

# APPENDIX C

## EPS Risk and Protected Sites and Species Assessment



**XODUS**  
ASSURE



# EPS Risk and Protected Sites and Species Assessment

## Pentland Firth East EPS Risk and Protected Sites and Species Assessment

Scottish and Southern Energy plc

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# 1 INTRODUCTION

## 1.1 Introduction

Scottish Hydro Electric Power Distribution plc (SHEPD) holds a licence under the Electricity Act 1989 for the distribution of electricity in the north of Scotland including the Islands.

SHEPD has a statutory duty to provide an economic and efficient system for the distribution of electricity and to ensure that its assets are maintained to ensure a safe, secure and reliable supply to domestic and business customers.

Electricity is considered to be an essential service for island communities. The cables for the cable route detailed below in Section 1.2 distribute electricity to domestic and business customers; providing a long term economic and social benefit to the communities on the Orkney islands.

The monitoring, maintenance and repair, and replacement of submarine power cables constitutes work of overriding public need. Following recent inspections carried out by SHEPD on the distribution submarine cables between Mainland Scotland to Hoy it was identified that the Pentland Firth East ('Pentland East') cable is nearing the end of its operational life and requires replacement. It was also identified that to install a new cable, the mainland cable landing needs to be relocated. As such, and in order to ensure a safe, secure and reliable supply of electricity to Orkney, SHEPD is planning to undertake geophysical, and geotechnical surveys over a broad cable survey area and identified cable corridor route options between mainland Scotland to Hoy, Trial Pits on the beach, but below Mean High Water Mark (MHWM) may be required at both landing points with borehole investigations and Horizontal Directional Drilling (HDD) and enabling works at the mainland landing point, as the first steps towards the cable replacement. Survey equipment calibration testing and cable installation activities are also covered within this European Protected Species (EPS) Risk Assessment and Protected Sites and Species Assessment

Ahead of any surveys, enabling works and cable replacement, all relevant consents and licences need to be in place. This document provides the necessary information to support the following:

1. An application for a European Protected Species (EPS) Licence to cover survey activities (including equipment calibration) and cable installation activities. An EPS Licence is required under the Conservation (Natural Habitats, &c) Regulations 1994 (as amended) where there is potential for the presence of vessels or underwater noise from the proposed survey and cable installation activities to injure or cause disturbance to an EPS.
2. An assessment of potential impacts on basking sharks as per the Wildlife and Countryside Act 1981 (as amended) and an application for a Basking Shark Licence.
3. An assessment as per the Habitats Regulation Appraisal (HRA) process and requirements to assess if the Project activities are likely to have a significant effect on a European site (either alone or in combination with other plans or projects). The HRA Regulations state that 'the effects of a project on the integrity of a European site need to be assessed and evaluated as part of the HRA process'. This includes any European sites with a marine component as well as any terrestrial or coastal European sites with qualifying features that could potentially be impacted.
4. An assessment of impacts on Nature Conservation Marine Protected Areas (NCMPAs) as per section 126 of the Marine and Coastal Access Act 2009.
5. An assessment of potential impacts on designated seal haul-out sites as per Act 117 of the Marine Scotland Act (2010).
6. Notice of intention to carry out a marine licence exempted activity for seabed sampling less than 1 m<sup>3</sup> volume.
7. Application for a Marine Licence for the HDD and enabling works, including trial pit excavation (if required).



8. A Crown Estate Scotland Survey Licence for seabed survey works.

A separate Marine Licence for the cable installation of the Pentland East cable will be submitted and supported by separate Environmental Supporting documents which will be informed by and incorporate the findings of the above listed marine surveys and geotechnical investigations.

## 1.2 Project overview

### 1.2.1 Surveys and Enabling works

The activities assessed for this Risk Assessment include undertaking geophysical (Ultra-short baseline (USBL) acoustic positioning, Side Scan Sonar (SSS), Multibeam Echosounder (MBES)), benthic and geotechnical (vibrocoring and/or Piezocone Penetration Testing (PCPT)) surveys to enable cable installation within a defined cable corridor in the Pentland Firth, between mainland Scotland (and Hoy, with a view to replacing the Pentland Firth East cable. Due to the narrowness of the access to the existing mainland cable landfall in Murkle Bay, this southern landing point of the cable route is required to be relocated further east into Dunnet Bay, which due to the geology and the nature of the landfall topography, will require a short length of HDD to enable the cable to be installed, supported by earlier geotechnical Site Investigation (SI) (i.e. borehole drilling) to inform the nature of the substrate and the location of the HDD point. In addition, trial pit excavations may be required at both land points, but particularly at the northern landing point located within Rackwick Bay, Hoy.

### 1.2.2 Cable Installation

The installation of the cable within the defined cable corridor in the Pentland Firth following the surveys and enabling works has also been assessed within this Risk Assessment.

## 1.3 Nature Conservation Legislation

### 1.3.1 European Species Protection (EPS) Protection

All species listed in Annex IV of the Habitats Directive are known as European Protected Species (EPS), meaning that they are species of community interest in need of strict protection, as directed by Article 12 of the Directive. This protection is afforded in Scottish territorial waters (out to 12 nautical miles) under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended). Regulation 39(1) of these Regulations makes it an offence to:

- a) Deliberately or recklessly capture, injure or kill a wild animal of a EPS;
- b) Deliberately or recklessly:
  - i. Harass a wild animal or group of wild animals of a EPS;
  - ii. Disturb such an animal while it is occupying a structure or place which it uses for shelter or protection;
  - iii. Disturb such an animal while it is rearing or otherwise caring for its young;
  - iv. Obstruct access to a breeding site or resting place of such an animal, or otherwise to deny the animal use of the breeding site or resting place;
  - v. Disturb such an animal in a manner that is, or in circumstances which are, likely to significantly affect the local distribution or abundance of the species to which it belongs;
  - vi. Disturb such an animal in a manner that is, or in circumstances which are, likely to impair its ability to survive, breed or reproduce, or rear or otherwise care for its young; or
  - vii. Disturb such an animal while it is migrating or hibernating.



All species of cetacean (whale, dolphin and porpoise) occurring in UK waters and otters are listed in Annex IV of the Habitats Directive as EPS. Further protection is afforded through an additional disturbance offence provided under Regulation 39(2) which states that “it is an offence to deliberately or recklessly disturb any dolphin, porpoise or whale (cetacean)”. An EPS Licence is required for any activity that might result in disturbance to cetaceans or otters.

### 1.3.2 Basking Sharks

Basking sharks are protected under Schedule 5 of the Wildlife and Countryside Act (1981 as amended) which prohibits the killing, injuring or taking by any method of those wild animals listed on Schedule 5 of the Act. The Nature Conservation (Scotland) Act 2004, Part 3 and Schedule 6 make amendments to the Wildlife and Countryside Act (1981 as amended), strengthening the legal protection for threatened species to include ‘reckless’ acts. The Act makes it an offence to intentionally or recklessly disturb basking sharks. Licensing requirements under the Wildlife and Countryside Act (1981 as amended) are similar to those for EPS protected under Annex IV of the Habitats Directive. Marine Scotland will determine specific licensing requirements as part of the application determination.

### 1.3.3 Pinnipeds

The Marine (Scotland) Act 2010 protects both harbour seal and grey seal around Scotland's coast. This Act provides the Scottish Ministers with the power to designate Seal Conservation Areas. The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) prohibits certain methods of catching or killing seals. The Protection of Seals (Designation of Haul-Out Sites) (Scotland) Order 2014 introduces additional protection for seals at 194 designated haul-out sites, where harbour seal and grey seal come ashore to rest, moult or breed.

### 1.3.4 Seabirds

The waters around Scotland are important for supporting both national and international populations of seabirds and waterfowl. Under the EC Birds Directive, breeding (Annex I) or regularly occurring migratory populations of seabird and marine waterfowl are protected through the designation of SPAs. The Scottish Government has also identified a suite of an additional 15 proposed SPAs (pSPAs) to protect the at sea territories for 45 species of rare and vulnerable seabirds which depend on the marine environment for a large part of their lifecycle.

Under the Wildlife and Countryside Act 1981 (as amended), it is an offence to harm wild bird species, their eggs and nests. Most development activities are unlikely to result in the intentional or reckless killing of wild birds, but if carried out during the breeding season, such works could disturb nesting Schedule 1 bird species (rare, threatened or vulnerable species given extra protection) or damage or destroy their nests or eggs. Licensing for wild birds does not cover development purposes so any development activity that could result in these actions should not proceed until the breeding season is over for these species.

## 1.4 Protected sites

### 1.4.1 Natura 2000 sites

The European Habitats Directive (92/43/EEC) and Birds Directive (79/409/EEC) are transposed into Scottish Law in the terrestrial environment and out to 12 nm by the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended).

European sites protected under this legislation (Natura sites) include Special Protected Areas (SPA), Special Area of Conservation (SAC) and Ramsar sites where they overlap an SAC or SPA. The European Habitats Directive (92/43/EEC) aims to promote the maintenance of biodiversity by requiring EU Member States to maintain or restore representative natural habitats and wild species at a *Favourable Conservation Status* (FCS), through the introduction of robust protection for those habitats and species of European importance.



As part of these protection measures, Member States are required to undertake assessments to determine whether a plan or project is likely to have an adverse effect on the integrity of a European site. The HRA process is discussed in more detail below.

### 1.4.2 NCMPAs

Under section 126 of the Marine and Coastal Access Act 2009, Marine Scotland Licensing Operations Team (MS-LOT) is required to consider whether a licensable activity is capable of affecting (other than insignificantly) a protected feature in a NCMPA or any protected ecological or geomorphological process on which the conservation of any protected feature in an NCMPA is dependant. If MS-LOT believe there is or may be a significant risk of a project hindering the achievement of the conservation objectives, then they must notify the relevant conservation bodies (Scottish Natural Heritage (SNH) in the case of this Project if relevant NCMPAs are within 12 nautical miles of the coast).

It is an offence to intentionally or recklessly kill, remove, damage, or destroy any protected feature of an NCMPA. Marine Scotland must be sure that consenting/licensing decisions do not cause a significant risk to the conservation objectives of any NCMPA. To ensure that MS-LOT has sufficient information available to make such a decision, this document presents information on the potential interaction with NCMPAs.

### 1.4.3 Seal Haul-Out Sites, Section 117 Marine Scotland Act (2010)

Seal haul-outs are coastal locations on land that seals use to breed, moult and rest. Almost 200 seal haul-out sites have been designated through "The Protection of Seals (Designation of Haul-Out Sites) (Scotland) Order 2014 which was amended with additional sites in 2017. These haul-out sites are now protected under Section 117 of the Marine (Scotland) Act 2010. The Act is designed to assist in protecting the seals when they are at their most vulnerable and as such provide additional protection from intentional or reckless harassment.

### 1.4.4 Determining the need for a Marine EPS Licence

The purpose of the EPS Risk and Protected Sites and Species Assessment presented in this report is to determine whether, when considering appropriate mitigation as presented in Section 5, there is still potential for the Project activities to injure or disturb cetaceans or other protected species. Where there is still potential for harm or disturbance to occur, a Marine EPS Licence (or Basking Shark Licence) may be required. The need for a Marine EPS Licence (or Basking Shark Licence) will be determined by MS-LOT with advice from SNH based on findings from the EPS Risk and Protected Sites and Species Assessment. MS-LOT's consideration of whether an EPS Licence will be required will comprise three tests:

1. To ascertain whether the licence is to be granted for one of the purposes specified in the Regulations;
2. To ascertain whether there are no satisfactory alternatives to the activity proposed (that would avoid the risk of offence); and
3. That the licensing of the activity will not be detrimental to the maintenance of the population of the species concerned at a *Favourable Conservation Status*.

#### What constitutes disturbance?

Whether or not a specific activity could cause 'disturbance' (for the purpose of Article 12(1) (b) of the Habitats Directive) depends on the nature of the particular activity and the impact on the particular species. Whilst 'disturbance' is not defined in the Habitats Regulations, Marine Scotland (2014) advises that the following matters should be taken into account when considering what constitutes disturbance:

- > 'Disturbance' in Article 12(1) (b) should be interpreted in light of the purpose of the Habitats Directive to which this Article contributes. In particular, Article 2(2) of the Directive provides that measures taken pursuant to the Habitats Directive must be designed to maintain or restore protected species at *Favourable Conservation Status*<sup>1</sup>;

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<sup>1</sup> The Habitats Directive defined the conservation status of a species to be taken as 'favourable' when population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, when the natural



- 
- > Article 12(1)(b) affords protection specifically to species and not to habitats;
  - > The prohibition relates to the protection of 'species' not 'specimens of species';
  - > Although the word 'significant' is omitted from Article 12(1)(b) in relation to the nature of the disturbance, that cannot preclude an assessment of the nature and extent of the negative impact and ultimately a judgement as to whether there is sufficient evidence to constitute prohibited 'disturbance' of the species;
  - > It is implicit that activity during the period of breeding, rearing, hibernation and migration is more likely to have a sufficient negative impact on the species and constitute prohibited 'disturbance' than activity at other times of the year;
  - > Article 12(1)(b) is transposed into domestic legislation by Regulation 39(1) and (2) of the Habitats Regulations 1994. Therefore, when considering what constitutes 'disturbance', thought should be given to Regulation 39(1)(b) which provides a number of specific circumstances where an EPS could be disturbed, and which can potentially have an impact on the status of the species; and
  - > Disturbance that could be considered an offence may occur in other circumstances and therefore be covered under Regulation 39(2) of the Habitats Regulations which state that it is an offence to 'deliberately or recklessly disturb any dolphin, porpoise or whale (cetacean)'.

Where there is the possibility for injury or disturbance to occur, an EPS Risk Assessment must be carried out and the need for a Marine EPS Licence determined. The injury and disturbance criteria for EPS are described in Section 3.4.1.

## 1.5 Document structure

This document provides the information to support the EPS licencing and protected sites and species assessment process:

- > Section 2 provides a description of the proposed Project activities and their proposed location;
- > Section 3 provides an assessment of the risk to EPS and other protected species;
- > Section 4 provides an assessment of potential impacts on protected sites and designated seal haul outs; and
- > Section 5 outlines the proposed species protection measures to be implemented.

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range of the species is not being reduced for the foreseeable future and there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.



## 2 DESCRIPTION OF PROJECT ACTIVITIES

### 2.1 Location of activities

The location of the existing Pentland East cable route is shown in Figure 2.1. A list of co-ordinates, and the area in which the cable surveys will take place is provided in Table 2-1. Prior to surveys commencing it will be necessary to undertake calibration/testing of USBL, MBES and SSS equipment. It is proposed that equipment calibration would be undertaken at dedicated test sites located at Back of Holms or Stromness Harbour or within the wider Scapa Flow area. Test sites will be selected based upon the weather, other activities occurring in the vicinity on the day and whether they cover small or large boat calibrations.

Figure 2.1 Pentland East proposed cable survey areas

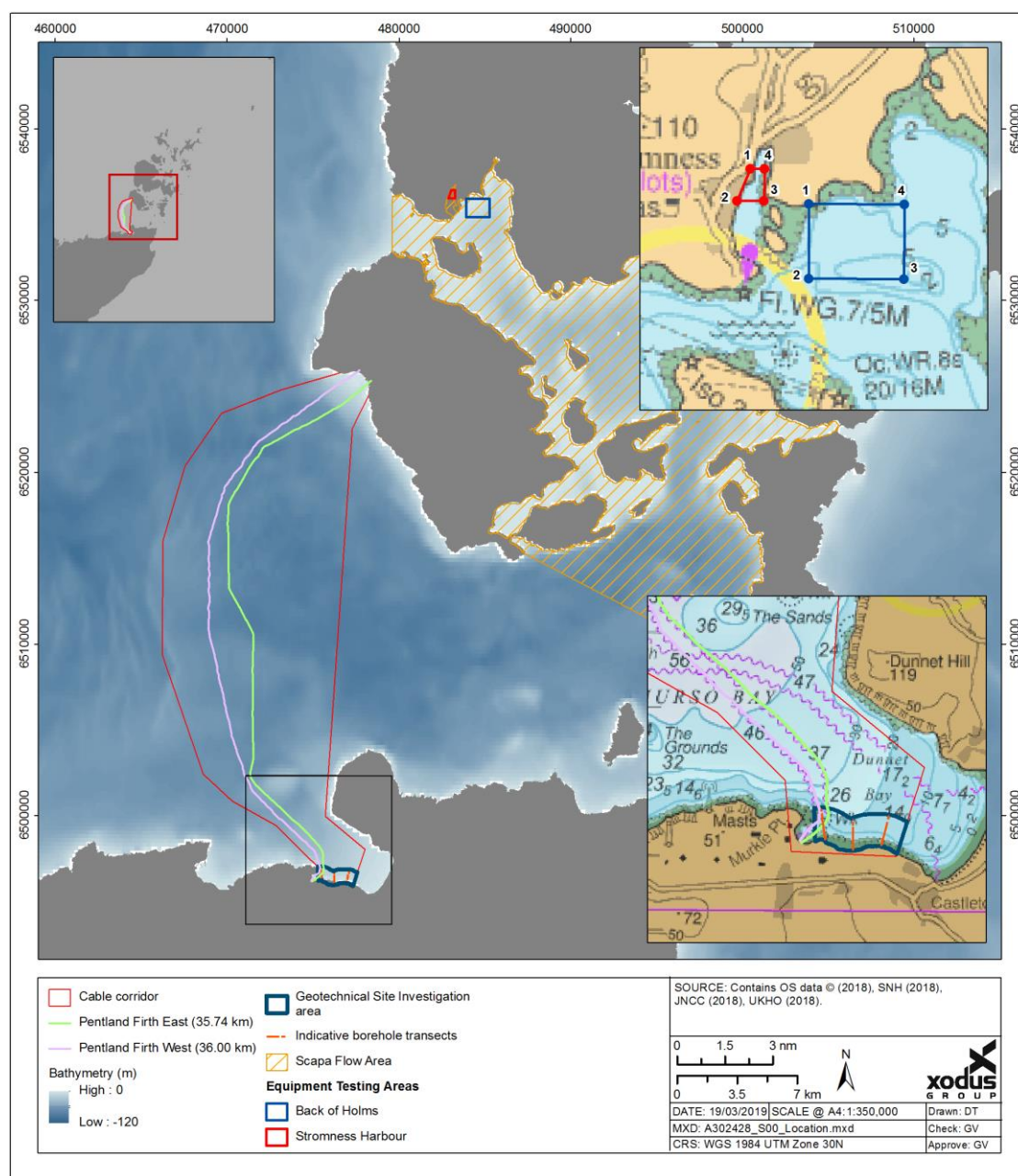




Table 2-1 Pentland East proposed cable survey area and co-ordinates

Area of works	Indicative area (km <sup>2</sup> )	Co-ordinates EPS licence application form and JNCC noise registry		Co-ordinates for the survey works, (WGS84) (the DDM are not negative due to these being westerlies i.e. west of Greenwich meantime)		Co-ordinates for the survey works, (WGS84) (the DMS are not negative due to these being westerlies i.e. west of Greenwich meantime)	
		Latitude DD	Longitude DD	Latitude DDM N	Longitude DDM W	Latitude DMS N	Longitude DMS W
Pentland East (Dunnet Bay – Rackwick Bay)	240	58.860	-3.467	58° 51.602' N	3° 28.018' W	58° 51' 36.12" N	3° 28' 1.08" W
		58.869	-3.407	58° 52.168' N	3° 24.440' W	58° 52' 10.10" N	3° 24' 26.41" W
		58.858	-3.378	58° 51.484' N	3° 22.707' W	58° 51' 29.05" N	3° 22' 42.39" W
		58.840	-3.395	58° 50.400' N	3° 23.700' W	58° 50' 24.00" N	3° 23' 42.00" W
		58.637	-3.420	58° 38.220' N	3° 25.200' W	58° 38' 13.20" N	3° 25' 12.00" W
		58.620	-3.380	58° 37.200' N	3° 22.800' W	58° 37' 12.00" N	3° 22' 48.00" W
		58.601	-3.392	58° 36.039' N	3° 23.497' W	58° 36' 2.33" N	3° 23' 29.80" W
		58.601	-3.392	58° 36.037' N	3° 23.498' W	58° 36' 2.22" N	3° 23' 29.87" W
		58.603	-3.427	58° 36.199' N	3° 25.605' W	58° 36' 11.94" N	3° 25' 36.30" W
		58.611	-3.427	58° 36.648' N	3° 25.637' W	58° 36' 38.90" N	3° 25' 38.24" W
		58.617	-3.440	58° 37.020' N	3° 26.400' W	58° 37' 1.20" N	3° 26' 24.00" W
		58.632	-3.469	58° 37.922' N	3° 28.145' W	58° 37' 55.33" N	3° 28' 8.70" W
		58.645	-3.513	58° 38.689' N	3° 30.809' W	58° 38' 41.32" N	3° 30' 48.54" W
		58.659	-3.542	58° 39.527' N	3° 32.548' W	58° 39' 31.62" N	3° 32' 32.86" W
		58.721	-3.585	58° 43.272' N	3° 35.093' W	58° 43' 16.33" N	3° 35' 5.56" W
		58.781	-3.585	58° 46.849' N	3° 35.104' W	58° 46' 50.92" N	3° 35' 6.21" W
		58.820	-3.564	58° 49.181' N	3° 33.811' W	58° 49' 10.88" N	3° 33' 48.65" W
		58.848	-3.527	58° 50.852' N	3° 31.614' W	58° 50' 51.14" N	3° 31' 36.83" W
		58.960	-3.281	58° 57.640' N	3° 16.870' W	58° 57' 38.400" N	3° 16' 52.200" W





Area of works	Indicative area (km <sup>2</sup> )	Co-ordinates EPS licence application form and JNCC noise registry		Co-ordinates for the survey works, (WGS84) (the DDM are not negative due to these being westerlies i.e. west of Greenwich meantime)		Co-ordinates for the survey works, (WGS84) (the DMS are not negative due to these being westerlies i.e. west of Greenwich meantime)	
		Latitude DD	Longitude DD	Latitude DDM N	Longitude DDM W	Latitude DMS N	Longitude DMS W
Back of Holms testing area	1.48	58.951	-3.281	58° 57.060' N	3° 16.870' W	58° 57' 3.600" N	3° 16' 52.200" W
		58.951	-3.257	58° 57.060' N	3° 15.440' W	58° 57' 3.600" N	3° 15' 26.400" W
		58.960	-3.257	58° 57.640' N	3° 15.440' W	58° 57' 38.400" N	3° 15' 26.400" W
Stromness Harbour testing area	0.14	58.965	-3.295	58° 57.910' N	3° 17.750' W	58° 57' 54.600" N	3° 17' 45.000" W
		58.961	-3.299	58° 57.660' N	3° 17.950' W	58° 57' 39.600" N	3° 17' 57.000" W
		58.961	-3.292	58° 57.660' N	3° 17.540' W	58° 57' 39.600" N	3° 17' 32.400" W
		58.965	-3.292	58° 57.910' N	3° 17.540' W	58° 57' 54.600" N	3° 17' 32.400" W



## 2.1.1 Pre-installation works

### 2.1.1.1 Equipment calibration

Prior to survey activities the survey equipment will need to be tested and calibrated for both small boats and large survey vessels. Three survey techniques will need to be tested; USBL, MBES and SSS. Small vessels will be tested within either the Back of Holms and Stromness Harbour test sites (see Figure 2.1). Alternatively, small and large vessels will be tested within the general Scapa Flow area, the exact location of which will be decided on the day and will be dependent on other activities ongoing outwith the Project. Indicative durations for survey equipment calibration are as follows:

- > USBL: small boat – 2 hours; large boat – up to 12 hours;
- > MBES: 6 – 12 hours;
- > SSS: up to 6 hours (but unlikely).

The survey equipment calibration testing is considered to have less of an impact than the actual surveys. The test sites are located within the vicinity of two protected sites; Scapa Flow pSPA and Bay of Ireland Seal Haul Out site. The potential impact of survey equipment calibration testing activities on the designated features of protected sites has been considered further within Section 4 of this Risk Assessment.

### 2.1.1.2 Geophysical Surveys

The Geophysical survey will occur in two phases.

- > Phase 1 is proposed as a high-level rapid survey over the entire cable survey area (as shown by the red survey area in Figure 2.1), to identify seabed characteristics and two potential new cable route options.
- > Phase 2 would be a more detailed geophysical survey (including benthic/ROV and sediment sampling), focussing at the shore ends (out to approximately 1 km from each landfall) and along an approximately 500 m width of each of the cable route options identified by Phase 1 (i.e. the cable corridors for the potential cable routes which, at this stage before the Phase 1 survey has taken place, are not possible to define).

Vibrocore and/or PCPT tests would also occur, where required, as part of Phase 2. The seabed substrate that the existing cables are laid on is predominantly bare rock, so depending on the location of the new cable route there may not be a requirement to undertake vibrocore/PCPT tests across the whole route and at points where jack up vessels are stationed.

The Phase 2 surveys will also enable SHEPD to narrow the area of search for the exploratory borehole drilling programme (see below).

The duration of the Phase 1 and 2 surveys is currently indicated as 26 days and 40 days respectively.

Additional pre- and -post lay cable installation surveys may also be undertaken by the appointed installation contractor. For all surveys any equipment calibration would be undertaken at designated test sites (see Section 2.1.1.1) for up to 12 hours. USBL positioning equipment would also be required during cable installation.

A description of the geophysical surveys that are required, and the location of the proposed survey areas are detailed within Table 2.2 and shown in Figure 2.1.

Indicative vessels have been provided in Section 2.3.1.

### 2.1.1.3 Borehole Drilling

Technical risk evaluations have identified a requirement to relocate the replacement Pentland East mainland cable landing from its existing location in Murkle Bay, further east into Dunnet Bay. The proposed method of shore landing installation requires a short length of HDD, and as such there is a need to undertake a



geotechnical SI incorporating geotechnical drilling to obtain borehole samples of the substrata, to inform the best landing point.

The borehole drilling will be carried out in an area below Mean High Water Springs (MHWS), as shown in Figure 2.1 and will involve the deployment of a jack-up barge which may drill to approximately 15 – 30 m below the seabed in the nearshore area. An onshore drilling rig will also drill boreholes above MHWS, which will be covered by a separate licence application. Up to three landfall locations may be explored, each requiring a transect of three boreholes in the seabed, and up to three boreholes onshore. It is assumed that each seaward borehole will take 24 hours to allow for tides, positioning and anchoring etc, and as such, the seaward SI will take a maximum of nine days.

#### **2.1.1.4 Horizontal Directional Drilling**

The results from the geotechnical investigations will feed into SHEPD's development of the HDD engineering activity. Both onshore and offshore units will be required to carry out the drilling and insertion of 600 m of High-Density Polyethylene (HDPE) duct into the drilled hole. The onshore component of this work will be the most significant activity with the longer duration, with equipment required to be delivered to site. As the drill nears the exit location on the seabed, an offshore vessel will be mobilised to site. This will be a multicat type vessel or small-jack-up, with vessel type dependent on seabed and tidal conditions. The vessel may prepare an area of seabed clear of sediment, then await the drill head to punch through the seabed. With the drill head free, divers will recover the drill head and drill pipe to the vessel and prepare to enlarge the hole on the return pull with a reamer. This activity is carried out until the diameter of the hole is suitable for the size of the duct necessary.

Depending on the currents and energy of the working area, conventional drilling fluids would be used and collected onshore until the drill is ready to emerge from the sea bottom. At that time the drilling fluid will be washed out and replaced by an environmentally friendly product which minimises caking or sedimentation on the seabed surface. Standard pollution prevention measures will be implemented as part of the Construction Environmental Management Plan (CEMP) to prevent accidental spills as part of HDD activity.

#### **2.1.1.5 Enabling works**

In parallel to the drilling activities, a duct of the required length will either be towed to site or duct sections will be welded together onshore near the HDD works site. When the drilled hole is ready for the duct, the duct will be floated to the offshore vessel and the end connected to the swivel and drill pipe from the hole. The duct will then be pulled in with small support vessels assisting to keeping the duct aligned during the pull to ensure the tensions and integrity of the duct is maintained. The duct pull is complete when the duct pipe end is at the drill rig and the offshore duct end is suitably located on the vessel/seabed. The duct is then opened up and proved before sealing the end with a flange offshore and the end lowered to the seabed, generally a pulling wire is fitted inside the duct if the duration of pulling is known, otherwise it may be left filled with seawater.

The duration of drilling activity is expected to be 3 – 4 weeks, with the marine component generally only being required near the end of the drilling and in readiness for the drill exit. As such, a maximum of 2 weeks has been assumed for the marine component of the HDD works. Any weather considerations would be in addition to this, with diver operations needing good conditions to provide safe working parameters.

#### **2.1.1.6 Trial Pits**

At the Hoy landfall located in Rackwick Bay, there may be a requirement for excavation of up to three trial pits within the intertidal area of the cable corridor. These trial pits could be up to 4m x 4m in size.

These trial pits will enable the nature of the subsoils and depth to bedrock to be determined and would be dug out using an excavator. All sediment excavated from the trial pits will be reinstated immediately. The duration of trial pit excavation works will be a maximum of 3-5 days. Although unlikely, there may also be a requirement to undertake similar trial pitting at the mainland (Dunnet Bay) landfall.

#### **2.1.1.7 Vehicle Access**

At both landfalls, there will likely be a need for vehicle access onto some of the beaches at the landing sites for accessibility and safety purposes.



## 2.1.2 Cable installation

### 2.1.2.1 Vessel mobilisation

Vessels (indicative details within Section 2.3) will be mobilised from an agreed location with all necessary cable installation equipment on board.

### 2.1.2.2 Seabed Preparations

Prior to offshore cable installation the contractor will clear the seabed of any obstacles from the path of the planned cable. This will be undertaken with a grapnel. Areas of boulders may also be cleared and along the route where areas of sandwaves cannot be avoided pre-sweeping may be required in order for the burial techniques to be employed effectively.

### 2.1.2.3 Cable burial

An installation Contractor has not yet been appointed. However, typical options available for cable burial include:

- > Undertaking separate cable lay and burial campaigns where the cable is buried by a cable plough or trencher after it has been laid on the seabed (post-lay burial).
- > Simultaneous lay and burial with a cable plough or trencher.
- > Separate trenching and burial campaigns where a trench is pre-cut by a large plough or trencher and the cable is laid into the open trench followed by backfill by plough, natural backfill or rock placement.

### 2.1.2.4 Cable burial tools

There are a diverse range of cable burial machines available on the market capable of burying and protecting offshore cables. These include:

- > Cable Burial Ploughs.
- > Jetting systems.
- > Mechanical Rock Wheel Cutters.
- > Mechanical Chain Excavators.

### 2.1.2.5 Additional cable protection

In areas where insufficient sediment cover, or burial cannot be achieved, or for cable crossings, additional cable protection may be required. This may include rock placement which is an established method of cable protection which can be utilised along lengths of cable as well as at crossings with existing cables.

### 2.1.2.6 Cable Landfalls

The onshore cables will be connected with the marine cables in a transition jointing pit (TJP) located above the high-water mark. Options available for installation across the landfall area include:

- > 'Open-cut' installation which would involve using mechanical diggers to construct a trench across a section of the beach
- > Installing conduits beneath the landfall area using a trenchless technique such as HDD.

### 2.1.2.7 Post-lay survey

A post-lay survey will be carried out once cable has been installed. This will be carried out by an inshore and an offshore survey vessel and will utilise the same types of vessels and equipment outlined for geophysical surveys in Section 2.3.



## 2.2 Summary of Project activities

### 2.2.1 Overview

Previous inspection surveys carried out by SHEPD on the Pentland East distribution cable indicate that the cable requires replacement. There are a number of potential activities covered within this EPS Risk and Protected Sites and Species Assessment as follows:

- > Survey equipment calibration testing;
- > Geophysical surveys;
- > Geotechnical surveys (vibrocores and/or PCPT, as required);
- > Geotechnical Site Investigation (SI) involving borehole drilling at the mainland Scotland landfall area;
- > Horizontal Directional Drilling (HDD) at the mainland Scotland landfall area;
- > Trial pits at both landfall areas; and
- > Cable replacement installation activities.

## 2.3 Vessels and survey / cable installation equipment

### 2.3.1 Vessels

The vessels required to complete the surveys and cable installation will be mobilised from an agreed mobilisation port as required. A number of vessels will be required at any one time on this project as detailed within Table 2-2.

Table 2-2 Summary of the activities associated with the cable route surveys, investigations and cable installation activities

Activities	
Vessels and support activities	Survey vessel / RIB / multicat / DSV
	Jack-up barge / Anchor handling tug
	Cable installation vessels
	Multicat / DSV
	Guard vessel
Positioning Equipment	USBL positioning system
Geophysical Survey (Phase 1)	Multi Beam Echosounder (MBES)
Geophysical Survey (Phase 2)	Side Scan Sonar (SSS)
	Sub-bottom profiler (electromagnetic)
	Magnetometer
	Depth of Burial (DoB) tracker system
	Subsea altitude metre
	Sound velocity profiler
	Acoustic Doppler Current Profiler (ADCP)



Activities	
	Obstacle Avoidance Sonar
Benthic Habitat Analysis	ROV survey / Observations
	Drop-down Video/Photo
	Benthic sediment grab sampling
Geotechnical Survey	Vibrocoring / PCPT
Landfall Area Investigations	Site Investigation (SI) (borehole drilling)
	Trial pit excavation
	Landfall topographical survey (note; this is not part of this application as above MHWS)
HDD Works	Seabed preparation (sediment clearance)
	Drilling (including use of drilling fluids)
	Line up and guiding floated duct length for insertion into drill hole (pulled through on land)
	Filling duct with seawater and capping with a flange
Cable installation activities	USBL positioning system on ROV
	PLGR
	Cable lay and burial
	Cable protection
Post-lay survey	USBL
	MBES
	SSS
	Sub-bottom profilers

Examples of the potential vessels utilised during both inshore and offshore survey activities are provided in Table 2-3.



Table 2-3 Example vessels which may be used during surveys

Example vessel	Description
<b>Survey and installation vessels</b>	
<b>Vessel for ROV surveys – DP2 vessel</b>	Purpose-designed vessel for ROV surveys, IRM and construction support. Generally, diesel-electric, DP2 vessel that has advanced DGPS, USBL acoustic system and a Seapath 200. Typically, these vessels utilise Launch and Recovery System (LARS). The typical lengths of vessel can be 85 m, breadth 20 m, deck area 630m <sup>2</sup> and draught 6 m.
<b>Multi-purpose vessel – both geophysical and geotechnical survey</b>	Multi-purpose vessel which will typically have diesel-electric propulsion and a specially designed hull. Vessel will be suitable for geophysical and geotechnical survey operations up to 1000m WD. Typical length is expected to be 54 m, beam 12.5 m, deck area is 250m <sup>2</sup> and the draught 3 m.
<b>Multi-purpose DP1 vessel – shallow and medium depth water</b>	Multi-purpose DP1 vessel designed for survey operations in shallow and medium water depths. The vessel will be suitable for shallow seismic and analogue geophysical surveys, bathymetric surveys, ROV support operations for up to light Work-Class vehicles, geotechnical CTP and vibrocoreing, oceanographic and environmental surveys. Typical length is expected to be 54 m, beam 12.5m, deck area is 250m <sup>2</sup> and the draught 3 m.
<b>Vessel for hydrographic and geophysical surveys</b>	Purpose built vessel for hydrographic and geophysical surveys which is typically equipped for 12h operations up to 60 NM from save haven. Typical length is expected to be 12 m, beam 5 m and the draught 2 m.
<b>Vessel for geophysical and hydrographic surveys</b>	Geophysical survey equipped with permanently mobilised geophysical and hydrographic survey spreads. Often, this type of vessel has diesel-electric propulsion and specially designed hulls. The equipment of this vessel will include multibeam echosounders, singlebeam echosounders, sub bottom profilers and side scan sonar. Typical length of vessel is expected to be 65 m, beam 14 m, deck area is 250m <sup>2</sup> and the draught 5 m.
<b>Special Purpose Ship</b>	A Special Purpose Ship (SPS) capable of undertaking subsea cable maintenance, repair and installation. Typical length is expected to be 131 m and the breadth 21 m.
<b>Vessel for deep water</b>	Purpose built IMR and ROV vessel, designed for deep water remote intervention, renewables, construction and survey works. Typical length of this type of vessel is expected to be 130 m, breadth 24 m and draught of 7.5m.
<b>Landfall area investigations</b>	
<b>Jack-Up Barge</b>	A jackup rig is a barge fitted with long support legs that can be raised or lowered. The jackup is maneuverer (self-propelled or by towing) into location with its legs up and the hull floating on the water. Upon arrival at the work location, the legs are jacked down onto the seafloor.
<b>Anchor Handling Tug</b>	Anchor handling tug (could also act as towing vessel).



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Example vessel	Description
Towing Vessel	Towing vessel (see above).

Offshore survey operations will be executed on a 24-hour basis. Inshore survey operations will be executed on a 12-hour basis. It is intended to use the Scrabster harbour as the port of call.

The contractors for the pre-installation works (trial pits, boreholes and HDD activities) have not yet been selected and, therefore, exact details on the survey and support vessels are as yet unavailable. The vessels detailed in Table 2-3.





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Table 2-3 are similar to the those likely to be employed by the survey contractors and have been proposed as proxy vessels for the purpose of the EPS Risk and Protected Sites and Species Assessment to represent the worst-case scenario. These proxy vessels include vessels of the maximum size that may be provided by the survey contractors to enable flexibility in the survey contractor procurement process.

### **2.3.2 Survey techniques**

A range of different equipment will be employed during the surveys of the Pentland East cable route (see Table 2-2). The survey techniques are described in detail in Table 2-4 below. They have also been assessed for their potential to introduce noise into the marine environment and/or interact with protected species or seabed habitat; the two most significant noise related impacts potentially generated by this project.



Table 2-4 Details of the equipment to be employed for the surveys of the two cable routes and their potential to emit noise or interact with the seabed habitat

System / survey equipment	Description
<b>Positioning Equipment</b>	
Ultra-Short Baseline (USBL)	<p>USBL systems are used to determine the position of subsea survey items, including ROVs, towed sensors, etc. This involves the emission of sound from a vessel-mounted transducer to a subsea transponder, thereby introducing sound into the marine environment. A USBL system consists of a transducer, which is mounted on the vessel and a transponder attached to the ROV. The transducer transmits acoustics through the water and the transponder sends a response which is detected by the transducer. The USBL calculates the bearing and time taken for the transmissions to be completed and thus the position of the subsea unit / sampling equipment is determined. These systems can either be used continuously or intermittently through the operation they are supporting. In the shallowest regions of the nearshore environment, alternative positioning methods (e.g. layback and position calculations) may need to be considered.</p> <p>This survey technique <b>does not</b> interact with the seabed.</p>
<b>Geophysical Survey (Phase 1)</b>	
Multi-beam Echosounder (MBES)	<p>Multi-beam echo-sounders are used to obtain detailed maps of the seafloor which show water depths. They measure water depth by recording the two-way travel time of a high frequency pulse emitted by a transducer. The beams produce a fanned arc composed of individual beams (also known as a swathe). Multi-beam echo-sounders can, typically, carry out 200 or more simultaneous measurements. With regards to this Project, the MBES specifications are to be high resolution; Max ping space of 25 cm or 9 pings per square metre with towed set up.</p> <p>This survey technique <b>does not</b> interact with the seabed.</p>
<b>Geophysical Survey (Phase 2)</b>	
Side-scan Sonar (SSS)	<p>Side-scan sonar is used to generate an accurate image of the seabed. An acoustic beam is used to obtain an accurate image of a narrow area of seabed to either side of the instrument by measuring the amplitude of back-scattered return signals. The instrument can either be towed behind a ship at a specified depth or mounted on to a ROV. The frequencies used by side-scan sonar are generally very high and outside of the main hearing range of all marine species (JNCC, 2010). The higher frequency systems provide higher resolution but shorter range measurements.</p> <p>This survey technique <b>does not</b> interact with the seabed.</p>
Sub-bottom profilers / shallow seismic (electromagnetic)	<p>Sub-bottom profiling / shallow seismic systems are used to identify and characterise layers of sediment or rock under the seafloor. A transducer emits a sound pulse vertically downwards towards the seafloor, and a receiver records the return of the pulse once it has been reflected off the seafloor.</p> <p>Sub-bottom profilers comprise either pingers or boomers. Pingers operate at a higher frequency but smaller bandwidth than boomers, which operate on a lower broadband frequency spectrum. The higher frequencies of operation provide the highest resolution, but are limited in amount of penetration below the sea floor. The high frequency profilers are particularly useful for delineating shallow features such as faults, gas accumulations and relict channels. The lower frequencies yield more penetration, but provide less resolution; lower frequency</p>



System / survey equipment	Description
	<p>systems are more general-purpose tools that provide a good compromise between penetration capacity and resolution.</p> <p>Parts of the sound pulse from both systems will penetrate the seafloor and be reflected off the different sub-bottom layers, providing data on the sub-floor sediment layers.</p> <p>Unlike the pinger system which has a combined transducer/transceiver deployed in-water from the vessel, the boomer system requires the deployment of a boomer plate and a receiver array that is a separate floating unit from the emission source.</p> <p>This survey technique <b>does not</b> interact with the seabed.</p>
Magnetometer survey	<p>Magnetometer surveys are used to detect any ferrous metal objects on the seabed, such as wrecks, unexploded ordinance (UXO), or any other obstructions. Marine magnetometers come in two types: Surface towed and near-bottom. Both are towed a sufficient distance (about two ship lengths) away from the ship to allow them to collect data without it being polluted by the ship's magnetic properties. Surface towed magnetometers allow for a wider range of detection at the price of precision accuracy that is afforded by the near-bottom magnetometers. These surveys use equipment to record spatial variation in the Earth's magnetic field.</p> <p>This survey technique <b>does not</b> interact with the seabed.</p> <p><b><i>The magnetic equipment does not generate any significant levels of noise. Therefore, does not require any further consideration with respect to potential injury or disturbance of EPS.</i></b></p>
Depth of Burial (DoB) tracker system (magnetic)	<p>Various geophysical methods may be used to survey the depth of burial of cables. Passive magnetic and active electromagnetic sensors can be used to detect and track buried cables underwater. With these the depth of burial can be determined through modelling. To access the coverage of underwater cables electromagnetic systems will be used.</p> <p>This survey technique <b>may</b> interact with the seabed if mounted on a tracked seabed vehicle rather than an ROV.</p> <p><b><i>The magnetic equipment does not generate any significant levels of noise. Therefore, does not require any further consideration with respect to potential injury or disturbance of EPS.</i></b></p>
Subsea altitude metre	<p>Subsea altitude metres (altimeters) utilise sonar technology to make precision underwater distance measurements by measuring the time it takes for sound pulses to travel from the altimeter to the seafloor and back to the altimeter. The altimeter will be attached to the magnetometer. These devices emit high frequency pulses to measure the distance.</p> <p>This survey technique <b>does not</b> interact with the seabed.</p>
Sound velocity profiler (SVP)	<p>The SVP continuously emits high frequency pulses as it is lowered towards the seafloor in order to measure the speed of sound within the water column. This technology makes use of sonar to determine how quickly sound attenuates in the marine environment, which can aid in calibrating geophysical survey equipment.</p>
Acoustic Doppler Current Profiler (ADCP)	<p>An ADCP is a hydro-acoustic current meter similar to a sonar, used to measure water current velocities over a depth range using the Doppler effect of sound waves scattered back from particles within the water column. Transducers on the ADCP transmit and receive sound signals in the form of high frequency pulses,</p>



System / survey equipment	Description
	<p>and the data is then processed to calculate the Doppler shift, and thus the water velocity along the acoustic beams.</p> <p>ADCPs are generally deployed from a small vessel, using a davit arm, and placed on the seabed where it remains for one lunar cycle, transmitting and recording continuously. To avoid location at the end of the lunar cycle, an acoustic beacon (which lies passively during the survey period) is activated when the vessel returns. An ROV or diver attaches a line and it is then recovered onto the vessel.</p> <p>This survey technique <b>does</b> interact with the seabed.</p>
Obstacle avoidance sonar	<p>High frequency pulses created by obstacle avoidance sonar systems produce sound waves which are used to identify small objects and hazards on the seabed. Higher frequency pulses provide higher resolution imaging.</p>
<b>Geotechnical Sampling</b>	
Vibrocoring (with PCPT)	<p>Geotechnical sampling will also be undertaken as part of the marine survey. This may include both vibrocoring operations and Piezocone Penetration Testing<sup>[1]</sup> (PCPT).</p> <p>Vibrocoring operations will be undertaken using a high power vibrocorer which will be deployed from both the offshore and nearshore vessels. The Piezocone Penetration tests will be carried out from both the offshore and nearshore vessels using piezocones that will be pushed into the seabed to collect samples in order to allow determination of the geotechnical engineering properties of the sediment and delineation of the seabed stratigraphy.</p> <p>This survey technique <b>does</b> interact with the seabed.</p> <p><b><i>It is unlikely that either the vibrocorer or PCPT equipment will generate any significant levels of noise. Therefore, they do not require any further consideration with respect to potential injury or disturbance of EPS.</i></b></p> <p>However, the USBL system may be used to determine the sampling locations when undertaking vibrocoring and PCPT operations.</p>
<b>Benthic Habitat Analysis</b>	
ROV survey / Observations	<p>Remotely Operated underwater Vehicle (ROV) is a tethered underwater mobile device. ROVs are commonly used for visual surveys of the seafloor. For underwater positioning a USBL system is used. The ROV is manoeuvrable by the use propellers.</p> <p>This survey technique <b>does not</b> interact with the seabed.</p> <p><b><i>The main noise source during ROV use is the USBL system which is employed for positioning purposes. ROV equipment is not considered further with respect to potential injury or disturbance to EPS.</i></b></p>
Drop-down video/ photography	<p>Ground-truthing of acoustic data will be undertaken using drop-down video/photography (drop frame and/or ROV) and grab sampling techniques (see below).</p> <p>This survey technique does not interact with the seabed. Required to provide detail on epifaunal species (animals living on the surface of the substrate), habitats and geological features.</p>

[1] An in situ testing method used to determine the geotechnical engineering properties of soils and assessing subsurface stratigraphy, relative density, strength and equilibrium groundwater pressures.



