400	No – Very low vulnerability to wave energy developments.

Note: All species listed in this table are designated for their breeding season interests

Figure 5.1 SPAs with potential connectivity to the Project



The qualifying features where there is potential connectivity with the proposed Project are listed in Table 5.3 along with the relevant SPAs.

Table 5.3 Summary of the thirteen SPA qualifying features with potential connectivity to the Project

Qualifying feature	Relevant SPAs
Arctic tern	Rousay
Atlantic puffin	Hoy
	North Caithness Cliffs
	Sule Skerry and Sule Stack
	East Caithness Cliffs
	Cape Wrath
Common guillemot	Hoy
	Marwick Head
	Rousay
	North Caithness Cliffs
	West Westray
	Copinsay
	Calf of Eday
	Sule Skerry and Sule Stack
	East Caithness Cliffs
Northern gannet	Sule Skerry and Sule Stack
	Fair Isle
	North Rona and Sula Sgeir
	Noss
Razorbill	North Caithness Cliffs
	West Westray
Red-throated diver	Hoy

Identification of pSPAs relevant to the Project

As for the SPAs above, the Project site is within foraging range of several species of birds that are qualifying features of proposed SPAs and as above the 'Aquatera HRA Screening Tool' was used to identify a long list of pSPAs with qualifying features that could potentially be present at the Project site using mean maximum foraging ranges. The foraging distances used in this process are presented in Table 5.4.

Five pSPA sites were identified as having potential connectivity to the Project site based on an overlap with mean maximum foraging ranges (see Table 5.4). Of these, two sites have qualifying features with potential connectivity to the proposed Project. Those qualifying features considered to have 'very low vulnerability' to wave energy deployments, as per Furness *et al* (2012), have been screened out of the assessment. In addition, low numbers of Manx shearwater were observed during the EMEC Wildlife Observations Programme (Marine Scotland, 2018) relatively infrequently therefore this species can be screened out of the assessment.

The findings of this screening process are presented in Table 5.4. The two pSPAs with qualifying features where there is potential connectivity due to overlap with mean maximum foraging range are shown in Figure 5.2 and listed in Table 5.5.

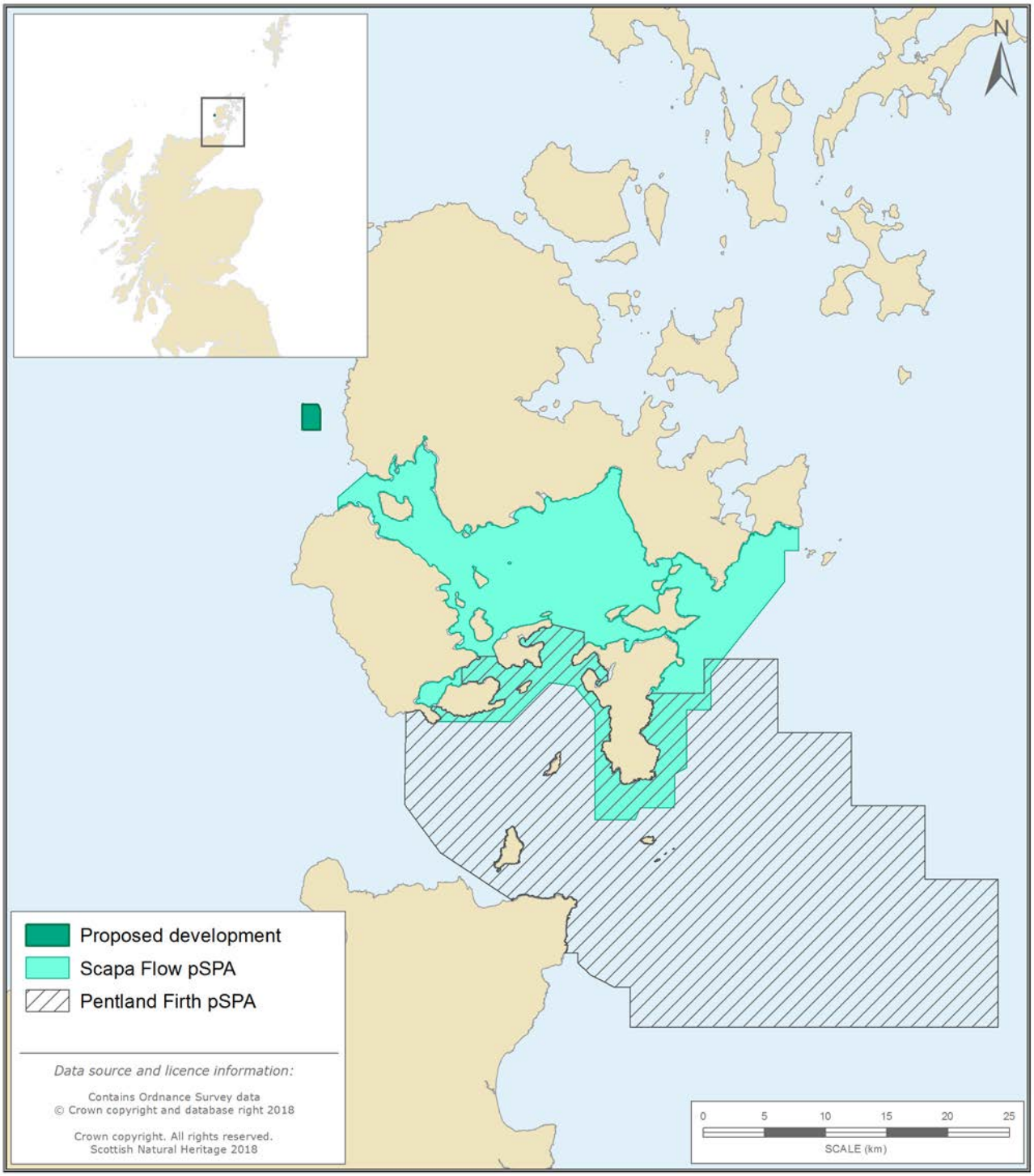
The vessel transit routes pass within two pSPAs designated for wintering aggregations of seaducks and waterfowl; these are Scapa Flow pSPA and North Orkney pSPA. The qualifying features of these sites have been screened out of the assessment as the relatively low level of vessel movements and type of vessel activity associated with the Project (see Section 4.3), is not anticipated to result in any likely significant effects in terms of disturbance to these species.

Table 5.4 Determining potential connectivity of pSPA qualifying features with the proposed Project site

pSPA	By-sea distance (km)	Straight line distance (km)	Qualifying feature	Distance measurement to use for this species	Mean maximum foraging range (breeding season) (km)	Potential connectivity with the proposed Project
Scapa Flow	5	5	Red-throated diver	Straight line	9	Yes
Pentland Firth	29	23	Arctic tern	Straight line	24.2	Yes
			Common guillemot	By-sea	84.2	Yes
			Arctic skua	Straight line	62.5	No – Very low vulnerability to wave energy developments.
Seas off Foula	120	111	Northern fulmar	By-sea	400	No – this species is not sensitive to potential impacts from this development.
Seas off St Kilda	284	262	Northern fulmar	By-sea	400	No – this species is not sensitive to potential impacts from this development.
Outer Firth of Forth and St Andrews Bay Complex	329	274	Manx shearwater	By-sea	330	No – Low numbers observed at the site.

Note: All species listed in this table are designated for their breeding season interests

Figure 5.2 pSPAs with potential connectivity to the proposed Project



The three qualifying features with potential connectivity with the Project site are listed in Table 5.5 along with the relevant pSPAs.

Table 5.5 Summary of the two pSPA qualifying features with potential connectivity to the proposed Project

Qualifying feature	Relevant pSPAs
Red-throated diver	Scapa Flow
Arctic tern	Pentland Firth
Common guillemot	Pentland Firth

Determination of potential for Likely Significant Effects (LSE)

A number of SPAs and pSPAs have been identified with potential connectivity to the Project site based on overlap of mean maximum foraging range (see above).

An assessment has been made to determine whether or not the proposal is likely to have a significant effect on the qualifying features of each site and therefore if there is the potential for any of the SPA or pSPA conservation objectives to be undermined (see Appendix B).

The conservation objectives for the SPAs identified as having potential connectivity with the Project site due to an overlap of mean maximum foraging ranges of qualifying features, which are relevant to the Project are as follows:

ii. Avoiding significant disturbance to the qualifying species; and
iii. Population of the bird species as a viable component of the SPA.

The conservation objectives for the pSPAs identified as having potential connectivity with the Project site due to an overlap of mean maximum foraging ranges of qualifying features, which are relevant to the Project are as follows:

1. To avoid significant mortality, injury and disturbance of the qualifying features so that the distribution of the species and ability to use the site are maintained in the long-term; and
2. To maintain the habitats and food resources of the qualifying features in favourable condition.

In determining whether the Project has the potential for likely significant effects on the qualifying features of the relevant SPAs and pSPAs, the potential impacts of the Project activities have been considered for each of the qualifying features taking into consideration knowledge of the behavioural ecology of each species and the characteristics and context of the Project to assess whether or not there is potential for any of the relevant conservation objectives to be undermined.

Potential impacts

All phases of the Project have been considered: construction, operation and maintenance and decommissioning. The following potential impacts associated have been identified for seabirds:

- During operation
  - o Displacement of seabirds due to the presence of the array; and
  - o Potential disturbance to seabirds from vessel activity at the site.