System / survey equipment	Description
	<p>Methodology will follow the SNH Guidance Notice No. 45 – Subsea Cable and Oil and Gas Pipeline Proposals – Benthic Habitat and Species Survey Requirements and consultation will be undertaken with SNH and Marine Scotland to ensure sufficient sampling frequency.</p> <p><b><i>Drop-down video/photography does not generate noise and as such it is not considered further with respect to potential injury or disturbance to EPS.</i></b></p>
Benthic Sediment Sampling	<p>Grab samples will be taken of the seabed to provide detail on the sediment itself and infauna (animals living within the substrate) which cannot be provided by the use of video and photography (see above).</p> <p>Grab samples will not be collected on hard substrates or at locations with sensitive habitats (e.g. Maerl); therefore, grab sampling will be preceded with video/camera drops. Grabs will be collected at selected video/photo sites on sedimentary substrate unless they support sensitive habitats; data collected will therefore be complementary and allow biotope classification to include consideration of infaunal components. A sediment sub-sample will also be retained from the grab for Particle Size Analysis (PSA) with the remainder sieved for infaunal analysis.</p> <p>Methodology will follow the SNH Guidance Notice No. 45 – Subsea Cable and Oil and Gas Pipeline Proposals – Benthic Habitat and Species Survey Requirements and consultation will be undertaken with SNH and Marine Scotland to ensure sufficient sampling frequency.</p> <p>This survey technique <b>does</b> interact with the seabed.</p>
<b>Landfall Area Investigations</b>	
Site Investigation (SI) (borehole drilling)	<p>A SI at the Mainland Scotland end of the cable corridor will take place in the nearshore environment. The SI consists of 3 transects within the intertidal area using a jack-up barge. Each transect will have 3 boreholes and will take approximately 24 hours to complete per borehole (9 days total).</p> <p>While SI activity will not generate significant levels of noise to generate injury or disturbance to EPS, there is potential for disturbance from interactions with protected species at the landfall sites.</p>
Trial pit excavation	<p>Trial pitting is undertaken to investigate the sediment composition of a site via sequential stripping of sediment layers (or strata), testing for infiltration rates, and subsequent laboratory analysis. Pits will be trialled within the Hoy (Rackwick Bay) area of the cable corridor, and may be required at Dunnet Bay.</p> <p>While trial pitting will not generate significant levels of noise to generate injury or disturbance to EPS, there is potential for disturbance from interactions with protected species at the landfall sites.</p>
Landfall topographical survey	<p>The intertidal part of the cable route will be inspected by an onshore survey team, using a RD8000 and standard topographic survey equipment. This survey activity will include two surveyors carrying the equipment along the beach.</p> <p>This survey technique <b>does not</b> interact with the seabed.</p> <p>While the landfall topographical survey will not generate significant levels of noise to generate injury or disturbance to EPS, there is potential for disturbance from interactions with protected species at the landfall sites.</p>
<b>Horizontal Directional Drilling</b>	



System / survey equipment	Description
Horizontal directional drilling (HDD)	<p>HDD is a type of drilling method used to assist the installation of a cable duct, such as that which might support cables, in rocky or large grain substrate environments.</p> <p>While horizontal directional drilling activity will not generate significant levels of noise to generate injury or disturbance to EPS, there is potential for disturbance from interactions with protected species at the landfall sites and to seabed habitat at the HDD 'pop-out' on the seabed.</p> <p>Depending on the currents and energy of the working area, conventional drilling fluids would be used and collected onshore until the drill is ready to emerge from the sea bottom. At that time the drilling fluid will be washed out and replaced by an environmentally friendly product which minimises caking or sedimentation on the seabed surface. Standard pollution prevention measures will be implemented as part of the Construction Environmental Management Plan (CEMP) to prevent accidental spills as part of HDD activity.</p>

### 2.3.3 Activity schedule

The Pentland East cable route activities are scheduled to be carried out between 1<sup>st</sup> March 2019 and 30<sup>th</sup> September 2021.

The offshore geophysical surveys are likely to be undertaken on a 24-hour working basis, while the inshore activities may be restricted to daylight to ensure safe navigation, but as a worst case have been assumed to be 24 hour working when anchored at site. Some of the Phase 1 and Phase 2 surveys may occur concurrently though these activities **will be geographically distinct** (e.g. shore-end survey of the Hoy landfall occurring at the same time as Phase 1 survey in the mainland Scotland survey area). The duration of the Phase 1 and 2 surveys is currently indicated as 26 days and 40 days respectively. The Phase 1 and Phase 2 activities are expected to take days to, at most, a few weeks to be completed.

There is also the possibility that the following geotechnical SI activities for the mainland Scotland landfall may take place at the same time as Hoy geophysical surveys, but again these activities **will be geographically distinct**. The nearshore Landfall Activities (trial pit and boreholes) are expected to take up to 9 days to complete. The HDD activities are expected to take up to 2 weeks to complete. The trial pit excavations and HDD activity will take place following the completion of the marine based survey campaign. The proposed contracting strategy will not result in activities being performed in the same geographical locality at the same time.

Following completion of the surveys, there will be a short period during which the collected survey data will be interpreted and subsequent works will be planned and mobilised.

The schedule for replacement cable installation is not known at this stage but is expected to take place over a period of several months, with discrete campaigns for seabed preparation, cable lay and burial and cable protection.



## 3 EPS AND OTHER PROTECTED SPECIES RISK ASSESSMENT

### 3.1 Overview

The primary function of the EPS and Other Protected Species Risk Assessment is to identify the potential for injury and disturbance to EPS and protected species from survey and other Project activities within the Pentland East Submarine Cable Project area. This section of the risk assessment addresses potential impacts to protected species, including EPS, regardless of their inclusion as qualifying features of protected sites. An assessment of potential impacts to protected sites and their qualifying features is provided in Section 4 – Protected sites assessment.

Activities to support the investigation and installation of the replacement cable for the Pentland East Submarine Cable Project are due to take place over a period of two years, between March 2019 and April 2021. A number of different Project activities will be employed as part of the surveys, investigation and installation of the replacement Pentland East cable and preparatory HDD works at the mainland Scotland landfall (see Section 2), each with varying degrees of risk to protected species; they include:

- > Survey equipment calibration testing;
- > Geophysical, benthic and geotechnical surveys of the seabed;
- > A geotechnical SI consisting of borehole drilling within the nearshore mainland Scotland cable landfall area;
- > Trial pit excavation at the Rackwick Bay landfall (and potentially at the Mainland Scotland landfall, though unlikely);
- > Horizontal Directional Drilling (HDD) at the mainland Scotland landfall; and
- > Cable replacement installation activities.

While some survey activities may introduce noise to the marine environment, the following activities do not generate significant levels of noise to be considered as potential sources of noise-related injury or disturbance to protected species and have, therefore, been omitted from this assessment:

- > Depth of Burial (DoB) tracker system (magnetic);
- > Magnetometer survey;
- > Vibrocoring (with PCPT);
- > ROV or Drop-down video / photography; and
- > Benthic sediment sampling.

Additionally, while some of the activities taking place in the landfall area investigations, such as borehole drilling, may introduce some minor noise to the marine environment, studies have shown that noise emissions from such activities is likely to be masked by nearby vessels (such as guard vessels) (Nedwell and Edwards, 2004). Consequently, borehole drilling, trial pit excavations and HDD are not assessed for noise-related impacts to protected species.

An overview of project activities and their potential impacts to protected species is provided in Table 3-1 below.



Table 3-1 Overview of activities with potential impacts to protected species

Project Activity	Impacting Factors					Potential Impacts on Protected Species	References / Example Equipment
	Source Frequencies (kHz)	Sound Pressure Level at 1 m		Area covered by activity (km <sup>2</sup> )	Potential Cumulative Duration		
		SEL dB re 1 μPa <sup>2</sup> s	Peak dB re 1 μPa				
Equipment calibration testing							
Ultra-low baseline (USBL) system	2 - 30	190 – 235	N/A	Back of Holms test site area = 1.48  Stromness Harbour test site area = 0.14	Small boat – 2 hours; large boat – up to 12 hours	Injury or disturbance to cetaceans and seals from noise emissions.	1000 Series Mini Beacon; Applied Acoustics Underwater Technology DAT-916-BC4; Teledyne Benthos
Multi-beam Echosounder (MBES)	210 – 300	200 – 230	214	Back of Holms test site area = 1.48  Stromness Harbour test site area = 0.14	6 – 12 hours	Injury or disturbance to cetaceans and seals from noise emissions.	SeaBat T20-R MBES; Teledyne RESON
Side scan sonar (SSS)	100 – 600	190 – 230	< 210	Back of Holms test site area = 1.48  Stromness Harbour test site area = 0.14	Up to 6 hours (but unlikely)	Injury or disturbance to cetaceans and seals from noise emissions.	Edgetech 4200 SSS system; MS760 digital recorder; Marine Sonic Arc Explorer
Vessels							
Survey vessel	below 1	175	178	240.5*	66 days	Injury or disturbance to cetaceans and seals from noise emissions. Collision risk to	Richardson <i>et al.</i> (1995)





Project Activity	Impacting Factors					Potential Impacts on Protected Species	References / Example Equipment
	Source Frequencies (kHz)	Sound Pressure Level at 1 m		Area covered by activity (km <sup>2</sup> )	Potential Cumulative Duration		
		SEL dB re 1 μPa <sup>2</sup> s	Peak dB re 1 μPa				
						cetaceans, basking sharks and birds.	
Guard vessel	below 1	178	181	240.5*	66 days	Injury or disturbance to cetaceans and seals from noise emissions. Collision risk to cetaceans, basking sharks and birds.	MacGillivray & Racca (2006)
RIB / Multicat / DSV	below 1	170	173	240.5*	66 days	Injury or disturbance to cetaceans and seals from noise emissions. Collision risk to cetaceans, basking sharks and birds.	Kipple (2004) <sup>2</sup>
Cable installation and support vessel/s	below 1	188	191	240.5*	2 – 3 months (est.)	Injury or disturbance to cetaceans and seals from noise emissions. Collision risk to cetaceans, basking sharks and birds.	N/A
Positioning Equipment							
USBL system	2 - 30	190 – 235	N/A	240.5*	66 days	Injury or disturbance to cetaceans and seals from noise emissions.	1000 Series Mini Beacon; Applied Acoustics Underwater Technology DAT-916-BC4; Teledyne Benthos
Geophysical Survey							

<sup>2</sup> Conservative estimate of noise level based on 20 - 40 ft vessel length.

\* Survey and cable installation activity areas have been estimated based on the potential cable corridors. The areas to be covered by the activities will be clarified by the Contractor.



Project Activity	Impacting Factors					Potential Impacts on Protected Species	References / Example Equipment
	Source Frequencies (kHz)	Sound Pressure Level at 1 m		Area covered by activity (km²)	Potential Cumulative Duration		
		SEL dB re 1 µPa²s	Peak dB re 1 µPa				
Multi-beam Echosounder (MBES)	210 – 300	200 – 230	214	240.5*	66 days	Injury or disturbance to cetaceans and seals from noise emissions.	SeaBat T20-R MBES; Teledyne RESON
Side scan sonar (SSS)	100 – 600	190 – 230	< 210	37.74*	66 days	Injury or disturbance to cetaceans and seals from noise emissions.	Edgetech 4200 SSS system; MS760 digital recorder; Marine Sonic Arc Explorer
Sub-bottom profiler / shallow seismic	2 – 12	156 – 197	< 200	37.74*	66 days	Injury or disturbance to cetaceans and seals from noise emissions.	EdgeTech 3100P sub-bottom profiling system
Subsea altitude metre	300 – 600	175 – 225	N/A	37.74*	66 days	Injury or disturbance to cetaceans and seals from noise emissions.	Tritech PA500
Sound velocity profiler (SVP)	2,000 – 3,000	150 - 200	N/A	37.74*	66 days	Injury or disturbance to cetaceans and seals from noise emissions.	Valeport MiniSVP Sound Velocity Profiler; Valeport MIDAS SVX2
Acoustic Doppler Current Profiler (ADCP)	800 – 1,500	200 - 250	N/A	37.74*	66 days	Injury or disturbance to cetaceans and seals from noise emissions.	RDI Workhorse Navigator
Obstacle Avoidance Sonar	500 – 700	170 - 230	N/A	37.74*	66 days	Injury or disturbance to cetaceans and seals from noise emissions.	Gavia OEM 852-000-147
Landfall Area Investigations							
Site Investigation (SI) (borehole drilling)	N/A	N/A	N/A	1.87*	9 days	Disturbance of otter holts at the landfalls.	N/A



Project Activity	Impacting Factors					Potential Impacts on Protected Species	References / Example Equipment
	Source Frequencies (kHz)	Sound Pressure Level at 1 m		Area covered by activity (km²)	Potential Cumulative Duration		
		SEL dB re 1 µPa²s	Peak dB re 1 µPa				
Trial pit (per landfall)	N/A	N/A	N/A	48	3 days	Disturbance of otter holts at the landfalls.	N/A
Horizontal directional drilling (HDD) landfall (per landfall)	N/A	N/A	N/A	>600m from HWM	14 days	Disturbance of otter holts at the landfalls.	N/A
Landfall topographical surveys (per landfall)	N/A	N/A	N/A	0.005	3 days	Disturbance of otter holts at the landfalls.	N/A
Cable installation							
Cable lay and burial	NA	NA	NA	37.74*	1 – 2 months	Injury or disturbance from noise emissions Increased sedimentation affecting ability to forage	Not known at this stage
Additional cable protection	NA	NA	NA	Not known at this stage	< 1 month	Injury or disturbance from noise emissions	Not known at this stage
Post-lay survey	NA	NA	NA	37.74*	< 1 week	Injury or disturbance to cetaceans and seals from noise emissions.	See geophysical survey above



## 3.2 European Protected Species

Two EPS inhabit the nearshore and offshore waters of the Pentland East cable route where the proposed marine surveys and cable installation will take place: cetaceans and otters. Of these, cetaceans are particularly susceptible to impacts from underwater noise and collision, while otters are vulnerable to impacts from human disturbance at landfall sites.

Baseline information on the EPS present within the project area is provided in Sections 3.2.1 and 3.2.2 below. Project activities which may potentially impact those species are subsequently summarised for use in the risk assessment (Section 3.4). The risk assessment considers all activities which emit underwater noise and / or have the potential to cause injury or disturbance to cetaceans and otters.

### 3.2.1 Cetaceans

All cetacean species within UK waters are deemed 'species of community interest' under Annex IV of the Habitats Directive and thus require strict protection as EPS. Harbour porpoise (*Phocoena phocoena*) and bottlenose dolphin (*Tursiops truncatus*) are listed as individual EPS, while all other cetaceans are listed as "All other cetacea". Cetaceans are also fully protected in Scottish waters under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended), while bottlenose dolphin and harbour porpoise have further protection under Annex II of the Habitats Directive, which regulates the designation of Special Areas of Conservation (SAC) for those species.

Nineteen cetacean species have been recorded in the Pentland Firth and waters around Orkney (Evans *et al.*, 2001; Reid *et al.*, 2003). There are several cetacean species known to frequent or seasonally visit the Pentland Firth; they include: harbour porpoise, bottlenose dolphins, short-beaked common dolphin (*Delphinus delphis*), white-beaked dolphin (*Lagenorhynchus albirostris*), white-sided dolphin (*Lagenorhynchus acutus*), Risso's dolphin (*Grampus griseus*), long-finned pilot whale (*Globicephala melas*), killer whale (*Orcinus orca*), and minke whale (*Balaenoptera acutorostrata*) (NMPi, 2018; Hammond *et al.*, 2018; Reid *et al.*, 2003; JNCC, 1997). Of these, harbour porpoise, bottlenose dolphins, white-beaked dolphins, Risso's dolphin, killer whale, and minke whale regularly occur within the project area (Evans *et al.*, 2011).

- > **Harbour porpoise** are the most abundant cetacean species found in Scottish waters and can be seen throughout the Pentland Firth and Orkney (Reid *et al.* 2003; Hammond *et al.* 2017; NMPi, 2018). They often form small groups of two to three individuals, though may occasionally form larger foraging groups (SNH, 2014). The European population of harbour porpoise is listed in the IUCN Red List of Threatened Species as 'Least Concern' (IUCN, 2018), and have a *Favourable Conservation Status* (FCS) in UK waters (Hammond *et al.*, 2008; Pinn, 2010).
- > **Bottlenose dolphins** also frequent the waters of the Pentland Firth and surrounding the Orkney Islands, with numbers peaking in the summer months (Evans *et al.*, 2011; NMPi, 2018). They are predominantly a nearshore species, hugging the 20-50 m depth contours, though they have been seen offshore on occasion (Evans *et al.*, 2011). Forming groups of 8-12 individuals, they do sometimes form larger groups of up to 80 individuals for social and breeding interactions (Evans *et al.*, 2011). Bottlenose dolphins are considered 'data deficient' on the IUCN Red List of Threatened Species (IUCN, 2018).
- > **White-beaked dolphins** frequent the deeper waters off the Pentland Firth year-round, often occupying depths of 50 – 10m (Reid *et al.*, 2003; Evans *et al.*, 2011). They are usually found in small groups of 10 or less but have also been observed in large groups of 50 and more. White-beaked dolphins have a conservation status of 'Least Concern' in the IUCN Red List of Threatened Species (IUCN, 2018).
- > **Risso's dolphins** are globally distributed between the tropical and temperate latitudes of both hemispheres. Small numbers of the species occupy the coastal waters surrounding the UK, with the greatest numbers occurring along the northwest coast of Scotland and the northern isles (Reid *et al.*, 2003; Evans *et al.*, 2011; NMPi, 2018). Sightings of this species peaks in the summer months, though they have been recorded in Orkney in every month except December (Evans *et al.* 2011). In the Pentland Firth and around Orkney, they form smaller groups of up to 8 individuals, with a maximum of



16 individuals sighted in a single group (Evans *et al.*, 2011). The species is listed as '*data deficient*' on the IUCN Red List of Threatened Species (IUCN, 2018).

- > **Killer whales** are large delphinids which occur globally in both nearshore and offshore waters. The species distribution in the UK is largely confined to northern and western Scotland. Sightings within northern Scotland are concentrated between the Pentland Firth and Orkney and tend to peak along the coastlines in the summer months, as the animals go offshore during the winter (Evans *et al.*, 2011). Killer whales form small groups of 1 to 10 individuals, though sometimes gather in groups of up to 20 (Evans *et al.*, 2011). Within the UK, killer whales are recognised as '*conservation dependant*,' meaning that without a viable conservation programme, the species is likely to become '*vulnerable*' or '*endangered*' within five years (Evans *et al.*, 2011).
- > **Minke whales** have a highly cosmopolitan distribution and are present throughout the Pentland Firth and Orkney Islands year-round, with sightings predominantly occurring in the summer months (Reid *et al.*, 2003; Hammond *et al.*, 2017). They prefer water depths of up to 200 m and are often solitary or found in pairs, however they may form larger groups of up to 15 individuals when foraging (Reid *et al.*, 2003). Minke whales have a conservation listing of '*Near threatened*,' meaning they are near qualifying for being listed as '*Vulnerable*' on the IUCN Red List of Threatened Species (Evans *et al.*, 2011).

The distribution, density and abundance of the cetacean species which regularly occur in the Pentland Firth is described in Table 3-2 below.

Table 3-2 Cetacean species potentially present in the marine survey area

Species & scientific name	General distribution	Density estimates within the project area (individuals/km <sup>2</sup> )	Estimated population abundance in the project area; and the North Sea	References
<b>Harbour porpoise</b> <i>Phocoena phocoena</i>	Individuals can be found in nearshore and offshore waters	0.152	16,822; 336,223	Evans et al., (2011); Hammond (2017)
<b>Bottlenose Dolphin</b> <i>Tursiops truncatus</i>	Predominantly nearshore species	0.004	637; 2,222	Evans et al., (2011) Hammond (2017)
<b>White-beaked dolphin</b> <i>Lagenorhynchus acutus</i>	Predominantly nearshore species	0.021	2,722; 16,562	Evans et al., (2011); Hammond (2017)
<b>Risso's dolphin</b> <i>Grampus griseus</i>	Individuals can be found in nearshore and offshore waters	N/A	1,569; N/A	Evans et al., (2011)
<b>Killer whale</b> <i>Orcinus orca</i>	Predominantly offshore species	N/A	30; 2,437	Evans et al., (2011)
<b>Minke whale</b> <i>Balaenoptera acutorostrata</i>	Individuals can be found in nearshore and offshore waters	0.010	1,319; 9,237	Evans et al., (2011); Hammond (2017)

### 3.2.1.1 Potential Impacts

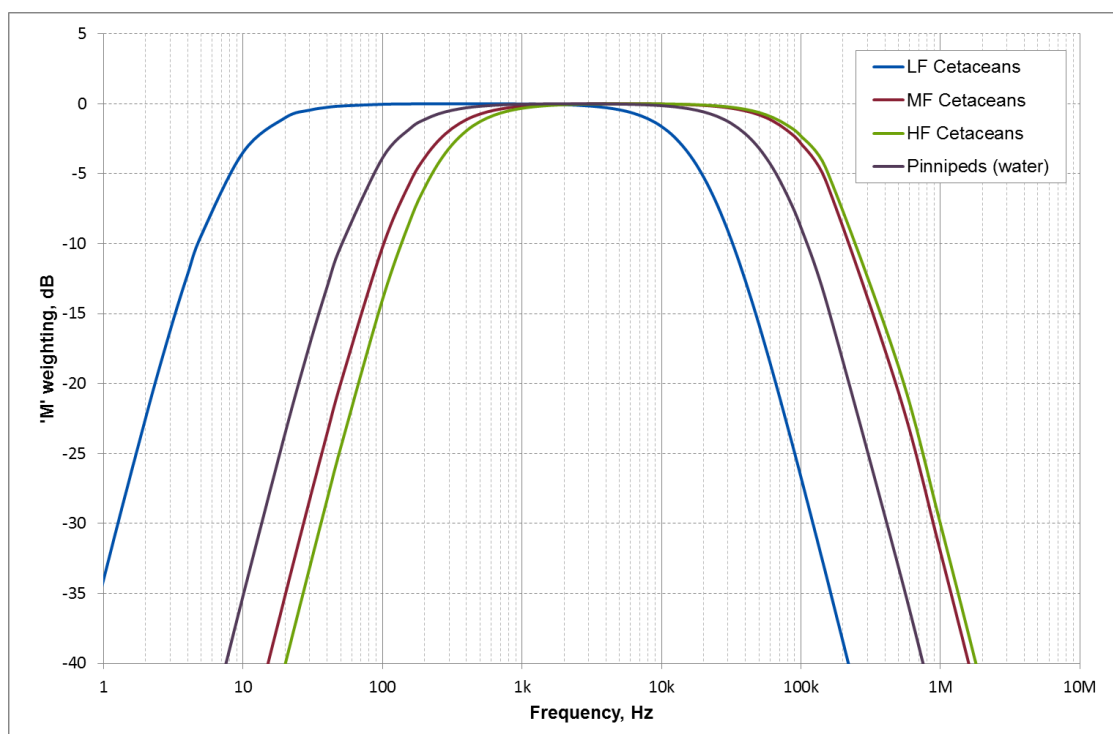
Noise emissions constitute the greatest potential risk to cetaceans within the vicinity of the project. Noise has the potential to impact cetaceans in two ways:

- > Injury — physiological damage to auditory or other internal organs; and
- > Disturbance (temporary or continuous) — disruptions to behavioural patterns, including, but not limited to: migration, breathing, nursing, breeding, foraging, socialising and / or sheltering. This impact factor does not have the potential to cause injury.



To determine the potential for noise to impact cetaceans, perceived sound levels are compared to available estimated thresholds for injury or disturbance. Several threshold criteria and methods for determining how sound levels are perceived by marine mammals are available (e.g. the dBht method and other hearing weighted and linear measures) and each has its own advantages and disadvantages. JNCC (2010) guidance recommends using the injury criteria proposed by Southall *et al.* (2007) based on a combination of linear (un-weighted) peak pressure levels and mammal hearing weighted (M-weighted) sound exposure levels (SEL). The M-weighting function represents the hearing sensitivity frequency bandwidth for marine mammal groups (see Figure 3.1 below).

Figure 3.1 M-weighting functions for pinnipeds and cetaceans in water (LF = low-frequency, MF = mid-frequency, HF = high-frequency (Southall *et al.* 2007)



If a sound emission is composed of frequencies which lie outside the estimated auditory bandwidth for a given species, then disturbance is unlikely. However, noise sources which are sufficiently high can still cause physical damage, including damage to hearing and other organs, even when the frequencies lie outside an animal's auditory range. To understand the potential for noise-related impacts, the likely hearing sensitivities of different cetacean hearing groups has been summarised below in Table 3-3. Section 3.4 assesses the potential for injury to be incurred for each hearing group, given the estimated auditory bandwidth.

Table 3-3 Auditory bandwidths estimated for cetaceans (Southall *et al.*, 2007; Scottish Government, 2013; NMFS, 2018)

Hearing group	Estimated auditory bandwidth
Low-frequency cetaceans (deep diving species – e.g. minke whale, pilot whale, etc.)	7 Hz to 35 kHz, with peak sensitivity around 100 – 200 Hz
Mid-frequency cetaceans (small dolphins – e.g. bottlenose dolphin, common dolphin, white-beaked dolphin, etc.)	150 Hz to 160 kHz, with peak sensitivity above 10 kHz; Except for killer whales: 50 Hz to 100 kHz
High-frequency cetaceans (only harbour porpoise are within UK waters)	200 Hz to 180 kHz, with peak sensitivity above 4 kHz

Collision risk is another potential risk to cetaceans in the project area and may cause mortality and sublethal injury (Laist *et al.*, 2001). However, cetaceans are highly mobile and the as the survey period is very short (26



days for Phase 1, and 40 days for Phase 2) collision risk is anticipated to be minimal and not cause any adverse or significant damage to the local cetacean populations.

### 3.2.2 Otters

Otters are small, semi-aquatic mammals which inhabit riverine, brackish and coastal environments throughout the UK. Although land mammals, otters depend upon both freshwater and marine environments for food. Their marine habitat comprises low, peat-covered coastlines with shallow, seaweed rich waters and a consistent freshwater supply (DECC, 2016).

Habitat loss, hunting and pollution have collectively reduced the historic range of this species throughout Europe to just a few key habitats in the North of the continent (JNCC, 2018). Scotland remains a stronghold for otters within Europe, with the greatest densities occurring in the northern and western parts of the country, including the northern islands (JNCC, 2018). Otters are known to occur in coastal areas around Orkney and the River Borgie on mainland Scotland; however, there are no SAC designated for otters within the vicinity of the cable corridor (NMPi, 2018).

#### 3.2.2.1 Potential Impacts

Otters are most vulnerable to human disturbance at landfall sites, which may cause them to abandon their holts. Project activities which are to be undertaken for the Landfall Area Investigation programme include: Site Investigation (SI) (borehole drilling); trial pitting; HDD; and a landfall topographic survey. These survey techniques are not noisy but will involve the presence of survey personnel on or near landfall sites in which otters may be present. Otters present in the nearshore marine environment may also potentially be disturbed by vessel presence, as vessels may be required to support the Landfall Area Investigations and cable installation. However, as this species is not particularly sensitive to noise and tends to occur in shallow waters of the very nearshore, injury from noise emissions and vessel collision is highly unlikely.

Landfall Area Investigation activities in the nearshore environment are anticipated to last for a short period of a few days. With regards to the HDD activities, it is estimated that this will take up to 2 weeks for the works to be carried out. Cable installation activities, including cable pull-in, are estimated to take only a few days at the landfalls. Consequently, interactions between otters and these survey/cable installation activities will be both spatially and temporally constrained. Whilst some level of temporary disturbance is possible in the very nearshore, mitigation approaches will be implemented to minimise potential disturbance to this EPS (Section 5). A separate Construction Environmental Management Plan (CEMP) will also be in place to cover cable installation.

## 3.3 Other protected species

### 3.3.1 Basking Sharks

Basking sharks (*Cetorhinus maximus*) are one of only three species of shark which filter feed and are the second largest fish in the world (Sims, 2008). Targeted hunting has reduced their abundance and historical range across the North Atlantic and North Sea, and there is evidence that basking sharks on the east coast of Scotland may be affected by disease (Dagleish *et al.*, 2010). The species can be found throughout the offshore waters of the UK continental shelf (Sims, 2008), and are considered infrequent visitors to the Pentland Firth and Orkney Waters (Evans *et al.*, 2011). Basking sharks seem to shift their distribution seasonally, coming in towards shallower Scottish waters in the summer months before returning offshore in the late autumn (Evans *et al.*, 2011). Localised population density is very low; sightings records of basking sharks indicate a small number of individuals (approximately 385) widely distributed across North Scotland and Orkney (Evans *et al.*, 2011). As such, they are a species of conservation concern and the Northeast Atlantic population is listed as 'Endangered' in the IUCN Red List of Threatened Species (IUCN, 2018).

#### 3.3.1.1 Potential Impacts

The hearing range of basking sharks is not known. However, the hearing range of other elasmobranchs has been determined to fall between 20 Hz to 1 kHz and may be similar in this species (Macleod *et al.*, 2011). As this frequency range encompasses only a small proportion of the noise emitted during the proposed survey





operations, noise disturbance is not expected to impact basking sharks. Furthermore, the surveys are both spatially and temporally constrained.

Vessel collision also poses a threat to this slow-moving species. Collision risk increases with increasing vessel speed. As the survey and cable installation vessels will be moving slowly, collision risk is minimised. Given the wide distribution of basking sharks around the project area, overlap between project vessels and survey equipment with basking sharks are highly unlikely and impacts to this species are considered to be not significant.

### 3.3.2 Seals

Two species of seals inhabit UK waters: the grey seal (*Halichoerus grypus*) and the harbour seal (*Phoca vitulina*) (Jefferson *et al*, 2015). The waters of the Pentland Firth and Orkney Islands are important habitat for both species, which utilise the coastlines and nearshore waters year-round for breeding and feeding (Pollock *et al*, 2000). The undisturbed coastlines in Orkney make excellent habitat for haul-outs, which is why over a quarter of the harbour seals in the UK can be found in this region. The majority of seal haul-outs are situated between the islands and along their eastern shores, avoiding steep, west-facing cliffs (Barne *et al.*, 1997).

The pupping season of harbour seals is June to early July and their moulting season occurs in August. Grey seals pup thereafter from mid-September through to January and then moult until early April (Bowen, 2016). Like seabirds, seals are central-place foragers, utilising a terrestrial 'base' for important life history events (i.e. breeding, pupping, moulting, etc.) and to rest, and then head offshore on foraging trips before returning to land (Pollock, 2000). While both species are associated with shallower shelf waters, grey seals often make longer foraging trips to deeper waters than harbour seals (Pollock, 2000). However, neither species regularly occur in waters beyond 200 m (Pollock, 2000). The mean at-sea distribution of harbour seals across the project area is approximately 0-10 individuals per 25 km<sup>2</sup>, which is very low to moderate in comparison to the rest of the North Sea (NMPi, 2018). The mean at-sea distribution of grey seals in the vicinity of the survey works is approximately 8-17 individuals per 25 km<sup>2</sup>, which is near the mean distribution across the North Sea (NMPi, 2018). Conservation regulations covering the protection of grey and harbour seals in UK waters include the Marine (Scotland) Act 2010 and the Conservation (Natural Habitats, &c.) Regulations 1994.

#### 3.3.2.1 Potential Impacts

Potential impacts of calibration testing, pre-installation surveys and cable installation activities on seals are restricted to underwater noise produced during survey activities and physical disturbance at haul outs (i.e. from vessel or human presence), particularly during the pupping and subsequent moulting seasons. As most of the survey works will be taking place some distance from shore, and there are no designated seal haul-outs within 500 m of any proposed survey area, no adverse impacts to seals at haul outs is expected (it is noted that the north-eastern part of Back of Holms survey equipment calibration test site is located adjacent to the Bay of Ireland seal haul-out (0.04 km), however testing will not be undertaken within 500 m of the haul out).

Underwater noise emissions have the potential to cause physical injury or disturbance to seals, particularly if they fall within their generalised hearing range of 50 Hz to 86 kHz (NMFS, 2018). Disturbances to seals at haul-outs can have dramatic repercussions if they are continual, as they may lead to permanent displacement of individuals if they swim away from the noise source and do not return. The surveys and cable installation activities will take place at discrete times over a two-year period and therefore have the potential to take place during the pupping and moulting season for both harbour and grey seals. However, contemporary data suggests that even with very intense noise emissions, such as those from pile driving activity, harbour seals are likely to return to the region of the noise source once the emissions have ceased (Brasseur *et al*, 2010). Where this leads to an animal avoiding their main feeding and breeding grounds this can have longer term effects the on health and breeding ability of that animal (Kastelein *et al.*, 2006).

Due to the short-term and localised nature of the proposed activities (estimated 26 days for Phase 1, 40 days for Phase 2 geophysical surveys, 9 days for SI activity and up to 2 - 3 months for the cable installation activity), long-term effects on harbour and grey seal populations are highly unlikely. Mitigation strategies are recommended in Section 5 below to provide protections against potential impacts to seals near the proposed survey operations.





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### 3.3.3 Birds

The Scottish marine environment forms vital habitat to a variety of seabird species (Pollock *et al*, 2000). The Orkney Islands are particularly important to cliff and island nesting seabirds, and the islands act as strongholds for a variety of gulls, terns, skuas, fulmars and auks. The species most likely to be present within the project area include: Arctic tern (*Sterna paradisaea*), Arctic skua (*Stercorarius parasiticus*), Great black-backed gull (*Larus marinus*), Great skua (*Catharacta skua*), Black Guillemot (*Cepphus grylle*), Common guillemot (*Uria aalge*), Fulmar (*Fulmarus glacialis*), Kittiwake (*Rissa tridactyla*), Common gull (*Larus canus*), and Puffin (*Fratercula arctica*) (Barne *et al*, 1997). Of these, the great skua, arctic skua and arctic tern are considered summer visitors to the region, while the common gull and black guillemot maintain an inshore distribution around the islands (Pollock *et al*, 2000).

While the marine environment forms important habitat to sea birds year-round, birds are most vulnerable to human disturbance at sea during the moulting season when they become flightless and spend greater time on the water's surface. The moulting season for the majority of marine birds is after the breeding season, except for puffins (



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Table 3-4). After the breeding season ends, moulting birds disperse from their coastal colonies to head to offshore waters. This at-sea period increases the likelihood of interactions with survey vessels and the potential collision risk. The important life-history periods for seabird species found in Scottish waters are shown in



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Table 3-4 below.



Table 3-4 Breeding seasons and nest occupancy periods of seabirds in Scottish waters (SNH, 2017)

Protected seabird species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Arctic Skua												
Arctic Tern												
Atlantic puffin		M	M									
Black guillemot								M	M	M	M	
Black-headed gull												
Common eider							M	M	M			
Common guillemot								M	M	M	M	
Common gull												
Common tern												
Cormorant												
European shag												
Fulmar												
Great black-backed gull												
Great skua												
Kittiwake												
Lesser black-backed gull												
Long-tailed duck												
Northern gannet												
Razorbill								M	M	M	M	
Red-breasted merganser								M	M	M		
Red-throated diver										M	M	M
Slavonian grebe												
Storm petrel												
Velvet scoter												

**Key:** Dark Blue = breeding season

White = not present in significant numbers

Blue = breeding site attendance

M = flightless moulting period

Light blue = non-breeding period

### 3.3.3.1 Potential Impacts

During the proposed activities, the physical presence of vessels may cause disturbance to birds in the project area. Disturbance from increased vessel light also has the potential to disorient fledgling birds, leading to collisions with vessels which may be fatal (Rodriguez *et al*, 2015). The proposed project activities will take place at different times over a two year period, and therefore the works described in Section 2 have the potential to coincide with sensitive moulting periods for birds (



Table 3-4). The geophysical surveys are estimated to take 26 days for Phase 1, 40 days for Phase 2, the SI activity is estimated to take 9 days and the cable installation activities estimated to take 2 - 3 months.

Despite the potential overlap between survey and cable installation vessels and breeding birds utilising the marine environment, the temporary nature of the activities both spatially and temporally preclude them from introducing significant impacts to birds in the area. Finally, vessels will be travelling slowly and in a predetermined pattern over the course of the surveys, which greatly diminishes the likelihood of collisions occurring. For these reasons, no significant impacts to sea birds are anticipated from project activities.

Impacts on conservation sites with seabird features are considered below in Section 4.

## 3.4 Protected species risk assessment

### 3.4.1 Protected species assessment criteria

#### 3.4.1.1 Injury

##### 3.4.1.1.1 Acoustic injury criteria

Injury criteria proposed by Southall *et al.* (2007) include for three different types of sound:

- > Multiple pulsed sound (i.e. sound comprising two or more discreet acoustic events within a 24-hour period, such as Multi Beam echosounders, side scan sonar and sub-bottom profilers surveys);
- > Single pulse sound (i.e. a discreet acoustic event within a 24-hour period, such as an underwater explosion); and
- > Continuous sound (i.e. non-pulsed sound, such as vessel engines).

The geophysical surveys comprise seismic equipment which emits multiple pulsed sound. The JNCC (2010) guidance on sound exposure thresholds for noise-related injury to marine mammals uses the thresholds identified by Southall *et al.* (2007). These injury thresholds are relevant for all cetaceans except harbour porpoise, which have a higher frequency hearing range (Table 3-5).

Southall *et al.* (2007) suggest a threshold of 230 dB re 1  $\mu$ Pa (peak pressure level) and an M-weighted Sound Exposure Level (SEL) of 198 dB re 1  $\mu$ Pa2s for multiple pulsed sound. The SEL is the cumulative energy for all sound pulses within a 24-hour period (normalised to a single second interval). These injury criteria values are derived from measurements of the onset of Temporary Threshold Shift (TTS) in several cetacean species, with a buffer of +6 dB for peak sound and +15 dB for SEL added to estimate the potential onset of Permanent Threshold Shift (PTS) based on measurements of terrestrial mammals. These thresholds are deemed appropriate for applying a precautionary approach to marine noise as they enable a worst-case assessment (Southall *et al.*, 2007).

Lucke *et al.* (2008) reported a lower threshold for the onset of TTS in harbour porpoise than was reported by Southall *et al.* (2007) (200 dB re 1  $\mu$ Pa peak threshold, equivalent to 194 dB re 1  $\mu$ Pa peak and a sound exposure level of 164.3 dB re 1  $\mu$ Pa2s, un-weighted). This work has been supported by more recent studies on noise thresholds in harbour porpoise (e.g. Kastelein *et al.* 2014; Kastelein *et al.* 2012). JNCC (2010) guidance on injury and disturbance to marine EPSs suggests that the lower threshold for TTS in harbour porpoise described by Lucke *et al.* (2008) may provide a better estimate of PTS for this species by applying the PTS onset calculation from Southall *et al.* (2007). This re-calculation results in a peak level injury criterion of 200 dB re 1  $\mu$ Pa (i.e. by adding +6 dB to the peak level for TTS) and a SEL injury criterion of 179.3 dB re 1  $\mu$ Pa2s (i.e. by adding +15 dB to the SEL level for TTS). However, the resulting SEL value is un-weighted, thus it is necessary to apply a correction factor to make them comparable to the HF M-weighted SELs. Lucke *et al.* (2008) suggested applying a correction factor of -2.5 dB to the resulting un-weighted SEL to generate a PTS value similar to that which would be calculated by the HF M-weighted SELs. Accordingly, an M-weighted SEL criterion of 177 dB re 1  $\mu$ Pa2s has been adopted to estimate the potential injury ranges for harbour porpoise.



The injury criteria used in this assessment are summarised in Table 3-5 below. For disturbance, a qualitative approach which considers source level, mitigation measures, length of operations and other influential factors have been considered.

Table 3-5 Criteria considered in this assessment for the onset of injury in marine mammals

Hearing Group	Type of sound	Injury criteria			
		Peak pressure dB re 1 µPa		SEL dB re 1 µPa2s (M-weighted)	
Reference		Southall (2007) Lucke (2008)	NMFS (2018)	Southall (2007); Lucke (2008)	NMFS (2018)
Low-frequency cetaceans (deep diving species – e.g. minke whale, pilot whale, etc.)	Single or multiple pulses	230	219	198	183
	Non-pulsed (e.g. continuous sound)	230	199	215	199
Mid-frequency cetaceans (small dolphins – e.g. bottlenose dolphin, common dolphin, white- beaked dolphin, etc.)	Single or multiple pulses	230	230	198	185
	Non-pulsed (e.g. continuous sound)	230	198	215	198
High-frequency cetaceans (only harbour porpoise are within UK waters)	Single or multiple pulses	200	202	177	155
	Non-pulsed (e.g. continuous sound)	230	173	215	173
Pinnipeds (only seals are within UK waters)	Single or multiple pulses	218	218	186	185
	Non-pulsed (e.g. continuous sound)	218	219	203	219

#### 3.4.1.1.2 Injury from vessel collision

Vessel collisions have been identified as another potential source of mortality and sublethal injury to a variety of marine megafauna, including EPSs and protected species such as cetaceans and basking sharks (Laist *et al.*, 2001). Injuries from vessels may result in either blunt trauma from a collision impact or lacerations from propellers. Sub-lethal injuries may eventually lead to mortalities if the individual then contracts a secondary infection. Vessel speed has been correlated to behavioural responses in cetacean species. Vessels travelling at high speeds and in unpredictable patterns often illicit an avoidance response in cetaceans, while large, slow moving vessels may illicit neutral or positive response in cetaceans (e.g. bow riding) (Ng and Leung, 2003; Au and Perryman, 1981). Such responses can be regarded as indicative of individual awareness of vessel presence and the potential for an unforeseen collision to occur.



### 3.4.1.2 Disturbance

#### 3.4.1.2.1 Disturbance Regulations

There are two regulations which govern disturbances to European Protected Species (EPS): Regulation 39(1) and Regulation 39(2). Regulation 39(1) from the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) defines disturbance for all EPS species in UK waters and individuals which are vulnerable to disturbance due to biological or environmental circumstances. Regulation 39(2) (for which a comparable offence is not found in offshore waters, or in English or Welsh inshore waters) goes beyond the disturbance guidelines provided in Regulation 39(1) by making it an offence to deliberately or recklessly disturb any cetacean in Scottish Territorial Waters (i.e. up to 12 NM) (Marine Scotland, 2014). The definitions of disturbance are provided in Box 1 below.

Box 1 – Disturbance Regulations in Scottish Territorial Waters

The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)

**Regulation 39 (1)** makes it an offence —

*(a) deliberately or recklessly to capture, injure, or kill a wild animal of a European protected species;*

*(b) deliberately or recklessly –*

*(i) to harass a wild animal or group of wild animals of a European protected species;*

*(ii) to disturb such an animal while it is occupying a structure or place which it uses for shelter or protection;*

*(iii) to disturb such an animal while it is rearing or otherwise caring for its young;*

*(iv) to obstruct access to a breeding site or resting place of such an animal, or otherwise to deny the animal use of the breeding site or resting place;*

*(v) to disturb such an animal in a manner that is, or in circumstances which are, likely to significantly affect the local distribution or abundance of the species to which it belongs;*

*(vi) to disturb such an animal in a manner that is, or in circumstances which are, likely to impair its ability to survive, breed or reproduce, or rear or otherwise care for its young; or*

*(vii) to disturb such an animal while it is migrating or hibernating.*

**Regulation 39(2)** provides that it is an offence —

*to deliberately or recklessly disturb any dolphin, porpoise or whale (cetacean).*

To consider the possibility of a disturbance offence resulting from the proposed project, it is necessary to consider the likelihood that survey activities would generate a non-trivial disturbance based on the sensitivities of the species present and whether the number of individuals impacted would generate population-level consequences. Where there is a possibility of disturbing an individual animal, it is necessary to apply for a Marine EPS Licence to ensure that an offence is not committed. However, in issuing a Marine EPS Licence, Marine Scotland must consider whether the *Favourable Conservation Status* (FCS) of any species will be affected (see Section 1). Consequently, the impacts of proposed activities on the FCS of all protected species must be considered to satisfy both Regulation 39(1) and 39(2). The impact assessment below addresses the impacts of survey activities on the existing conservation statuses of protected species within the project area.

#### 3.4.1.2.2 Acoustic disturbance criteria

Guidance from Marine Scotland (2014) describes disturbance as activities which is likely “to significantly affect the local distribution or abundance of the species to which it belongs.” The relevant European Commission (2007) guidance suggests that a disturbance must significantly impact the local distribution or abundance of a species, even if those impacts are temporary. The JNCC (2017) guidance regards “any action that is likely to increase the risk of long-term decline of the population(s) of (a) species ... as disturbance under the (Species) Regulations.” In this way, a disturbance must not adversely impact the FCS of a population.



To consider the potential of vessels and cable installation activities resulting in a disturbance offence, it is necessary to consider the likelihood that the marine mammals in the area are likely to respond to activities in such a way as to result in a significant population-level effect. Assessment of population-level impacts from a temporary disturbance is complicated by the variability of disturbance factors and the environmental factors influencing them (e.g. the complex nature of sound propagation in moving water), the inconsistency of behavioural responses by free ranging animals, and the availability of robust population estimates for marine mammals in the Northern North Sea.

The preeminent method for assessing a potential disturbance is to compare the circumstances of the situation with empirical studies (Southall *et al.*, 2007). To identify potential disturbance of marine mammals from noise emissions, a quantitative approach has been adopted comparing disturbance thresholds developed from measurements of TTS to activity noise emissions data. Table 3-6 summarises the threshold criteria for disturbance from continuous and multiple pulsed sounds (NMFS, 2018; Stone, 1998).

Table 3-6 Disturbance threshold criteria for continuous and pulsed sounds (NMFS, 2018; Stone, 1998).

Type of Sound / Criteria Metric	Effect	Criteria
<b>Continuous sound</b>		
RMS sound pressure level, dB re 1 $\mu$ Pa	Potential strong behavioural reaction	120
<b>Multiple Pulsed sound</b>		
RMS sound pressure level, dB re 1 $\mu$ Pa	Potential strong behavioural reaction	160
	Low level marine mammal disturbance	140

Where there is a possibility of disturbing an individual animal within the Scottish Territorial Seas (up to 12 NM), it is necessary to apply for a Marine EPS Licence to ensure that an offence is not committed. However, in issuing a Marine EPS Licence, Marine Scotland must consider whether or not the FCS of any species will be affected.

### 3.4.2 Assessment of impacts of activities on protected species

#### 3.4.2.1 Vessels

During the proposed surveys and cable installation activities, the use of vessels will result in noise emissions being introduced into the marine environment and may increase the potential for collisions to occur with protected species. The potential impacts of noise emissions and collision risk from vessel presence is discussed below.

##### 3.4.2.1.1 Collision Risk Assessment

Throughout the Pentland East Submarine Cable Project, the following vessels will be used; a survey vessel; RIB; multicat; DSV; a jack-up barge; cable installation vessels; guard vessel; and a rock placement vessel. These vessels are small to medium in size and will be following a defined, predominantly linear, route at a very slow speed of 4 knots, with intermittent stationary periods when the vessel must remain fixed for operational purposes. This dramatically reduces the risk of collision with marine species concurrent to the project area.

Cetaceans and basking sharks are highly mobile species which will not be constrained to the location of the project activity. As the vessel activity for the project will take place at prescribed locations over a 240.5 km<sup>2</sup> area for a short period of time, collision risk is anticipated to be insignificant and will not cause any adverse impacts to basking sharks or cetacean populations.

As discussed above, the timing of the proposed survey activities (see Section 2) have the potential to temporarily overlap with the breeding periods of several species which are known to utilise the marine environment within the project area (





Table 3-4). Despite the potential for overlap between project vessels and breeding seabirds, the temporary nature of the Project activities and the slow speed at which vessels will be moving preclude significant collision risks with seabirds from being generated. For these reasons, no significant impacts to seabirds are anticipated from project activities.

Vessel presence is highly constrained for this project and therefore does not pose a significant collision risk to protected species within the project area. Vessels will be travelling slowly and in a predetermined pattern over the course of the surveys and installation works, which greatly diminishes the likelihood of collisions occurring. There is predicted to be no risk of injury to any EPS species and thus no potential to commit an offence with regards injury. There will therefore be no impact on the FCS of any EPS species. As such, there is no offence and thus no requirement for a Marine EPS licence in this respect.

Mitigation measures to further minimise risk of collision will be adhered to; these are described in Section 5 below. Collision risk has been considered in these mitigation measures through the employment of a Marine Mammal Observer (MMO), the management of vessel speed and the education of survey crew on the Scottish Marine Wildlife Watching Code and Guide to Best Practice for Watching Marine Wildlife.

### **3.4.2.1.2 Noise Impact Assessment**

#### ***Injury impact***

Experience from modelling studies conducted to support EPS applications suggests that injury to cetaceans from vessel noise (where peak emissions are between 160 – 175 dB re 1µPa (Richardson *et al.* 1995)) occurs at a range of '0 m', based on an animal swimming at a constant speed of 1.5 ms<sup>-1</sup> from the noise source. Consequently, an animal would need to be within the boat engine to experience sufficiently high noise levels that would result in injury. Movement speeds for marine mammals have been recorded well in excess of 1.5 ms<sup>-1</sup>, particularly if the animal is being evasive (Au and Perryman, 1981). Moreover, the vessels proposed for the survey works will be small to medium sized offshore survey vessels, so noise emissions will be minor compared to those of large offshore survey vessels. As such, there is likely to be no significant risk of injury to marine mammals from noise emissions from vessels.

#### ***Disturbance impact***

While the predicted source levels associated with the vessels have the potential to elicit a behavioural response in concurrent cetacean species, the vessel noise would need to be emitted over a period of months to cause a disturbance offence as defined under the Regulations 39(1) or 39(2). As the vessels will not be stationary during both survey and cable installation activities, animals within a particular area will not be exposed to extended periods of noise from the vessels. They would have to follow the vessels to be subjected to lasting or prolonged periods of noise, which would preclude their being disturbed.

Given the temporary and transient nature of the surveys and installation activities, it is highly unlikely that vessel noise emissions would influence the ability of an animal to survive or reproduce or result in significant impacts to the population abundance or distribution. As such, vessel noise is not anticipated to negatively impact upon the FCS of any EPSs.

While negative impacts on the survival, reproduction or population abundance or distribution are not expected to result from noise emissions from the survey vessels or geotechnical investigation techniques, it is possible that animals may experience some level of disturbance for the short period they may encounter noise emissions from a vessel. As such, a Marine EPS Licence is required for these activities within 12 nautical miles (as per Regulation 39(2)).

### **3.4.2.2 Positioning Equipment**

Positioning equipment is used during subsea surveys to track the position of deployed submarine vessels, such as ROVs or towed sensors, or to search the seabed for objects or areas of interest.

#### **3.4.2.2.1 USBL system**

USBL systems will be required for the execution of the majority of survey activities and may be required continuously throughout survey periods. The potential impacts of continuous sound from USBL systems on marine mammals which may be present in the survey area are outlined below.



### ***Injury impact***

The USBL system is used for determining the position of subsea equipment during surveys and cable installation. The system operates by emitting a low frequency acoustic pulse between the transponder on the vessel and the transducer on the subsea unit. Low frequency emissions propagate further than high frequency emissions, increasing the potential for exposure over a greater spatial area than would higher frequency emissions (such as those from MBES or SSS). However, the only low-frequency sensitive species likely to be present in the survey area is the minke whale, which has a density estimate of approximately three individuals per 100 km<sup>2</sup> (Table 3-2), so the potential for an injury occurring should be very low.

Continuous sound emissions from the USBL system throughout the survey and cable installation activities would present a worst-case scenario which would increase the potential risk of injury to marine mammals from noise emissions. However, the USBL system is likely to be employed intermittently, with gaps between noise emissions offering animals the opportunity to move away from the source and avoid exposure. Considering that the surveys themselves will take place while the vessel is moving, the cumulative exposure level for the USBL system (as measured by the M-weighted SEL) will be lower based on the premise that animals are highly unlikely to follow the mobile noise source. As such, this eliminates the potential to commit an offence with regards to injury or to affect the FCS of any of the cetacean species; thus, there is no offence and a Marine EPS licence will not be required.

The available noise emission mitigation measures are specifically designed for geophysical surveys in 200 m (JNCC, 2017). However, their implementation in shallower waters bolsters mitigation against injury to cetaceans around the survey area. Consequently, the mitigation measures outlined in the JNCC guidelines (2017) have been incorporated into mitigation measures for marine mammals described in Section 5 below. These measures include deployment of a MMO to monitor for the presence of marine mammals within a 500 m mitigation zone prior to commencement of, and during, the surveys.

### ***Disturbance impact***

The low noise frequency sound emissions generated by the USBL system are within the hearing range of the cetaceans anticipated to be within the project area. For this reason, there is potential for USBL survey activities to potentially illicit a disturbance response in animals that are present during the surveys (JNCC, 2010).

The survey period is anticipated to span up to 66 days (26 days for Phase 1, and 40 days for Phase 2) and the cable installation period is anticipated to span up to 2 months, but the vessels will be traversing the pre-defined route during that time, so noise emissions will be localised and temporary. For a disturbance impact to occur, the animals would have to stay in close proximity to, and potentially follow the USBL, for the duration of the surveys.

Even if the short-term operations result in a response by an animal on its own, this would not be likely to impair the ability of an animal to survive or reproduce or result in any significant impacts to the local populations or distribution. As such, there would be no impact on the FCS of any cetacean species. However, it is possible that a small number of animals may experience some disturbance for the short period they may encounter noise emissions. As such, a Marine EPS Licence is required for activities within 12 nautical miles (as per Regulation 39(2)).

#### ***3.4.2.3 Geophysical Survey***

As geophysical survey techniques utilise sound propagation to evaluate and probe the seabed habitat, they inherently introduce noise into the marine environment. Consequently, geophysical survey activities have the potential to injure or disturb noise sensitive species which are occupying the marine environment during their operation; these include cetaceans and seals.

##### **3.4.2.3.1 Side scan sonar (SSS) & Multibeam Echosounders (MBES)**

Multibeam echo sounders and side scan sonar will be required during the surveys. The potential impacts of continuous sound from SSS or MBES on protected species that are potentially present along the survey route are discussed below.

### ***Injury impact***



The sounds emitted by echosounders and SSSs are of a higher source level than other seismic equipment (e.g. USBL), but also operate at a higher frequency. For the proposed surveys, the expected frequency range for such operations is likely to be between 300 kHz and 600 kHz. These frequencies are generally beyond the hearing range of cetaceans and seals, including high-frequency sensitive species such as harbour porpoise (Table 3-5).

Higher frequency sounds attenuate more quickly than lower frequency sounds, thus an animal would need to be much closer to the sound source for it to cause injury. The likelihood of a cetacean being very close to an operational SSS or MBES is low, particularly as the source will be emitted from a moving vessel, thus the subsequent risk to cetaceans in the survey area is very low (DECC, 2011; JNCC 2010). Given the increased attenuation associated with these high frequencies, it can be concluded that use these survey technologies present a negligible risk of injury to cetaceans (DECC, 2011; JNCC 2010). Consequently, the potential to commit an offence is negligible and thus there is no requirement for a Marine EPS licence in this respect.

The available noise emission mitigation measures are specifically designed for geophysical surveys in 200 m (JNCC, 2017). However, their implementation in shallower waters bolsters mitigation against injury to cetaceans around the survey area. Consequently, the mitigation measures outlined in the JNCC guidelines (2017) have been incorporated into mitigation measures for marine mammals described in Section 5 below. These measures include deployment of a MMO to monitor for the presence of marine mammals within a 500 m mitigation zone prior to commencement of, and during, the surveys.

### ***Disturbance impact***

In addition to physical injury, noise emissions have the potential to modify the behaviours of animals in the vicinity of the noise source. As outlined in Section 3, significant disturbance may occur when an animal is at risk of a sustained or chronic disruption of behaviour or habitat use resulting in population-level effects. SSS and MBES largely operate beyond the most sensitive frequencies of most cetaceans (Table 3-5, Table 3-3) (JNCC, 2010); thus, the potential for a disturbance having negative repercussions on the FCS of a species is extremely low.

The geophysical survey programme is anticipated to take up to 66 days (26 days for Phase 1, and 40 days for Phase 2), with SSS and MBES surveys taking place intermittently throughout the survey area. This value does not constitute the total duration of survey activities, but rather indicates the timeframe in which the surveys may take place. For a disturbance to occur during the intermittent geophysical surveys, noise sensitive species would have to stay in close proximity to, and potentially follow, the vessels using SSS, SBES and MBES while they were actively emitting noise.

Given the temporary and short-term nature of the survey activities, it is highly unlikely that SSS, SBES and MBES would negatively impact upon the FCS of any of the cetacean species which may be present in the survey area. This is on the basis that the level of disturbance caused is unlikely to affect the ability of an animal to survive or reproduce or result in a significant population-level impact (e.g. by modifying the abundance or distribution of a localised population). However, it is possible that a small number of animals may experience some disturbance for a short period that they encounter noise emissions. As such, a Marine EPS Licence is required for the proposed survey activities within 12 nautical miles (as per Regulation 39(2)).

### **3.4.2.3.2 Sub-bottom profilers**

Sub-bottom profilers will be required intermittently throughout the detailed survey. The potential impacts of sound emissions from sub-bottom profilers on marine mammals are outlined below.

### ***Injury impact***

Sub-bottom profiler surveys operate by emitting intermittent low frequency sounds which maximise seabed penetration. For the majority of marine mammal species potentially present in the survey area, the sounds emitted by sub-bottom profilers are below their auditory thresholds, though, these low-frequency noise emissions still have the potential to cause injury. Much like USBL seismic emissions, marine mammals may be exposed to these low frequency sounds over a greater spatial area than they would higher frequency sounds. However, injury would only occur within the direct and very narrow 'beam' from the transducer. Furthermore, the majority of the acoustic energy will be directed downward toward the seabed, as opposed to being emitted horizontally. This further reduces the potential for injury from sub-bottom profiler noise



emissions. As the majority of the species likely to be found near the survey route are less sensitive to low frequency sounds, the potential for impact can be considered low.

The available noise emission mitigation measures are specifically designed for geophysical surveys in 200 m water depth (JNCC, 2017). However, their implementation in shallower waters bolsters mitigation against injury to cetaceans around the survey area. Consequently, the mitigation measures outlined in the JNCC guidelines (2017) have been incorporated into mitigation measures for marine mammals described in Section 5 below. These measures include deployment of a MMO to monitor for the presence of marine mammals within a 500 m mitigation zone prior to commencement of, and during, the surveys.

### ***Disturbance impact***

Although the programme of geophysical surveys will extend over a period of approximately 66 days in total, use of sub-bottom profilers will be intermittent therein. There will be periods of inactivity during weather downtime and during geotechnical data collection. For a disturbance impact to result from sub-bottom profiling methods, animals would have to stay in close proximity to, and potentially follow, the vessels operating the sub bottom profilers. Even if the short-term geophysical survey operations result in a behavioural response, it is not likely that such a response would impair the ability of the animal to survive or reproduce or generate significant population-level impacts. As such, there would be no impact on the FCS of any cetacean species. However, it is possible that a small number of animals may experience some level of disturbance while they encounter noise emissions. As such, a Marine EPS Licence is required for activities within 12 nautical miles (as per Regulation 39(2)).

### **3.4.2.3.3 Subsea Altitude Metre, Sound Velocity Profiler (SVP) & Acoustic Doppler Current Profiler (ADCP)**

#### ***Injury impact***

Subsea Altitude Metres (altimeters), SVPs and ADCPs all rely on high frequency pulsed sounds to gather data on the marine environment. Subsea altimeters use sonar to identify the distance to the seafloor, while SVPs are used to measure the speed of sound within the water column to calibrate geophysical survey equipment with. Alternatively, ADCPs emit very high frequency doppler waves and use the back-scatter of those sound waves to measure current speeds and directions within the water column.

All of these technologies produce high frequency sounds which attenuate quickly and have source levels below the threshold for the mid and low-frequency cetacean species and, likely, for pinnipeds when in water. The source levels for the altimeters and SVPs are likely to be lower than the threshold criteria for the majority of cetacean species, and their source frequencies are beyond the hearing range of any marine mammal species. While, there is potential for auditory damage to occur, despite the sound being inaudible, the high frequency emissions used by this technology attenuates very quickly and is rapidly lost to the marine environment. Furthermore, most of the acoustic energy will be emitted directly downward toward the seabed, as opposed to being emitted horizontally. So marine mammals would have to remain within the narrow emissions beam to experience the source levels at full intensity, which would require individuals to follow the vessel during the survey transect. These characteristics dramatically reduce the potential for sound emissions to impact nearby marine mammals.

ADCPs may have the potential to cause injury to cetaceans which utilise the high frequency hearing range for communication, such as harbour porpoise. However, such impacts are only possible if individuals are directly adjacent to the sound source because of the rapid loss of intensity of such noise emissions to the marine environment. As ADCPs are placed on the seabed for the duration of their deployment, which is beyond the mean dive depth of foraging harbour porpoise, interactions between this species and the sound source are anticipated to be very low (Westgate *et al.*, 1995). Moreover, ADCPs are generally only deployed for a short duration (e.g. one day or lunar cycle) and thus form a very temporary risk to marine mammals.

The available noise emission mitigation measures are specifically designed for geophysical surveys in 200 m (JNCC, 2017). However, their implementation in shallower waters bolsters mitigation against injury to cetaceans around the survey area. Consequently, the mitigation measures outlined in the JNCC guidelines (2017) have been incorporated into mitigation measures for marine mammals described in Section 5 below.



These measures include deployment of a MMO to monitor for the presence of marine mammals within a 500 m mitigation zone prior to commencement of, and during, the surveys.

#### ***Disturbance impact***

Although the programme of geophysical surveys will extend over a period of approximately 66 days in total, use of Subsea Altitude Metres (altimeters), SVPs and ADCPs will be intermittent therein. There will be periods of inactivity during weather downtime and during geotechnical data collection. For a disturbance impact to result from these survey methods, animals would have to stay in close proximity to, and potentially follow, the vessels during survey operations. Even if the short-term geophysical survey operations result in a behavioural response, it is not likely that such a response would impair the ability of the animal to survive or reproduce, or adversely impact cetacean populations. As such, there would be no impact on the FCS of any cetacean species. However, it remains a possibility that a small number of animals may experience some level of disturbance from these survey activities. As such, a Marine EPS Licence is required for activities within 12 nautical miles (as per Regulation 39(2)).

#### **3.4.2.3.4 Obstacle Avoidance Sonar**

Obstacle avoidance sonar may be employed to identify obstacles along the cable route. The potential impacts from noise emissions of this geophysical survey method are outlined below.

#### ***Injury impact***

High frequency pulses created by obstacle avoidance sonars produce high frequency sound waves which can be used to generate high-resolution images of the seabed. The source levels for this sonar technology are likely to be lower than the threshold criteria for the majority of cetacean species, however, the source frequencies for this sonar technology are beyond the hearing range of any marine mammal species. As such, there is potential for auditory damage to occur, despite the sound being inaudible. Nevertheless, the high frequency emissions used by this technology causes sounds to attenuate very quickly and become rapidly lost to the marine environment. Furthermore, most of the acoustic energy will be emitted directly downward toward the seabed, as opposed to being emitted horizontally. These characteristics dramatically reduce the potential for sound emissions to impact nearby marine mammals.

The available noise emission mitigation measures are specifically designed for geophysical surveys in 200 m (JNCC, 2017). However, their implementation in shallower waters bolsters mitigation against injury to cetaceans around the survey area. Consequently, the mitigation measures outlined in the JNCC guidelines (2017) have been incorporated into mitigation measures for marine mammals described in Section 5 below. These measures include deployment of a MMO to monitor for the presence of marine mammals within a 500 m mitigation zone prior to commencement of, and during, the surveys.

#### ***Disturbance impact***

Although the programme of geophysical surveys will extend over a period of approximately 66 days in total, use of obstacle avoidance sonars will be intermittent therein. There will be periods of inactivity during weather downtime and during geotechnical data collection. For a disturbance impact to result from obstacle avoidance sonars methods, animals would have to stay in close proximity to, and potentially follow, the vessels operating the sub bottom profilers. Even if the short-term geophysical survey operations result in a behavioural response, it is not likely that such a response would impair the ability of the animal to survive or reproduce or generate significant population-level impacts. As such, there would be no impact on the FCS of any cetacean species. However, it is possible that a small number of animals may experience some level of disturbance while they encounter noise emissions. As such, a Marine EPS Licence is required for activities within 12 nautical miles (as per Regulation 39(2)).

#### **3.4.2.4 Landfall Area Investigations**

The Landfall Area Investigation activities include borehole drilling, trial pitting, HDD and topographical surveys, which each have the potential to disturb protected species in the vicinity of this activity with varying consequences.

#### **3.4.2.4.1 Disturbance at landfalls**





The taxa which are most likely to be impacted by landfall area investigations in the nearshore environment and at landing points are seals and otters. Potential impacts to these species include habitat loss and disturbance.

### **Seals**

Although they occupy the marine environment for the majority of the year, grey and harbour seals do utilise the coastal environment during their most sensitive life-history periods: breeding, pupping and moulting. They form breeding colonies and haul-outs for these purposes along rocky, often remote coastlines around the UK, though sometimes colonies may extend onto sandbanks and up cliffs (Nordstrom, 2006). Disturbance at these important terrestrial habitats, either from human interaction or vessel presence, has the potential to cause acute distress, which may lead to individuals vacating the site and returning to the water. At pupping sites, this behavioural response to stressors has the potential to impact pup survival, as it can disrupt nursing and lead to energetic deficits in pre-weaned pups (NMFS, 2018b).

The landfall sites for the Pentland East Submarine Cable Project do not include known grey or harbour seal pupping sites or haul-outs. As survey activities at the mainland Scotland landing site, including the borehole transects as part of the geotechnical SI will be spatially constrained to an area of 1.87 km<sup>2</sup>, the project is not anticipated to have any adverse impacts to the FCS of seals within the vicinity of the project. Mitigation measures delineated to minimise impacts to marine mammals, including seals, are set out in Section 5. These include the employment of a Marine Mammal Observer (MMO) who will work with the technical staff to minimise seal encounters during project activities.

### **Otters**

Otters are particularly sensitive to anthropogenic changes to their habitats, as their coastal habitat use is highly dependent the inclusion of freshwater features (Roos *et al.*, 2015). As such, the location of their holts (or dens) is restricted and anthropogenic changes to their habitat may have dramatic repercussions, including localised extinctions. At present, the selected landfalls do not overlap with areas recognised as otter habitat. Additionally, the temporary nature of project activities due to take place on land and in the very nearshore habitat preclude significant impacts to the FCS of any otters found to be present in the project area.

While the landfall sites for the Pentland East Submarine Cable Project preclude known otter holts, the landfall area will be surveyed for evidence of otters (e.g. spraints) prior to commencing Landfall Area Investigations to ensure no otters are disturbed by survey activities. Additional mitigation measures for avoiding potential impacts to otters are presented in Section 5. If potential disturbance to otters cannot be ruled out, SHEPD will consult on the requirement to apply for a EPS Licence to disturb otters (Section 4).

#### **3.4.2.5 Cable lay activities including jet trenching and rock and mattress placement**

The potential impacts of noise from cable lay activities including placement of rock, concrete mattresses and jet trenching activities on cetaceans that are potentially present along the cable route are as follows:

##### ***Injury impact***

There is currently no data available on what the noise levels generated by rock placement might be (JNCC, 2010). However, it is assumed that levels associated with the activities involved in cable installation are usually not detectable above vessel noise. Therefore, applying the same rationale to the assessment of potential impacts from these noise sources as to that applied to the assessment of impacts from vessel noise (e.g. assuming that the animal will swim at a constant speed of 1.5 ms<sup>-1</sup> from the source of noise) it can be concluded that there is likely to be no significant risk of injury to marine mammals at any distance from the proposed cable lay activities.

##### ***Disturbance impact***

As with injury impacts discussed above, given that noise levels associated with cable installation activities are usually not detectable above vessel noise and given the short-term duration of the proposed activities, it is highly unlikely that this would negatively impact upon the Favourable Conservation Status of any cetacean species that is potentially present in along the replacement cable route. This is on the basis that the level of disturbance caused is unlikely to affect the ability of an animal to survive or reproduce or result in any significant impacts on local population abundance or distribution.



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### 3.5 Conclusion

While no adverse or injurious impacts to cetaceans are anticipated to result from project activities, there is potential for disturbances to both cetaceans and otters. Therefore, a European Protected Species (EPS) licence application will be submitted. Nevertheless, adverse impacts to localised marine mammal or otter populations are not anticipated to result from disturbances due to the geophysical survey, cable installation activities or landfall investigations. Therefore, there should not be any adverse impacts to the *Favourable Conservation Status* (FCS) of cetacean species known to occur near the Project area. Further to this, mitigations listed in Section 5 will be followed to further minimise any potential disturbances to EPS.

The potential impact to basking sharks is considered very low and will be reduced further through implementation of the mitigation measures outlined in Section 5.3. However, as disturbance to basking sharks remains a possibility, an application for a Basking Shark Licence under the Wildlife and Countryside Act 1981 (as amended) will be submitted.

Due to the low density of harbour and grey seals within most of the proposed survey area and the short-term and localised nature of the proposed activities, long-term impacts to harbour and grey seal populations will not be significant. A number of mitigation strategies will also be followed to further reduce any potential impact on seals if any are encountered during the proposed survey operations.

Several seabird species have the potential to be impacted by the physical presence of vessels during the surveys and cable installation activities. However, given the temporary and relatively short-term nature of the proposed activities, the potential impacts on protected seabirds are not considered to be significant.

Overall the proposed survey operations constitute work of overriding public need while presenting a trivial and temporary disturbance in a limited area.



## 4 PROTECTED SITES ASSESSMENT

### 4.1 Protected sites assessment criteria

In addition to assessing potential impacts on protected species, potential impacts to protected sites (including seal haul outs) from the proposed survey works and cable installation activities need to be considered. The following criteria has been used to select those designated protected sites where potential impacts need to be assessed:

- > SAC's and NCMPAs (including proposed and candidate sites) with cetaceans as qualifying features within 50 km of the proposed survey area;
- > SACs (including proposed and candidate sites) with harbour seal interests within 50 km of the proposed survey area and breeding grey seal within 20 km of the proposed survey area;
- > Designated seal haul outs that overlap with or are located within 500 m of the proposed survey area; and
- > SACs (including proposed and candidate sites) with otter interests that overlap with or are located within 500 m of the proposed survey area;
- > SPAs and NCMPAs (including proposed and candidate sites) with birds as qualifying features that overlap with or are located within 2 km of the proposed survey area; and
- > SACs and NCMPAs (including proposed and candidate sites) with benthic interests which are directly overlapping with the project.

Figure 4.1 shows the protected sites within a 50 km range of the survey areas, of which there are only three sites that meet the above selection criteria. The designated sites located within the vicinity of the Pentland East cable routes have the potential to be impacted by survey activities. These are:

- > Hoy SAC;
- > Hoy SPA; and
- > North Caithness Cliffs SPA.

The designated sites located within the vicinity of two of the testing areas (Back of Holms and Stromness Harbour) have the potential to be impacted by the testing activities. These are:

- > Scapa Flow pSPA; and
- > Bay of Ireland Seal Haul Out site.

Table 4.1 lists each designated site that has the potential to be impacted by the geophysical survey works, cable installations and the geotechnical investigations. Table 4.2 lists each designated site that has the potential to be impacted by the survey equipment calibration testing activity. Both Table 4.1 and Table 4.2 identify the distance from the proposed activities, summarises the qualifying features of the site, and outlines the mitigation measures that would be applied, based upon site-specific qualifying species. Details of the mitigation measures are provided in Section 5. (Note: some of the mitigation measures included in Section 5 may not be listed in Table 4.1 and Table 4.2 if they are not related to protecting the designated features of those sites. However, the identified mitigation measures in Section 5 will be applied to all activities, regardless of proximity to a protected site).





Table 4-1 Protected sites in the vicinity of cable survey corridor

Cable route	Designated site potentially affected	Survey corridor overlaps with protected site or is within site selection criteria distance to protected site	Distance from nearest part of survey corridor to protected site	Features of designated site (those marked *potentially most likely to be affected, PR=primary reason for selection)	Activity	Duration of activity within site selection criteria distance to protected site (days)	Proposed mitigation measures	Potential for likely significant effect
Pentland East	Hoy SAC	0.1% of the survey corridor overlaps with the site. 4.1% of the survey corridor is within 2 km of the site.	0 km	1230 Vegetated sea cliffs of the Atlantic and Baltic Coasts 3160 Natural dystrophic lakes and ponds 4010 Northern Atlantic wet heaths with <i>Erica tetralix</i> 4060 Alpine and Boreal heaths 7130 Blanket bogs (PR)	Survey	2	N/A	No
	North Caithness Cliffs SPA	5.5% of the survey corridor overlaps with the site. 17% of the survey corridor is within 2km of the site.	0 km	Peregrine, Guillemot, Puffin, Razorbill, Kittiwake, Fulmar, Guillemot	Survey and Cable installation	110	M1, M2, M3, M4, M6, M7, M8, M9, M10, M11, M12, M13, M15, M16, M17, M18	No



	Hoy SPA	6% of the survey corridor overlaps with the site. 12.5% of the survey corridor is within 2km of the site.	0 km	Peregrine, Red-throated Diver, Great Skua, Puffin, Guillemot, Kittiwake, Great Black-backed gull, Arctic Skua, Fulmar, Great Skua	Survey and Cable installation	120	M1, M2, M3, M4, M6, M7, M8, M9, M10, M11, M12, M13, M15, M16, M17, M18	No
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Table 4-2 Protected sites in the vicinity of testing calibration sites

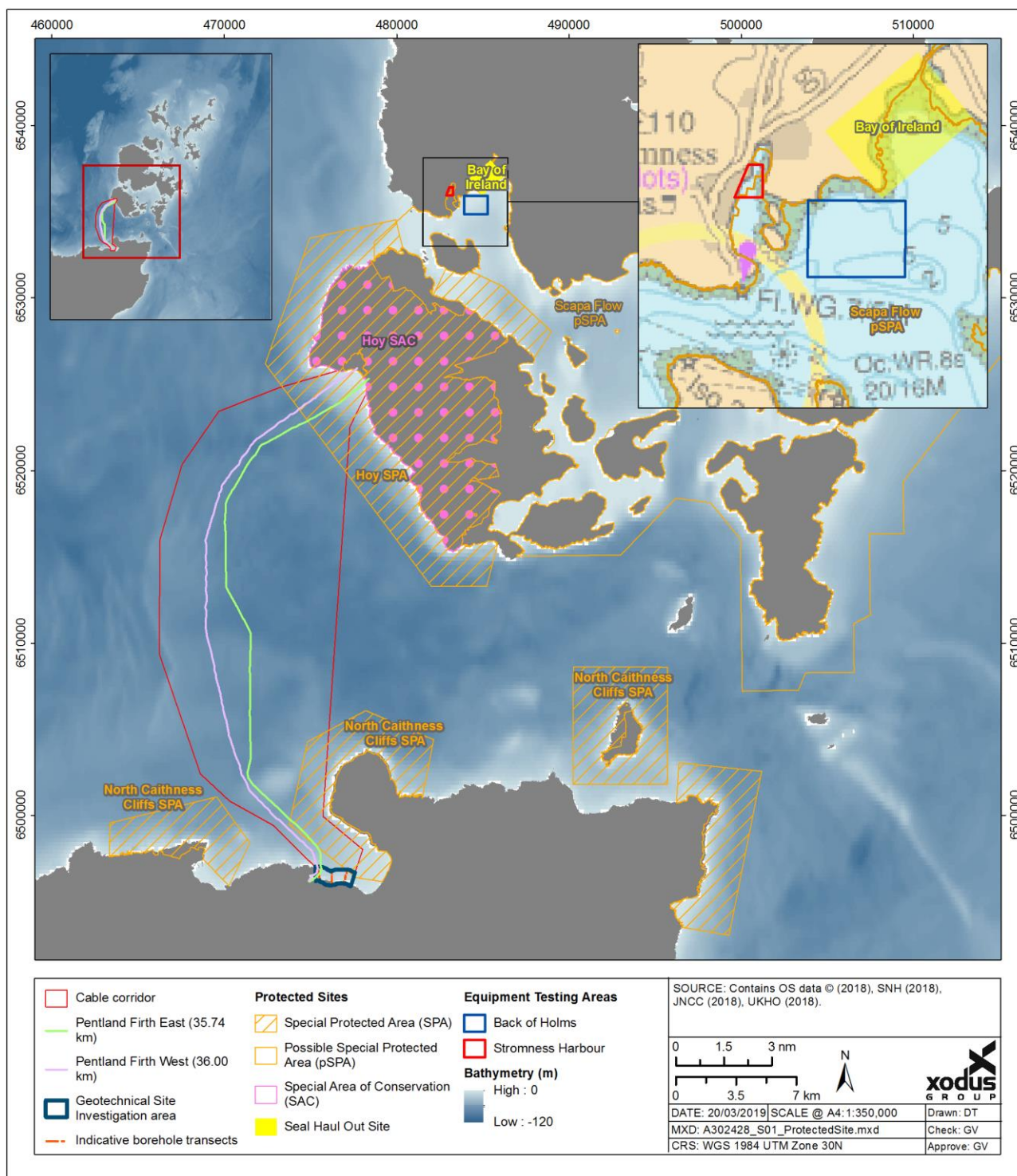
Testing site	Designated site potentially affected	Survey corridor overlaps with protected site or is within site selection criteria distance to protected site	Distance from nearest part of survey corridor to protected site	Features of designated site (those marked *potentially most likely to be affected, PR=primary reason for selection)	Activity	Duration of activity within site selection criteria distance to protected site (hours)	Proposed mitigation measures	Potential for likely significant effect
Back of Holms	Scapa Flow pSPA	100% of the test site overlaps with the site.	0 km	Great northern diver, Black throated diver, Slavonian grebe, Common eider, Long-tailed duck, Common goldeneye, Red-breasted merganser, European shag, and Red-throated diver.	Survey Equipment Calibration testing	Up to 12	M1, M2, M3, M4, M6, M7, M8, M9, M10, M11, M12, M13, M15, M16, M17, M18	No



	Bay of Ireland Seal Haul Out	100% of the test site is within 500m of the site.	40 m	Grey and Harbour seals	Survey Equipment Calibration testing	Up to 12	M1, M2, M3, M4, M5, M6, M7, M8.	No
Stromness Harbour	Scapa Flow pSPA	100% of the test site overlaps with the site.	0 km	Great northern diver, Black throated diver, Slavonian grebe, Common eider, Long-tailed duck, Common goldeneye, Red-breasted merganser, European shag, and Red-throated diver.	Survey Equipment Calibration testing	Up to 12	M1, M2, M3, M4, M6, M7, M8, M9, M10, M11, M12, M13, M15, M16, M17, M18	No
Scapa Flow Area	Unknown at this stage	Testing activities may occur anywhere within the area. Where possible, the testing activities will be carried out outwith the designated site criteria listed in Section 4.1	NA	Unknown at this stage	Survey Equipment Calibration testing	Up to 12	M1, M2, M3, M4, M5, M6, M7, M8, M9, M10, M11, M12, M13, M15, M16, M17, M18	No



Figure 4.1 Pentland East cable survey area and European protected sites





## 4.2 Conclusion of protected site assessment

A summary is presented below of the potential impacts to designated sites which will be further reduced through implementation of the specific species protection measures outlined in Section 6. The cable corridor is within 2 km of the Hoy SAC but as the Hoy SAC does not have any designated marine features it has been screened out of the risk assessment.

### 4.2.1 Potential impact on SACs with cetaceans as a feature

The cable corridor is not within 50 km of a SAC with cetacean as a designated feature. A full assessment of the potential impact on cetaceans from the cable inspection and survey activity is provided in Section 3.

### 4.2.2 Potential impacts on SACs with seals as a feature and seal haul-out sites

The cable corridor is not within 500 m of a seal haul-out site. A full assessment on the potential impact on the potential impact on seals from cable survey activities is provided in Section 3.

The Back of Holms survey equipment calibration test site is located 40 m north-east of the Bay of Ireland Seal Haul Out site. The calibration test activities will take place prior to any scheduled geophysical surveys undertaken during the Project period from March 2019 to September 2021. The duration of activities adjacent to the seal haul-out represents the worst-case scenario as the time taken to undertake the testing activities will be up to 12 hours and most likely less than this.

Harbour seals are most sensitive to impact during the pupping and moulting season which occurs between June to early July. Grey seals are most sensitive during their pupping period during mid-September to January. The calibration testing activities have the potential to be carried out during either Harbour Seals or Grey Seals sensitive periods, however it should be noted that due to the short duration of the testing activities, they will **not** be carried out during periods for which both species are sensitive. Given the short temporal aspect of the testing activities, it is considered that no adverse impact is expected on either species during these activities. A number of mitigation strategies will also be followed to further reduce any potential impact on seals, as provided in Section 5.

### 4.2.3 Potential impacts to SACs with otter interests

The cable corridor is not within 500 m of an SAC with otter as a designated feature. A full assessment on the potential impact on otters from cable survey and installation activities is provided in Section 3.

### 4.2.4 Potential impacts to SPAs and MPAs with birds as a feature

There are two SPA's with designated species with potential to be impacted by the cable survey and cable installation activities located within the 2 km search criteria distance of the cable installation corridor for the Pentland East geographical area. The SPAs are listed in Table 4-1 along with the bird species they have been designated for. A summary of each SPA is provided below.

#### 4.2.4.1 Hoy SPA

Hoy is one of the most southerly and major islands of the Orkney archipelago in northern Scotland. The Hoy SPA covers the northern and western two-thirds of the island (95 km<sup>2</sup>). Most of the island is moorland, drained by numerous streams with diverse vegetation. Cliffs provide important breeding sites for a number of seabird specific, especially gulls and auks, whilst moorland areas support large numbers of breeding birds, in particular Great Skua, Red-throated Diver (*Gavia stellate*) nest on the numerous small lochans found on the moorland. The divers and seabirds feed in the rich waters around Hoy, outside the SPA (JNCC, 2005a).

The site qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting populations of European importance of the migratory species including; Red-throated Diver, 56 pairs representing at least 6.0% of the breeding population in Great Britain and Great Skua 1,900 pairs representing at least 14.0% of the breeding World population.



The site also qualifies under Article 4.2 of the Directive by regularly supporting 120,000 individual seabirds including; Puffin, Guillemot, Kittiwake, Great Black-backed Gull, Arctic Skua, Fulmar and Great Skua (JNCC, 2005a).

Approximately 12.5% of the existing Pentland East cable is within 2 km of the site and 6% of the survey corridor overlaps directly with the site. The proposed survey area will only impact a very small area of the SPA area and will take approximately 66 days in total to complete (20 days for Phase 1 and 40 days for Phase 2). Due to the temporary and localised nature of the geophysical surveys no likely significant effect on populations of birds is expected and thus, no adverse impact is expected on the conservation status of qualifying species of birds within this site.

#### 4.2.4.2 North Caithness Cliffs SPA

The North Caithness Cliffs SPA is located on the north coast of Caithness in northern Scotland. The site comprises most of the sea-cliff areas between Red Point and Duncansby Head on the north mainland coast, and the western cliffs on the island of Stroma. Cliff ledges, stacks and geos provide ideal nesting sites for important populations of seabirds, especially gulls and auks. The seabirds nesting on the North Caithness Cliffs feed outside the SPA in the surrounding waters of the Pentland Firth, as well as further afield. The cliffs also provide important nesting habitat for Peregrine (*Falco peregrinus*) (JNCC, 2005b).

The site qualifies under Article 4.1 of the Directive by supporting populations of European importance including; Peregrine. The site also qualifies under Article 4.2 by supporting populations of the migratory species including Guillemot.

During the breeding seas, the area regularly supports 110,000 individual seabirds including; Puffin, Razorbill (*Alca torda*), Kittiwake, Fulmar and Guillemot (JNCC, 2005b).

Approximately 17% of the existing Pentland East cable is within 2 km of the site and 5.5% of the survey corridor overlaps directly with the site. The proposed survey area will only impact a very small part of the SPA area and will take a approximately 66 days to complete. Whilst the landfall SI activity may take place on a 24 hour basis, this activity is expected to take nine days in total. Due to the temporary and localised nature of the geophysical surveys and SI activity no likely significant effect on populations of birds is expected and thus, no adverse impact is expected on the conservation status of qualifying species of birds within this site.

#### 4.2.4.3 Scapa Flow pSPA

The Scapa Flow pSPA is located within the Orkney Islands. Scapa Flow is an enclosed area, sheltered by Orkney Mainland to the north, Hoy, South Walls and Flotta to the west and south and Burray and South Ronaldsay to the east. The Flow is linked to the Pentland Firth on the south through the Sound of Hoxa, and to the Atlantic Ocean on the west through Hoy Sound. The site comprises of nearshore waters to the east of Orkney, extending from South Ronaldsay to Deerness and includes the sheltered shallow waters of Holm Sound, between Burray and East Mainland.

The site qualifies under Article 4.1 of the Directive by supporting populations of European importance of the following annex 1 species: Great northern diver (*Gavia immer*), Red-throated diver (*Gavia stellate*), Black-throated diver (*Gavia arctica*) and Slavonian grebe (*Podiceps auratus*). The site also support migratory populations of European importance including: European shag (*Phalacrocorax aristotelis*), Common eider (*Somateria mollissima*), Long-tailed duck (*Clangula hyemalis*), Common goldeneye (*Bucephala clangula*) and Red-breasted merganser (*Mergus serrator*).

Both the Back of Holms and Stromness Harbour survey equipment calibration testing sites overlap with this designated site. The testing activity will be carried out for a period of up to 12 hours. Due to the temporary and localised nature of the testing activity, no likely significant effect on populations of birds is expected and thus, no adverse impact is expected on the conservation status of the qualifying species of birds within this site.

### 4.2.5 Potential on SACs and MPAs with benthic features

There are no SAC's or MPAs with benthic features which overlap with the cable route survey corridor.





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#### 4.2.6 Conclusion

As the geophysical surveys (including equipment calibration testing), geotechnical investigations and cable installation activities of the Pentland East may take place across a two-year period, there is potential for activities to coincide with breeding periods and other life history events of marine birds. The cable surveys and cable installation may be undertaken during breeding and moulting months for which protected species of birds are more sensitive. However, these works will not be carried out concurrently. In conjunction with the short-term nature of each activity, it is considered unlikely that the Project works will impact significantly upon breeding and moulting birds. No adverse impact is expected on the conservation status of qualifying species of birds within this proposed site.

Due to the temporary and localised nature of the Project activities no significant or adverse impact is anticipated. Overall, the monitoring and replacement (if required) of submarine power cables constitutes work of overriding public need while presenting a trivial and temporary disturbance in a limited area.



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## 5 SPECIES PROTECTION MEASURES

### 5.1 Overview

This section summarises the proposed mitigation measures to be implemented for avoiding and reducing potential impacts to protected species which may be present during the proposed survey works.

### 5.2 Marine Mammals

A Marine Mammal Protection Plan (MMPP) will be prepared in order to reduce collision risk and disturbance to marine mammals. The key components of the MMPP include:

- > Deployment of a Marine Mammal Observer (MMO) to monitor for the presence of cetaceans and seals, prior to the commencement of, and during, marine operations;
- > For activities that take place in hours of darkness and/or in periods of poor visibility and/or during periods when the sea state is greater than Code 3, deployment of an active Passive Acoustic Monitoring (PAM) system prior to soft starts to detect for the presence of cetaceans that cannot be detected by the MMO;
- > Pre-soft start search;
- > 500 m mitigation zone for cetaceans;
- > 500 m mitigation zone for seals, reducing to 100 m in the event of a need to avoid critical delay to the project;
- > Deployment of soft-start techniques; and
- > Reporting.

#### 5.2.1 M1 - Marine mammal monitoring

There will be MMO coverage for the duration of the marine activities, with adequately trained and experienced MMO(s) working standard 12-hour shifts. They will have experience of working at sea and will have successfully deployed and used PAM equipment previously.

#### 5.2.2 M2 - Marine Mammal Observer (MMO)

During daylight hours the MMO(s) will carry out visual observations to monitor for the presence of cetaceans, seals and basking sharks before the soft-start commences and will recommend delays in the commencement of the operations should any cetaceans be detected within the 500 m mitigation zone for cetaceans. This distance will be 500 m for seals and basking sharks, except in the event of a need to avoid critical delay to the project in which case, the mitigation zone for both species groups will be 100 m. The criteria as to what constitutes a critical delay leading to reduction in mitigation zone distance from 500 m to 100 m would be agreed on a case by case basis in consultation with MS-LOT

#### 5.2.3 M3 - Passive Acoustic Monitoring (PAM)

When visibility is poor (i.e. due to fog or during hours of darkness) and/ or during periods when the sea state is greater than Code 3, the PAM system will be operated by a single MMO/PAM operator prior to soft starts.

#### 5.2.4 M4 - Pre-soft-start search

Visual (MMO) (and acoustic (PAM) monitoring if required) will be conducted for a pre-soft-start search of 30 minutes i.e. prior to the commencement of marine operations (MM9, Multi Beam Echosounder, side-scan sonar, ultra-short baseline and sub-bottom profiling). This will involve a visual (during daylight hours) and acoustic assessment (during poor visibility or at night) to determine if any cetaceans, seals or basking sharks





are within 500 m of the activities (or 100 m in the event of the critical delay described in mitigation measure M2).

#### **5.2.5 M5 - Seal haul-outs**

During hours of darkness and in poor visibility when the MMO cannot monitor for the visibility of seals and otters, the equipment must not be started within a 100 m of any SAC designated for seals or designated seal haul-out site. The vessel must be started outwith this distance and be moved into position.

#### **5.2.6 M6 - Cetacean and seal mitigation zone**

Should any cetaceans or seals be detected within 500 m of the vessel prior to the commencement of geophysical surveys (or after breaks in geophysical survey activity of more than 10 minutes), operations will be delayed until their passage, or the transit of the vessel, results in the cetaceans or seals being more than 500 m away from the vessel. In all three cases, there will be a 20 minute delay from the time of the last sighting within 500 m of the source to the commencement/recommencement of the operations.