Conclusion

Displacement of seabirds due to the presence of an additional two floating devices with no external moving parts, together with their anchors and moorings, in an established test site is not anticipated to result in any likely significant

effects on any of the qualifying features of the SPAs or pSPAs, either individually, cumulatively or in-combination with other plans or projects. **Conclude no LSE.**

The relatively low level of vessel movements and type of vessel activity associated with the Project (see Section 4.3), is not anticipated to result in disturbance that would result in any likely significant effects on any of the qualifying features of the SPAs or pSPAs, either individually, cumulatively or in-combination with other plans or projects. **Conclude no LSE.**

6 SUPPLEMENTARY MONITORING PLAN

Under the CEFOW Project, the universities of Exeter, Plymouth and Uppsala have received grant funding to undertake environmental research campaigns to investigate the responses of seals, seabirds, fish and seabed organisms to the deployment of single and multiple WECs. The proposed investigative research utilises a range of novel and established marine wildlife population census and behavioural observation techniques. In summary, the proposed research includes:

- Device-mounted HD cameras to assess seal and seabird utilisation and behaviour;
- Mounted sonar survey to investigate fish aggregation;
- Annual towed underwater camera survey to assess response of seabed biodiversity to device; and
- Annual static underwater camera survey to assess mobile species distribution and behaviour.

The developer will actively pursue opportunities to undertake and facilitate strategic environmental research around the array and the wider test site during the Project and will work closely with Marine Scotland and Scottish Natural Heritage to develop any research plans. Furthermore, the developer would welcome any additional research by other interested parties around the array during its operation at EMEC.

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APPENDIX A SEABIRD FORAGING DISTANCES

Appendix table A.1 lists the mean maximum foraging range for those species that are present at the Project site. SNH currently advise that the preferred source of information that provides parameters on mean maximum foraging ranges for seabird species is Thaxter *et al*. (2012), which is the most up to date source of information for foraging ranges. Where no data could be found for a particular species, a conservative estimate based on the mean maximum values for a closely related species with similar ecology has been used e.g. for great black-backed gull, herring gull has been used as a proxy.

Appendix table A.1 Mean maximum foraging distances for seabird species

Species	Common name	Mean maximum foraging range (km)	Source
Stercorarius parasiticus	Arctic skua	62.5	Thaxter *et al*., 2012
Sterna paradisaea	Arctic tern	24.2	Thaxter *et al*., 2012
Fratercula arctica	Atlantic puffin	105.4	Thaxter *et al*., 2012
Cepphus grylle	Black guillemot	12	BirdLife International
Rissa tridactyla	Black-legged kittiwake	60	Thaxter *et al*., 2012
Somateria mollissima	Common eider	80	Thaxter *et al*., 2012
Uria aalge	Common guillemot	84.2	Thaxter *et al*., 2012
Larus canus	Common gull	50	Thaxter *et al*., 2012
Phalacrocorax aristotelis	European shag	14.5	Thaxter *et al*., 2012
Hydrobates pelagicus	European storm-petrel	91.7	Based on Leach's storm-petrel from Thaxter *et al*., 2012
Larus marinus	Great black-backed gull	61.1	Based on herring gull from Thaxter *et al*., 2012
Stercorarius skua	Great skua	86.4	Thaxter *et al*., 2012
Larus argentatus	Herring gull	61.1	Thaxter *et al*., 2012
Oceanodroma leucorhoa	Leach's storm-petrel	91.7	Thaxter *et al*., 2012
Puffinus puffinus	Manx shearwater	330	Thaxter *et al*., 2012
Fulmarus glacialis	Northern fulmar	400	Thaxter *et al*., 2012
Morus bassanus	Northern gannet	229.4	Thaxter *et al*., 2012
Alca torda	Razorbill	48.5	Thaxter *et al*., 2012
Gavia stellata	Red-throated diver	9	Thaxter *et al*., 2012

APPENDIX B CONSERVATION OBJECTIVES

B.1 SPAS

The conservation objectives for the SPAs identified as having potential connectivity with the proposed Development due to an overlap of mean maximum foraging ranges of qualifying features are as follows:

To ensure that site integrity is maintained by:

i. Avoiding deterioration of the habitats of the qualifying species; and
ii. Avoiding significant disturbance to the qualifying species.

To ensure for the qualifying species that the following are maintained in the long term:

iii. Population of the bird species as a viable component of the SPA;
iv. Distribution of the bird species within the SPA;
v. Distribution and extent of habitats supporting the species; and
vi. Structure, function and supporting processes of habitats supporting the species; and, repeat of (ii) No significant disturbance of the species.

B.2 PROPOSED SPAS

Consideration of the conservation objectives is essential in determining effects on site integrity. The draft conservation objectives for the pSPAs identified as having potential connectivity with the proposed Development due to an overlap of mean maximum foraging ranges of qualifying features are as follows:

3. To avoid significant mortality, injury and disturbance of the qualifying features so that the distribution of the species and ability to use the site are maintained in the long-term; and
4. To maintain the habitats and food resources of the qualifying features in favourable condition.