As outlined above (5.2.2 M2 - Marine Mammal Observer (MMO)), the mitigation zone for seals may be reduced from 500 m to 100 m in the event of a need to avoid critical delay to the project subject to agreement with MS-LOT.

#### **5.2.7 M7 - Soft-start**

The source will, where feasible, not be operated at full power straight away, but the power will be built up slowly over at least 20 minutes to give any cetaceans, seals or basking sharks adequate time to leave the area. Build-up of power will occur in uniform stages to provide a constant 'ramp-up' in amplitude. The soft start procedures will be undertaken if the source is stopped for longer than 10 minutes, to avoid injury to any species which have entered the area during this 'downtime'. MMO or PAM observations will only take place prior to any soft start. Once operations have commenced there will be no further observations until another soft start is required.

#### **5.2.8 M8 - Reporting**

All recordings of cetaceans, seals and basking sharks will be made using JNCC Standard Forms. At the end of the operations, a monitoring report detailing the features of interest recorded, methods used to detect them, and details of any problems encountered will be submitted to Marine Scotland and SNH. The report will also include feedback on how successful the mitigation measures were. This requirement will be communicated to the MMOs at project start up meetings and at crew change. If the MMOs have any queries on the application of the guidelines during the works they will contact Marine Scotland and SNH for advice.

### **5.3 Basking shark**

The following mitigation measures will be implemented in order to reduce collision risk and disturbance to basking sharks:

#### **5.3.1 M9 - Basking shark monitoring**

There will be MMO coverage for the duration of the marine activities, with adequately trained and experienced MMO(s) working standard 12 hour shifts. The MMO will also monitor for the presence of basking shark following the mitigation measures described above for Marine Mammal Monitoring (see 5.2.1). Should any basking sharks be detected within 500 m of the vessel prior to the commencement of geophysical surveys (or after breaks in geophysical survey activity of more than 10 minutes), operations will be delayed until their passage, or the transit of the vessel, results in the animals being more than 500 m away from the vessel. In all three cases, there will be a 20 minute delay from the time of the last sighting within 500 m of the source to the commencement/recommencement of the operations.



### **5.3.2 M10 - Basking shark mitigation zone**

During survey works, the MMO will monitor for the presence of basking sharks, in addition to marine mammals and otters, and will delay start of the survey if any are seen within 500 m of the survey vessel. The mitigation zone for basking sharks may be reduced from 500 m to 100 m in the event of a need to avoid critical delay to the project subject to agreement with MS-LOT.

### **5.3.3 M11 - Slow moving survey vessel**

The survey vessels will be moving at a maximum speed of 4 knots to allow any basking sharks time to move away from the vessel should they be disturbed by the vessel presence or noise. Should a basking shark be found to be in the direct way of the survey route, the survey vessel will slow down further or, if possible, alter survey course to avoid collision.

### **5.3.4 M12 - Tool box talks**

Survey crew will be made aware of all protected species within the marine environment through the following guidance; the Marine Conservation Society (MCS) Basking Shark Code of Conduct and good practice measures for boat control near basking sharks and the Scottish Marine Wildlife Watching Code and Guide to Best Practice for Watching Marine Wildlife.

## **5.4 Otters**

A Otter Species Protection Plan (OSPP) will be prepared in order to reduce disturbance to otters. The key components of the OSPP include:

- > Otter Survey;
- > Deployment of a MMO to monitor for the presence of otter, prior to the commencement of, and during, marine operations;
- > Otter mitigation zones.

The following mitigation measures will be implemented in order to reduce disturbance to otters:

### **5.4.1 M12 – Otter survey**

A pre-installation survey at the cable landfalls will be conducted at least two months prior to works commencing. This survey should be followed up with additional surveys immediately prior to works commencing if suitable habitat is identified at either of the landfalls.

### **5.4.2 M13 - Otter monitoring**

There will be MMO coverage for the duration of the marine activities, with adequately trained and experienced MMO(s) working standard 12-hour shifts. The MMO will also monitor for the presence of otters (see also Section 6.2.1 Mitigation Measure 1).

### **5.4.3 M14 - Otter mitigation zone**

When working within 500 m of any SAC designated for otters, the MMO monitors for the presence of otters in the water, in addition to marine mammals and basking sharks, and delays the start of the survey if any are seen within 500 m of the survey vessel. If working during the hours of darkness or in poor visibility when the MMO is not able to monitor otters the equipment is not started up within 500 m of the any SAC designated for otters but is started beyond this distance and the vessel then moved into position.

If an otter shelter is discovered at the landfall nearshore areas, a protection zone with a minimum of 30 m radius will be set up and will be clearly demarcated/fenced off. Vegetation will not be cleared from within any protection zones.



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## 5.5 Seabirds

The following mitigation measures will be implemented in order to reduce disturbance to seabirds:

### 5.5.1 M15 - Rafting seabirds

The cable survey area is far enough away from breeding cliffs to avoid direct disturbance of nesting birds. The survey vessels will be moving at a maximum speed of 4 knots to allow any rafting seabirds time to move away from the vessel should they be disturbed by the vessel presence.

### 5.5.2 M16 - Wintering birds

When within a SPA which has been designated for wintering birds that may roost or feed in close proximity to the cable survey corridor or the landfall, further consultation will be undertaken with SNH on the requirement for any seasonal restriction to be implemented for cable installation or survey activities in order to avoid disturbance to qualifying species during the most sensitive time of the year.

### 5.5.3 M17 - Breeding birds

When within a SPA which has been designated for breeding birds that may nest or feed in close proximity to the cable survey corridor or the landfall, further consultation will be undertaken with SNH on the requirement for any seasonal restriction to be implemented for cable installation or survey activities in order to avoid disturbance to qualifying species during the most sensitive time of the year.

### 5.5.4 M18 – Light disturbance

When within an SPA and where there is potential for 24 hour working, the following measures will be implemented to minimise potential impacts to birds:

- > Lighting on-board the cable survey vessel(s) will be kept to the minimum level required to ensure safe operations; and
- > Lights will be directed or shielded to prevent upward illumination and minimise disturbance.



## 6 CONCLUSIONS

This risk assessment has assessed the risk posed by survey (including equipment calibration), site investigation/preparatory HDD activities and cable installation activity along the Pentland East cable corridor to European protected sites and species. This has included assessing the risk caused by noise emitted from the vessel and the survey/cable installation equipment, collision impact and disturbance to the following protected species and sites;

- > Cetaceans;
- > Seals;
- > Otters;
- > Basking sharks;
- > Birds;
- > SACs;
- > NCMPAs; and
- > SPAs.

No adverse impact on cetaceans is anticipated, however the use of geophysical survey equipment may cause disturbance to the marine mammals in the vicinity and as such an EPS Licence will be submitted.

The potential impact to basking sharks is considered very low and will be reduced further through implementation of the mitigation measures. However, disturbance to basking sharks is remains a possibility, an application for a Basking Shark Licence will be submitted.

Due to the low density of harbour and grey seals within most of the proposed survey area and the short-term and localised nature of the proposed activities, long-term impacts to harbour and grey seal populations will not be significant. A number of mitigation strategies will also be followed to further reduce any potential impact on seals if any are encountered during the proposed survey operations.

Breeding and moulting seabird species may be impacted by the physical presence of vessels within the survey area. However, given the temporary and short-term nature of the proposed activities (approximately 66 days), the potential impacts on seabirds are not considered to be significant.

The survey corridor is in the vicinity of North Caithness Cliffs SPA (designated for seabirds) and the Hoy SPA (designated for seabirds). Due to the temporary and localised nature of the geophysical and geotechnical surveys and nearshore site investigations no significant or adverse impact is anticipated on any of the sites. Further to this, a number of mitigation strategies will also be followed to further reduce any potential impact on seals if any are encountered during the proposed survey operations.

Overall the proposed survey operations, site investigation and cable installation activities constitute work of overriding public need while presenting a trivial and temporary disturbance in a limited area.



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# APPENDIX D

## Pre-Application Consultation (PAC) Report



# **Scottish Hydro Electric Power Distribution Pre-application Consultation Report Pentland Firth East Cable Replacement**



## Pre-application Consultation Report Pentland Firth East Cable Replacement

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## Pre-application Consultation Report Pentland Firth East Cable Replacement

### Foreword

Scottish Hydro Electric Power Distribution plc (SHEPD) holds a licence under the Electricity Act 1989 for the distribution of electricity in the north of Scotland including the Islands. It has a statutory duty to provide an economic and efficient system for the distribution of electricity and to ensure that its assets are maintained to ensure a safe, secure and reliable supply to customers.

Routine inspections have identified that the existing Pentland Firth East subsea electricity cable is reaching the end of its operational life and has twice faulted in recent months. Repairs were successful and the cable re-energised, however, a long-term solution is required. The purpose of the Pentland Firth East cable replacement project is to secure essential electricity supplies from the mainland to homes and businesses in Orkney.

This Pre-Application Consultation (PAC) report has been prepared to accompany an application for a proposed marine licensable activity in accordance with section 24 of the Marine (Scotland) Act 2010.

As part of the marine licencing process, SHEPD has undertaken engagement with the general public and all interested stakeholders. This report demonstrates how all views have been considered and influenced the approach to cable design, installation and protection for this application.

Prior to the PAC events SHEPD had meetings with key statutory consultees including Scottish Natural Heritage (SNH), Orkney Council Planning, MS-LOT. Early consultation was also undertaken with key fishing organisations and marine users operating within the Pentland Firth. As result, a Navigational Risk Assessment (NRA) report was drafted, the outcomes of which will influence how the installation will be carried out to minimise impacts on those particular stakeholders. A consultation meeting was also held with SNH on the 21 October 2019 to present the marine survey results and outline the proposed content for the Environmental Supporting Information (ESI) Report provided in support of the main licence application

Stakeholder views have also been balanced through a cost benefit analysis model to demonstrate to all relevant parties that the method proposed in the *Project Description* justifies the expenditure and provides best value. The output from this model is used as supporting evidence within this application.

This document should be read in conjunction with the following documents:

- Marine Licence Application Form
- Project Description
- Pre-Application Consultation (PAC) report with appended Navigational Risk Assessment and Cost Benefit Analysis
- Environmental Supporting Information Report
- Fishing Liaison and Mitigation Action Plan (covering all legitimate sea users)
- Offshore Construction Environment Management Plan

## **Pre-application Consultation Report Pentland Firth East Cable Replacement**

### **1 Proposed licensable marine activity**

- 1.1 SHEPD proposes to install a replacement 33kV submarine electricity cable across the Pentland Firth from Murkle Bay on the Scottish Mainland to Rackwick Bay on the island of Hoy, Orkney. This replacement submarine electricity cable is essential to securing power supplies to the Orkney Isles.
- 1.2 The application for the Marine Licence is being submitted to permit the cable to be installed within a 500 m wide subsea installation corridor.
- 1.3 More detail on the proposed cable installation, burial and protection requirements along the installation corridor is provided in Table 4-1 Cable Protection and Stabilisation Plan of the supporting Project Description, Global Marine Document Reference: 2472-GO-S-SW-0001.

## Pre-application Consultation Report Pentland Firth East Cable Replacement

### 2 Applicant details

2.1 Applicant details are provided below: John Buchan on behalf of Scottish Hydro

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Scottish Hydro Electric Power Distribution plc is registered in Scotland No SC213460.

## **Pre-application Consultation Report Pentland Firth East Cable Replacement**

### **3 Proposed licensee details**

3.1 As per applicant details provided in Section 2.1.



## Pre-application Consultation Report Pentland Firth East Cable Replacement

### 4 Pre-application consultation event (PAC event) Overview

- 4.1 A copy of the PAC event notice is provided in Appendix A: Pre-application Consultation Notice.
- Statutory notices advertising the PAC events were published within the Orcadian on 26 July and 1 August 2019, John O Groat Journal on 26 July and 2 August 2019 and the Caithness Courier on 24 July and 31 July 2019.
- 4.2 Other media was used to share information (See Appendix B for examples) including:
- Dedicated webpage was set up by SHEPD to host information about the project <https://www.ssen.co.uk/SubmarineCables/Pentland/>
  - Social media provided a forum to publicise the events via the Scottish and Southern Electricity Networks Facebook and Twitter feeds
  - Emails sent to organisations, affected stakeholders, Councillors, Community Councils informing of events
  - Additionally, posters advertising the event were displayed in public areas in the vicinity of the event on Hoy, Stromness and Castletown.
  - Blog and press release about submarine electricity cables and the consultation events were issued and appeared in local paper
- 4.3 As part of the engagement programme, SHEPD hosted three open door PAC events during September 2019 within the vicinity of the proposed subsea cable development as detailed within Table 1. At the request of the local community, an additional “drop in” was held in Hoy Kirk, Hoy to complement the event in Longhope, Hoy. The purpose of these events was to provide information and to seek the views of members of the public.
- 4.4 The events were held to enable any interested party to comment upon the cable installation proposals and process. They were targeted at legitimate sea users, SHEPD customers, public sector, non- governmental organisations, statutory consultees and the local community. Venues and times were chosen to ensure optimum turnout and arranged as a “drop-in” format.

**Table 1: Pre-application Consultation Events**

DATE	VENUE	TIME	VISTORS
10 September 2019	YM Community Hall, Longhope, Hoy	3pm -9pm	9
	Hoy Kirk, Hoy	6pm-8pm	6
12 September 2019	Stromness Library, Stromness, Orkney	2pm -7pm	26
17 September 2019	Castletown Community Hall, Castletown, Caithness	2pm-7pm	13

## Pre-application Consultation Report Pentland Firth East Cable Replacement

### 5 Information provided by the prospective applicant at the Pre-application consultation event

- 5.1 The PAC event format involved the display of information boards and the attendance of the Pentland Firth East Project team, including the preferred contractors and environmental consultants. They were held as “Open Door” events where anyone could “drop in” and attend as and when it suited. In addition, large scale maps and videos were available to view, and feedback forms were provided to garner comments and feedback.
- 5.2 The PAC events consisted of several information boards as presented within Appendix C. The boards provided the following information:
- Location of the existing cable to be replaced;
  - Information on the project need;
  - The marine corridor in which it is proposed to lay the replacement cable;
  - Method of cable installation and protection suited to the cable location;
  - How stakeholders could provide comments and date for submission; and
  - Project timeline.
- 5.3 The events provided an opportunity for public involvement and encouraged participation by people who may be discouraged from contributing in the forum of a conventional public meeting. As the consultation was held across three afternoons and into the evenings, it increased the accessibility to a wider spread of people.
- 5.4 The events provided attendees direct access to the project team, who were able to discuss technical and environmental questions that were raised. After attendees had read the information boards and discussed concerns/ queries with the project team, they were given the opportunity to complete feedback forms. This allowed the project team to capture any and all opinions about the proposed works.

## **6 Information received by the prospective applicant during the Pre-application consultation event**

- 6.1 The following section summarises the information received during and post the pre-application consultation events.
- 6.2 A total of 54 people attended the PAC events, of which 37 completed the feedback form (69%). An example of the blank feedback form is provided in Appendix D and a summary of the return forms is detailed in Table 2.

## Pre-application Consultation Report Pentland Firth East Cable Replacement

**Table 2: Summary of comments regarding attendees' feedback to the proposed development by question**

Question	The Pentland Firth East is nearing the end of its operational life. Do you agree that the cable needs to be replaced?				
No of responses	Strongly agree	Agree	Not sure	Disagree	Strongly Disagree
	19	17	1	0	0
Comments received					
<b>Hoy</b>	<p><i>"We need power"</i></p> <p><i>"The cable sheath has long been exposed at Rackwick beach. To upgrade to meet new demands can only be a good thing"</i></p> <p><i>"Security of supply and ability to export renewables"</i></p> <p><i>"Secure supply is necessary"</i></p> <p><i>"Having seen the disruption of ongoing repairs, I feel that a "one off" project of laying a new cable with a higher capacity can only be a positive thing. Reducing the need for regular repairs will be a lot less disruptive than it is at the moment"</i></p> <p><i>"There is no gas on Orkney, therefore we are totally reliant on electricity for heat and light"</i></p>				
<b>Castletown</b>	<p><i>"Needs to be sorted"</i></p> <p><i>"Yes, if it has already had two faults"</i></p> <p><i>"To prevent problems in the future"</i></p> <p><i>"Can feel power coming up my creel ropes, the cable needs replaced"</i></p>				
<b>Stromness</b>	<p><i>"Increased reliability"</i></p> <p><i>"To maintain the security of supply for importing power (Kirkwall Power Station unable to meet islands need in emergency. Also currently allows export of wind and tidal power"</i></p>				

## Pre-application Consultation Report Pentland Firth East Cable Replacement

	<p><i>"If it has persistent issues and additional costs to repair, then a more robust and newer cable should be installed to service the archipelago"</i></p> <p><i>"Importance of the cable"</i></p> <p><i>"The ability to transport electricity to mainland Scotland helps the advancement of renewables technology on Orkney"</i></p> <p><i>"Orkney needs a working electricity cable. Construction disrupting area of natural beauty and access for users e.g. surfers."</i></p> <p><i>"To secure better and stronger network connection"</i></p> <p><i>"Emergency repairs maybe more damaging to the sea bed and marine life than replacing in a very well thought way"</i></p> <p><i>"It will provide a reliable connection from mainland Scotland grid for the future. Giving 20 plus years rather than relying on 40-year-old infrastructure"</i></p> <p><i>"Providing stability for future rather than waiting for issues"</i></p> <p><i>"Original cable was only set to last circa 20 years and has been in for circa 37 years, needs replacing"</i></p> <p><i>"Maintenance of existing services"</i></p> <p><i>"We need a reliable electrical supply"</i></p> <p><i>"Two faults this year is an indicator of equipment coming to the end of its useable life"</i></p> <p><i>"The existing cable has failed"</i></p>				
<b>Question</b>	<b>The routing of the proposed cable and landing points are appropriate?</b>				
<b>No of responses</b>	<b>Strongly agree</b>	<b>Agree</b>	<b>Not sure</b>	<b>Disagree</b>	<b>Strongly disagree</b>
	<b>6</b>	<b>23</b>	<b>5</b>	<b>0</b>	<b>1</b>
<b>Comments received</b>					
<b>Hoy</b>	<p><i>"There really appears to be little alternative bearing in mind it runs through an environmental area of global significance"</i></p> <p><i>"The new Rackwick landing zone is more stable. One section of overhead lines to be removed"</i></p>				

## Pre-application Consultation Report Pentland Firth East Cable Replacement

	<p><i>"This looks like an improvement for visual landscape of birds, as well as practical"</i></p> <p><i>"From what I can see from the plans, the area chosen for the routing of the cable is relatively sympathetic to the environment and the impact upon it"</i></p>
<b>Castletown</b>	<p><i>"Following the last cable routing, not changing anything"</i></p> <p><i>"More or less just a replacement"</i></p> <p><i>"Same as is, doing no harm"</i></p> <p><i>"Not sure, disturbance of seabed and beach?"</i></p>
<b>Stromness</b>	<p><i>"Less prone to damage"</i></p> <p><i>"Better to have cables near together and avoid additional overhead poles in accessible, peaty conditions. East end of beach is known to be more affected by sand and boulder movement"</i></p> <p><i>"Seems reasonable to do so using the hydrographic survey data shown"</i></p> <p><i>"Agree - conditioned on local and environmental society support- but I have no major objections"</i></p> <p><i>"The placement is well suited to minimise the effect of fast flowing waters of Pentland Firth"</i></p> <p><i>"I think it is bad for surfers. Best place to construct for longevity of cable"</i></p> <p><i>"Based on the old cable routes, these points have been proven as the best route/ landing points"</i></p> <p><i>"Agree- only small impact onshore and offshore"</i></p> <p><i>"It appears to be taking one of the shortest routes (avoiding strong currents etc) and doesn't seem to be causing environmental damage"</i></p> <p><i>"Particularly the onshore area- impressed by the details and willingness to adapt to undergrounding to fit around designations and constraints"</i></p> <p><i>"Representatives at the consultation explained all possible routes were considered and many factors were taken into consideration"</i></p>

## Pre-application Consultation Report Pentland Firth East Cable Replacement

	<p><i>"Not sure - the cable seems to land at Rackwick Bay which is a popular visitor attraction"</i></p> <p><i>"Works at the moment. No real issue"</i></p> <p><i>"Routing and landing points are fine BUT no consultation or consideration regarding a non like for like replacement i.e. Potential for bigger cable."</i></p>		
Question	Are the following cable protection methods for the location of the Pentland Firth East cable appropriate?		
No of responses (could choose more than one option)	Yes	No	Not Sure
Rock Placement	16	2	13
Rock Filter Bags	17	1	14
Mattressing	18	2	13
HDD	10	1	19
Burial	24	0	9
Comments received			
Hoy	<p><i>"Use whatever is best for the conditions"</i></p> <p><i>"Appreciate each protective method have pros and cons with cost implications but must create minimal visual and environmental impact"</i></p> <p><i>"Options need to withstand strong currents"</i></p> <p><i>"Due to varying types of surface that the cable needs to be laid on, the decision of protection methods is very important. To this end I feel that rock filter bags would be more environmentally friendly than mattressing. Also, burial would be viable as long as it is not too detrimental to the wildlife and it is also considered how easy it would be for the cables to dislodged due to unpredictability of the tides of the Pentland Firth"</i></p>		



## Pre-application Consultation Report Pentland Firth East Cable Replacement

<b>Castletown</b>	<i>"None should impact my fishing. Expect a range of methods will be needed. Rock replacement will be an issue if my gear is still there."</i>
<b>Stromness</b>	<p><i>"Is concrete safe to put in the sea for the ecology of our waters? What material are the rock filter bags made from?"</i></p> <p><i>"Got to be held in place"</i></p> <p><i>"Rock filter bags. What type of rock use? Different geological make up could affect ecosystem."</i></p> <p><i>"Burial- anything else will wash away in Firth"</i></p> <p><i>"Ensure cable is as secure as possible where it is likely to be subjected to sea and swell particularly in Tideline area."</i></p> <p><i>"As long as the appropriate natural conservation measures are taken"</i></p> <p><i>"HDD expensive, burial not sure because of environmental impact"</i></p> <p><i>"Only natural resources should be placed to avoid dispersement of foreign materials from degradation"</i></p> <p><i>"Burial where appropriate with minimal damage"</i></p> <p><i>"Use method appropriate for the amount of sand cover over the particular stretch of seabed"</i></p> <p><i>"Burial is not strictly necessary in most areas- little fishing pressure"</i></p>

Question	Do you support or object to these proposals as shown today?				
<b>Total No of responses</b>	<b>Strongly support</b> <b>13</b>	<b>Support</b> <b>19</b>	<b>Not sure</b> <b>3</b>	<b>Object</b> <b>1</b>	<b>Strongly Object</b> <b>0</b>
<b>Comments received</b>					

## Pre-application Consultation Report Pentland Firth East Cable Replacement

<b>N/A</b>					
<b>Hoy</b>	<b>6</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Castletown</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>0</b>	<b>0</b>
<b>Stromness</b>	<b>5</b>	<b>12</b>	<b>1</b>	<b>1</b>	<b>0</b>
<b>Question</b>	<b>Works are planned to minimise any disruption to the environment and marine users. Are you aware of anything which may be impacted by the works- e.g. Designated conservation areas (not covered in information provided), shellfish harvesting times, times of preferred work etc?</b>				
<b>No of responses N/A</b>					
<b>Comments received</b>					
<b>Hoy</b>	<i>"I would hope that consideration is taken to minimise the impact of machinery on footpaths and access to the beach. Repair work during the Summer caused quite a lot of disruption as, due to the weather the ground was wetter than usual and with the works, the footways became quite precarious"</i>				
<b>Castletown</b>	<i>"Key fishing times: Inshore (10 fathoms in)- fishing can be done all year round- some fishermen do. Aug/Sept (Harvest) is a peak time. Mid-February - Mid June peak lobster fishing. Spring Tides will be a problem for cable installation"</i>  <i>"Shellfish grounds from Rora Head towards Greenhill at Rackwick (varies with the seasons)"</i>				
<b>Stromness</b>	<i>"Removing the old cable could disrupt the environment , leave in place"</i>  <i>"Works are ongoing at nearby renewable sites"</i>				

## Pre-application Consultation Report Pentland Firth East Cable Replacement

	<p><i>"I'm aware that Hoy is a beautiful island with RSPB reserves and that it would be a terrible travesty to think that the ecosystem might change causing irreparable damage to plants and wildlife"</i></p> <p><i>"Use locally quarried material if possible"</i></p>
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## **7 Amendments to the application following comments and/or objections received at the Pre-application Consultation Events.**

- 7.1 Following a review of the feedback received during the public consultation events, no amendments to the marine licence application have been deemed necessary. Responses to comments received on the marine aspects of the application are outlined in Table 3 below and where necessary the relevant environmental supporting information provided in support of the marine licence application has been signposted.

## Pre-application Consultation Report Pentland Firth East Cable Replacement

**Table 3: Response to relevant comments received as part of the pre-application consultation**

Question	The routing of the proposed cable and landing points are appropriate?	
Comment Received	Response	Where addressed in the ESI Report or supporting document
<i>"Not sure, disturbance of seabed and beach?"</i>	Disturbance to the seabed and beach will be minimised as much as possible. The footprint of any placed cable protection will be limited to that required to ensure cable stability on the seabed and protection at crossings.	<p>More detail on the proposed cable installation, burial and protection requirements along the installation corridor is provided in Protection and Stabilisation Plan, Table 4-1 of the supporting Project Description, Document Reference [Global Marine Document Reference: 2472-GO-S-SW-0001).</p> <p>Potential impacts to the seabed and landfall area are outlined in Section 2.2 Environmental Overview of the ESI Report (Intertek Document Reference: P2291_R4837).</p>
<p><i>"I think it is bad for surfers"</i></p> <p><i>"Not sure – the cable seems to land at Rackwick Bay which is a popular visitor attraction".</i></p>	The temporary nature of the installation activities at both nearshore sites will limit the time in which access for recreational use may be precluded. Effective communication with local organisations and providing the finalised installation schedule in advance of activities starting will allow these organisations to create alternative arrangements in a reasonable timeframe. As such the impacts of the loss of access to recreational users is expected to be minimal.	More detail on potential impacts to tourism and recreation is provided in Section 12 of the ESI Report (Intertek Document Reference: P2291_R4837).
<i>"Routing and landing points are fine BUT no consultation or consideration regarding a non like</i>	As part of the submarine cable replacement programme SHEPD will consider the demand need, and in some cases generation requirement, on each circuit being replaced.	More detail on the proposed cable installation is provided in the supporting Project Description, Document Reference [Global

## Pre-application Consultation Report Pentland Firth East Cable Replacement

<i>for like replacement i.e. Potential for bigger cable.”</i>	<p>When proposing a replacement SHEPD would determine the most economic, efficient and co-ordinated solution to ensure that the cable is suitably—sized for the submarine cables life expectancy on any given circuit.</p> <p>Any new renewables project will always be considered for a connection on the SHEPD network if a customer applies. The network on Orkney is currently at capacity and existing connections are being managed through an Active Network Management system to ensure the network operates within its rated capability.</p>	Marine Document Reference: 2472-GO-S-SW-0001).
<b>Question</b>	<b>Are the following cable protection methods for the location of the Pentland Firth East cable appropriate?</b>	
<b>Comment Received</b>	<b>Response</b>	<b>Where addressed in the ESI Report or supporting document</b>
<i>“Appreciate each protective method have pros and cons with cost implications but must create minimal visual and environmental impact”</i>	The footprint of any placed cable protection will be limited to that required to ensure cable stability on the seabed and protection at crossings.	<p>More detail on the proposed cable installation, burial and protection requirements along the installation corridor is provided in the Protection and Stabilisation Plan, Table 4-1 of the supporting Project Description, Document Reference [Global Marine Document Reference: 2472-GO-S-SW-0001).</p> <p>Potential impacts to the seabed and landfall area are outlined in Section 2.2 Environmental Overview of the ESI Report (Intertek Document Reference: P2291_R4837).</p>
<i>“Options need to withstand strong currents”</i>	Currents across Pentland Firth generally lessen to the west and a cable route between the existing cables	More detail on the proposed cable installation, burial and protection

## Pre-application Consultation Report Pentland Firth East Cable Replacement

	benefits from more favourable current conditions when surveying and installing the cable and during the cable's lifetime with a lower abrasive damage risk to the cable.	requirements along the installation corridor is provided in Protection and Stabilisation Plan, Table 4-1 of the supporting Project Description, Document Reference [Global Marine Document Reference: 2472-GO-S-SW-0001).
<i>"Due to varying types of surface that the cable needs to be laid on, the decision of protection methods is very important. To this end I feel that rock filter bags would be more environmentally friendly than mattresses. Also, burial would be viable as long as it is not too detrimental to the wildlife and it is also considered how easy it would be for the cables to dislodge due to unpredictability of the tides of the Pentland Firth"</i>	<p>The footprint of any placed cable protection will be limited to that required to ensure cable stability on the seabed and protection at crossings.</p> <p>Rock bags are proposed for cable protection and stability, however the Navigation Risk Assessment requires that chart datum is not altered by more than 5% without consultation with the MCA. Therefore the decision was taken to use concrete mattresses in the very shallow water due to the lower profile of the structure.</p> <p>A Cost Benefit Analysis has been conducted by SHEPD which has recommended that the following combination of cable protection and stabilisation is adopted, in terms of achieving best value to society: 28% burial, 9% rock bags and 63% surface lay (4% variance in cost to society). However, the final design of cable protection and stabilisation is in progress and it is not possible to determine the exact combination that will be recommended.</p>	<p>More detail on the proposed cable installation, burial and protection requirements along the installation corridor is provided in the Protection and Stabilisation Plan, Table 4-1 of the supporting Project Description, Document Reference [Global Marine Document Reference: 2472-GO-S-SW-0001).</p> <p>Potential impacts to the seabed and landfall area are outlined in Section 2.2 Environmental Overview of the ESI Report (Intertek Document Reference: P2291_R4837).</p>
<i>"Is concrete safe to put in the sea for the ecology of our waters? What material are the rock filter bags made from?"</i>	Concrete itself is considered by The International Marine Contractors Association (IMCA) to be environmentally-friendly. Once set concrete is	More detail on the proposed cable installation is provided in the supporting Project Description, Document Reference [Global



## Pre-application Consultation Report Pentland Firth East Cable Replacement

<p><i>“Rock filter bags. What type of rock use? Different geological make up could affect ecosystem.”</i></p> <p><i>“Only natural resources should be placed to avoid dispersement of foreign materials from degradation”</i></p>	<p>chemically inert, with similar properties to naturally occurring rocks and boulders.</p> <p>It is proposed to use Kyowa’s Filter Unit which due to its flexible structure fits well with irregular seabeds. Inert stones in the Filter Unit create a porous structure, it creates space for small marine life such as fish to live. The Filter Unit is made of synthetic fibre that will not rust and toxic substances will not elute.</p>	<p>Marine Document Reference: 2472-GO-S-SW-0001).</p>
<p><i>“Burial- anything else will wash away in Firth”</i></p> <p><i>“Burial where appropriate with minimal damage”</i></p> <p><i>“Use method appropriate for the amount of sand cover over the particular stretch of seabed”</i></p> <p><i>“Burial is not strictly necessary in most areas- little fishing pressure”</i></p>	<p>The final design of cable protection and stabilisation is in progress and it is not possible to determine the exact combination that will be recommended. The Protection and Stabilisation Plan outlined in Table 4-1 of the supporting Project Description, Document Reference [Global Marine Document Reference: 2472-GO-S-SW-0001 is intended to provide an envelope of the possible protection and stabilisation methods that could be adopted.</p>	<p>More detail on the proposed cable installation, burial and protection requirements along the installation corridor is provided in the Protection and Stabilisation Plan, Table 4-1 of the supporting Project Description, Document Reference [Global Marine Document Reference: 2472-GO-S-SW-0001).</p>
<p><i>“Ensure cable is as secure as possible where it is likely to be subjected to sea and swell particularly in Tideline area.”</i></p>	<p>The final design of cable protection and stabilisation is in progress and it is not possible to determine the exact combination that will be recommended. The Protection and Stabilisation Plan outlined in Table 4-1 of the supporting Project Description, Document Reference [Global Marine Document Reference: 2472-GO-S-SW-0001 is intended to provide an envelope of the possible protection and stabilisation methods that could be adopted.</p>	<p>More detail on the proposed cable installation, burial and protection requirements along the installation corridor is provided in the Protection and Stabilisation Plan, Table 4-1 of the supporting Project Description, Document Reference [Global Marine Document Reference: 2472-GO-S-SW-0001).</p>
<p><i>“As long as the appropriate natural conservation measures are taken”</i></p>	<p>An Environmental Supporting Information (ESI) Report has been prepared in support of the marine licence application. This will be supported by a separate</p>	<p>Potential impacts to the seabed and landfall area are outlined in Section 2.2 Environmental</p>

## Pre-application Consultation Report Pentland Firth East Cable Replacement

	European Protected Species (EPS) Licence and Basking Shark Licence and EPS Risk and Protected Sites and Species Assessment.	Overview of the ESI Report (Intertek Document Reference: P2291_R4837).  Additional assessment is also provided in the EPS Risk and Protected Sites and Species Assessment (Xodus Document Reference:
<i>"HDD expensive, burial not sure because of environmental impact"</i>	The project initially had landing points at the Eastern End of Rackwick Bay, Hoy and the coastline just east of Murkle Bay on mainland Scotland. The Murkle Bay landing had a Horizontal Directional Drilled (HDD) duct solution, but after consultation with SHEPD it was identified that a more conventional landing solution at Murkle Bay with a floated shore end could offer a significant cost reduction to the project– please refer to the Cost Benefit Analysis model demonstrating the considerations to value to society of the project. Thereafter a landing on the beach at Murkle Bay was the solution adopted as the cable route landing on mainland Scotland.	More detail on the proposed cable installation is provided in the supporting Project Description, Document Reference (Global Marine Document Reference: 2472-GO-S-SW-0001) and the appended Cost Benefit Analysis to that document.
<b>Question</b>	<b>Works are planned to minimise any disruption to the environment and marine users. Are you aware of anything which may be impacted by the works- e.g. Designated conservation areas (not covered in information provided), shellfish harvesting times, times of preferred work etc?</b>	
<b>Comment Received</b>	<b>Response</b>	<b>Where addressed in the ESI Report or supporting document</b>
<i>"Key fishing times: Inshore (10 fathoms in)- fishing can be done all year round- some fishermen do. Aug/Sept (Harvest) is a peak time. Mid-February - Mid June peak lobster fishing.</i>	A fishing activity analysis has been undertaken as part of the supporting Fisheries Liaison Action and Mitigation Plan.	Please see supporting FLMAP (Fishing Liaison Mitigation Action Plan for Pentland East and Hoy)

## Pre-application Consultation Report Pentland Firth East Cable Replacement

<i>Spring Tides will be a problem for cable installation</i>  <i>"Shellfish grounds from Rora Head towards Greenhill at Rackwick (varies with the seasons)"</i>		
<i>"Removing the old cable could disrupt the environment , leave in place"</i>	A separate Operation, Inspection, Maintenance and Decommissioning Strategy will be prepared prior to marine cable installation.	Please see supporting Operation, Inspection, Maintenance and Decommissioning Strategy (OIMD).
<i>"Works are ongoing at nearby renewable sites"</i>	Details of other activities in the Pentland Firth area, including renewables projects have been considered in the cumulative effects section of the supporting ESI Report.	More detail on cumulative effects is provided in Section 13 of the ESI Report (Intertek Document Reference: P2291_R4837).
<i>"I'm aware that Hoy is a beautiful island with RSPB reserves and that it would be a terrible travesty to think that the ecosystem might change causing irreparable damage to plants and wildlife"</i>	An Environmental Supporting Information (ESI) Report has been prepared in support of the marine licence application. This will be supported by a separate European Protected Species (EPS) Licence and Basking Shark Licence and EPS Risk and Protected Sites and Species Assessment.	Potential impacts to the seabed and landfall area are outlined in Section 2.2 Environmental Overview of the ESI Report (Intertek Document Reference: P2291_R4837).  Additional assessment is also provided in the EPS Risk and Protected Sites and Species Assessment (Xodus Document Reference:
<i>"Use locally quarried material if possible"</i>	<i>Where practicable, the Rock Bags will be filled with stone local to the installation site.</i>	More detail on the proposed cable installation is provided in the supporting Project Description, Document Reference (Global Marine Document Reference: 2472-GO-S-SW-0001).

## **8 Explanation of approach taken where, following comment and/or objection, no relevant amendment has been made**

- 8.1 Due to the nature of the feedback received during the public consultation events, during which only minor comments and no objections were received, no relevant amendments to the marine licence application have been deemed necessary. The proposed approach to the marine licence application and provision of supporting documents remains as follows:
- Completion of Marine Licence Application Form;
  - Provision of environmental supporting information in the form of the Pentland Firth East Replacement Cable Environmental Supporting Information Report;
  - Provision of a Navigational Risk Assessment (NRA) as part of the Environmental Supporting Information (appended to the PAC Report);
  - Provision of a Fisheries Liaison Mitigation Action Plan for Pentland East and Hoy (FLMAP) as part of the Environmental Supporting Information;
  - Provision of a Schedule of Mitigation as part of the Environmental Supporting Information Report;
  - Provision of an Offshore Construction Environmental Management Plan (Offshore CEMP);
  - Provision of an Operation, Inspection, Maintenance and Decommissioning Strategy (OIMD).
- 8.2 The Pentland Firth East Replacement Cable Environmental Supporting Information Report considers the Project with respect to the policies from the National Marine Plan and the Orkney Local Development Plan.

## 9 Certification

John Buchan  
Head of Subsea Cable Projects  
Scottish Hydro Electric Power Distribution plc  
Inveralmond House  
200 Dunkeld Road  
Perth  
PH1 3AQ

I certify that I have complied with the legislative requirements relating to pre-application consultation and that the pre-application consultation has been undertaken in accordance with statutory requirements.

Signature

---

Date

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## Appendix A: Pre-application Consultation Notices

### 1. Statutory Public Notices

Statutory notices appeared in Orcadian on 26 July and 1 August 2019, John O Groat Journal on 26 July and 2 August 2019 and the Caithness Courier on 24 July and 31 July 2019. Example of inserts below.

THE ORCADIAN NEWS 5  
Thursday, August 1, 2019

## Second family pulls children out of school over 5G concerns

By Rachael Betty

ANOTHER Johnny family has decided to pull their children out of school over concerns for the 5G trial currently taking place in the island.

The trial, which is being undertaken as part of the wider 5G Research Initiative, has seen a 5G mast sited at the island's school alongside a number of trials happening across the country. The trials are exploring the potential of 5G to improve connectivity in remote and rural communities, which currently have little or limited access to broadband and mobile phone networks.

In May, The Orcadian reported that Russell and Naomi Bremner, who form a kind of buffer on the island, have returned their three children from the school, with their concerns over the trial. They have been home schooling them since then, and as was reported in last week's The Orcadian, are calling for the trial to be halted before schools re-start in August 20.

Another parent has contacted The Orcadian this week to say that

they also plan on keeping their children home after the summer holidays. Patricia Wren Davis says that she and her wife, Anna, have removed their six children — Lillian (11), Nathaniel (ten), Noah (seven), Christopher (eight), Rose (six) and Amy (five) — from school until such time as the trial is halted.

"We share the same concerns, but left our children at school due to the value of education and the short nature of the trial," he says. "However, the trial has already been extended once (until the end of September), and its use will give written assurance that the transmitter and all associated devices will be turned off and removed at the end of September — and so our children will not be returning to school until the mast is turned off, and its removal details put into writing."

Children in the area calling for an early end to the trial.

"Our school and other parents/teachers of the community have asked that the trial be ended six weeks early for the start of term, to allow our children to feel safe returning to school in August," he continues.

In response, Orkney Islands Council said this week: "The 5G is planning the delivery of radio broadcasts over a 5G network through the Orkney trial."

"The council worked with the BBC in identifying frequency which has poor existing connectivity, as a suitable location for the trial. The aim is to explore the potential of 5G to improve connectivity in remote communities which currently have little or limited access to broadband and mobile phone networks."

"The council obtained guidance on 5G safety from Public Health England (PHE) before agreeing for the 5G equipment to be installed in Orkney."

"PHE is the national body that takes the lead on public health matters involving radio frequency electromagnetic fields, or radio waves, used in telecommunications."

"PHE's advice is that there should be no consequences for public health."

"The council is in ongoing discussion with the BBC over the duration of the trial, which is currently due to end in September."

## St Magnus markers unveiled

AN UNVEILING ceremony was held, last Saturday, for a memorial stone and interpretation board marking the start of the Finstown to Orkney section of the St Magnus Way. The memorial stone was made by Professor Peto, and the interpretation board was designed by Ian Ashman. The unveiling of the stone was performed by the Rev Susan Kirkbride and the Rev Dr. Peter Wood. The theme for this section of the Way is 'forgiveness', reflecting on whether the film was sorry for the murder of Magnus.

After the ceremony, there followed the 10.5 mile pilgrimage walk from Finstown to Orkney which was much enjoyed by a group of walkers on a lovely sunny day. At the end of the walk, the group enjoyed a wonderful spread of home-baked and tea, kindly provided by the Orkney Kirk by Katherine Wilson.

The commemorative of the board and stone in Finstown will take place on the August 14, with the commemorative of the final section between Orkney and Kirkwall on the September 14.

A new marker stone and interpretation board was unveiled for the Finstown to Orkney section of the St Magnus Way last Saturday.

## Police made aware of fly-tipping in Shapinsay

By Sarah Sutherland

A SHAPINSAY man has claimed he found what he estimates to be more than 20kg of scrap electrical waste dumped on one of his remote island beaches last week.

Last Thursday, Peter Braham went for an afternoon stroll along Nole of Ork when he says he came across the pile of waste. "I found material that looks like it has come out of a car workshop," he explained.

"It was quite random, as I got a fair bit of it and used put it in bin bags."

"It was definitely dumped here in Shapinsay."

It had dry ash on the top of the pile.

"The material was brass, burning, iron and metal after removal. It's just not something you expect to see. Orkney has such a beautiful landscape."

Mr Braham believes he collected between 20 and 30kg of waste from the beach, despite not being able to collect all of the scrap metal.

Police have confirmed that they are aware of the case.

## Scottish Hydro Electric Power Distribution plc MARINE (SCOTLAND) ACT 2010 THE MARINE LICENSING (PRE-APPLICATION CONSULTATION) (SCOTLAND) REGULATIONS 2013

Notice is hereby given that Scottish Hydro Electric Power Distribution plc, a company registered in Scotland under number SC213460, having its registered office at Inverleith House, 200 Dundee Road, Perth, PH1 3AQ, plans to hold a pre-application consultation event regarding a proposed submarine marine activity between:

May, Rackwick Bay: 58.87°N, 3.36°W  
Caithness, Murlie Bay: 58.90°N, 003.43°W

The activity consists of the installation of a submarine electricity cable across the Pentland Firth between Rackwick Bay, May, and Murlie Bay, Caithness. The replacement cable is critical for a safe and reliable supply of electricity to our customers.

Further information concerning the proposed installation of this cable can be obtained from: **Aida Forbes** [aida.forbes@she.com](mailto:aida.forbes@she.com)

The pre-application consultation events will be held at:

Date	Location	Venue	Time
Tuesday, 10 Sep, 2019	May	YM Community Hall Langhorne, May Kirk KY16 3PS	5pm - 7pm
Thursday, 12 Sep, 2019	Stromness	Stromness Library 2-12 Victoria Street KY16 3AA	2pm - 7pm
Tuesday, 17 Sep, 2019	Caithness	Custafson Drift Hall Main Street KY14 8TU	2pm - 7pm

Persons wishing to provide comments on the proposed installation of a new Pentland Firth East submarine electricity cable can do so by writing to the prospective applicant at: [submarinecables@she.com](mailto:submarinecables@she.com)

Or by post to **Submarine Cable Team**, Inverleith House, 200 Dundee Road, Perth PH1 3AQ, not later than 4th October, 2019.

Comments should be dated and clearly state the name (in block capital) and full return email or postal address of those making comment. Comments made to the prospective applicant are not representations to the Scottish Ministers. If Scottish Hydro Electric Power Distribution submits an application for a marine licence to Scottish Ministers, an opportunity will be given for representations to be made to the Scottish Ministers on the application.

Scottish & Southern  
Electricity Networks



28 Caithness Courier

www.cdnjournal.co.uk

Wednesday, July 24, 2019

## public notices

### PUBLIC NOTICES

Scottish Hydro Electric Power Distribution plc

MARINE (SCOTLAND) ACT 2010

THE MARINE LICENSING (PRE-APPLICATION CONSULTATION)  
(SCOTLAND) REGULATIONS 2013

Notice is hereby given that Scottish Hydro Electric Power Distribution plc a company registered in Scotland under number SC213460 having its registered office at Inverlorn House, 200 Dunkeld Road, Perth PH1 3AQ plans to hold a pre-application consultation event regarding a proposed licensable marine activity between:

Hoy, Rackwick Bay: 58.67°N, 3.38°W

Caithness, Murkle Bay: 58.60°N, 003.43°W

The activity consists of the installation of a submarine electricity cable across the Pentland Firth between Rackwick Bay, Hoy and Murkle Bay, Caithness. The replacement cable is critical for a safe and reliable supply of electricity to our customers.

Further information concerning the proposed installation of this cable can be obtained from: Aida Forbes: aida.forbes@sse.com

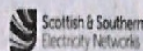
The pre-application consultation events will be held at:

Date	Location	Venue	Time
Tuesday 10 Sep 2019	Hoy	YM Community Hall Longhope, Hoy Kirk KW16 3PG	3pm - 9pm
Thursday 12 Sep 2019	Stranraer	Stranraer Library 2-12 Victoria Street KW16 3AA	3pm - 7pm
Tuesday 17 Sep 2019	Caithness	Castletown Drill Hall Main Street KY14 8TU	3pm - 7pm

Persons wishing to provide comments on the proposed installation of a new Pentland Firth East submarine electricity cable can do so by writing to the prospective applicant at: submarinecables@sse.com

Or by post to: Submarine Cable Teams Inverlorn House, 200 Dunkeld Road, Perth PH1 3AQ, not later than 4 October 2019.

Comments should be dated and clearly state the name (in block capitals) and full return email or postal address of those making comment. Comments made to the prospective applicant are not representations to the Scottish Ministers. If Scottish Hydro Electric Power Distribution submits an application for a marine licence to Scottish Ministers, an opportunity will be given for representations to be made to the Scottish Ministers on the application.



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## public notices

PUBLIC NOTICES

**Scottish Hydro Electric Power Distribution plc**  
**MARINE (SCOTLAND) ACT 2010**  
**THE MARINE LICENSING (PRE-APPLICATION CONSULTATION)**  
**(SCOTLAND) REGULATIONS 2013**

Notice is hereby given that Scottish Hydro Electric Power Distribution plc a company registered in Scotland under number SC213460 having its registered office at Inverlornock House, 200 Dunkeld Road, Perth PH11 3AQ plans to hold a pre-application consultation event regarding a proposed licensable marine activity between:

**Hoy, Rackwick Bay: 58.87°N, 3.38°W**  
**Caithness, Morkle Bay: 58.60°N, 003.43°W**

The activity consists of the installation of a submarine electricity cable across the Pentland Firth between Rackwick Bay, Hoy and Morkle Bay, Caithness. The replacement cable is critical for a safe and reliable supply of electricity to our customers.

Further information concerning the proposed installation of this cable can be obtained from:  
**Aida Forbes: aida.forbes@sse.com**


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Tuesday 17 Sep 2019	Caithness	Castletown Drill Hall Main Street KW14 8TU	2pm – 7pm


Persons wishing to provide comments on the proposed installation of a new Pentland Firth East submarine electricity cable can do so by writing to the prospective applicant at:  
[submarinecables@sse.com](mailto:submarinecables@sse.com)

Or by post to Submarine Cable Team: Inverlornock House, 200 Dunkeld Road, Perth PH11 3AQ, not later than 4 October 2019.

Comments should be dated and clearly state the name (in block capitals) and full return email or postal address of those making comment. Comments made to the prospective applicant are not representations to the Scottish Ministers. If Scottish Hydro Electric Power Distribution submits an application for a marine licence to Scottish Ministers, an opportunity will be given for representations to be made to the Scottish Ministers on the application.

 **Scottish & Southern**  
Electricity Networks

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## Appendix B: Other media

### 1. Poster



**Scottish & Southern  
Electricity Networks**

## Public Consultation for Pentland Firth East Subsea Cable Replacement

For over 50 years, we have distributed electricity to the Scottish Islands via subsea cables. As these cables approach the end of their scheduled operational lives, we need to make arrangements to replace them to ensure the ongoing safe and reliable supply of electricity.

One such cable is across the Pentland Firth, between Murkle Bay in Caithness and Rackwick Bay on Hoy, which carries electricity to our customers in Orkney.

Ahead of our application to Marine Scotland for a licence to carry out these replacement works, we will be holding a series of consultation events to give local communities, fishermen, environmental groups and other interested parties an opportunity to speak to our team and comment on the proposals.

**These pre-consultation events will be held on:**

<p><b>Tuesday 10 September 2019</b></p> <p>Hoy</p> <p>YM Community Hall Longhope KW16 3PG</p> <p>3pm - 9pm</p>	<p><b>Thursday 12 September 2019</b></p> <p>Stromness</p> <p>Stromness Library Warehouse Buildings 2-12 Victoria Street KW16 3AA</p> <p>2pm - 7pm</p>	<p><b>Tuesday 17 September 2019</b></p> <p>Caithness</p> <p>Castletown Drill Hall Main Street KW14 8TU</p> <p>2pm - 7pm</p>
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We look forward to seeing you there.  
For more information visit: [www.ssen.co.uk/subseacables](http://www.ssen.co.uk/subseacables)

  @ssencommunity

## 2. Website

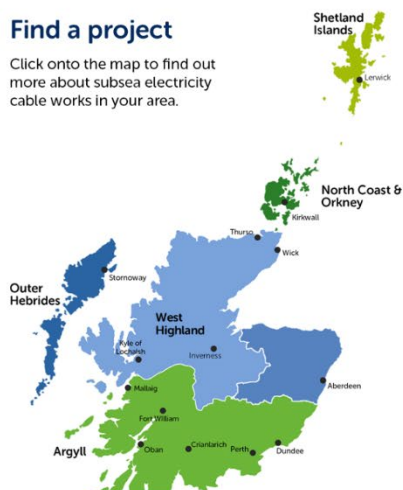


### Submarine Electricity Cables

Delivering power to fifty nine Scottish Islands

#### Find a project

Click onto the map to find out more about subsea electricity cable works in your area.



#### Information Centre



##### About us

We are responsible for monitoring the efficiency and integrity of the submarine electricity cable network which provides power supplies from the mainland to fifty nine Scottish Islands. Find out what we do here.

##### About us



##### Video Library

Check out our videos to see the work that goes into installing and decommissioning our subsea electricity cables.

##### Video Library



##### Consultation Events

Ahead of our application to Marine Scotland for a licence to replace the Pentland Firth East cable between Muckle Bay, Caithness and Rackwick Bay, Hoy, we are holding a series of consultation events to give local people, fishermen, environmental groups and other interested parties an opportunity to speak to our team and comment on the proposals.



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### Pentland Firth East cable replacement

#### Why are we carrying out the works?

Two subsea cables in the Pentland Firth supply electricity from the mainland to the Orkney Islands via the island of Hoy.

Routine inspections have identified that the Pentland Firth East cable is nearing the end of its operational life. More recently, two faults have occurred on the cable requiring emergency repairs. The repairs were successful, and the cable continues to supply electricity, however, a longer-term solution is needed to maintain electricity supplies to homes and businesses.

The same inspections revealed that the Pentland Firth West cable is in good condition and no further action is required at this time.

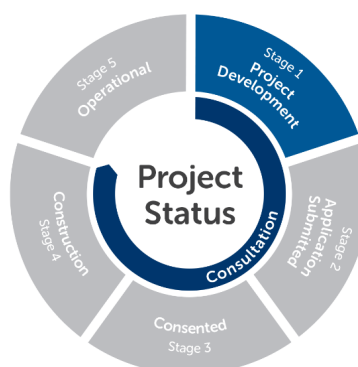
#### The proposal

Investigations to assess potential routes for a replacement 33kV Pentland Firth East subsea electricity cable and associated shore end landing points are ongoing.

Surveys to confirm the route of the replacement cable are due to take place during September and will take 4 weeks to complete. For more information about the surveys [download the Notice to Mariners](#).

A wide search corridor will be surveyed to find the optimum cable route. Key considerations include:

- Identifying suitable coastal locations to achieve the most effective shore end burial whilst avoiding any minimising any environmental impacts
- Consideration of the international importance of Hoy for breeding birds and habitats and its National Scenic value





## 3. Press release/ article

### John O'Groat Journal and Caithness Courier

Home News Sport Inspiration Lifestyle What's On Supplements Family Notices Energy North Highland Heroes

Home > News > Article

#### Views sought on plans to replace subsea electricity cable

By Staff Reporter- NOSN - editor@nosn.co.uk

Published: 11:55, 30 August 2019 | Updated: 11:57, 30 August 2019



A CONSULTATION session will take place in Castletown to seek feedback on plans to replace one of two subsea electricity cables supplying Orkney.

The open-door event in the Drill Hall on Tuesday, September 17 (2-7pm), is one of a series of three arranged by Scottish and Southern Electricity Networks (SSEN) to gather views on its proposals, with others being held in Longhope and Stromness.

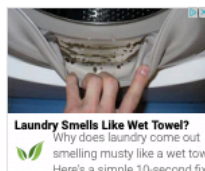
SSEN says routine inspections have identified that the Pentland Firth East cable is coming to the end of its operational life and needs replacing. More recently, two faults have occurred on the cable requiring emergency repairs.

These repairs were successful, and the cable was re-energised, but a long-term solution is needed to maintain a safe, secure and reliable power supply to homes and businesses on the islands.



Murkle Bay. SSEN's pre-application work will include a survey of the proposed cable route.

SSEN is now proposing to replace the cable and will shortly be applying to Marine Scotland for a licence to carry out these works.



A key part of SSEN's pre-application work is a survey of the proposed cable route, which will be carried out by its specialist contractor, Global. Work began on September 1 and is scheduled to last for four weeks.

“

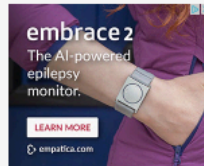
We want to share our plans with the local community.

Ahead of the application to Marine Scotland, SSEN's project team will be holding a series of sessions to give communities, the fishing and marine industries, environmental groups and other interested parties an opportunity to learn more about the plans and comment on the proposals.

The feedback will be used to develop and refine SSEN's plans prior to submitting a marine licence application this winter.

Kirstine Wood, SSEN's lead stakeholder manager, said: "As a responsible network operator, we believe that good communications are an essential part of a successful project, and ahead of our application to Marine Scotland we want to share our plans with the local community, gather their thoughts and feedback and ensure our proposals meet their needs.

"We have developed our proposals based on a balance of environmental, engineering and economic considerations and we're committed to consulting with everyone who has an interest – from the homes and businesses relying on the electricity the subsea cable delivers to the marine industry who may be impacted by this essential work. We look forward to welcoming everyone along to our forthcoming events."



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## FEATURED NEWS

## Consultation launched on subsea cable replacement

August 30, 2019 at 11:17 am

Scottish and Southern Electricity Networks (SSEN) has launched a consultation into plans to replace a subsea cable in the Pentland Firth.

According to the company, routine inspections have identified that the Pentland Firth East cable is coming to the end of its operational life and needs replacing. More recently, two faults have occurred on the cable requiring emergency repairs. These repairs were successful, and the cable was re-energised, but a long-term solution is needed to maintain a safe, secure and reliable power supply to homes and businesses on the island.

SSEN is now proposing to replace the cable and will shortly be applying to Marine Scotland for a licence to carry out these essential works.

A key part of SSEN's pre-application work is a survey of the proposed cable route, which will be carried out by its specialist contractor, Global; work will start on September 1 and is scheduled to last for four weeks.

Ahead of the application to Marine Scotland, SSEN's project team will be holding a series of open-door events to give local communities, the fishing and marine industries, environmental groups and other interested parties an opportunity to learn more about the plans and comment on the proposals.

The feedback received during these events will be used to develop and refine SSEN's plans prior to submitting a Marine Licence Application during Winter 2019.

Kirstine Wood, SSEN's Lead Stakeholder Manager, said: "As a responsible network operator, we believe that good communications are an essential part of a successful project, and ahead of our application to Marine Scotland we want to share our plans with the local community, gather their thoughts and feedback and ensure our proposals meet their needs.

"We have developed our proposals based on a balance of environmental, engineering and economic considerations and we're committed to consulting with everyone who has an interest – from the homes and businesses relying on the electricity the subsea cable delivers, to the marine industry who may be impacted by this essential work, and we look forward to welcoming everyone along to our forthcoming events."

The events will take place at the following locations:

**Tuesday, September 10, 3-9pm**

YM Community Hall, Longhope

**Thursday, September 12, 2-7pm**

Stromness Library Warehouse Buildings

**Tuesday, September 17, 2-7pm**

Castletown Drill Hall, Main Street, Thurso

Share this:



## Appendix C: PAC Event Information

### Pentland Firth East

## Why are we replacing the cable?

We are part of Scottish and Southern Electricity Networks, operating under licence as Scottish Hydro Electric Power Distribution plc (SHEPD). We are responsible for monitoring and maintaining the efficiency and integrity of the subsea electricity cable networks which provide power supplies to 59 Scottish islands.

### The background

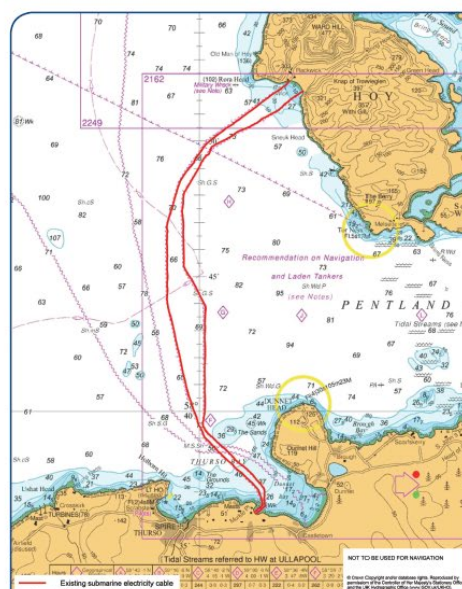
Two subsea cables in the Pentland Firth supply electricity from the Mainland to the Orkney Islands via the island of Hoy.

Routine inspections have identified that the Pentland Firth East cable is coming to the end of its operational life. More recently two faults have occurred on the cable requiring emergency repairs.

These repairs were successful and the cable was re-energised but a long term solution is needed to maintain essential electricity supplies to homes and businesses.

The same inspections revealed that the Pentland Firth West cable is in good condition and no further action is required at this time.

Map to show existing subsea cable routes



### Facts about the proposed new cable

- New cable length up to 40km subject to final route design.
- The new cable will cross two existing telecoms cables.
- The cable weighs over 2000 tonnes and will be delivered and laid in 1 continuous length.
- The new 33kV cable is double wire armoured which will provide additional protection in the extreme conditions of the Pentland Firth.



# Pre-application Consultation Report Pentland Firth East Cable Replacement

Pentland Firth East

## The proposal

Investigations to assess potential routes for the replacement Pentland Firth East subsea electricity cable and associated shore-end landing points are ongoing.

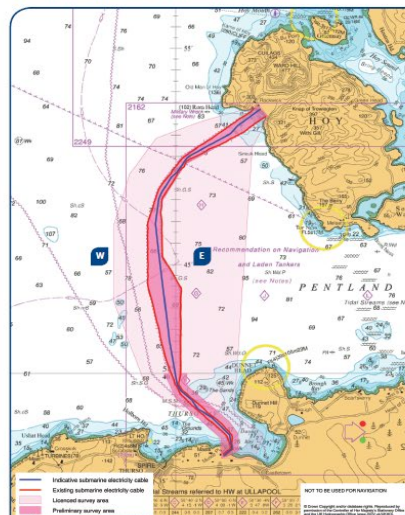
A wide search corridor will be surveyed to find the optimum cable route. Key considerations include:

- Identifying suitable coastal locations to achieve the most effective shore-end burial whilst avoiding or minimising environmental impacts.
- Consideration of the international importance of Hoy for breeding birds and habitats and its National Scenic value.
- Protecting the cable from the strong currents of the Pentland Firth.
- Ensuring the operational safety of both existing cables until the new cable is installed and energised.

### Benefits of proposal:

- Security of supply to our customers on Orkney.
- Route design and installation methodology will be selected to maximise the life expectancy of the cable.
- Opportunity to reduce the number of existing overhead electricity poles at Rackwick Bay which is within a National Scenic Area.
- Minimise our impact on marine users, businesses and visitors.

Map to show survey corridor and indicative cable route



### Landfall cable location

The landfall point of the existing Pentland Firth East cable at Rackwick Bay is in an area of the coast prone to shifting and on occasion, the cable has become exposed.

At this location it is likely that the new subsea cable will be laid to the west of the existing east subsea cable where the beach is more stable and therefore offers better natural protection.

The cable landing point at Caithness would remain close to the existing location at Murkle Bay.

### Photo of Murkle Bay



Pentland Firth East

## Cable installation method

Historically all our subsea cables were surface laid on the seabed with minimal protection. The introduction of Scotland's National Marine Plan requires a risk-based approach to burying or protecting cables where appropriate.

Within the Pentland Firth, most of the seabed is exposed rock due to the strong currents which have swept away much of the seabed sediment. This means burial will not be possible over most of the route.

In this case, the cable will be surface laid with protection to stabilise and prevent movement in the strong tidal currents.

Methods of protection suitable for the Pentland Firth are:

- Rock Placement**  
Covering the cable with rock of a suitable size and type.
- Rock Filter Bags**  
A filter bag filled with rocks placed at intervals used to protect and secure the cable at key points for stability.
- Mattressing**  
A concrete 'mattress' is used to protect the cable at key points for stability.

Other methods of protection such as burial using mass flow excavation (MFE) or ploughing are not appropriate for this location.

The rocky conditions of the Murkle Bay shore-end may require Horizontal Directional Drilling to land the new cable, but this is considered unlikely at this time.

Based on the most recent inspection of the existing cable, it can be seen that:

- less than 15% of the cable is buried.
- approximately 35% of the cable is only partially buried.
- approximately 50% of the cable is assumed to be lying on the seabed.

Map showing depth of existing Pentland Firth East cable

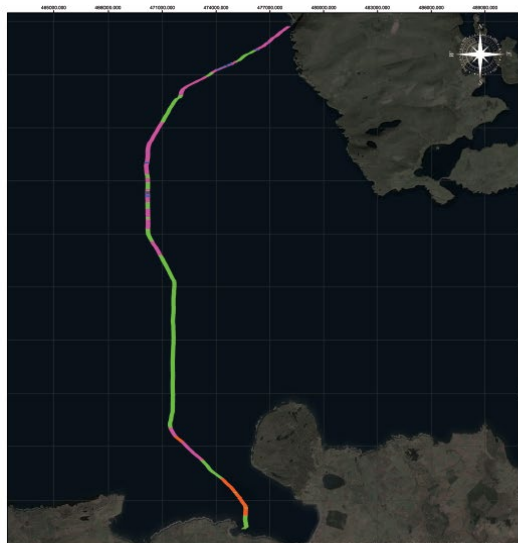
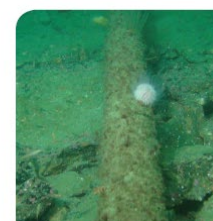
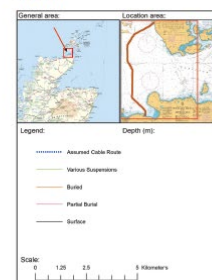


Photo of surface laid cable on the seabed



### Map key



# Pre-application Consultation Report Pentland Firth East Cable Replacement

Pentland Firth East

## How will our plans affect the marine environment?

We undertake desktop environmental studies and surveys of the marine, onshore and inland areas to identify any protected species, habitats, local cultural heritage or archaeology which could be affected by our works and surveys.

These studies will enable us to put measures in place to avoid or minimise any potential impacts caused by the new cable.

To date we have completed a European Protected Species and Protected Sites Risk Assessment which helps to inform if our survey and installation activities will disturb marine species. It also assesses our impact on breeding birds and otters at the shore-ends.

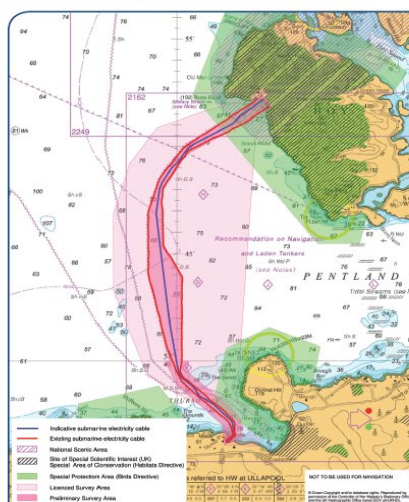
The land and coastlines of both Hoy and Caithness have very high conservation value, particularly for seabirds (see map for areas of designated conservation interest). These protected sites also extend into the marine area. We have programmed our activities to avoid the bird breeding season.

A full marine mitigation plan has been prepared which sets out how the installation will be carried out to minimise any disturbance.

### Minimising our impact

- A 500m exclusion zone from porpoises, dolphins, basking sharks, whales and seals.
- A Marine Mammal Observer will monitor for the presence of porpoises, dolphins, basking sharks, whales and seals prior to the start of and during works.
- The use of a Passive Acoustic Monitoring System to detect for marine wildlife when visibility is poor.
- Use of soft – start techniques and reporting of activity when visibility is poor.

Map to show existing and indicative cable routes and land designations



Bottlenose Dolphin



Harbour Seal



Pentland Firth East

## How will our plans affect marine users, customers, businesses and visitors?

Our plans are developed to minimise impacts on marine users, local people and businesses.

Studies show the water around the Pentland Firth coast is a popular area for marine recreation. Low levels of canoeing, kayaking, coasteering, jet skiing, power boating, diving and medium levels of sea angling from shore, sailing, cruising and motor cruising take place in the water around our proposed cable location. These activities are unlikely to be affected by our proposal.

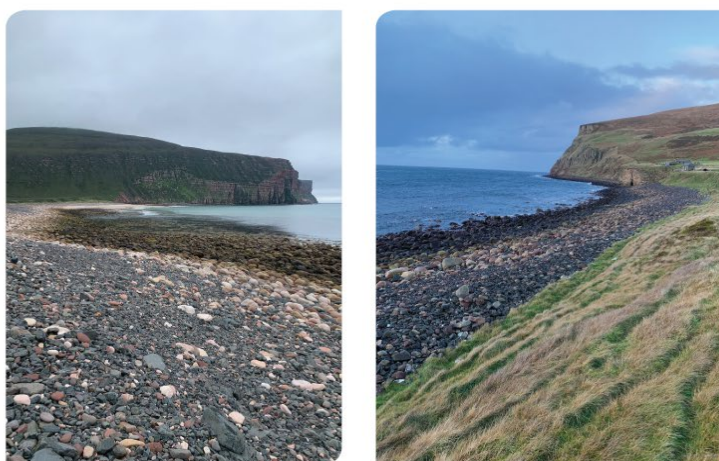
The main fishing activity in the Pentland Firth and Hoy area is potting. Static fishing with pots and creels would be unaffected by the cable once installed. However, during the surveys and installation phase, nearshore potting vessels operating close to the cable location may be affected.

We will employ a Company Fishing Liaison Officer and Fishing Industry Representative who will advise local mariners of plans in advance of work starting and during the installation phase, to minimise any disruption.

Photos of Murlie Bay



Photos of Rackwick Bay





# Pre-application Consultation Report Pentland Firth East Cable Replacement

Pentland Firth East

## Your views matter and next steps

Consultation is a key element of project development and we are committed to involving the local community and interested parties in this process.

Before leaving today, please take the time to let us know what you think about our proposal. The information you provide will be helpful in assessing the acceptability of the proposal as displayed at this event.

You can do this by:

- speaking directly to a member of staff at the event
- filling out a feedback form
- emailing your comments and suggestions to [submarinecables@sse.com](mailto:submarinecables@sse.com)



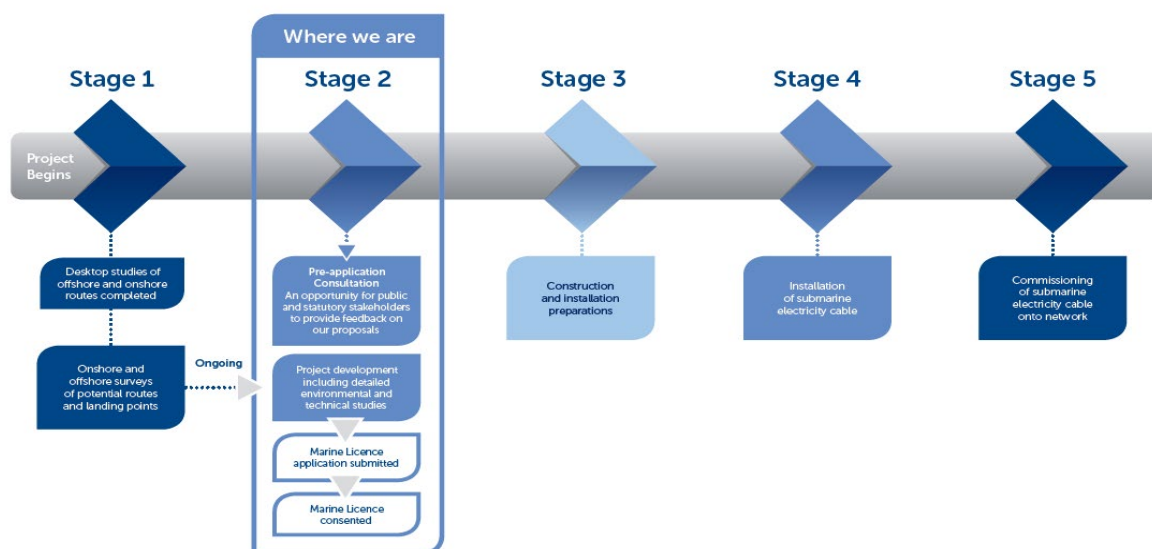
Thank you in advance for participating in the consultation today. Your feedback will form part of the Marine Licence Application for this project.

### Next steps

- You have until 4 October 2019 to submit your comments about our proposal directly to us.
- Your comments will be compiled and summarised in the Pre-Application Consultation (PAC) Report, which will form part of the Marine Licence application for the installation of the replacement cable. Also included in the PAC will be a description of how our project has been amended in response to your comments, where applicable. We will also explain why some suggestions/comments may not be feasible.
- The Marine Licence application will be submitted to Marine Scotland in Winter 2019.
- A formal newspaper advertisement in the local press will notify members of the public and stakeholders that an application has been submitted.
- Consultees and members of the public will then have another opportunity to comment on our application as part of Marine Scotland's consultation process.

Pentland Firth East

## Development timeline



## Pre-application Consultation Report Pentland Firth East Cable Replacement

### Appendix D: Comments form template

#### Your Comments



We hope that you have found the information useful. To help us record your views about our subsea electricity cable proposal, please take a moment to complete this questionnaire.

##### About the consultation

How did you hear about the event?

Local newspaper ☐

SSEN website ☐

Community website ☐

Word of mouth ☐

Poster ☐

Letter ☐

Other.....

Which event did you attend?

Hoy ☐

Stromness ☐

Castletown ☐

##### About the proposal

The Pentland Firth East cable is nearing the end of its operational life. Do you agree that the cable needs to be replaced?

Strongly agree

Agree

Not sure

Disagree

Strongly disagree

☐☐☐☐☐

Please explain your reasons:

The routing of the proposed cable and landing points are appropriate?

Strongly agree

Agree

Not sure

Disagree

Strongly disagree

☐☐☐☐☐

Please explain your reason:

**PLEASE TURN OVER**

## Pre-application Consultation Report Pentland Firth East Cable Replacement

Are the following cable protection methods for the location of Pentland Firth East cable appropriate?

Rock Placement	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Not Sure <input type="checkbox"/>
Rock Filter Bags	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Not Sure <input type="checkbox"/>
Mattressing	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Not Sure <input type="checkbox"/>
HDD	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Not Sure <input type="checkbox"/>
Burial	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Not Sure <input type="checkbox"/>

Please explain your reasons:

Works are planned to minimise any disruption to the environment and marine users. Are you aware of anything which may be impacted by the works- for example, designated conservation areas (not covered in the information provided), shellfish harvesting areas, timings of works?

Please provide further details here:

Do you support or object to these proposals as shown today?

Strongly support	Support	Not sure	Object	Strongly object
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Keep in touch

We want to keep you informed about progress on the proposals. If you would like to join our email list for updates, please complete your details below.

Your details will only be used for communications from us to you about submarine electricity cables and you can unsubscribe at any time by emailing [unsubscribe@ssen.co.uk](mailto:unsubscribe@ssen.co.uk)

Please use BLOCK CAPITALS.

Name:

Address:

Postcode:

Email:

*Comments made to the prospective applicant are not representations to the Scottish Ministers. If Scottish Hydro Electric Power Distribution plc submits an application for a marine licence to Scottish Ministers, an opportunity will be given for representations to be made to the Scottish Ministers on the application.*

Please leave your completed form with a member of the project team or post it to:

Submarine Cables Team

SSEN, Inveralmond House

200 Dunkeld Road

Perth, PH1 3QA

All responses to be received by 4 October 2019

## **Appendix E: Navigational Risk Assessment**

## **1 Navigational Risk Assessment Report Kirkwall February 2019**

# Pentland Firth East Submarine Cable Replacement

Navigational Risk Assessment Report Kirkwall 19  
February 2019

Project number: 60591722  
60591722-REP-03

21<sup>st</sup> February 2019

## Quality information

Prepared by	Checked by	Verified by	Approved by
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## Revision History

Revision	Revision date	Details	Authorized	Name	Position
P01	12 April 2019	First Issue	David Meikle	David Meikle	Regional Director Ports and Marine

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## 1. Location and Scope of the Navigation risk Assessment

The proposed corridor of the replacement cable is shown in Figure 1. It is proposed to follow the path set by the existing pair of cables which are no longer fit for purpose. This path can be seen to follow a ridge on the seafloor, representing the shallowest route between Murkle Bay on the North coast of Scotland and the island of Hoy.

A five nautical mile (nm) buffer is considered around the proposed corridor of the replacement cable for the purposes of hazard identification relevant to the project.

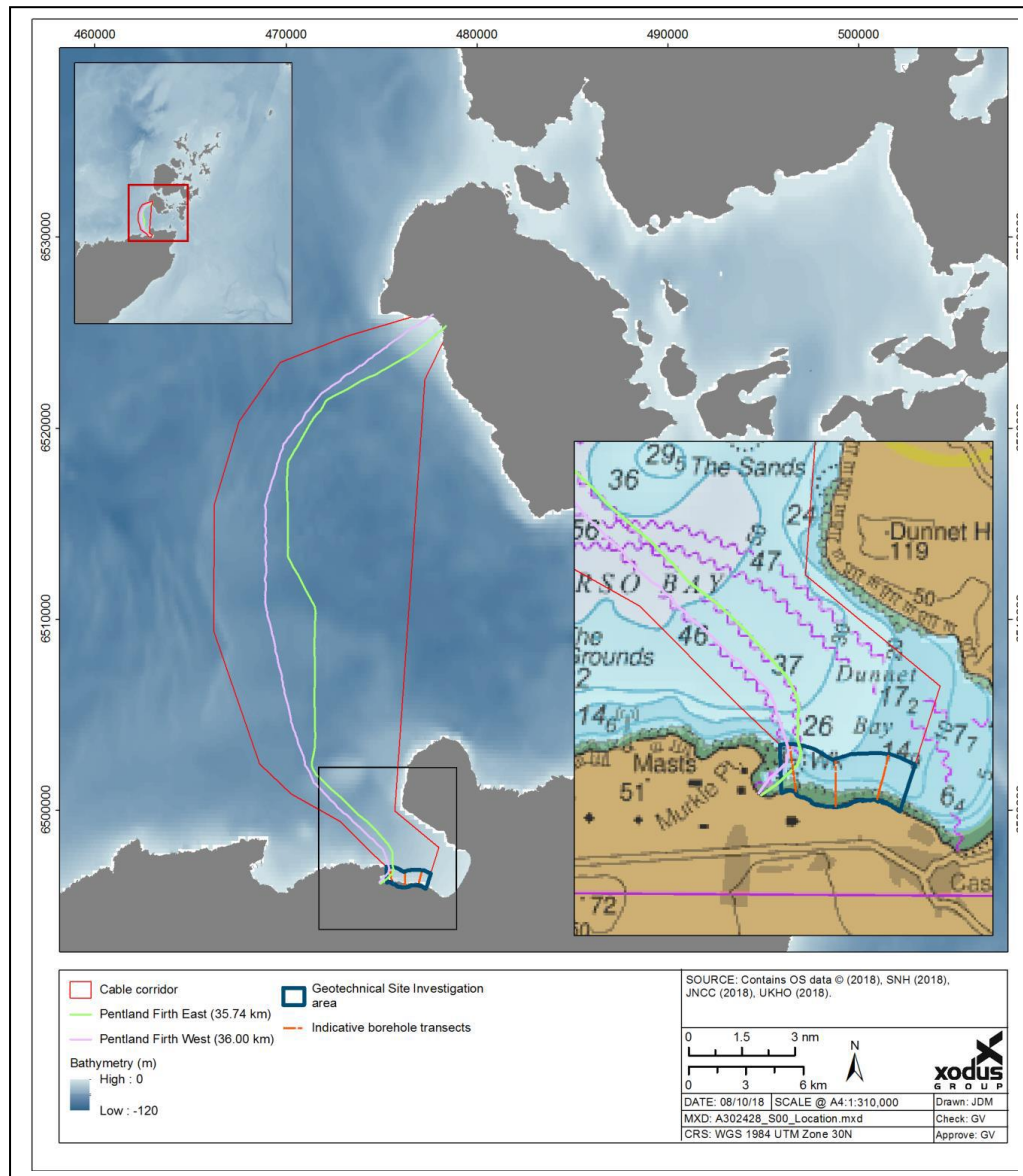


Figure 1: Proposed Cable Corridor

The metocean data for Murkle Bay and Rackwick Bay are attached in Appendix A

## 2. Navigation Risk Assessment Procedure

### 2.1 What is a Risk Assessment

A risk assessment is a written document that records a three-step procedure: -

1. Identifying the hazards in the workplace/project;
2. Assessment of the risks presented by these hazards;
3. Putting controls measures in place to reduce the risk of these hazards causing harm, to an acceptable level.



### 2.2 Terminology and Outline Procedure.

- A hazard is an unwanted and unplanned event or danger which has the potential to cause harm to persons, the environment, property, or the reputation of key stakeholders;
- Hazards shall be identified by consensus during the procedures and listed, for each aspect of the Navigational operations of the IOMFT;
- Each hazard shall be assessed and a consensus will be reached in relation to the likelihood, or probability (P) of that hazard occurring;
- Each hazard shall also be assessed and a consensus will be reached, in relation to the consequences, if the hazard were to be realised. This will include consideration of outcomes for people, environment, property, and reputation ( PEPR);
- The agreed consensual values of likelihood and consequence (C) are used to determine the risk;
- A risk (R) is therefore a weighted probability of the hazard occurring / being realised, where  $R = P \times C$ ;
- The above process will produce a base line numeric risk score for each hazard;
- If the base line numeric risk score lies within one of the unacceptably high bands (see matrix in Appendix A), then further risk control measures shall be considered and applied until the residual risk score is tolerable, as defined in the matrix.

In an ideal situation, the numeric values of C and **P** would be known from historic data bases of similar, however this is rarely the case. Therefore, in order to ensure that these variables are assessed as accurately as they can be, in a Formal Risk Assessment (FRA), Hazard identification (HAZID) work-shop shall be held. The participants in the HAZID workshop shall be persons with expert knowledge of the operations which are being assessed and who have been involved in such operations on a day to day basis for a number of years.

## 3. Baseline Information

### 3.1 Navigational features

The principal navigational features relative to proposed corridor of the replacement cable are presented in Figure 2. This figure displays charted anchorage areas and navigational aids. The buoy and anchorage positions are taken from the Admiralty Charts of the area, with supplementary information taken from previous NRAs compiled for the Pentland Firth, informed by Admiralty Sailing Directions and Clyde Cruising Club Sailing Directions and Anchorages.

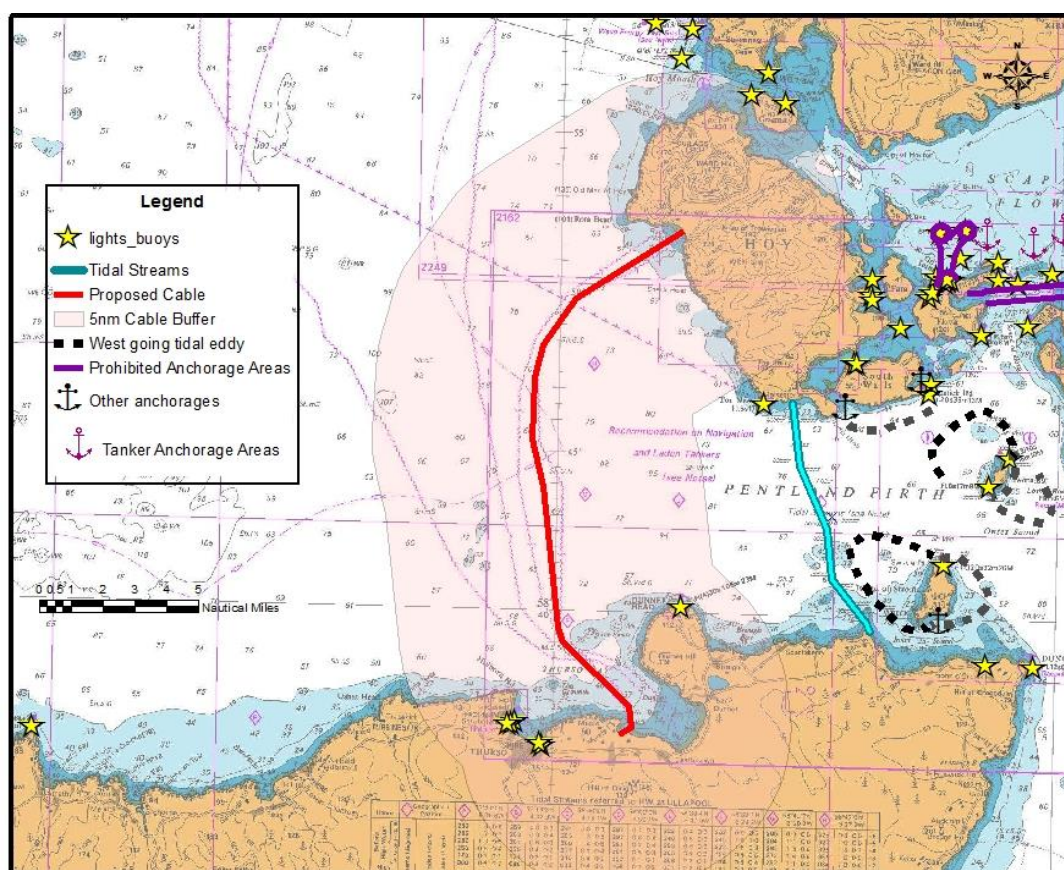


Figure 2: Navigational features

A number of prohibited anchorage areas exist in Scapa Flow, to the East of proposed corridor of the replacement cable, to protect pipelines and structures associated with the Flota Oil Terminal, and a military wreck. These are highlighted as survey vessels used for bathymetric surveys of the cable corridor and AIS vessel tracking may need to shelter in these areas.

Tidal streams with eddies and turbulence occur in the Pentland Firth and approaches to Scapa Flow in both Easterly and Westerly directions. None are noted within the 5nm buffer surrounding the cable corridor, however they may pose a risk to vessels involved in the surveying, commissioning and maintenance of the new cables.

### 3.2 Ports, Harbour Limits and Recommended Tracks

OIC Marine Services administers 29 Orkney Harbour Areas for which it is the Competent Harbour Authority. The Council exercises its jurisdiction through a Director of Marine Services. The Duty Holder for the Authority is now the Harbour Authority Sub-committee, established in July 2016. Proposed corridor of the replacement cable is at no point in the vicinity of the Limits of Orkney Harbours. However, berthing and overnighting of survey vessels may be required at anchorages within these Limits.



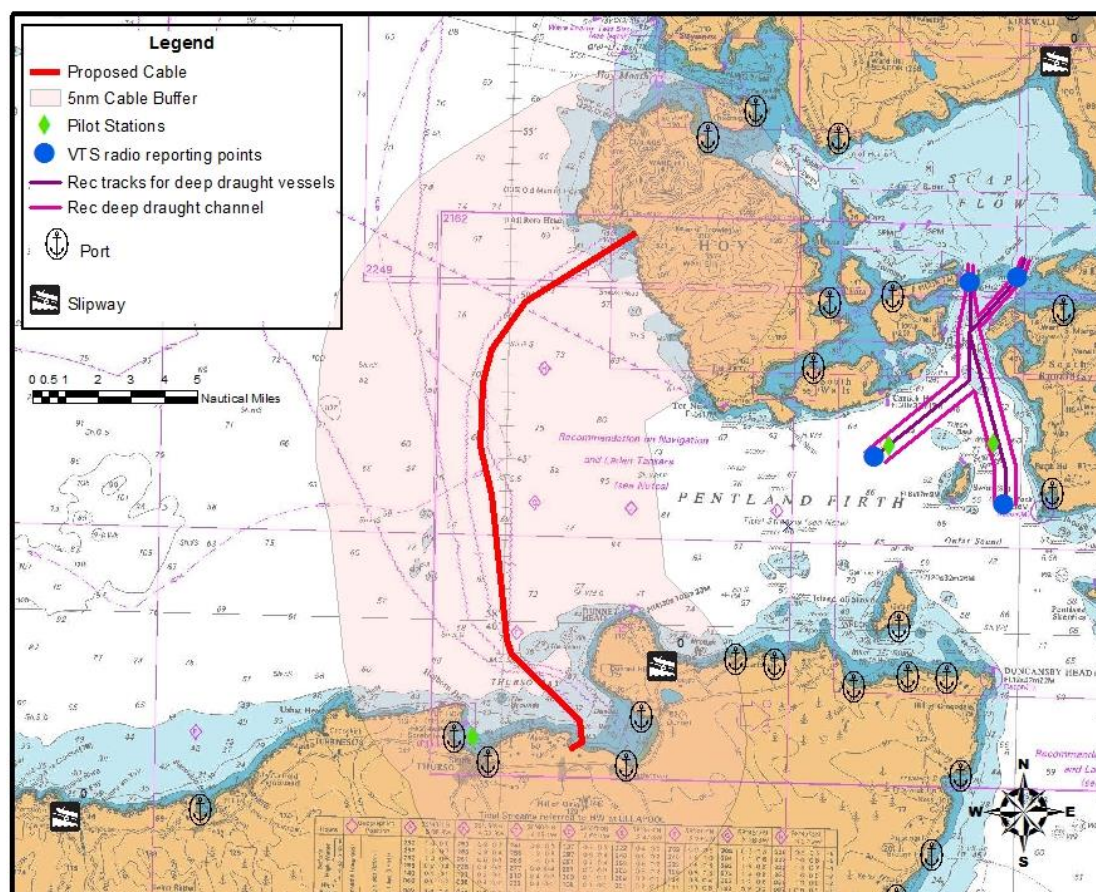


Figure 3: Ports, Harbour Limits and Recommended Tracks

Within 5nm of proposed corridor of the replacement cable, there are five ports; Scrabster, Thurso, Castletown and Dunnet on the Scottish North coast, and at Bu Point on the isle of Hoy. There is also a slipway in Brough Bay.

Pilotage rules require confirmation from Orkney Island Council Marine Services, or local harbour masters.

Approximately 10nm east of proposed corridor of the replacement cable are recommended tracks for deep-draught vessels. The channels and deep-water tracks between the Pentland Firth and Scapa Flow are those recommended by the Orkney Harbours Navigation Service for tankers under pilotage proceeding to or from the Flotta Oil Terminal. Radar surveillance of these channels is continuously maintained by VTS. There is no predicted interference with these channels during surveying operations or cable laying, however they are noted in the event that vessels require to use them in the event of adverse weather.

The harbour at Scrabster is the setting off point for the Northlink Ferries Scrabster-Stromness ferry service which runs twice at weekends during off-peak season (September to April) and three times daily in the peak season. As can be seen in Figure 3, the principal route to the west of Hoy crosses over the proposed cable route twice and is entirely within the 5nm buffer. Consultation with Northlink Ferries will be required to assess the risk to the proposed cable due to falling objects from the Ro-Ro service and dropped anchors during adverse weather, as well as impacts on the ferry service of survey vessels traversing the Pentland Firth at the same time as ferry sailings.

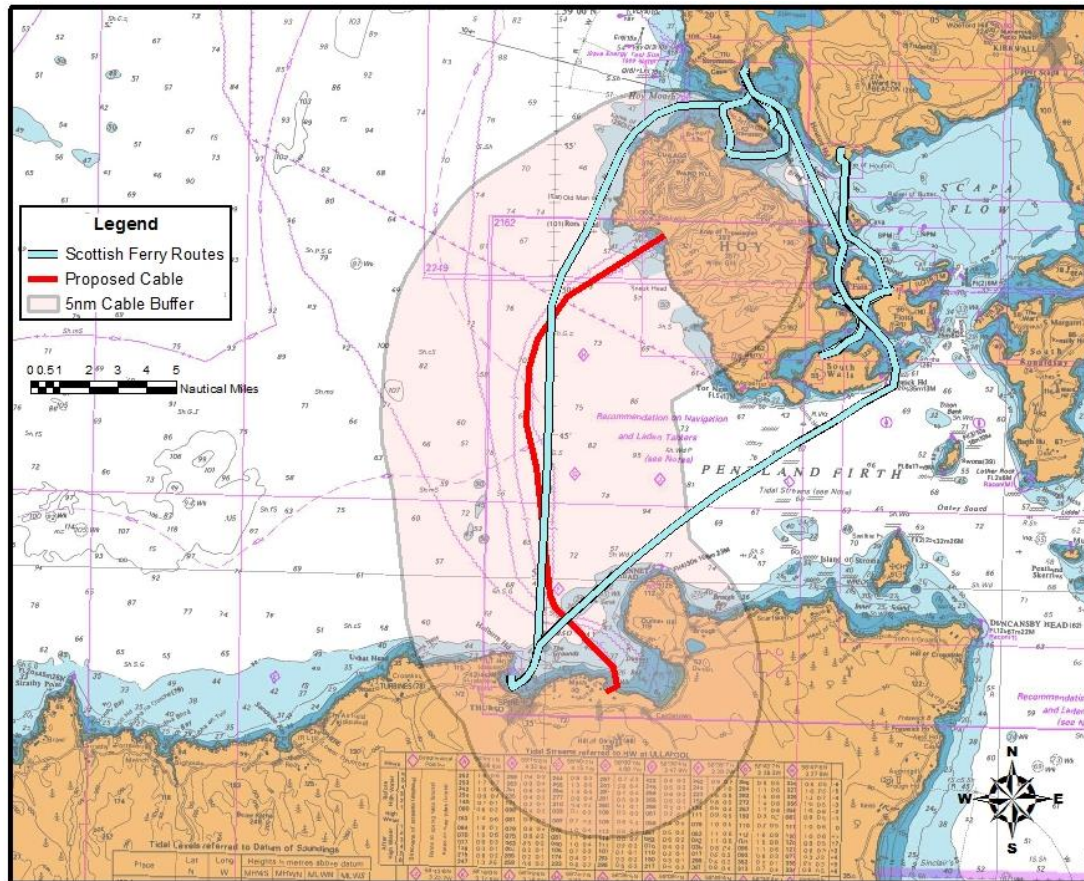


Figure 4: Ferry Routes from Scrabster

### 3.3 IMO Routeing Measures

Proposed corridor of the replacement cable lies partially within the IMO-adopted Area to be Avoided (ATBA) which surrounds most of Orkney (excluding the Pentland Firth and Scapa Flow). The ATBA was established to protect the sensitive coastline following the *Braer* incident. To avoid the risk of pollution and damage to the environment, all vessels over 5,000 GT carrying oil or other hazardous cargoes in bulk, should avoid this area.

Chart notes advise that laden tankers not bound to or from Flotta and Scapa Flow should not use the Pentland Firth in restricted visibility or adverse weather. At other times there may be a case for transiting with the tide to reduce the time spent in the Firth, although they should be aware of very strong tidal streams and sets within the area. Difficulties can be encountered when transiting either with or against the tide. Masters should ensure that a close watch is kept at all times on the course, speed and position of vessels.

The statutory regulations surrounding the burial of pipelines and cables within this region should be checked to ensure no regulatory obstacles exist to both surveying and cable laying operations.



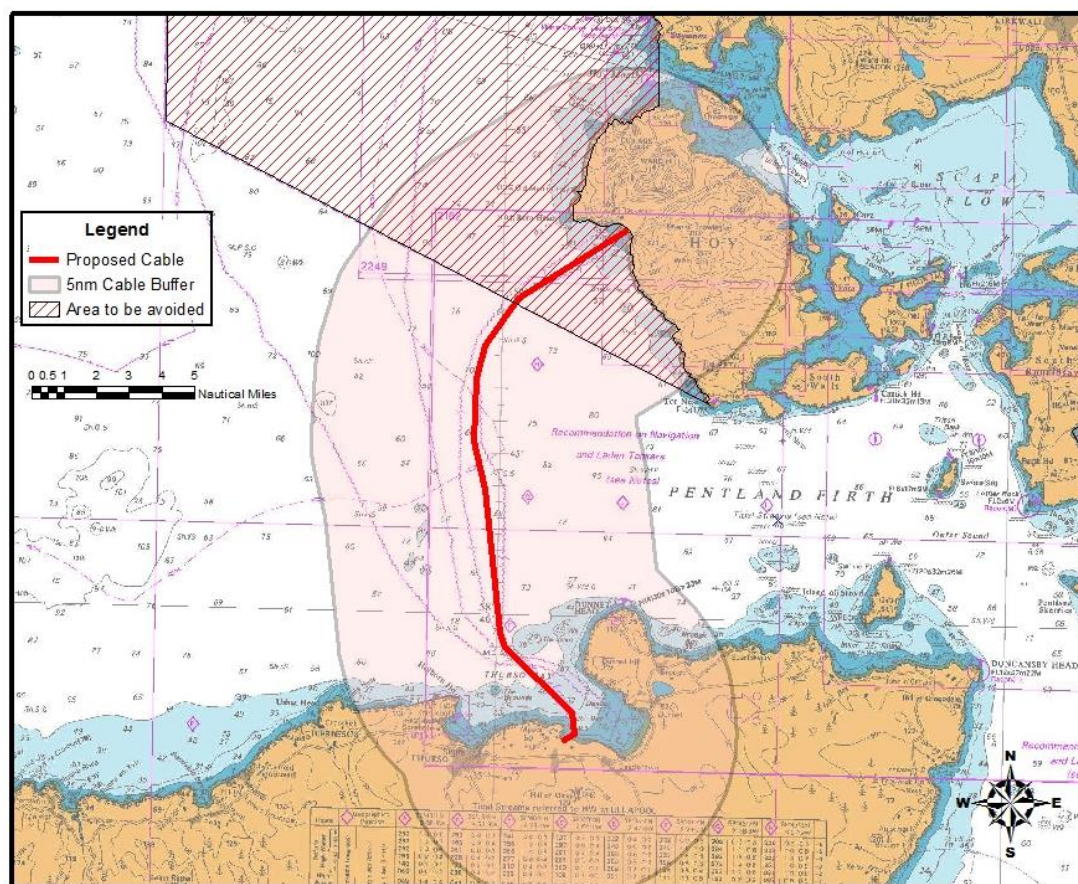


Figure 5: ATBA in the vicinity of the proposed cable

### 3.4 Wrecks

There are several protected and unprotected wrecks within the 5nm buffer surrounding proposed corridor of the replacement cable. The two protected wrecks are; HMS Pheasant, and HMT Beech.

HMS Pheasant was a WWI M-class destroyer, sunk in 1917 after contact with a mine. The wreck lies roughly in an East-West orientation at a depth of 82m roughly 1nm from the proposed landing site on Hoy. It may be necessary to exercise additional care to avoid this area during cable laying operations, and additional interest in bathymetric results may be taken by interested parties.

HMT Beech was a minesweeping trawler vessel sunk by German aircraft in 1941 in Scrabster Bay. The general water depth around the wreck is reported as 13m. Direction from Scrabster harbour master may be required for survey and cable laying vessels in order to ensure avoidance of this wreck. This site is classified as a maritime war grave.

There are 24 reported unprotected wrecks within 5nm of proposed corridor of the replacement cable. Of particular interest are two wrecks identified in Murkle Bay where the proposed cable will land on the Scottish North coast. The condition of these wrecks is not known and the effect they may have on survey and cable laying operations is unknown.

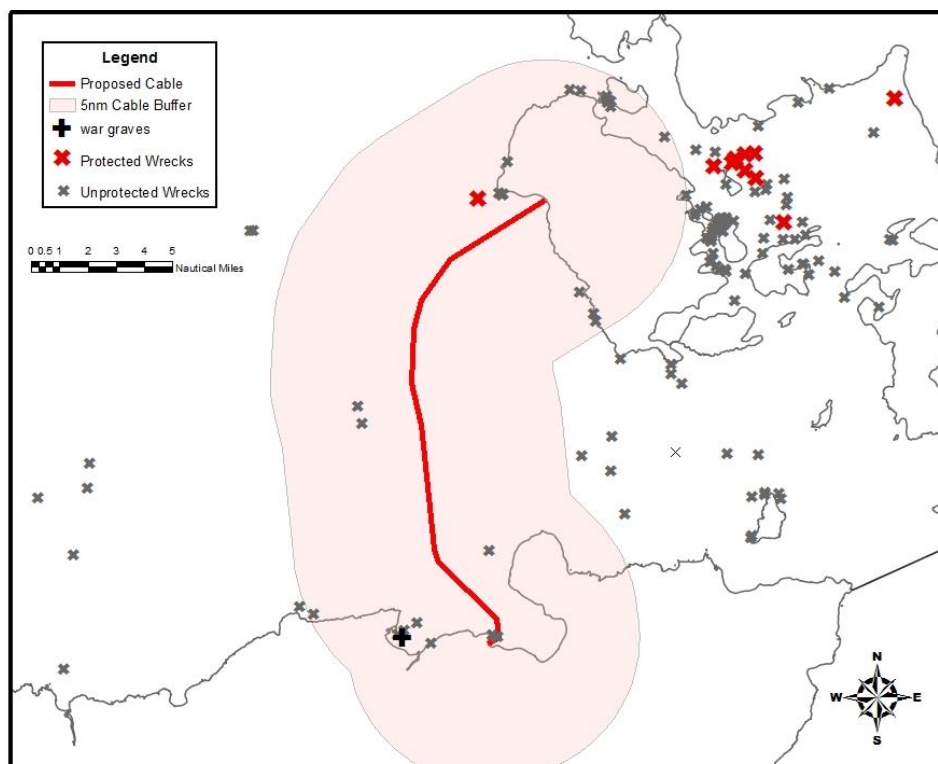


Figure 6: Identified Wrecks

### 3.5 Oil and gas Infrastructure

There are no oil and gas installations or licence blocks in the immediate vicinity of the proposed cable, however there are installations to the east of the project, in Scapa Flow, associated with Flotta Oil Terminal, which is approximately 10nm east of the area. Installations here include a tank farm, pumping station, power station and burn- off flare.

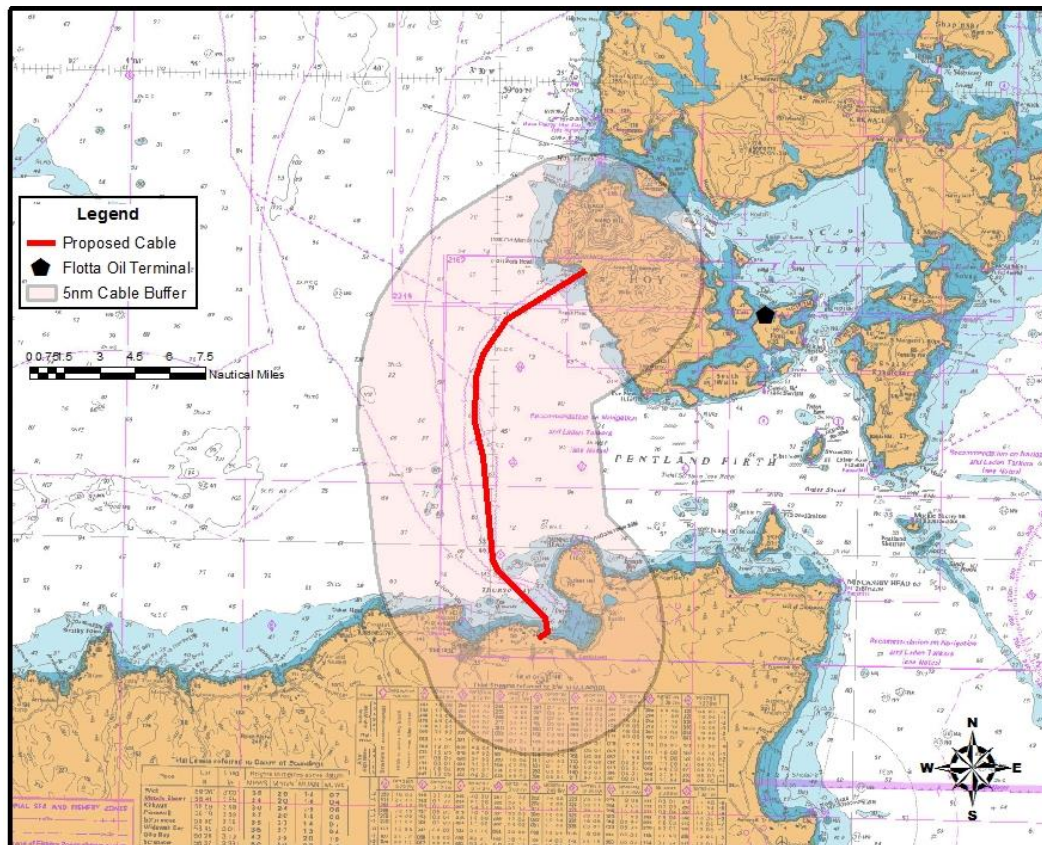


Figure 7: Oil and Gas Infrastructure

### 3.6 Recreational Dive Sites

There are 5 recreational dive sites within 5nm of proposed corridor of the replacement cable, with one closer by at the southern tip of Hoy.

The site close by the southern cable landing site is at Dwarwick Pier and is considered a suitable dive for novices with entry to the water via the slipway. Notice may need to be posted here, or at nearby dive centres with air compressors, to inform visitors of works taking place offshore, with increased risk of noise.

The next most relevant dive is at the site of HMS Pheasant (although the dive site is mapped at the south tip of Hoy). Access to this dive is by boat and so displacement of dive boats away from cable laying vessels is possible.



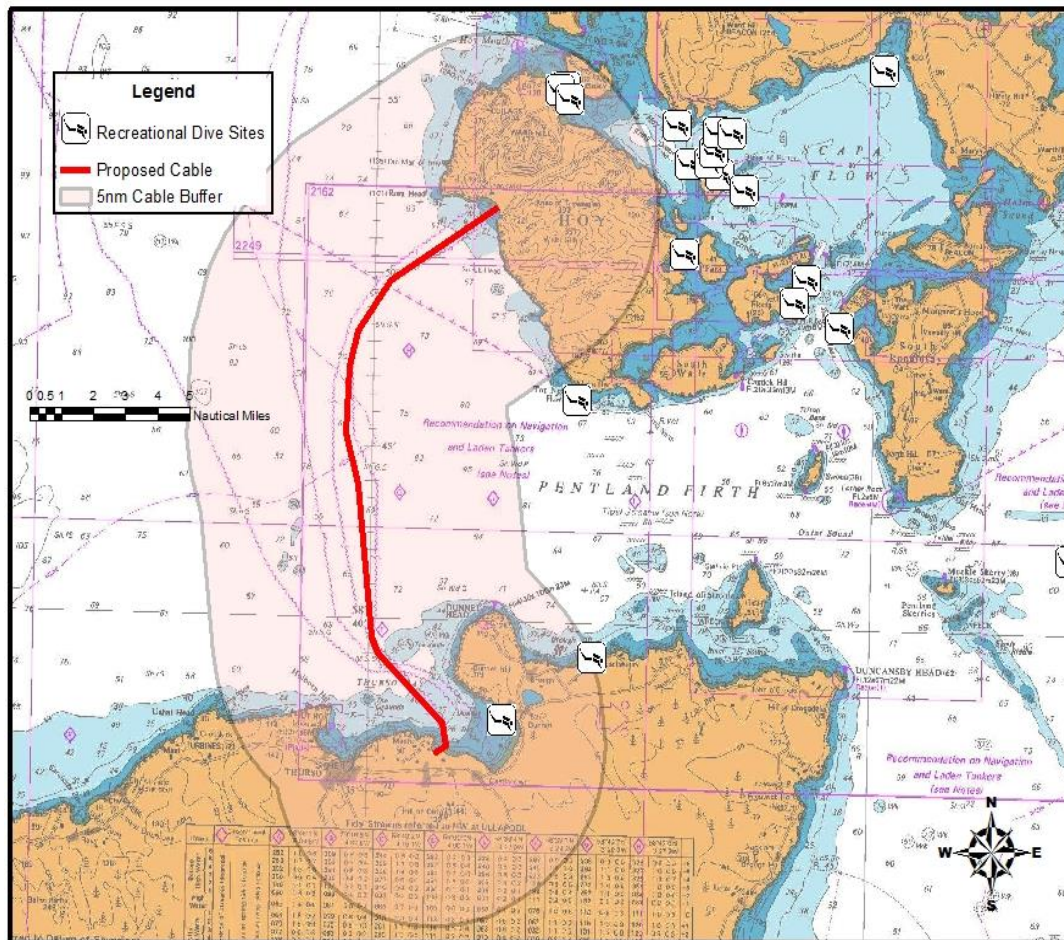


Figure 8: Recreational Dive Sites

### 3.7 Offshore Wind

There are no existing or planned offshore wind farm projects in the vicinity of the proposed cable route.

### 3.8 Offshore tidal

There are two tidal power generation projects of significance within the Pentland Firth.

Brims tidal array, directly to the east of proposed corridor of the replacement cable to the south of Hoy, is no longer in development as of 2018, with no significant installation of infrastructure in the sea.

MeyGen is currently running monitor and reporting phases of their tidal power project in the Inner Sound to the south of the Isle of Stroma. This currently comprises a single turbine on a gravity foundation and is not anticipated to impact cable laying operations directly. Vessel traffic to and from the site from local ports by maintenance, reporting and installation vessels may impact on available berths in the area as the project is reported to enter into a second phase of installation in 2019, with further turbines being put in place.

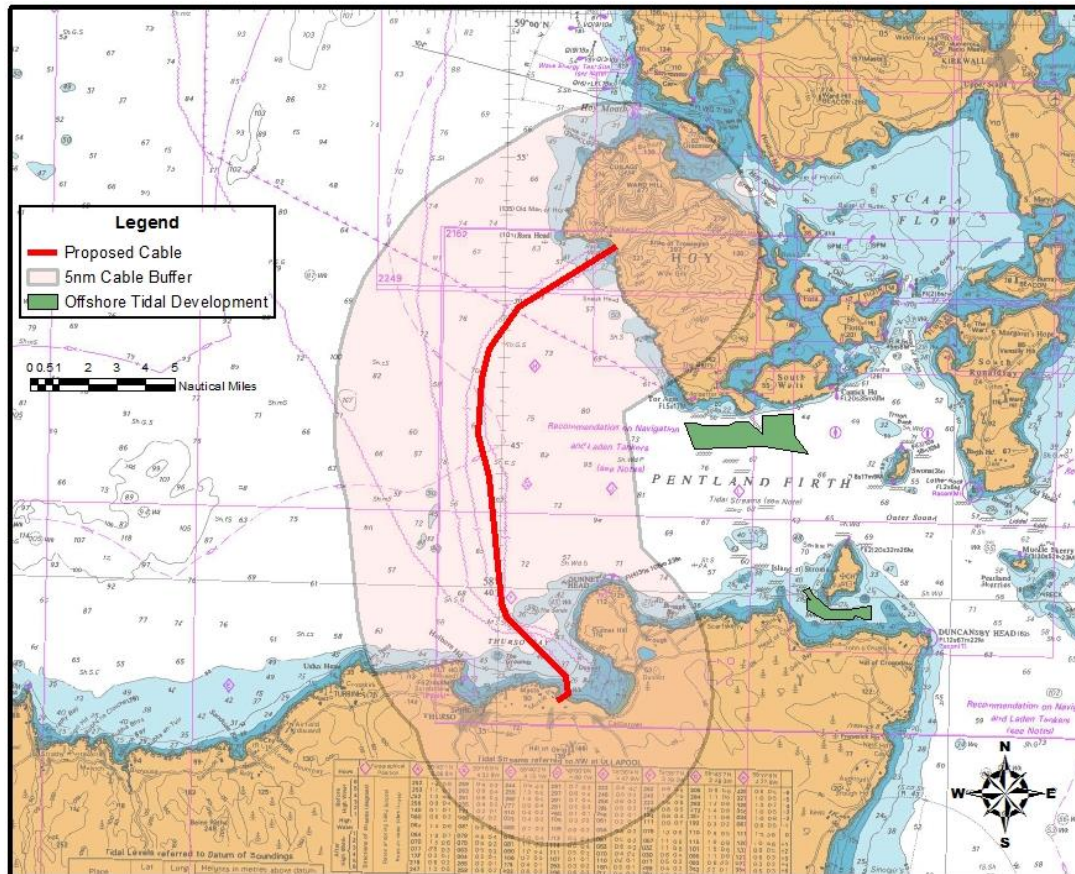


Figure 9: Tidal Power Projects in the Pentland Firth

### 3.9 Offshore Wave development

The European Marine Energy Centre (EMEC) currently runs 2 wave energy testing sites around the Orkney Isles. Billia Croo around 6nm north of proposed corridor of the replacement cable, is currently operational and provides technology developers the space to test new technologies with grid connections.

No impact is predicted on surveying or cable laying operations however, the area should be avoided to prevent collision with floating wave energy generators.



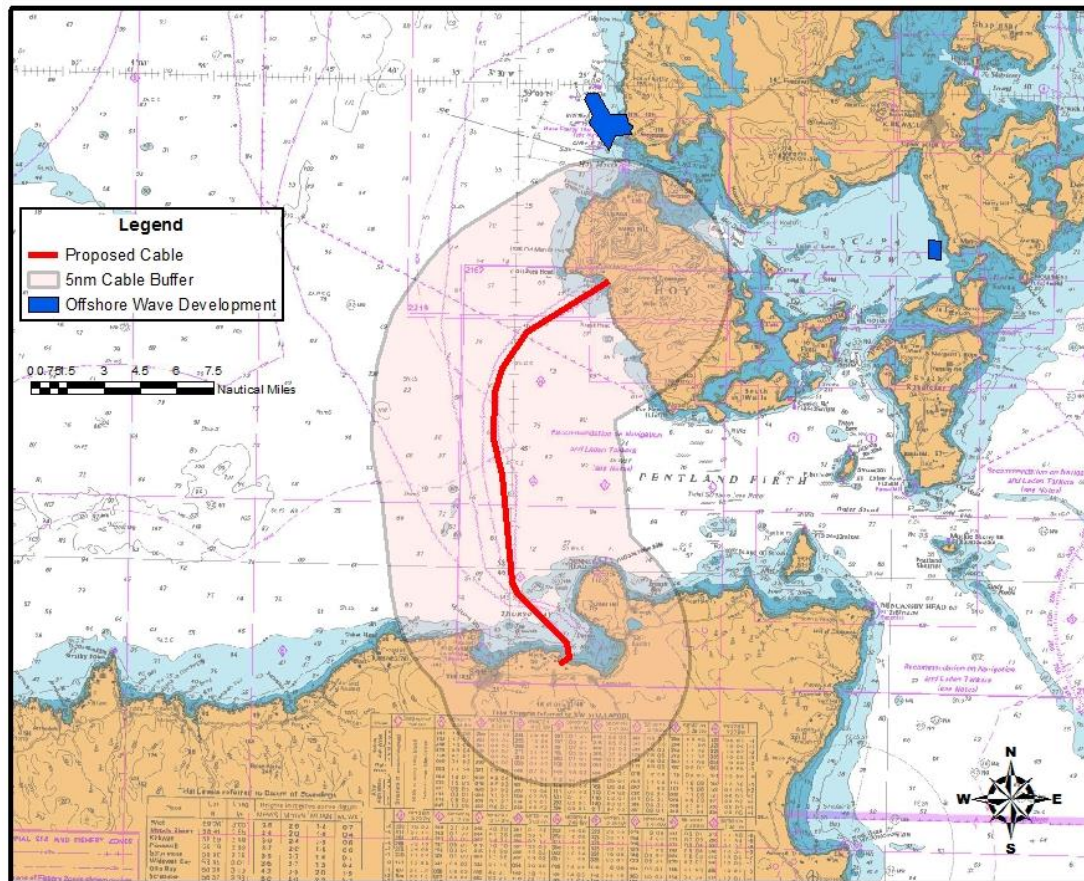


Figure 10: Wave Energy Projects

### 3.10 Dredging

Within 5nm of proposed corridor of the replacement cable there are 3 disused and a single operational dredge arising's disposal site (as of the most up to date charts in December 2018). The most significant is the larger disused dredge disposal site which lies over the proposed cable route at its southern extent and could impact on the ease of cable burial. The active site will require further monitoring to determine the effects of dredge disposal during project operations, however it lies around 1nm to the south-west of the proposed cable route.

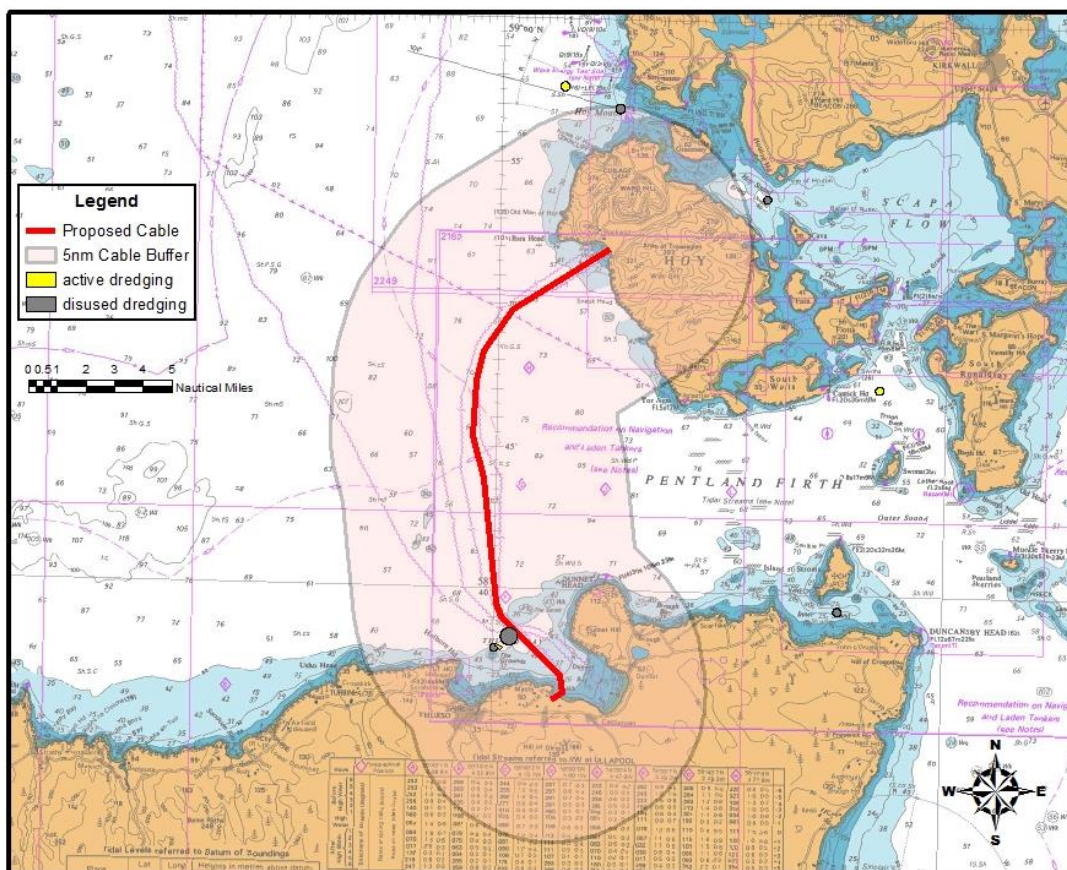


Figure 11: Dredge Disposal sites

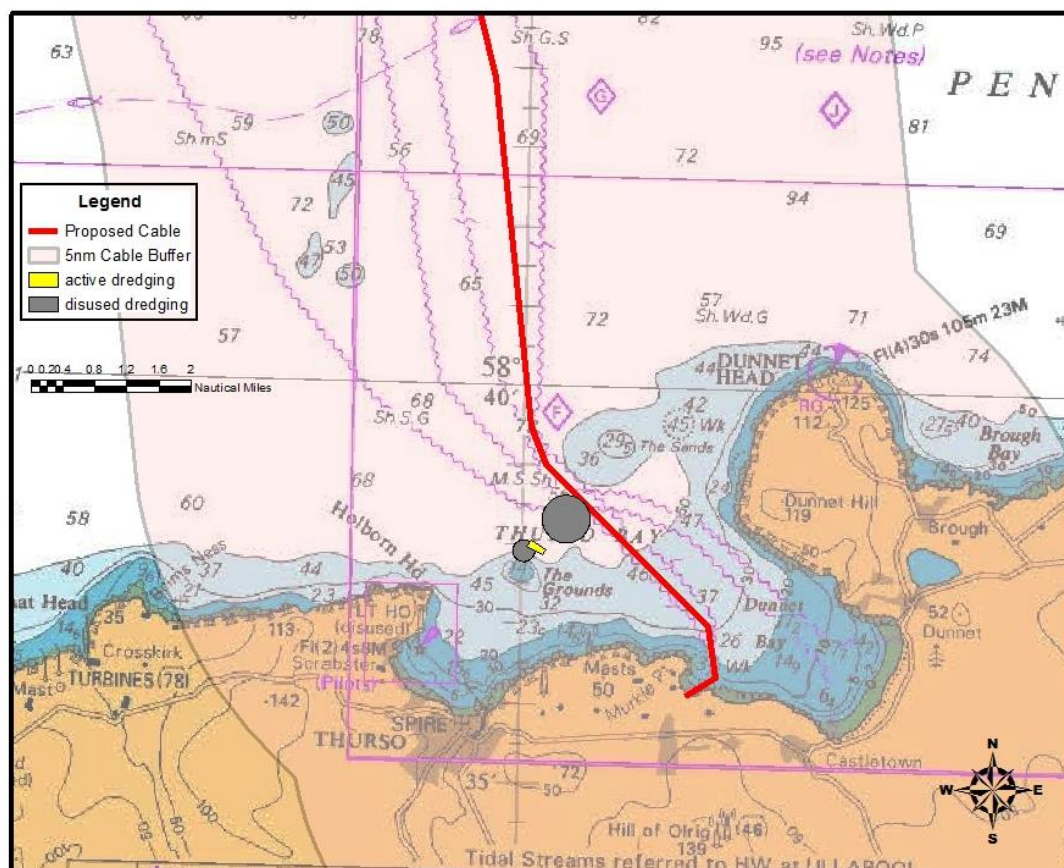


Figure 12: Dredge Disposal sites at southern end of cable



### 3.11 Cables and Pipelines

There are several existing cables and pipelines between the Orkney Isles, these are marked on Admiralty maps and mariners are advised to avoid dredging or trawling in their vicinity to ensure damage to vessels, gears and cables are prevented.

Two long distance cables run through the 5nm buffer around proposed corridor of the replacement cable, and cross over it at its southern extent as they approach their landfall on the Scottish north coast at Dunnet Bay. Care will be required during cable laying operations to avoid damage to these cables. Damage to these communication cables may incur additional costs and delay to the project, while also potentially disrupting international lines of communication.

Of particular interest are the two existing cables which this project aims to replace. They run to either side of proposed corridor of the replacement cable typically at a distance of 0.5nm from each other. They make landfall within Murkle Bay on the Scottish north coast and at Rackwick on Hoy. Care will be required where trenches are required to bury the new cables that the existing cables are not damaged. The combined capacity of these cables is 40MW.

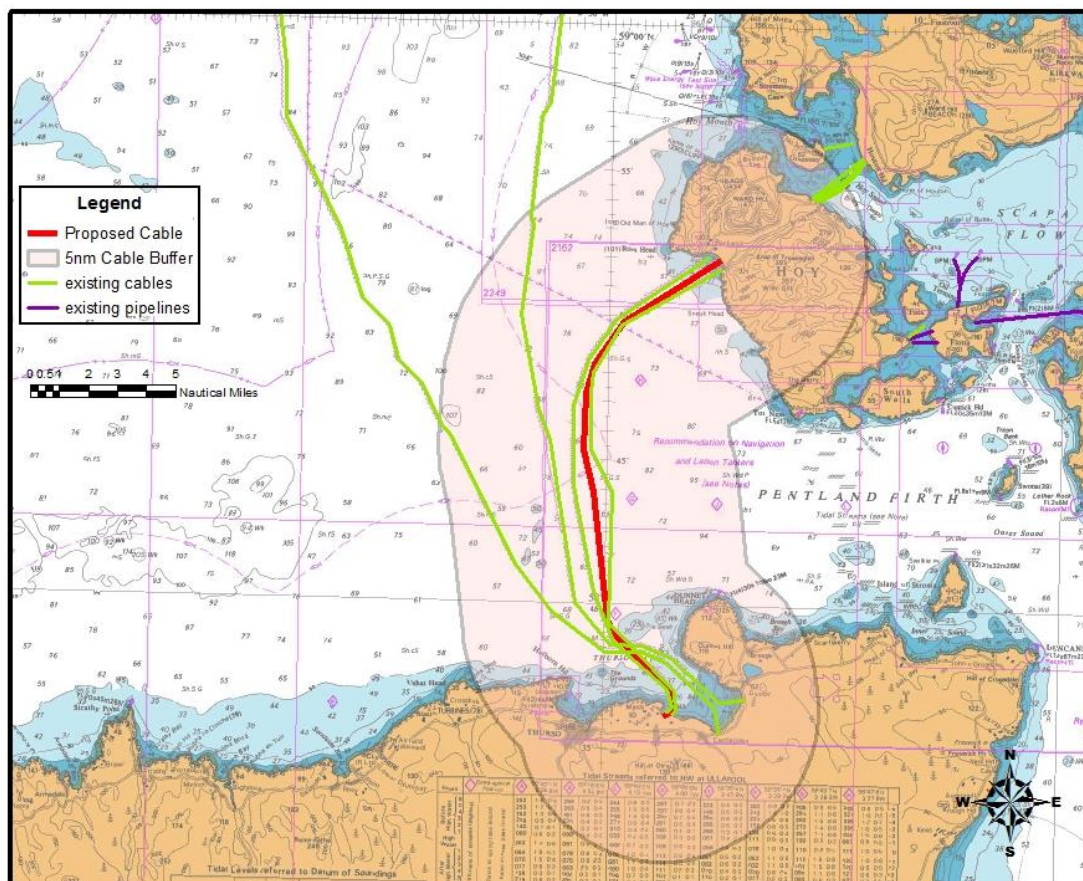


Figure 13: Existing Cables and Pipelines



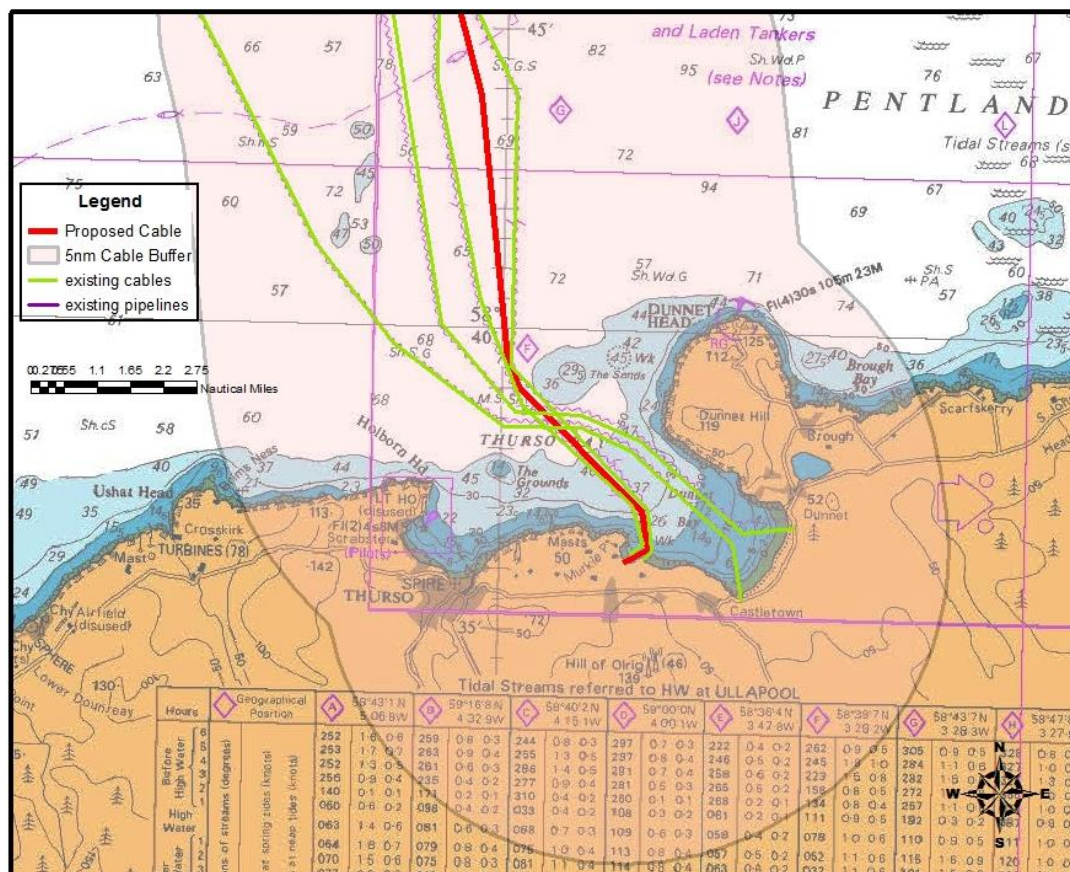


Figure 14: View on Murckle and Dunnet Bay

### 3.12 Military Exercise areas

There are no military practice areas in use by the Ministry of Defence (MoD) in the vicinity of proposed corridor of the replacement cable.

This should be confirmed independently with MOD following the two workshops.

### 3.13 Marine Environment High Risk Areas (MEHRA's)

Tor Ness on Hoy, has been identified as a Marine Environmental High-Risk Area (MEHRA) by the UK Government, i.e., an area of environmental sensitivity and at high risk of pollution from ships. The Government expects mariners to take note of MEHRAs and either keep well clear or, where this is not practicable, exercise an even higher degree of care than usual when passing nearby.

Tor Ness has underlying statutory designations on wildlife, landscape and geological grounds, a very high concentration of vulnerable seabirds and a high level of offshore fishing activity. Figure XXX shows the Tor Ness MEHRA in relation to proposed corridor of the replacement cable and landing site on Hoy.

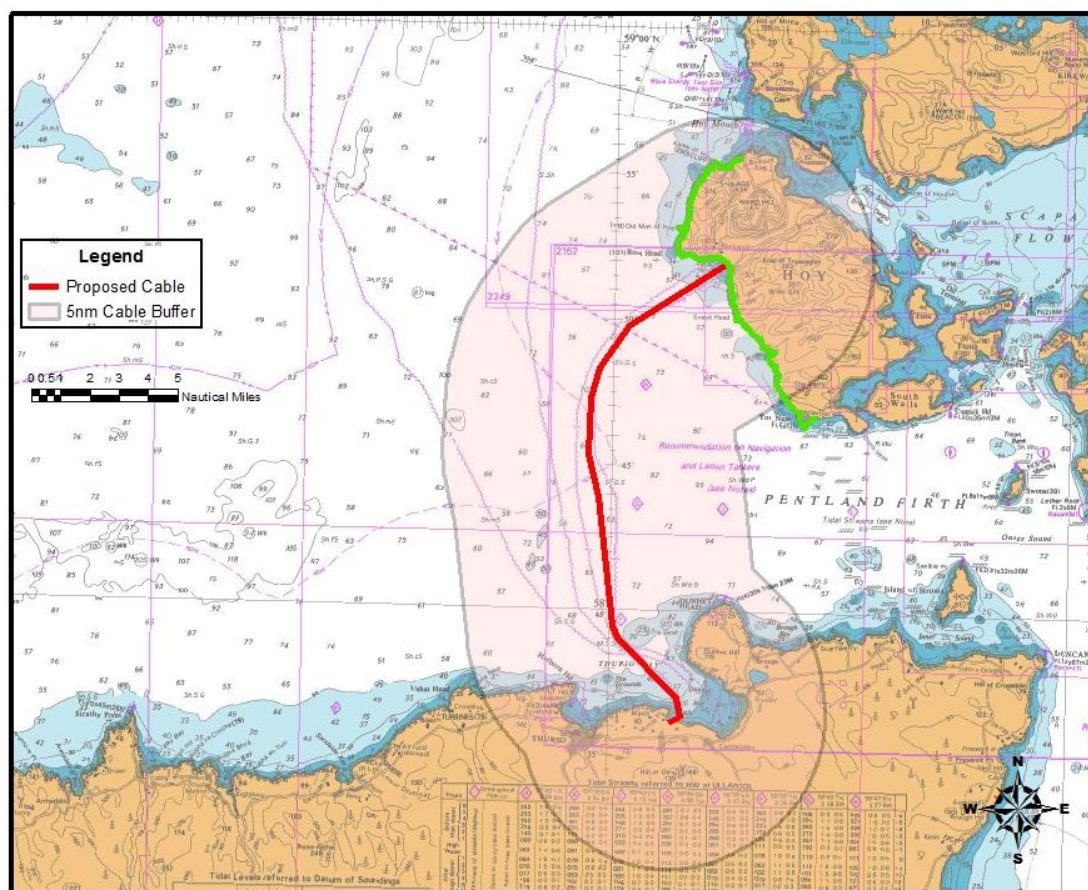


Figure 15: MEHRA

### 3.14 Sailing Directions

Sailing directions for this region are provided in Reeds Nautical Almanac (2016). Specific harbour entrance instructions are also presented in this publication

## 4. Navigation Risk Assessment Detail

A Briefing Document (Document Reference 60591722\_Rep-02) was distributed to all prospective workshop participants at seven days prior to the work shop date. The purpose of this briefing document was to confirm the methodology, terminology, and process for the Navigation Risk Assessment workshop.

It was assumed that the participant have read the contents of the briefing document and were familiar with the project and the NRA procedure prior to attendance.

After this period of preparation, a Navigation risk Assessment Workshop was convened at the Magnus Centre, Kirkwall, on Tuesday 19<sup>th</sup> February 2019. The attendees at the Navigation Risk Assessment workshop were:

**Table 1: List of participants in the Navigation Risk Assessment Workshop**

Name	Position /Organisation
Jill Meikle	AECOM– Workshop Facilitator
David Meikle	AECOM Regional Director Ports & Marine
Alistair Chan	AECOM Regional Director Ports & Marine
Fiona Mathieson	Orkney Fisheries
Brian Archibald	Orkney Council
Douglas Manson	Orkney Council
Stephen Barnes	Orkney Ferries
Chris Tait	Northlink Ferries
Alda Forbes	SSE

The workshop was run by an AECOM Workshop Facilitator (WF), Jill Meikle. The process was carried out using a custom spreadsheet in order to keep a record and also to allow a rapid comparison of effects. During the one day workshop the participants used their knowledge and past experience to: -

- Identify hazards (HAZID) as an open forum and such hazards were listed and grouped by the WF;
- Individually assess the likelihood or probability of each hazard occurring using the sheet 1 of the spread sheet shown in Appendix B**Error! Reference source not found.**. This was converted to a consensus average by sheet 2 the spreadsheet shown in Appendix B**Error! Reference source not found.**;
- Individually assess the consequence of the occurrence of each hazard using the sheet 1 shown in Appendix B. This was converted to a consensus average by sheet 2 of the spreadsheet shown in Appendix B;
- Participants agreed the resulting average probability and consequence for each hazard as generated by the spreadsheet;
- Sheet 2 provided a Base line risk for each hazard;
- Risk base line scores were reviewed in turn in open forum and either accepted or if unacceptably high, then set aside to consider mitigation measures;
- For the hazards requiring mitigation, the cause and occurrences was discussed in more detail and possible mitigation measure listed;
- Mitigation measures were discussed in open forum and agreed estimates made of how such mitigation can reduce to reduce Consequence and/or Probability;

- Reduction percentages were entered in the spreadsheet sheet 3 given in Appendix B. The sheet computes the compound effect of such measures. This continued until all risks become acceptable. This was done by embedded non-linear algorithms which are based on probability functions. Particularly for likelihood when dealing with frequent hazards it is necessary to utilise high levels of risk reduction to significantly change the risk.

## 4.1 Risk Matrix and Risk Categories

As stated above, the definitions of the likelihood and consequence of a hazard occurrence are contained within an industry standard 5 x 5 matrix, which also shows the resultant risk categorisation ranging from:

- Extreme Risk;
- High Risk;
- Moderate Risk;
- Minor Risk;
- Slight Risk.

Whilst all hazards should be kept under review, it may be considered that a hazard categorised as Moderate, Minor, or slight is already As Low As Reasonably Practicable (ALARP). Hazards categorised as Extreme or High Risk must have some suitable mitigations or risk control options (RCO's) to reduce the risk score until the residual risk is ALARP.

The Risk Matrix, with the risk tolerance definitions, and an Excel scoring matrix is shown in Appendix B.

## 4.2 NRA Results – Summary

As an open forum the work shop participants agreed a list of 23 Hazards for discussion. Appendix B contains the output from the Navigation Risk Assessment.

Hazards that were identified at the Navigation Risk Assessment workshop are listed below:

- 1 Passing (Commercial) vessel powered allision with marine cable (with Protection)
- 2 Passing (Fishing) Vessel powered allision with marine cable (with Protection)
- 3 Passing (Recreational) Vessel powered allision with marine cable (with Protection)
- 4 Passing (Commercial) vessel drifting allision with marine cable (with Protection)
- 5 Passing (Fishing) Vessel drifting allision with marine cable (with Protection)
- 6 Passing (Recreational) Vessel drifting allision with marine cable
- 7 Passing (Commercial) vessel powered allision with cable landing site
- 8 Passing (Fishing) Vessel powered allision with cable landing site
- 9 Passing (Recreational) Vessel powered allision with cable landing site
- 10 Passing (Commercial) vessel drifting allision with cable landing site
- 11 Passing (Fishing) Vessel drifting allision with cable landing site
- 12 Passing (Recreational) Vessel drifting allision with cable landing site
- 13 Construction activity - Displacement of Vessels due to Avoidance of Site Leading to Increased Vessel-to-Vessel Collision Risk
- 14 Fishing Gear Interaction by demersal trawl (Rackwick)
- 15 Vessel anchoring on or dragging anchor over marine cable
- 16 Loss of cable or equipment from construction associated vessels
- 17 Deliberate damage to cable (at landing sites)
- 18 Experience of staff, available on passing ships during the construction phase (Exxon Valdez)
- 19 Tidal Conditions



- 20 Collision between passing vessel and construction vessel (at site or en-route)
- 21 Dropped object (Floating)
- 22 Man Overboard
- 23 Adverse Environmental conditions (wind, Wave, current, etc.) - Construction

#### 4.2.1 Base Line Risk Score for Each Hazard

Individual work shop participants separately and individually assessed the likelihood and consequence of each hazard in turn, in accordance with the risk matrix. These were averaged together during the work shop to give a Base Line Risk Score for each hazard.

The results summary was as follows:

Category	Baseline scores: Nr of hazards	Comment
Extreme	2	Due to the environmental conditions on the Pentland Firth the Hazards that were extreme where associated mainly with weather and sea conditions
High	4	The Firth is a busy and sometimes unpredictable body of water. Construction in a fixed location in the Firth has created high risk hazard
Moderate	4	The Firth is a busy and sometimes unpredictable body of water. Construction in a fixed location in the Firth has created moderate risk hazard
Minor	11	These have been identified due to the activity in the firth from fishing, ferry traffic and passing traffic.
Slight	2	Due to the remoteness of the site and the communities in the vicinity slight risk from deliberate damage and passing vessels were identified at the landing sites.
<b>Total</b>		<b>23</b>

#### 4.2.2 Mitigation

Although some risk scores were lower than others, all of the hazards were considered for mitigation.

Full details of the mitigation against each hazard can be seen from the sections of the risk spread sheet include in this report as a pdf in Appendix B. However, there were some recurrent mitigations.

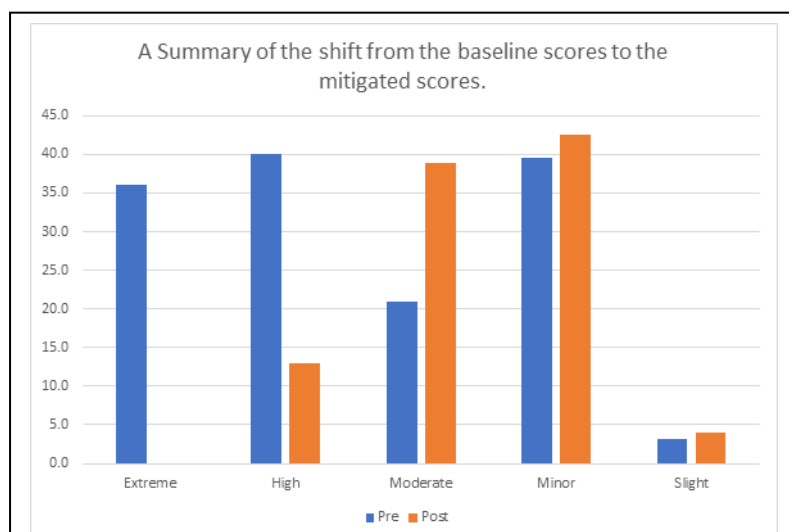
A summary of recurrent mitigations found is as follows: -

Following the workshop open forum mitigation exercise the revised risk scores were as follows: -

Category	Baseline scores: Nr of hazards	Comment
Extreme	0	The environmental conditions are well known; therefore, procedures and planning has meant the extreme risks have been mitigated.
High	1	Weather and sea condition are still unpredictable in this body of water therefore

		even with all the mitigation, this remains a high risk
Moderate	8	The construction activity within the Firth and landing sites have produced numerous moderate risks. These should be managed and monitored
Minor	12	The minor risk show a prevalence to low likelihood but the consequences of the risk are substantial. The NRA was unable to reduce much of the consequence. Monitoring of these risks should continue throughout the duration of the project and especially construction phase.
Slight	2	These should be noted.
Hazard removed	0	
<b>Total</b>	<b>23</b>	

A graphical summary of the shift from the baseline scores to the mitigated scores is shown below:



#### 4.2.2.1 Discussion on Risk Mitigation

1. Tanker anchorage area shown are highly unlikely as they are not well sheltered.
2. Braer Area to be avoided – Post meeting note – Clarification sent by Stephen Barnes,  
*‘The waters around Orkney (excluding the Pentland Firth and Scapa Flow) are categorised by the IMO as an Area to be Avoided (ATBA).  
To avoid the risk of pollution and damage to the environment, all vessels over 5,000 GT carrying oil or other liquid hazardous cargoes in bulk, should avoid this area.’*
3. UXO – discussion on this clarified this is of low risk and was dismissed as an overall navigational risk.
4. Risk 2 - White fish trawling is undertaken this was perceived as low risk as vessels are passing and not working.
5. Risk 13 - Risk reduction provided by Notice to Mariners, sip communication (VHF) and escorts for larger vessels.



6. Risk 14 - Potential additional risk presented by BREXIT due to fisherman working in area that do not have local knowledge and experience and could be insufficiently trained and lack of understanding of Pentland firth operating during construction and trawling the area of the cable in it permanent position.
7. Risk 16 - Timing of construction is critical as in good weather risk is less likely. Extreme and spring tides could be detrimental during construction works as equipment lost at sea would take longer to recover and if bad weather is prolonged the loss of cable and equipment could become navigational hazard.
8. Risk 20 - Master operating in the Pentland Firth are under pressure passing through the firth to complete Paperwork and also skipper the vessel. This could mean that inexperience staff are operating the vessel as masters have to complete multiple duties. This should not happen as the Pentland Firth and the Minch require their full attention.
9. Risk 24 - Construction vessels could increase risk to navigation through channel. This includes increase in survey vessels moving slowly in the firth.
10. General – The procedures at sea provide significant mitigation to navigational risk. The Pentland Firth is a voluntarily monitored area by the MCA and Orkney Harbours. The use of a guard boat would reduce significantly the likelihood of collisions. The Firth is well monitored meaning the level of risk presented by passing or even working vessels in the area is significantly reduced.

## 5. Conclusion

The workshop was closed by AECOM with a brief general commentary on the above results and the participants all agreed that in their view the procedure and the results were reasonable and acceptable.

## Appendix A Metocean Data for Murkle Bay and Rackwick Bay

## 1. Metocean Data – Murkle Bay

### 1.1 Tidal Range and Storm Surge

The following tidal information is available from the Admiralty Tide Tables:

Scrabster	m CD	m OD
Mean High Water Springs (MHWS)	+5.0m CD	+2.3m OD
Mean High Water Neaps (MWHN)	+4.0m CD	+1.3m OD
Mean Low Water Neaps (MLWN)	+2.2m CD	-0.5m OD
Mean Low Water Springs (MLWS)	+1.0m CD	-1.7m OD

Table 1: Tidal Levels Scrabster. Source: Admiralty Chart No. BA2162 Pentland Firth and Approaches, 2012

In addition to regular tidal variations, total water levels include factors such as surge effects and impacts of set-up due to wind forcing. The storm surge component of the total water level is the resultant increase in sea levels caused by low pressure weather systems associated with storm events.

The following extreme water levels have been derived from the Coastal flood boundary conditions for UK mainland and islands (Project: “SC060064/TR2: Design sea levels report” published by Environment Agency in February 2011 - Table A5.1 Kinlochbervie.

Extreme Event/ Return Period (yrs)	1	2	5		10	20	50	100	200
Sea Level (m, OD)	3.19	3.28	3.41		3.51	3.61	3.74	3.84	3.94
+ Sea Rise Level (50 years*)	3.39	3.48	3.61		3.71	3.81	3.94	4.04	4.14

Table 2: Extreme Water Levels

*\*Recommends that 0.2m be added to present day levels to account for 50 years of climate change (Environment Agency, Adapting to Climate Change. Advice for Flood and Coastal Erosion Risk Management Authorities)*

### 1.2 Wind

To determine the design wind speed, BS EN 1991-1-4 2005 A1 2010 shows basic wind speed in meters per second for the British Isles. This basis wind speed can be used to determine design wind speeds at the location.

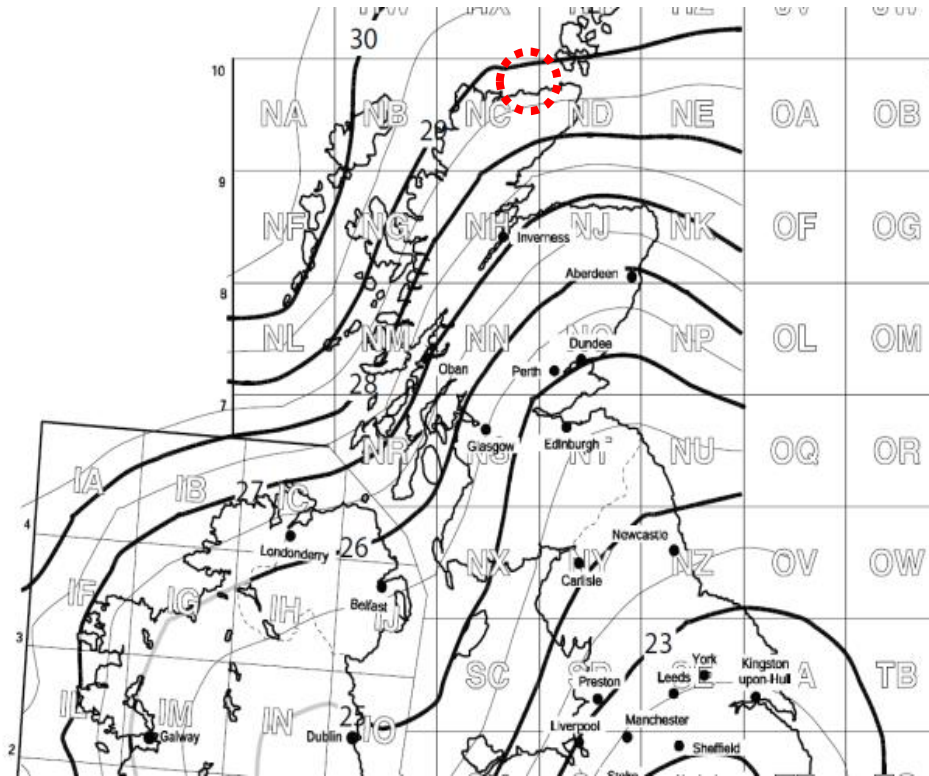


Figure 1: Value of fundamental basic wind velocity  $v_b$ , map (m/s) 50 years return period. Source: NA to BS EN 1991-1-4:2005+A1:2010.

From the figure above, it can be expected an extreme wind (50 years return period) of 28.7 m/s at the site. In order to obtain the design wind speed for the rest of the return periods (1, 5, 50, 100 year) BS 6399 Part 2 presents a wind speed ratio relative to 50 years return period. Table 3 below shows the design wind speed for the following return periods after applying the mentioned wind speed ratio.

Return Period (yr)	Wind Speed (m/s)
1	19.2
5	23.8
50	28.7
100	30.1
200	31.6

Table 3: Estimated Extreme Wind Conditions

The fundamental value of the basic wind velocity (50 year return period) shown in the table above is the characteristic 10 minutes mean wind velocity, irrespective of the wind direction and time of year, at 10m above ground.

The wind rose for Thurso, Figure 17 below, shows on how many hours per year the wind blows from the indicated direction.

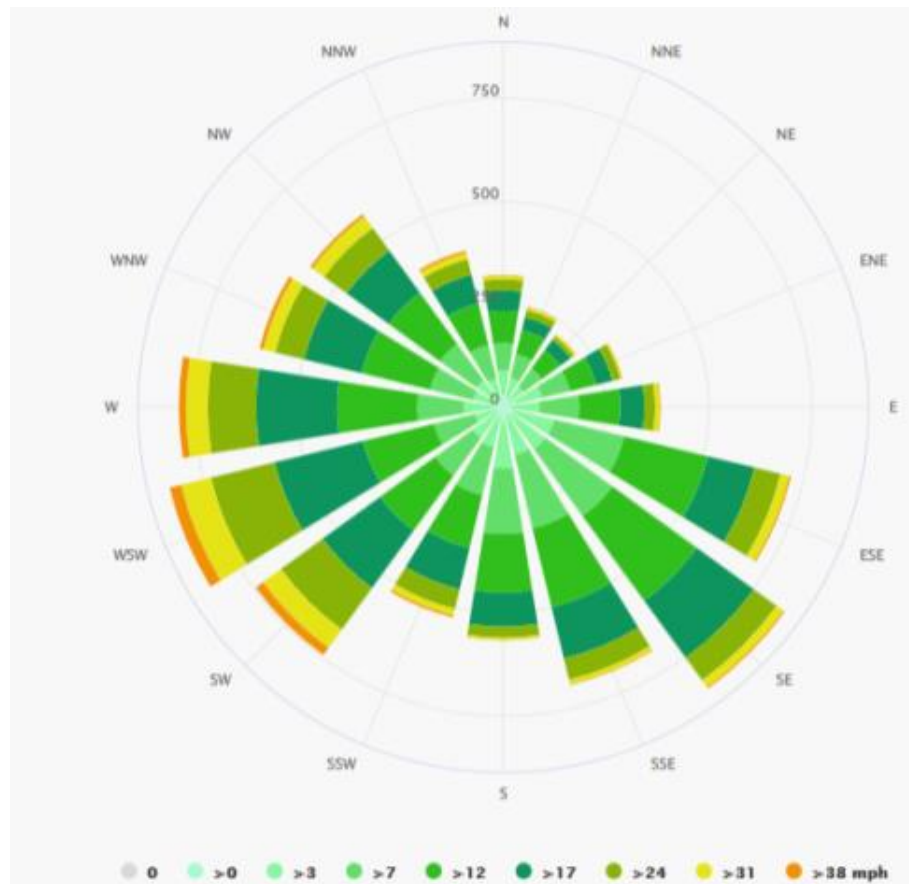


Figure 17: Thurso wind rose. Source: Meteoblue website:  
[https://www.meteoblue.com/en/weather/forecast/modelclimate/thurso\\_united-kingdom\\_2635881](https://www.meteoblue.com/en/weather/forecast/modelclimate/thurso_united-kingdom_2635881)

## 1.3 Waves

Wave heights and periods were chosen to produce the most critical combination. Wave characteristics are based on the analysis of wave hindcast and the maximum breaking wave at the site. Due to very limited data of the area, a hindcast analysis has been done according to BS EN 1991-1-4:2005 +A1 2010.

Wave heights derived from the hindcast method were checked against the maximum breaking wave and statistics found for the area. The design height adopted shall be the smaller of either the maximum breaker height or the hindcasted wave height.

### 1.3.1 Hindcast Analysis

Hindcast analysis has been undertaken for several locations to get a better understanding of the estimated waves near the area of study.



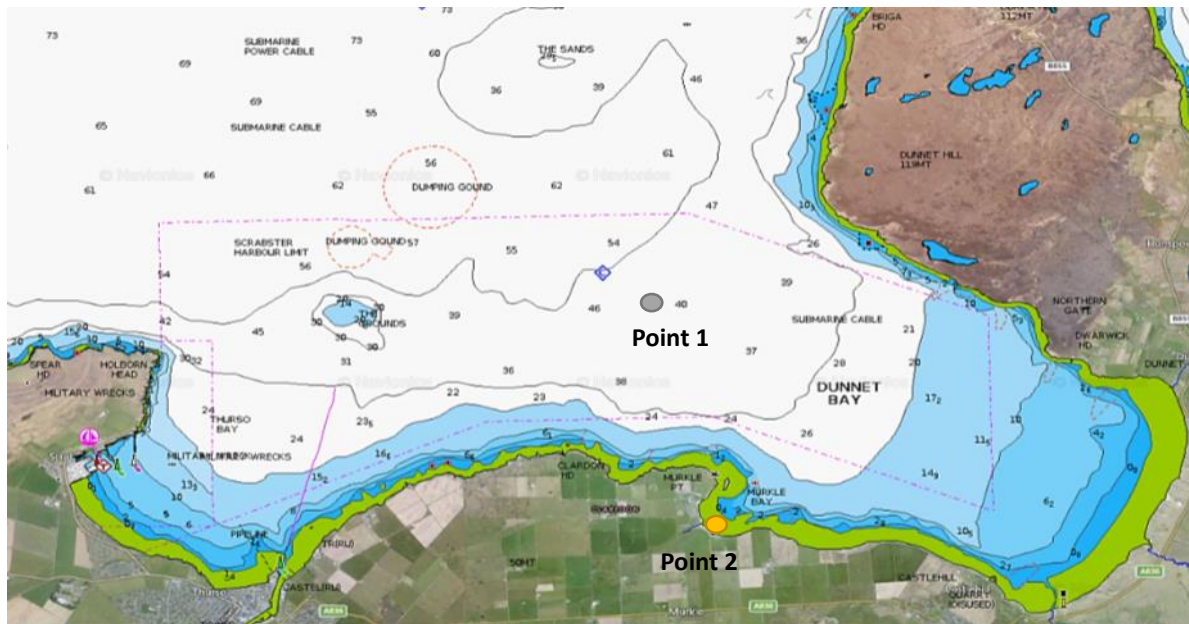


Figure 18: Hindcast analysis - Point 1 and 2 locations. Source basemap: navionics.

#### 1.3.1.1 Point near Murkle Point (P01)

At Point 1 the longest fetches are at approx. 300 to 0 degrees. The 1:200 year wind is 31.6 m/s; this results in waves of  $H_s$  between 15.7m to 26.5m. For this outline design and in order to be conservative at this stage, the coastal processes that may provoke a reduction of incident wave were not taken into consideration.

##### Return Period 100yr

Direction	0	30	60	90	120	150	180	210	240	270	300	330
	N	NNE	NEE	E	EES	ESS	S	SSW	SWW	W	WWN	WNN
Wave height (m)	<b>23.79</b>	2.13	0.64	0.94	1.14	0.93	0.75	1.25	1.49	<b>5.84</b>	<b>25.3</b>	<b>14.97</b>

##### Return Period 200yr

Direction	0	30	60	90	120	150	180	210	240	270	300	330
	N	NNE	NEE	E	EES	ESS	S	SSW	SWW	W	WWN	WNN
Wave height (m)	<b>24.92</b>	2.23	0.67	0.98	1.19	0.98	0.79	1.31	1.56	<b>6.12</b>	<b>26.5</b>	<b>15.68</b>

#### 1.3.1.2 Murkle Point (P02)

At Point 2 the longest fetches are at approx. 0 to 90 degrees. The 1:200 year wind is 31.6 m/s, this results in waves of  $H_s$  between 2.9 to 1.1m. As waves approach the coast they undergo a number of transformations such as refraction, shoaling, diffraction, dissipation due to bottom friction, wave-wave interactions and reflection. For this outline design and in order to be conservative at this stage, the coastal processes that may provoke a reduction of incident wave were not taken into consideration.

##### Return Period 100yr

Direction	0	30	60	90	120	150	180	210	240	270	300	330
	N	NNE	NEE	E	EES	ESS	S	SSW	SWW	W	WWN	WNN
Wave height (m)	<b>2.77</b>	0.95	0.98	1.05	-	-	-	-	-	-	-	0.25

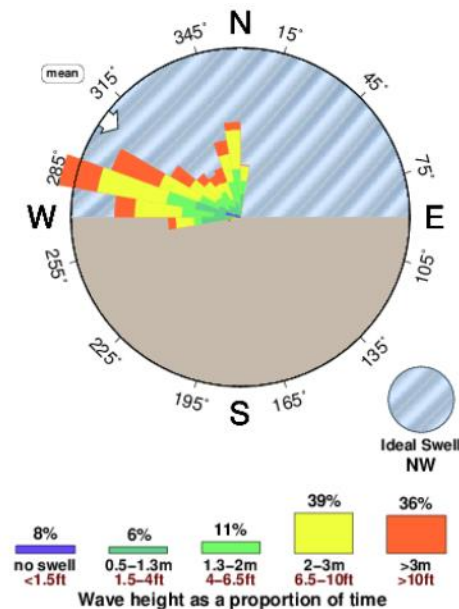
#### Return Period 200yr

Direction	0	30	60	90	120	150	180	210	240	270	300	330
	N	NNE	NEE	E	EES	ESS	S	SSW	SWW	W	WWN	WNN
Wave height (m)	2.9	1.0	1.03	1.10	-	-	-	-	-	-	-	0.26

### 1.3.2 Statistics – Murkle Point

Statistics show that the greatest wave height approaching Murkle Point with an angle of approximately 285 degrees results in wave heights greater than 3m.

Figure 19 below shows the range of swells directed at Murkle Point through an average December, and is based on 2953 NWW3 model predictions since 2006 (values every 3 hours). The wave model does not forecast surf and wind right at the shore. Therefore, this information has been used only for information as an estimate on the possible wave height reaching Murkle Point coast and to be compared with other results obtained.



75% of the wave heights are greater than 2m

17% between 0.5 to 2m

8% less than 0.5m

Figure 19: Murkle Point Swell Statistics for December. Source: [www.surf-forecast.com](http://www.surf-forecast.com)

### 1.3.3 Breaking Waves

McCowan (1894) defined a maximum wave height for solitary waves in a given water depth. This criterion is commonly used in engineering practice as a first estimate of the wave breaker height.

$$H_b = \gamma h_b$$

Where:

$\gamma=0.78$  flat seabed

$h_b$  = water depth (m)

AECOM do not hold any recent bathymetric survey of Murkle Point. The successful Contractor will have to carry out more detailed coastal modelling to derive the significant wave height and wave period for the determination of design wave loadings at the chosen shore cable landing site.

Currents at the site have been taken from Admiralty Chart BA2162 Pentland Firth and Approaches, 2012.



Hours		D		
		Directions of streams (degrees)	Rates at spring tides (knots)	Rates at neap tides (knots)
Before High Water	6	100	0.4	0.2
	5		0.0	0.0
	4	307	0.1	0.0
	3	270	0.2	0.1
	2	260	0.4	0.2
	1	262	0.6	0.3
High Water	0	248	0.5	0.3
After High Water	1	215	0.2	0.1
	2	065	0.2	0.1
	3	060	0.5	0.3
	4	084	0.6	0.3
	5	088	0.5	0.3
	6	098	0.3	0.2

## 1.5 Temperature

The averages High/Low has been extrapolated from the latest Met Office set of 30-year averages, covering the period 1981-2010, for the nearest / most similar climate station to Murkle Bay.

	Location:	Altitude:	Distance:
	Strathy East (Nearest climate station to Dunnet Bay - Murkle Bay/Dunnet (Beach))	58.561, -3.990	68.0 m above mean sea level
			37.1 km from Dunnet Bay - Murkle Bay/Dunnet (Beach)

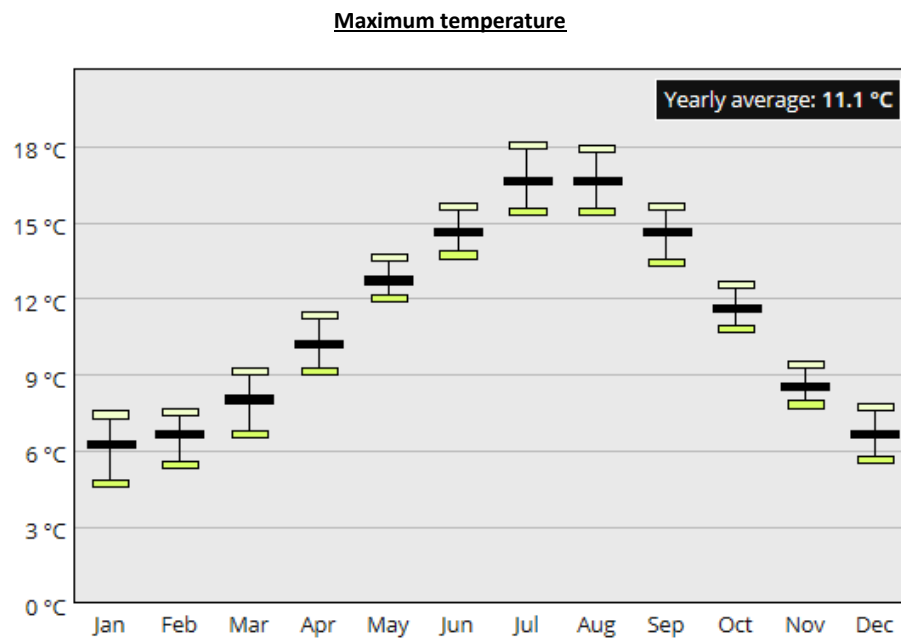


Figure 21: Maximum temperature. Source: <https://www.metoffice.gov.uk/public/weather/climate/gfmt7skdt>

### Minimum temperature

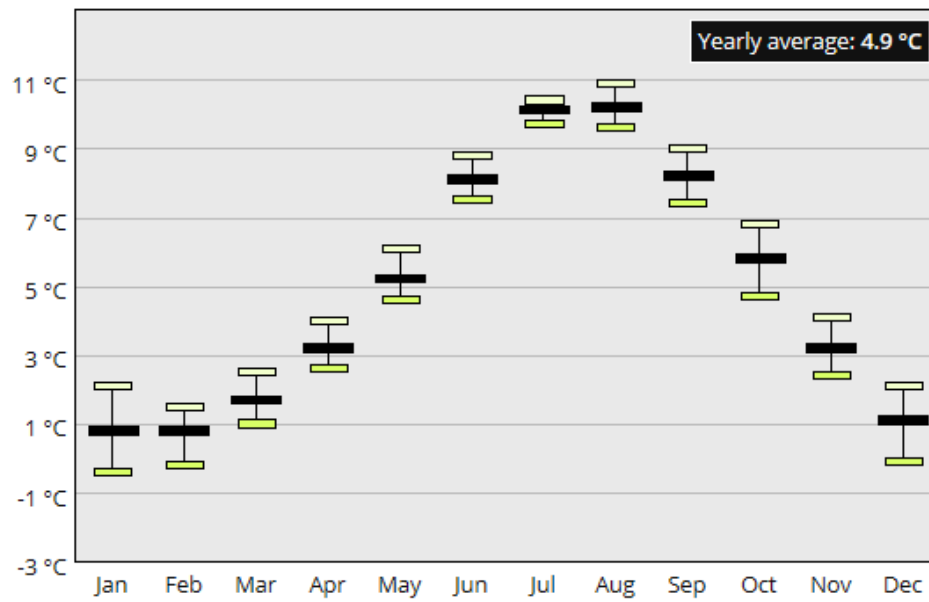


Figure 22: Minimum temperature. Source: <https://www.metoffice.gov.uk/public/weather/climate/gfmt7skdt>

## 1.6 Bathymetry

AECOM do not hold any detailed bathymetric survey for the site. For the purpose of this report, regional bathymetry was based on the Admiralty Chart BA2162 Pentland Firth and Approaches, 2012.

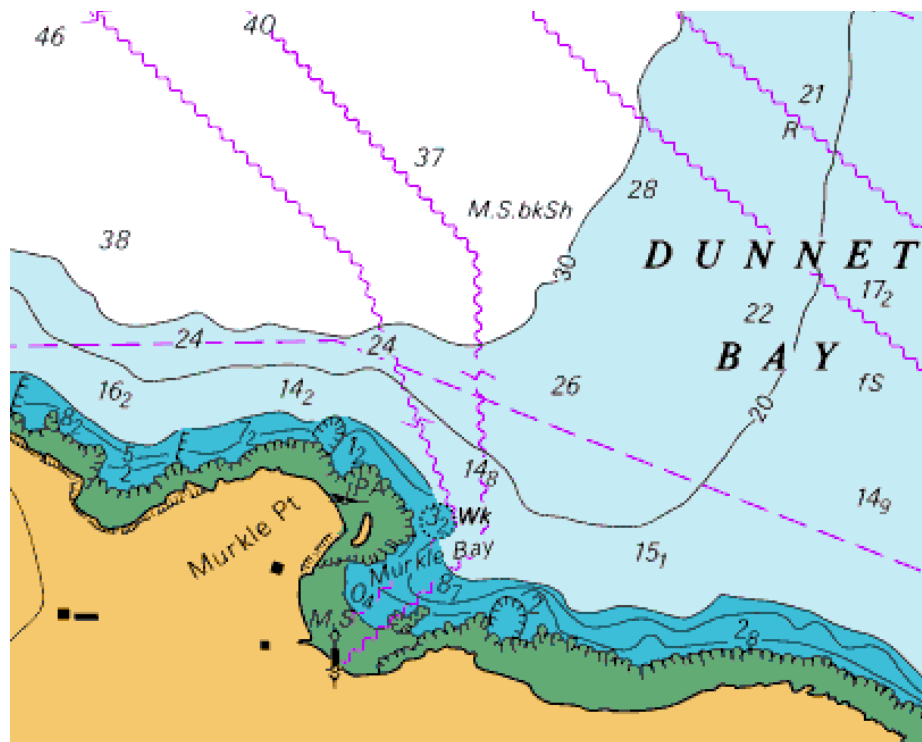


Figure 23: Murkle Bay. Source: Admiralty Chart BA2162, 2012.

## 2. Metocean data – Rackwick

### 2.1 Tidal Range and Storm Surge

The following tidal information is available from the Admiralty Tide Tables:

Stromness	m CD	m OD
Mean High Water Springs (MHWS)	+3.6m CD	+1.91m OD
Mean High Water Neaps (MWHN)	+2.7m CD	+1.01m OD
Mean Low Water Neaps (MLWN)	+1.4m CD	-0.29m OD
Mean Low Water Springs (MLWS)	+0.7m CD	-0.99m OD

Table 5: Tidal Levels Stromness. Source: Admiralty Chart No. BA2249 Orkney Islands, 2012.

In addition to regular tidal variations, total water levels include factors such as surge effects and impacts of set-up due to wind forcing. The storm surge component of the total water level is the resultant increase in sea levels caused by low pressure weather systems associated with storm events.

The following extreme water levels have been derived from the Coastal flood boundary conditions for UK mainland and islands (Project: “SC060064/TR2: Design sea levels report” published by Environment Agency in February 2011 - Table A5.1 Lerwick.

Extreme Event/ Return Period (years)	1	2	5	10	20	50	100	200
Sea Level (m, levels referenced to Local Datum)	1.52	1.57	1.64	1.69	1.73	1.79	1.83	1.87
+ Sea Rise Level (50 years*)	1.72	1.77	1.88	1.89	1.93	1.99	2.03	2.07

Table 6: Extreme Water Levels

*\*Recommends that 0.2m be added to present day levels to account for 50 years of climate change (Environment Agency, Adapting to Climate Change. Advice for Flood and Coastal Erosion Risk Management Authorities)*

### 2.2 Wind

To determine the design wind speed, BS EN 1991-1-4 2005 A1 2010 shows basic wind speed in meters per second for the British Isles. This basis wind speed can be used to determine design wind speeds at the location.



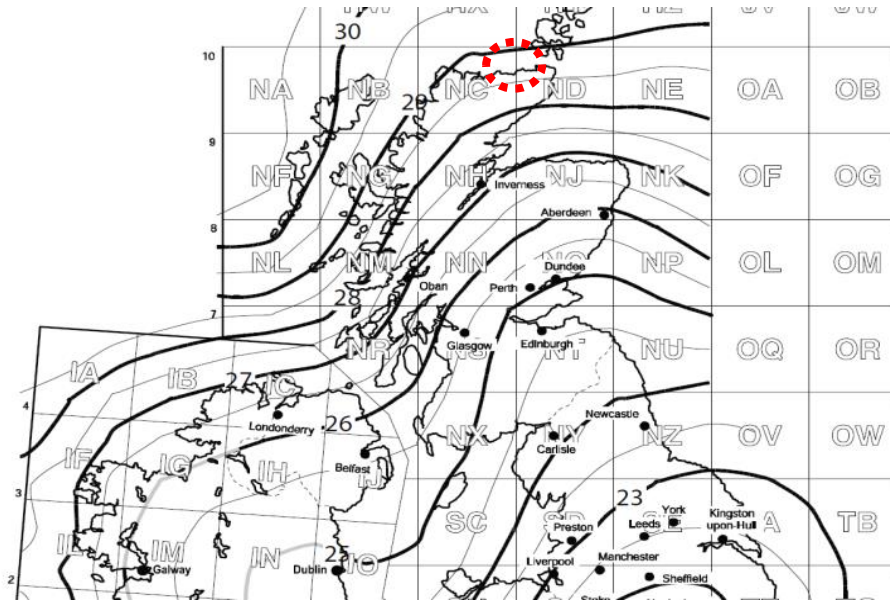


Figure 24: Value of fundamental basic wind velocity  $v_{b,map}$  (m/s) 50 years return period. Source: NA to BS EN 1991-1-4:2005+A1:2010.

From the figure above, it can be expected an extreme wind (50 years return period) of 28.9 m/s at the site. In order to obtain the design wind speed for the rest of the return periods (1, 5, 50, 100 year) BS 6399 Part 2 presents a wind speed ratio relative to 50 years return period. Table 7 below shows the design wind speed for the following return periods after applying the mentioned wind speed ratio.

Return Period (yr)	Wind Speed (m/s)
1	19.4
5	24
50	28.9
100	30.3
200	31.8

Table 7: Estimated Extreme Wind Conditions.

The fundamental value of the basic wind velocity (50 year return period) shown in the table above is the characteristic 10 minutes mean wind velocity, irrespective of the wind direction and time of year, at 10m above ground.

The wind rose for Stromness, Figure 25 below, shows on how many hours per year the wind blows from the indicated direction.

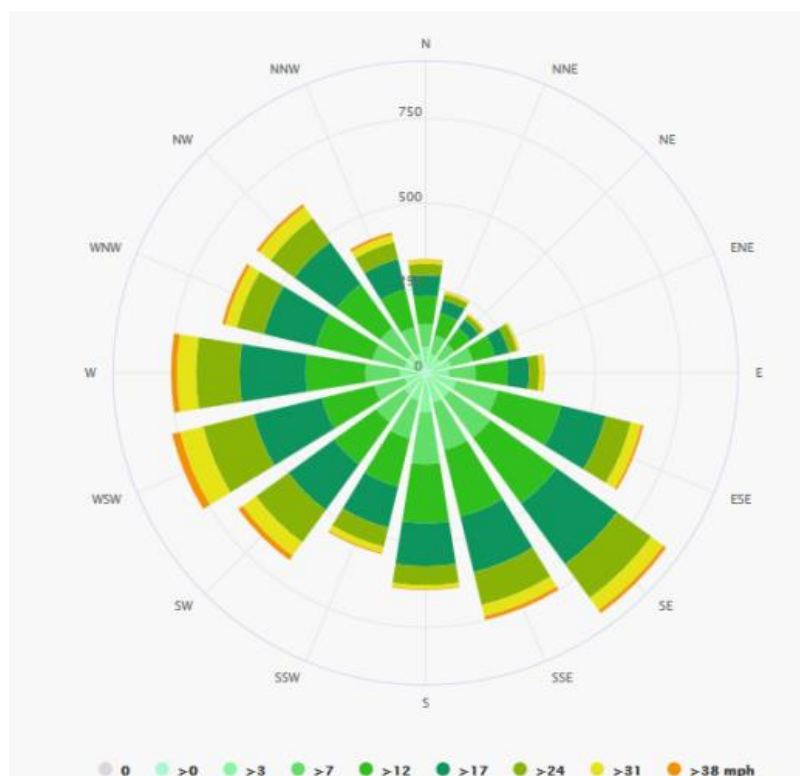


Figure 25: Stromness wind rose. Source: Meteoblue website:  
[https://www.meteoblue.com/en/weather/forecast/modelclimate/stromness\\_united-kingdom\\_2636638](https://www.meteoblue.com/en/weather/forecast/modelclimate/stromness_united-kingdom_2636638)

## 2.3 Waves

Wave heights and periods were chosen to produce the most critical combination. Wave characteristics are based on the analysis of wave hindcast and the maximum breaking wave at the site. Due to very limited data of the area, a hindcast analysis has been done according to BS EN 1991-1-4:2005 +A1 2010.

Wave heights derived from the hindcast method were checked against the maximum breaking wave and statistics found for the area. The design height adopted shall be the smaller of either the maximum breaker height or the hindcasted wave height.

### 2.3.1 Hindcast Analysis

At Rackwick point the longest fetchs are at approx. 210 to 300 degrees. The 1:200 year wind is 31.8 m/s, this results in waves of  $H_s$  between 3.8 to 35m. As waves approach the coast they undergo a number of transformations such as refraction, shoaling, diffraction, dissipation due to bottom friction, wave-wave interactions and reflection. For this outline design and in order to be conservative at this stage, the coastal processes that may provoke a reduction of incident wave were not taken into consideration.

#### Return Period 100yr

Direction	0	30	60	90	120	150	180	210	240	270*	300	330
	N	NNE	NEE	E	EES	ESS	S	SSW	SWW	W	WWN	WNN
Wave height (m)	-	-	-	-	-	0.43	2.52	3.81	5	34.07	0.47	-

#### Return Period 200yr

Direction	0	30	60	90	120	150	180	210	240	270*	300	330
	N	NNE	NEE	E	EES	ESS	S	SSW	SWW	W	WWN	WNN
Wave height (m)	-	-	-	-	-	0.45	2.64	4	5.2	35.6	0.48	-

\*Fetch at 270° is up to Canada, an estimated value of 3000km has been considered to undertake hindcast calculations.

As mentioned in section above, hindcast results shall be checked against the maximum breaking wave that the design still-water level depth and near-shore bottom slope can support. This will define the maximum wave, especially on big waves approaching the coast.

### 2.3.2 Statistics – Rackwick

Statistics show that the greatest wave heights approaching Rackwick with an angle of approximate 240-290 degrees are greater than 3m.

Figure 26 below shows the range of swells directed at Rackwick through an average December and is based on 2953 NWW3 model predictions since 2006 (values every 3 hours). The wave model does not forecast surf and wind right at the shore. Therefore, this information has been used only for information as estimation on the possible wave height reaching Rackwick coast and to be compared with other results obtained.

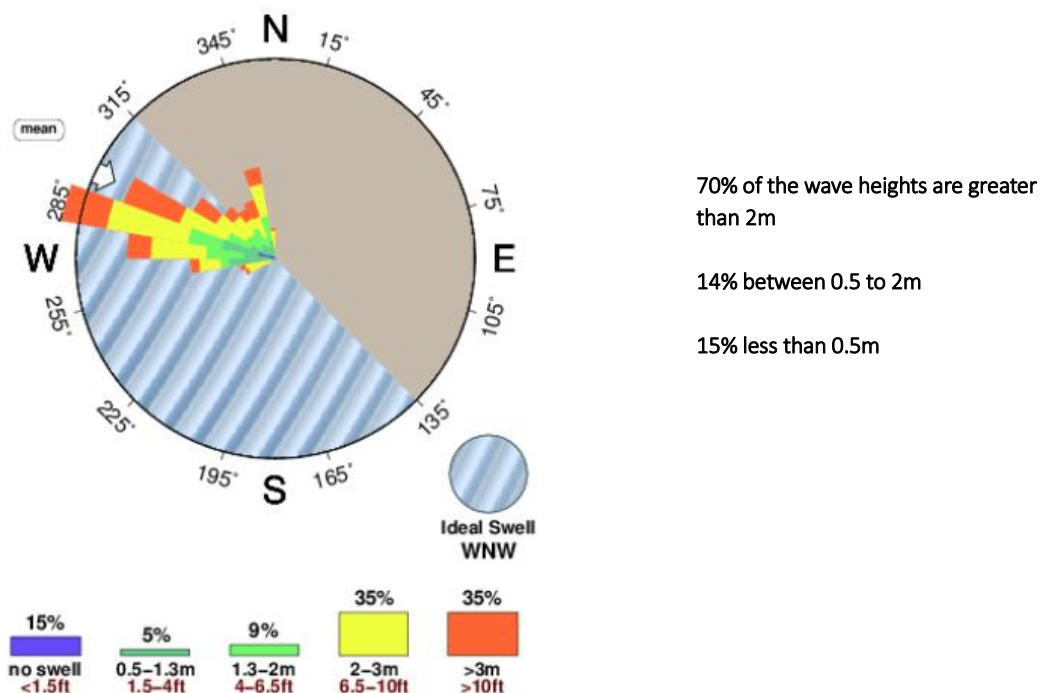


Figure 26: Rackwick Swell Statistics for December. Source: [www.surf-forecast.com](http://www.surf-forecast.com)

### 2.3.3 Breaking Waves

McCowan (1894) defined a maximum wave height for solitary waves in a given water depth. This criterion is commonly used in engineering practice as a first estimate of the wave breaker height.

$$H_b = \gamma h_b$$

Where:

$\gamma=0.78$  flat seabed

$h_b$  = water depth (m)

AECOM do not hold any recent bathymetric survey of Rackwick. The successful Contractor will have to carry out more detailed coastal modelling to derive the significant wave height and wave period for the determination of design wave loadings at the chosen shore cable landing site.

## 2.4 Currents

Currents at the site have been taken from Admiralty Chart BA2162 Pentland Firth and Approaches, 2012.

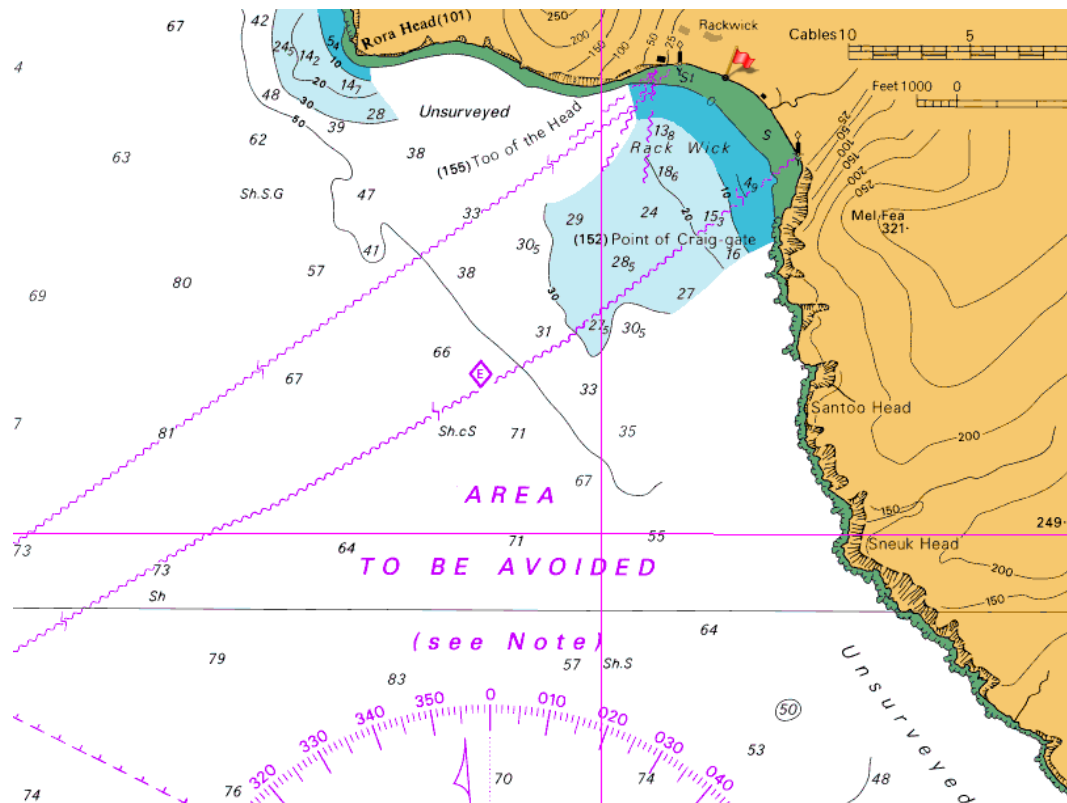


Figure 27: Tidal Streams Points. Source: Admiralty Chart BA2162 Pentland Firth and Approaches, 2012.

Table 8: Tidal Strems referred to HW at Aberdeen. Source: Admiralty Chart BA2162 Pentland Firth and Approached, 2012.

Hours		E		
		Directions of streams (degrees)	Rates at spring tides (knots)	Rates at neap tides (knots)
Before High Water	6	136	1.5	0.8
	5	130	1.0	0.6
	4	132	0.7	0.4
	3	083	0.3	0.2
	2	350	0.6	0.3
	1	333	0.8	0.5
High Water	0	323	1.0	0.6
After High Water	1	319	1.2	0.7
	2	326	0.9	0.5
	3	330	0.1	0.1
	4	134	0.4	0.2
	5	123	0.6	0.3
	6	134	1.8	1.0

## 2.4.1 Currents at approximately Midpoint of the Proposed Cable location

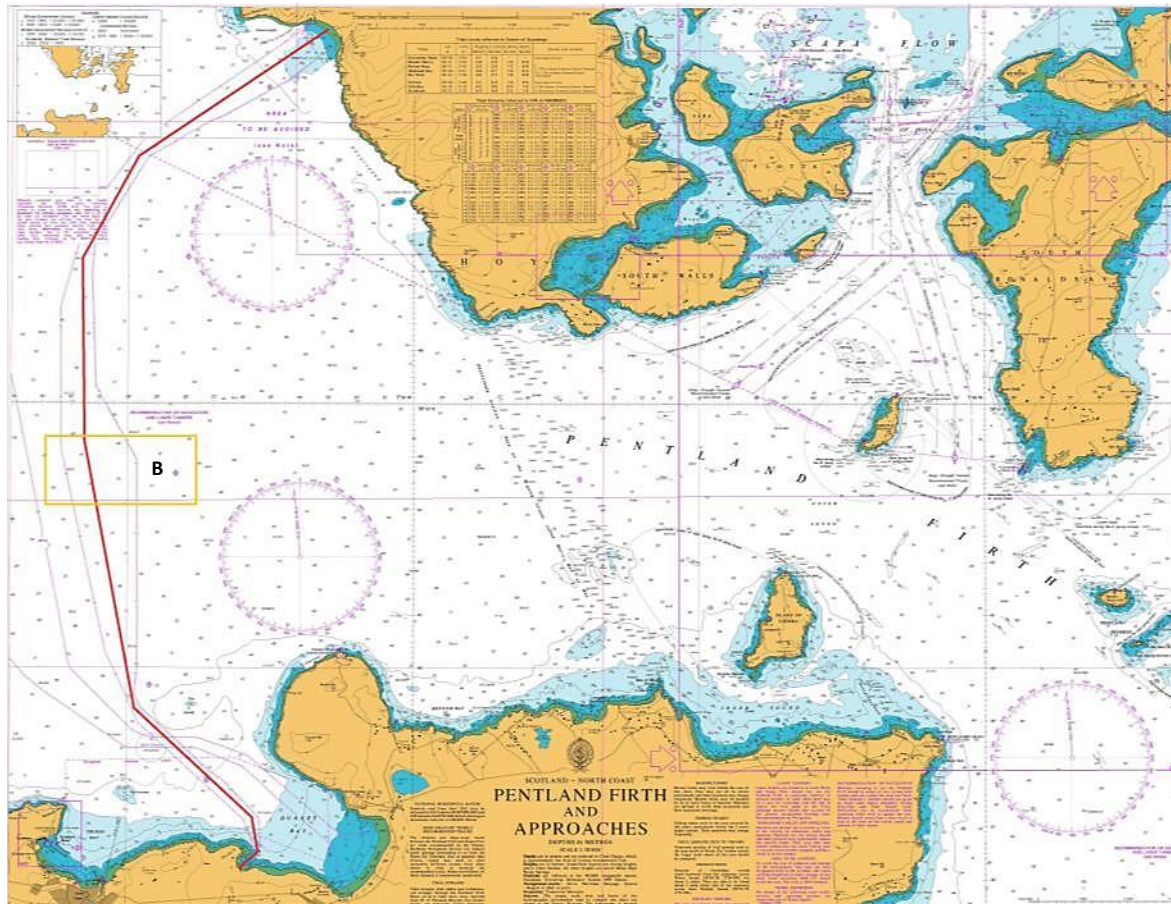


Figure 28: Admiralty Chart BA2126, 2012

Table 9: Tidal Strems referred to HW at Aberdeen. Source: Admiralty Chart BA2162 Pentland Firth and Approached, 2012.

Hours		B		
		Directions of streams (degrees)	Rates at spring tides (knots)	Rates at neap tides (knots)
Before High Water	6	116	1.4	0.8
	5	105	1.6	0.9
	4	097	1.2	0.7
	3	094	0.8	0.5
	2	066	0.2	0.1
	1	318	0.6	0.3
High Water	0	299	0.9	0.5
After High Water	1	284	1.2	0.7
	2	280	1.5	0.8
	3	268	1.4	0.8
	4	252	0.9	0.5
	5	140	0.3	0.2
	6	113	1.1	0.6

## 2.5 Temperature

The averages High/Low has been extrapolated from the latest Met Office set of 30-year averages, covering the period 1981-2010, for the nearest / most similar climate station to Rackwick.

Location:	Altitude:	Distance:
Orkney: Loch of Hundland	59.113, -3.228	28.0 m above MSL 16.7 km from Stromness

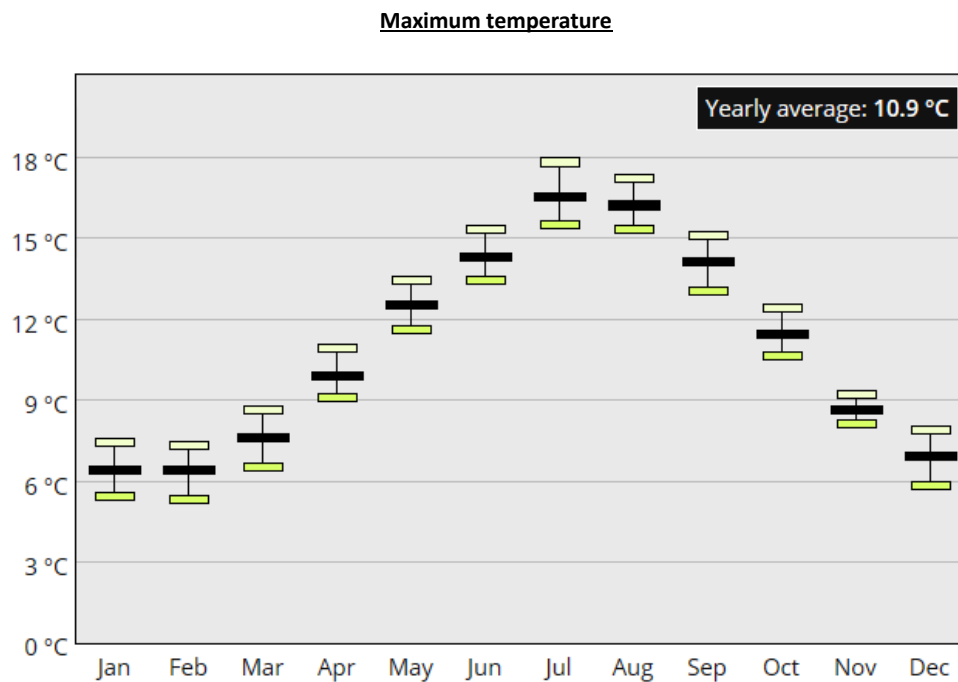


Figure 29: Maximum temperature. Source: <https://www.metoffice.gov.uk/public/weather/climate/gfmxmphm1>

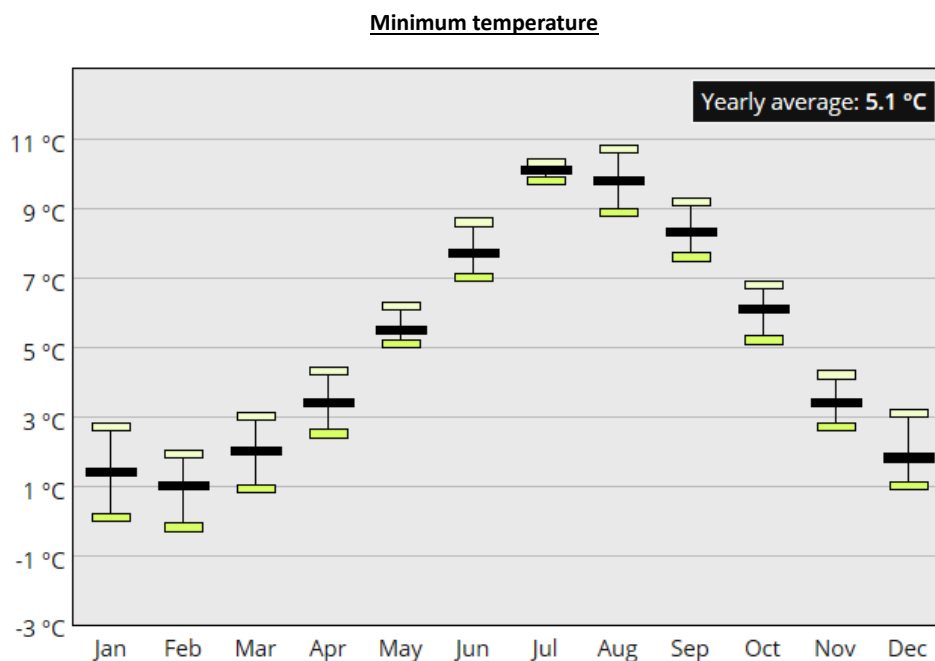


Figure 30: Minimum temperature. Source: <https://www.metoffice.gov.uk/public/weather/climate/gfmxmphm1>



## 2.6 Bathymetry

AECOM do not hold any detailed bathymetric survey for the site. For the purpose of this report, regional bathymetry was based on the Admiralty Chart BA2162 Pentland Firth and Approaches, 2012.

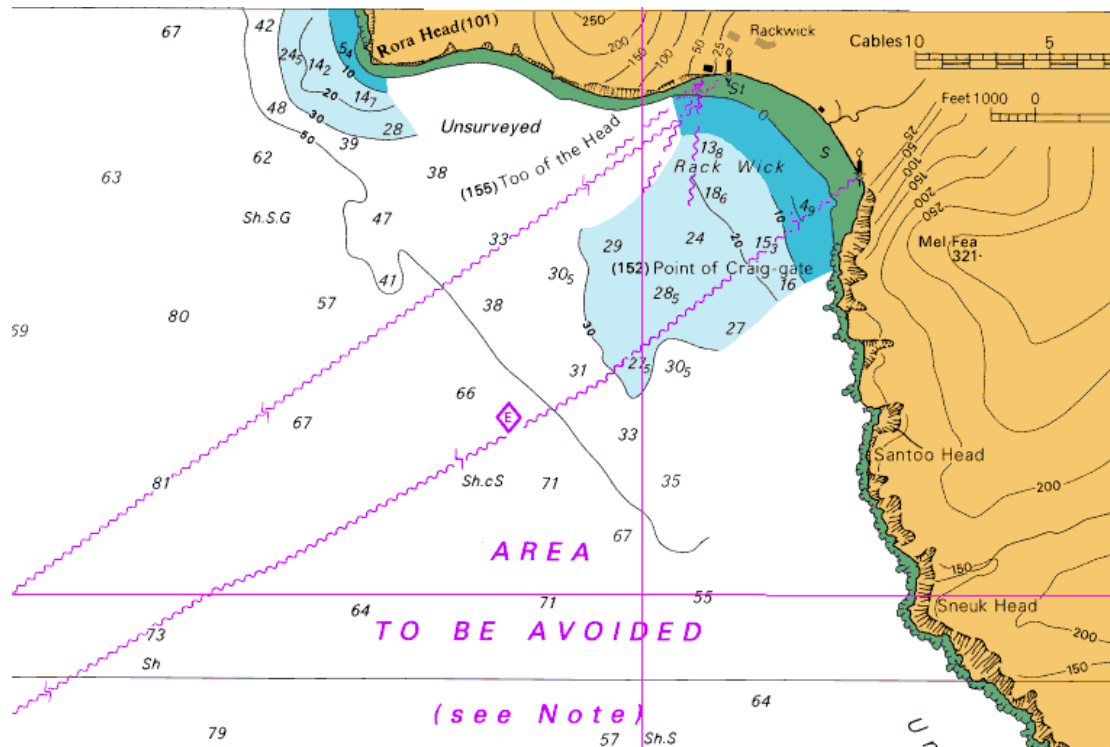


Figure 31: Rackwick. Source: Admiralty Chart BA2162, 2012

## 2.7 Historical Data available

AECOM have undertaken a desk study on available information for the area regarding metocean data. Figure 32 below shows different points near the area that provide historical data on a mean climatic year.

AECOM do not hold any historical data on extreme conditions. However, in absence of this, the information shown below will provide a better understanding of the mean/average conditions expected on site.

### Point Information

Longitude:	3.50° W
Latitude:	59.00° N
Data sampling:	1 h
Code:	1066136
First record date:	04-01-1958
Data Set:	SIMAR point

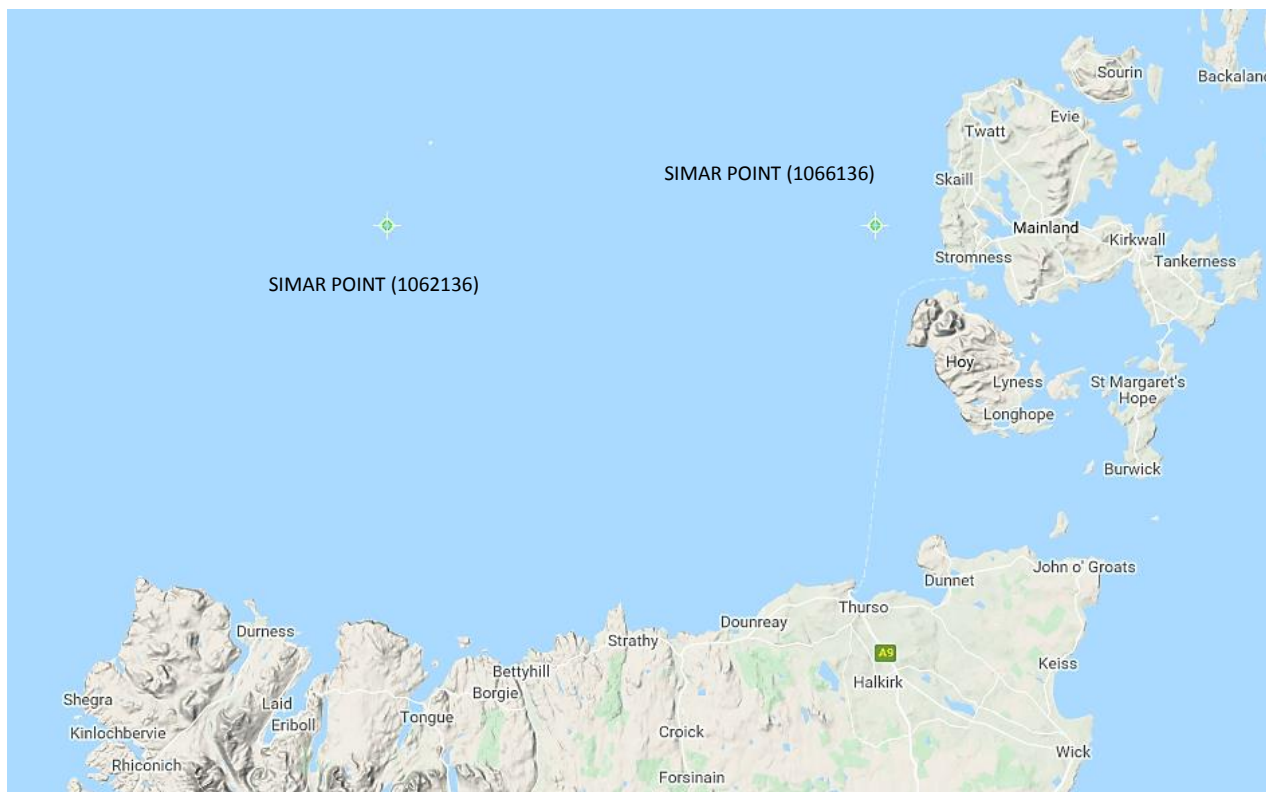
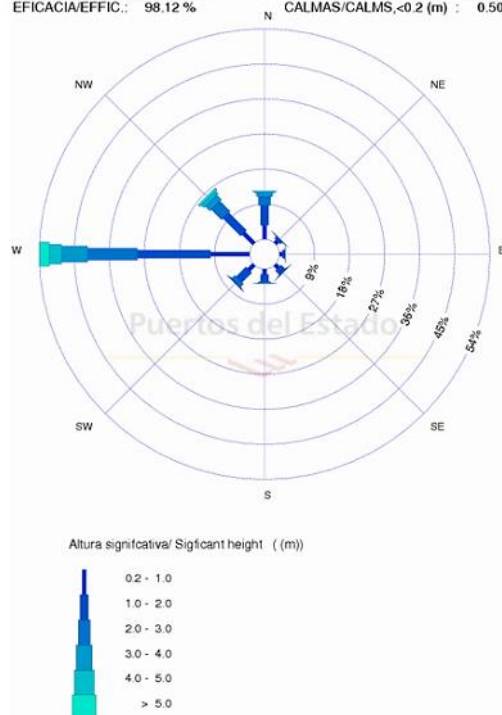


Figure 32: SIMAR Point. Source: [www.Puertos.es](http://www.Puertos.es)

**SIGNIFICANT HEIGHT ROSE at SIMAR Point 1066136 , period 1958-2019**  
 LUGAR/LOCATION: SIMAR 1066136 MUESTREO/SAMPLING: 1Hor.  
 PERIODO/PERIOD: 1958-2019 INTERVALO/INTERVAL: Global  
 EFICACIA/EFFIC.: 98.12 % CALMAS/CALMS,<0.2 (m) : 0.50 %



La eficacia del proceso de medida para el periodo seleccionado fue de un 98.12 % de datos validos.  
 Las Direcciones son Direcciones de Procedencia  
 Efficiency: 98.12 % of valid data. Angles refer to coming-from directions

Figure 33: Significant Height Rose at SIMAR Point 1066136. Source: [www.puertos.es](http://www.puertos.es)

EFICACIA: 98.05% AÑO/YEAR: 1958-2019		Tp (s)											
		<=1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	>10.0	TOTAL
Hs (m)	<=0.5	---	---	0.039	0.143	0.169	0.514	0.851	1.100	0.845	0.617	0.717	4.997
	1.0	---	---	0.066	1.648	0.671	1.110	2.441	3.236	3.214	2.909	3.542	18.837
	1.5	---	---	0.005	0.423	1.759	1.087	1.775	3.081	3.287	3.849	6.202	21.468
	2.0	---	---	0.004	0.065	0.766	1.028	1.200	1.969	2.238	2.833	6.714	16.817
	2.5	---	---	0.002	0.037	0.110	0.357	0.845	1.260	1.497	1.949	6.032	12.090
	3.0	---	---	0.002	0.025	0.057	0.124	0.335	0.805	1.007	1.219	4.788	8.361
	3.5	---	---	---	0.019	0.035	0.038	0.096	0.370	0.701	0.927	3.553	5.741
	4.0	---	---	---	0.008	0.018	0.017	0.034	0.130	0.371	0.697	2.657	3.931
	4.5	---	---	---	0.003	0.018	0.013	0.013	0.033	0.139	0.478	1.965	2.662
	5.0	---	---	---	0.002	0.006	0.005	0.005	0.010	0.030	0.243	1.503	1.804
	> 5.0	---	---	---	0.003	0.006	0.004	0.003	0.018	0.020	0.120	3.118	3.292
	TOTAL	---	---	0.119	2.376	3.613	4.297	7.598	12.013	13.350	15.842	40.791	100%

Figure 34: Hs vs Tp - SIMAR Point 1066136. Source: [www.puertos.es](http://www.puertos.es)

From results shown on Figure 34 above, the following observations can be made:

- Waves with a period  $\leq 10$ s presents 59.3%;
- Periods greater than 10s represents approx. the 41%;
- Waves greater than 3m represents the 17.5%; and
- Waves from 1.5 to 3m represents the 58.7%.

#### Table of Height Monthly Maximums - 2018

Hs:	Waves Significant Height	meters
Tp:	Peak Period	seconds
Dir:	Mean Direction, "coming from"	0= North; 90= East

Punto SIMAR 1066136 Año 2018 / SIMAR Point 1066136 Year 2018					
Mes/Month	Hs Max./Max. Hs	Tp	Dir	Día/Day	Hora/Hour
Enero/January	14.64	17.74	274	27	22
Febrero/February	7.69	17.74	264	15	21
Marzo/March	4.33	9.10	285	23	19
Abril/April	3.32	17.74	263	12	16
Mayo/May	4.58	17.74	258	10	05
Junio/June	7.47	12.11	267	14	18
Julio/July	2.38	6.83	157	29	04
Agosto/August	5.74	12.11	268	18	13
Septiembre/September	6.12	14.66	284	30	01
Octubre/October	8.36	14.66	281	23	00
Noviembre/November	5.74	13.32	252	30	12
Diciembre/December	7.08	13.32	277	31	21

Figure 35: Table of Waves - Monthly Maximum Heights. SIMAR Point 1066136 Year 2018. Source: [www.puertos.es](http://www.puertos.es)

## Appendix B Output Data from Navigation Risk Assessment

RISK ASSESSMENT MATRIX: RISK CRITERIA		FREQUENCY				
		Level 1	Level 2	Level 3	Level 4	Level 5
		Rare	Unlikely	Possible	Likely	Almost certain
		One or more times greater than 200	One or more times 100 year	One or more times in 10 years	One or more times per year	Ten or more times per year
Consequences	5- Loss of vessel or severe damage to vessel. Multiple fatalities International news coverage. Serious long-term impact on environment and or permanent effects	Moderate(5)	High (10)	Extreme (15)	Extreme(20)	Extreme(25)
	4- Major damage to vessel. Single fatality. National news coverage. Significant impact on environment with short-term or long-term effects	Minor (4)	Moderate (8)	High (12)	Extreme (16)	Extreme(20)
	3- Moderate damage to vessel. Moderate/major injury. Regional news coverage. Limited impact on environment with short term or long term effects	Minor (3)	Moderate (6)	Moderate (9)	High (12)	Extreme (15)
	2- Minor or superficial damage to vessel. Minor injuries and local news coverage. Minor impact on environment with no lasting effects.	Slight (2)	Minor (4)	Moderate (6)	Moderate (8)	High (10)
	1- Insignificant or no damage to vessel/equipment. No injuries. Insignificant impact on environment	Slight(1)	Slight (2)	Minor (3)	Minor (4)	Moderate(5)
Action Key	Slight (1-2)	No action is required				
	Minor (3-4)	No additional control are required, monitoring is required to ensure no changes in circumstances				
	Moderate (5-9)	Efforts should be made to reduce risk to "As low as reasonable practicable" (ALARP) but activity may be undertaken				
	High (10-14)	Efforts should be made to reduce risk to "As low as reasonable practicable" (ALARP). Activity can only be undertaken with further additional controls				
	Extreme (15-25)	Intolerable risk. Activity no authorised				

Prepared :=.....

<u>Nr</u>	<u>Hazard</u>	<u>Frequency</u> (1-5)	<u>Consequence</u> (1-5)
1	Passing (Commercial) vessel powered allision with marine cable (with Protection)	1	4
2	Passing (Fishing) Vessel powered allision with marine cable (with Protection)	1	4
3	Passing (Recreational) Vessel powered allision with marine cable (with Protection)	1	3
4	Passing (Commercial) vessel drifting allision with marine cable (with Protection)	1	4
5	Passing (Fishing) Vessel drifting allision with marine cable (with Protection)	1	4
6	Passing (Recreational) Vessel drifting allision with marine cable	1	3
7	Passing (Commercial) vessel powered allision with cable landing site	1	5
8	Passing (Fishing) Vessel powered allision with cable landing site	1	4
9	Passing (Recreational) Vessel powered allision with cable landing site	1	3
10	Passing (Commercial) vessel drifting allision with cable landing site	1	4
11	Passing (Fishing) Vessel drifting allision with cable landing site	1	3
12	Passing (Recreational) Vessel drifting allision with cable landing site	1	2
13	Construction activity - Displacement of Vessels due to Avoidance of Site Leading to Increased Vessel-to-Vessel Collision Risk	2	5
14	Fishing Gear Interaction by demersal trawl (Rackwick)	1	5
15	Vessel anchoring on or dragging anchor over marine cable	1	3.5
16	Loss of cable or equipment from construction associated vessels	2	3
17	Deliberate damage to cable (at landing sites)	1	1
18	Experience of staff, available on passing ships during the construction phase (Exxon Valdez)	1	5
19	Unfavourable Tidal Conditions during Construction	4	4
20	Collision between passing vessel and construction vessel (at site or en route)	2	5
21	Dropped object (Floating)	2	3
22	Man Overboard	2	5
23	Adverse Environmental conditions (wind, Wave, current, etc) - Construction	4	5
24			
25			
26			
27			
28			
29			

RISK ASSESSMENT MATRIX: RISK CRITERIA		FREQUENCY				
		Level 1	Level 2	Level 3	Level 4	Level 5
		Rare	Unlikely	Possible	Likely	Almost certain
		One or more times greater than 200	One or more times 100 year	One or more times in 10 years	One or more times per year	Ten or more times per year
Consequences	5- Loss of vessel or severe damage to vessel. Multiple fatalities International news coverage. Serious long-term impact on environment and or permanent effects	Moderate(5)	High (10)	Extreme (15)	Extreme(20)	Extreme(25)
	4- Major damage to vessel. Single fatality. National news coverage. Significant impact on environment with short-term or long-term effects	Minor (4)	Moderate (8)	High (12)	Extreme (16)	Extreme(20)
	3- Moderate damage to vessel. Moderate/major injury. Regional news coverage. Limited impact on environment with short term or long term effects	Minor (3)	Moderate (6)	Moderate (9)	High (12)	Extreme (15)
	2- Minor or superficial damage to vessel. Minor injuries and local news coverage. Minor impact on environment with no lasting effects.	Slight (2)	Minor (4)	Moderate (6)	Moderate (8)	High (10)
	1- Insignificant or no damage to vessel/equipment. No injuries. Insignificant impact on environment	Slight(1)	Slight (2)	Minor (3)	Minor (4)	Moderate(5)
Action Key	Slight (1-2)	No action is required				
	Minor (3-4)	No additional control are required, monitoring is required to ensure no changes in circumstances				
	Moderate (5-9)	Efforts should be made to reduce risk to "As low as reasonable practicable" (ALARP) but activity may be undertaken				
	High (10-14)	Efforts should be made to reduce risk to "As low as reasonable practicable" (ALARP). Activity can only be undertaken with further additional controls				
	Extreme (15-25)	Intolerable risk. Activity no authorised				

Prepared :=.....

**Nr Hazard**
**Frequency**  
**(1-5)**
**Consequence**  
**(1-5)**

30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
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60  
61  
62  
63



RISK ASSESSMENT MATRIX: RISK CRITERIA		FREQUENCY				
		Level 1	Level 2	Level 3	Level 4	Level 5
		Rare	Unlikely	Possible	Likely	Almost certain
		One or more times greater than 200	One or more times 100 year	One or more times in 10 years	One or more times per year	Ten or more times per year
Consequences	5- Loss of vessel or severe damage to vessel. Multiple fatalities International news coverage. Serious long-term impact on environment and or permanent effects	Moderate(5)	High (10)	Extreme (15)	Extreme(20)	Extreme(25)
	4- Major damage to vessel. Single fatality. National news coverage. Significant impact on environment with short-term or long-term effects	Minor (4)	Moderate (8)	High (12)	Extreme (16)	Extreme(20)
	3- Moderate damage to vessel. Moderate/major injury. Regional news coverage. Limited impact on environment with short term or long term effects	Minor (3)	Moderate (6)	Moderate (9)	High (12)	Extreme (15)
	2- Minor or superficial damage to vessel. Minor injuries and local news coverage. Minor impact on environment with no lasting effects.	Slight (2)	Minor (4)	Moderate (6)	Moderate (8)	High (10)
	1- Insignificant or no damage to vessel/equipment. No injuries. Insignificant impact on environment	Slight(1)	Slight (2)	Minor (3)	Minor (4)	Moderate(5)
Action Key	Slight (1-2)	No action is required				
	Minor (3-4)	No additional control are required, monitoring is required to ensure no changes in circumstances				
	Moderate (5-9)	Efforts should be made to reduce risk to "As low as reasonable practicable" (ALARP) but activity may be undertaken				
	High (10-14)	Efforts should be made to reduce risk to "As low as reasonable practicable" (ALARP). Activity can only be undertaken with further additional controls				
	Extreme (15-25)	Intolerable risk. Activity no authorised				

Prepared :=.....

**Nr** **Hazard**
**Frequency** **Consequence**  
**(1-5)** **(1-5)**

64  
65  
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Fill grey cells

PENTLAND FIRTH EAST SUBMARINE CABLE REPLACEMENT - KIRKWALL NAVIGATIONAL RISK ASSESSEMENT

NAVIGATIONAL RISK ASSESSEMENTS													
Hzd Nr.	AGREED HAZARD	Workshop	Workshop	BASE LINE	HAZARD	HAZARD	MITIGATION	RISK Control measures	% reduce	%reduce	INDIVIDUAL	CUMULATIVE RISK SCORE MITIGATED	Result
		Survey	Survey						RISK				
		Averaged	Averaged						CONTROL				
		Likelihood	CON										
					Likelihood/Cause	CONSequence	Y/N		USER ASSESSED	USER ASSESSED			
1	Passing (Commercial) vessel powered allision with marine cable (with Protection)	1.0	4.0	4.0			Y				4.0	4.0	Minor
					Adverse Weather	injury to public	y	Cable is mapped and position is relatively well known and communicated	90	0	0.0	4.0	
					Equipment Failure	minor damage to vessel	n		0	0		4.0	
					Human error	damage to cable	n		0	0		4.0	
					Lack of awareness/experience	damage to cable laying vessel	n		0	0		4.0	
					if vessel close to shore	negligible environmental damage	n		0	0		4.0	
					if vessel close to laying vessel	disruption to electricity supply	n		0	0		4.0	
					maneouivering error	disruption to cable laying op.	n		0	0		4.0	
					Poor Visibility		n		0	0		4.0	
					Navigational Aid Failure		n		0	0		4.0	
Watchkeeper failure		n		0	0		4.0	Minor					
2	Passing (Fishing) Vessel powered allision with marine cable (with Protection)	1.0	4.0	4.0			Y				4.0	4.0	Minor
					Adverse Weather	injury to public	n		0	0		4.0	
					Equipment Failure	minor damage to vessel	n		0	0		4.0	
					Human error	damage to cable	n		0	0		4.0	
					Lack of awareness/experience	damage to cable laying vessel	n		0	0		4.0	
					if vessel close to shore	negligible environmental damage	n		0	0		4.0	
					if vessel close to laying vessel	disruption to electricity supply	n		0	0		4.0	
					maneouivering error	disruption to cable laying op.	n		0	0		4.0	
					Poor Visibility		n		0	0		4.0	
					Navigational Aid Failure		n		0	0		4.0	
gear snagging		n		0	0		4.0	Minor					
3	Passing (Recreational) Vessel powered allision with marine cable (with Protection)	1.0	3.0	3.0			Y				3.0	3.0	Minor
					Adverse Weather	injury to public	n		0	0		3.0	
					Equipment Failure	minor damage to vessel	n		0	0		3.0	
					Human error	damage to cable	n		0	0		3.0	
					Lack of awareness/experience	damage to cable laying vessel	n		0	0		3.0	
					if vessel close to shore	negligible environmental damage	n		0	0		3.0	
					if vessel close to laying vessel	disruption to electricity supply	n		0	0		3.0	
					maneouivering error	disruption to cable laying op.	n		0	0		3.0	
					Poor Visibility		n		0	0		3.0	
					Navigational Aid Failure		n		0	0		3.0	
Watchkeeper failure		n		0	0		3.0	Minor					
4	Passing (Commercial) vessel drifting allision with marine cable (with Protection)	1.0	4.0	4.0			Y				4.0	4.0	Minor
					Adverse Weather	injury to public	n	Use correct bath charts	0	0		4.0	
					Equipment Failure	minor damage to vessel	n	Regular berth maintenance sonar	0	0		4.0	
					Human error	damage to cable	n	Depth sounder procedure on vessel	0	0		4.0	
					Lack of awareness/experience	damage to cable laying vessel	n	Weather updates	0	0		4.0	
					if vessel close to shore	negligible environmental damage	n		0	0		4.0	
					if vessel close to laying vessel	disruption to electricity supply	n		0	0		4.0	
					maneouivering error	disruption to cable laying op.	n		0	0		4.0	
					Poor Visibility		n		0	0		4.0	
					Navigational Aid Failure		n		0	0		4.0	
Watchkeeper failure		n		0	0		4.0	Minor					
5	Passing (Fishing) Vessel drifting allision with marine cable (with Protection)	1.0	4.0	4.0			Y				4.0	4.0	Minor
					Adverse Weather	injury to public	n	Use correct bath charts	0	0		4.0	
					Equipment Failure	minor damage to vessel	n	Regular berth maintenance sonar	0	0		4.0	
					Human error	damage to cable	n	Depth sounder procedure on vessel	0	0		4.0	
					Lack of awareness/experience	damage to cable laying vessel	n	Weather updates	0	0		4.0	
					if vessel close to shore	negligible environmental damage	n		0	0		4.0	
					if vessel close to laying vessel	disruption to electricity supply	n		0	0		4.0	
					maneouivering error	disruption to cable laying op.	n		0	0		4.0	
					Poor Visibility		n		0	0		4.0	
					Navigational Aid Failure		n		0	0		4.0	
gear snagging		n		0	0		4.0	Minor					
6	Passing (Recreational) Vessel drifting allision with marine cable	1.0	3.0	3.0			Y				3.0	3.0	Minor
					Adverse Weather	injury to public	n	Use correct bath charts	0	0		3.0	
					Equipment Failure	minor damage to vessel	n	Regular berth maintenance sonar	0	0		3.0	
					Human error	damage to cable	n	Depth sounder procedure on vessel	0	0		3.0	
					Lack of awareness/experience	damage to cable laying vessel	n	Weather updates	0	0		3.0	
					if vessel close to shore	negligible environmental damage	n		0	0		3.0	
					if vessel close to laying vessel	disruption to electricity supply	n		0	0		3.0	

PENTLAND FIRTH EAST SUBMARINE CABLE REPLACEMENT - KIRKWALL NAVIGATIONAL RISK ASSESSEMENT

					maneouvering error	disruption to cable laying op.	n		0	0		3.0		
					Poor Visibility		n		0	0		3.0		
					Navigational Aid Failure		n		0	0		3.0		
					Watchkeeper failure		n		0	0		3.0	Minor	
7	Passing (Commercial) vessel powered allision with cable landing site	1.0	5.0	5.0			y				5.0	5.0	Moderate	
					Adverse Weather	injury to public	n		0	0		5.0		
					Equipment Failure	minor damage to vessel	n		0	0		5.0		
					Human error	damage to cable	n		0	0		5.0		
					Lack of awareness/experience	damage to cable laying vessel	n		0	0		5.0		
					if vessel close to shore	negligible environmental damage	n		0	0		5.0		
					if vessel close to laying vessel	disruption to eletricity supply	n		0	0		5.0		
					maneouvering error	disruption to cable laying op.	n		0	0		5.0		
					Poor Visibility		n		0	0		5.0		
					Navigational Aid Failure		n		0	0		5.0		
					Watchkeeper failure		n		0	0		5.0		Moderate
					8	Passing (Fishing) Vessel powered allision with cable landing site	1.0	4.0	4.0			y		
Adverse Weather	injury to public	n		0						0		4.0		
Equipment Failure	minor damage to vessel	n		0						0		4.0		
Human error	damage to cable	n		0						0		4.0		
Lack of awareness/experience	damage to cable laying vessel	n		0						0		4.0		
if vessel close to shore	negligible environmental damage	n		0						0		4.0		
if vessel close to laying vessel	disruption to eletricity supply	n		0						0		4.0		
maneouvering error	disruption to cable laying op.	n		0						0		4.0		
Poor Visibility		n		0						0		4.0		
Navigational Aid Failure		n		0						0		4.0		
gear snagging		n		0						0		4.0		Minor
9	Passing (Recreational) Vessel powered allision with cable landing site	1.0	3.0	3.0								Y		
					Adverse Weather	injury to public	n		0	0		3.0		
					Equipment Failure	minor damage to vessel	n		0	0		3.0		
					Human error	damage to cable	n		0	0		3.0		
					Lack of awareness/experience	damage to cable laying vessel	n		0	0		3.0		
					if vessel close to shore	negligible environmental damage	n		0	0		3.0		
					if vessel close to laying vessel	disruption to eletricity supply	n		0	0		3.0		
					maneouvering error	disruption to cable laying op.	n		0	0		3.0		
					Poor Visibility		n		0	0		3.0		
					Navigational Aid Failure		n		0	0		3.0		
					Watchkeeper failure		n		0	0		3.0		Minor
					10	Passing (Commercial) vessel drifting allision with cable landing site	1.0	4.0	4.0			y		
Adverse Weather	injury to public	n		0						0		4.0		
Equipment Failure	minor damage to vessel	n		0						0		4.0		
Human error	damage to cable	n		0						0		4.0		
Lack of awareness/experience	damage to cable laying vessel	n		0						0		4.0		
if vessel close to shore	negligible environmental damage	n		0						0		4.0		
if vessel close to laying vessel	disruption to eletricity supply	n		0						0		4.0		
maneouvering error	disruption to cable laying op.	n		0						0		4.0		
Poor Visibility		n		0						0		4.0		
Navigational Aid Failure		n		0						0		4.0		
gear snagging		n		0						0		4.0		Minor
11	Passing (Fishing) Vessel drifting allision with cable landing site	1.0	3.0	3.0								Y		
					Adverse Weather	injury to public	n		0	0		3.0		
					Equipment Failure	minor damage to vessel	n		0	0		3.0		
					Human error	damage to cable	n		0	0		3.0		
					Lack of awareness/experience	damage to cable laying vessel	n		0	0		3.0		
					if vessel close to shore	negligible environmental damage	n		0	0		3.0		
					if vessel close to laying vessel	disruption to eletricity supply	n		0	0		3.0		
					maneouvering error	disruption to cable laying op.	n		0	0		3.0		
					Poor Visibility		n		0	0		3.0		
					Navigational Aid Failure		n		0	0		3.0		
					Watchkeeper failure		n		0	0		3.0		Minor
					12	Passing (Recreational) Vessel drifting allision with cable landing site	1.0	2.0	2.0			Y		
Adverse Weather	injury to public	n		0						0		2.0		
Equipment Failure	minor damage to vessel	n		0						0		2.0		
Human error	damage to cable	n		0						0		2.0		
Lack of awareness/experience	damage to cable laying vessel	n		0						0		2.0		
if vessel close to shore	negligible environmental damage	n		0						0		2.0		
if vessel close to laying vessel	disruption to eletricity supply	n		0						0		2.0		
maneouvering error	disruption to cable laying op.	n		0						0		2.0		
Poor Visibility		n		0						0		2.0		
Navigational Aid Failure		n		0						0		2.0		
Watchkeeper failure		n		0						0		2.0		Slight
	Construction activity -											y		
					Communication Failure	injury to public	y	Notice to Mariners published	50	0	8.5	8.5		
					Failure to comply with Colregs	minor damage to vessel	y	Non-compulsary Reporting Area	50	0	8.5	7.0		
					Fatigue	minor environmental damage	y	Communication VHF/Guard Vessel	70	0	7.4	5.0		

PENTLAND FIRTH SUBMARINE CABLE REPLACEMENT- KIRKWALL NAVIGATIONAL RISK ASSESSEMENT

13	Displacement of Vessels due to Avoidance of Site Leading to Increased Vessel to-Vessel Collision Risk	2.0	5.0	10.0	Human Error	minor injury to crews	y	Navigation Warnings	30	0	9.2	5.0	Moderate
					Increased Vessel Density		n		0	0		5.0	
					Lack of awareness/experience		n		0	0		5.0	
					Lack of Passage Planning		n		0	0		5.0	
					Poor Visibility		n		0	0		5.0	
					Watchkeeper Failure		n		0	0		5.0	
							n		0	0		5.0	
14	Fishing Gear Interaction by demersal trawl (Rackwick)	1.0	5.0	5.0			Y				5.0	5.0	Moderate
					Failure to Promulagte Information	loss of gear	n		0	0		5.0	Moderate
					Equipment Failure	disruption to fishing operations	n		0	0		5.0	
					Fishing Vessel attracted to site	injury to crew members	n		0	0		5.0	
					Human Error	negligible environmental impact	n		0	0		5.0	
					Lack of awareness/experience	damage to fishing vessel	n		0	0		5.0	
						damage to cable	n		0	0		5.0	
						disruption of electricity supply	n		0	0		5.0	
							n		0	0		5.0	
							n		0	0		5.0	
15	Vessel anchoring on or dragging anchor over marine cable	1.0	3.5	3.5			Y				3.5	3.5	Minor
							n		0	0		3.5	Minor
							n		0	0		3.5	
							n		0	0		3.5	
							n		0	0		3.5	
							n		0	0		3.5	
							n		0	0		3.5	
							n		0	0		3.5	
							n		0	0		3.5	
							n		0	0		3.5	
16	Loss of cable or equipment from construction associated vessels	2.0	3.0	6.0			Y				6.0	6.0	Moderate
					Failure to Promulagte Information	loss of gear	Y	Construction Management Plan	80	0	3.9	3.9	Moderate
					Equipment Failure	disruption to fishing operations	y	Licencing Condition	50	0	5.1	3.0	
					Fishing Vessel attracted to site	injury to crew members	n		0	0		3.0	
					Human Error	negligible environmental impact	n		0	0		3.0	
					Lack of awareness/experience	damage to fishing vessel	n		0	0		3.0	
						damage to cable	n		0	0		3.0	
						disruption of electricity supply	n		0	0		3.0	
							n		0	0		3.0	
							n		0	0		3.0	
17	Deliberate damage to cable (at landing sites)	1.0	1.1	1.1			Y				1.1	1.0	Slight
					Adverse Weather	damage to cable	n		0	0		1.0	Slight
					Equipment Failure	surfacing of cable	n		0	0		1.0	
					failure to promulgate information	disruption of electricity supply	n		0	0		1.0	
					Human Error		n		0	0		1.0	
					incident in proximity to site		n		0	0		1.0	
					Lack of awareness/experience		n		0	0		1.0	
					Navigational Aid Failure		n		0	0		1.0	
					Poor holding ground		n		0	0		1.0	
							n		0	0		1.0	
18	Experience of staff, available on passing ships during the construction phase (Exxon Valdez)	1.0	5.0	5.0			Y				5.0	5.0	Moderate
					adverse weather	minor environmental impact	Y	Construction Management Plan	80	0	1.5	5.0	Moderate
					vessel collision	allision with passing vessel	y	Licencing Condition	50	0	3.5	5.0	
					Equipment Failure	disruption to cable laying operation	n		0	0		5.0	
							n		0	0		5.0	
							n		0	0		5.0	
							n		0	0		5.0	
							n		0	0		5.0	
							n		0	0		5.0	
							n		0	0		5.0	
19	Unfavourable Tidal Conditions during Construction	4.0	4.0	16.0			y				16.0	16.0	Extreme
							y	Don't undertake works during spring tides	50	50	13.7	13.7	Moderate
							y	Check weather Reports/Forecasting	50	0	14.8	12.6	
							y	Construction Management Plan	50	50	13.7	10.5	
							y	Robust planning using local experience	0	50	14.8	9.6	
							y	Plan for Worst case scenarios	0	25	15.5	9.2	
							n		0	0		9.2	
							n		0	0		9.2	
							n		0	0		9.2	
							n		0	0		9.2	
							Y				10.0	10.0	High

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PENTLAND FIRTH SUBMARINE CABLE REPLACEMENT- KIRKWALL NAVIGATIONAL RISK ASSESSEMENT

20	Collision between passing vessel and construction vessel (at site or en route)	2.0	5.0	10.0			y	Notice to Mariners published	15	0	9.7	9.6	
							y	Non-compulsary Reporting Area	75	0	7.0	6.6	
							y	Communication VHF/Guard Vessel	75	0	7.0	5.0	
							y	Navigation Warnings	50	0	8.5	5.0	
							y	Construction Management Plan	20	0	9.5	5.0	
							y	Collision Regulation/training and experience	50	0	8.5	5.0	
							n		0	0		5.0	
							n		0	0		5.0	
							n		0	0		5.0	
							n		0	0		5.0	
21	Dropped object (Floating)	2.0	5.0	10.0			y				10.0	10.0	Moderate
							y	Construction Management Plan	80	0	6.5	6.5	High
							y	Licencing Condition	50	0	8.5	5.0	
							n		0	0		5.0	
							n		0	0		5.0	
							n		0	0		5.0	
							n		0	0		5.0	
							n		0	0		5.0	
							n		0	0		5.0	
							n		0	0		5.0	
22	Man Overboard	2.0	5.0	10.0			Y				10.0	10.0	Moderate
							Y				10.0	10.0	High
					Communication Failure	minor damage to vessels	y	Construction Management Plan	50	0	8.5	8.5	
					Failure to comply with Colregs	minor injuries to crew members	y	Training and Experience	50	50	8.0	6.6	
					Fatigue	minor environmental impact	y	Safety Boat	50	50	8.0	4.8	
					Human Error	negligible disruption to cable laying	y	Appropriate PPE	0	25	9.8	4.7	
					Increased Vessel Density		n		0	0		4.7	
					Lack of awareness/experience		n		0	0		4.7	
					Lack of Passage Planning		n		0	0		4.7	
					Poor Visibility		n		0	0		4.7	
23	Adverse Environmental conditions (wind, Wave, current, etc) - Construction	4.0	5.0	20.0	Watchkeeper Failure		n		0	0		4.7	Moderate
							n		0	0		4.7	
							Y				20.0	20.0	
					Communication Failure	minor damage to vessels	y	Weather Forecasting (don't do in bad weather) during the work window	40	25	18.4	18.4	
					Failure to comply with Colregs	minor injuries to crew members	y	Construction Management Plan	50	50	17.4	15.9	
					Fatigue	minor environmental impact	y	Not undertaking work in restricted visibility	25	50	18.2	14.3	
					Human Error	negligible disruption to cable laying	y	Robust planning using local experience	25	25	18.9	13.4	
					Increased Vessel Density		y	Plan for Worst case scenarios	0	25	19.5	13.0	
					Lack of awareness/experience		n		0	0		13.0	
					Lack of Passage Planning		n		0	0		13.0	
					Poor Visibility		n		0	0		13.0	High
					Watchkeeper Failure		n		0	0		13.0	
					adverse weather		n		0	0		13.0	
												13.0	

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## **2 Navigational Risk Assessment Report Thurso 26<sup>th</sup> March 2019**

# Pentland Firth East Submarine Cable Replacement

Navigational Risk Assessment Report Thurso 26th March  
2019

Project number: 60591722  
60591722-REP-04  
27<sup>th</sup> March 2019

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## 1. Location and Scope of the Navigation risk Assessment

The proposed corridor of the replacement cable is shown in Figure 1. It is proposed to follow the path set by the existing pair of cables which are no longer fit for purpose. This path can be seen to follow a ridge on the seafloor, representing the shallowest route between Murkle Bay on the North coast of Scotland and the island of Hoy.

A five nautical mile (nm) buffer is considered around the proposed corridor of the replacement cable for the purposes of hazard identification relevant to the project.

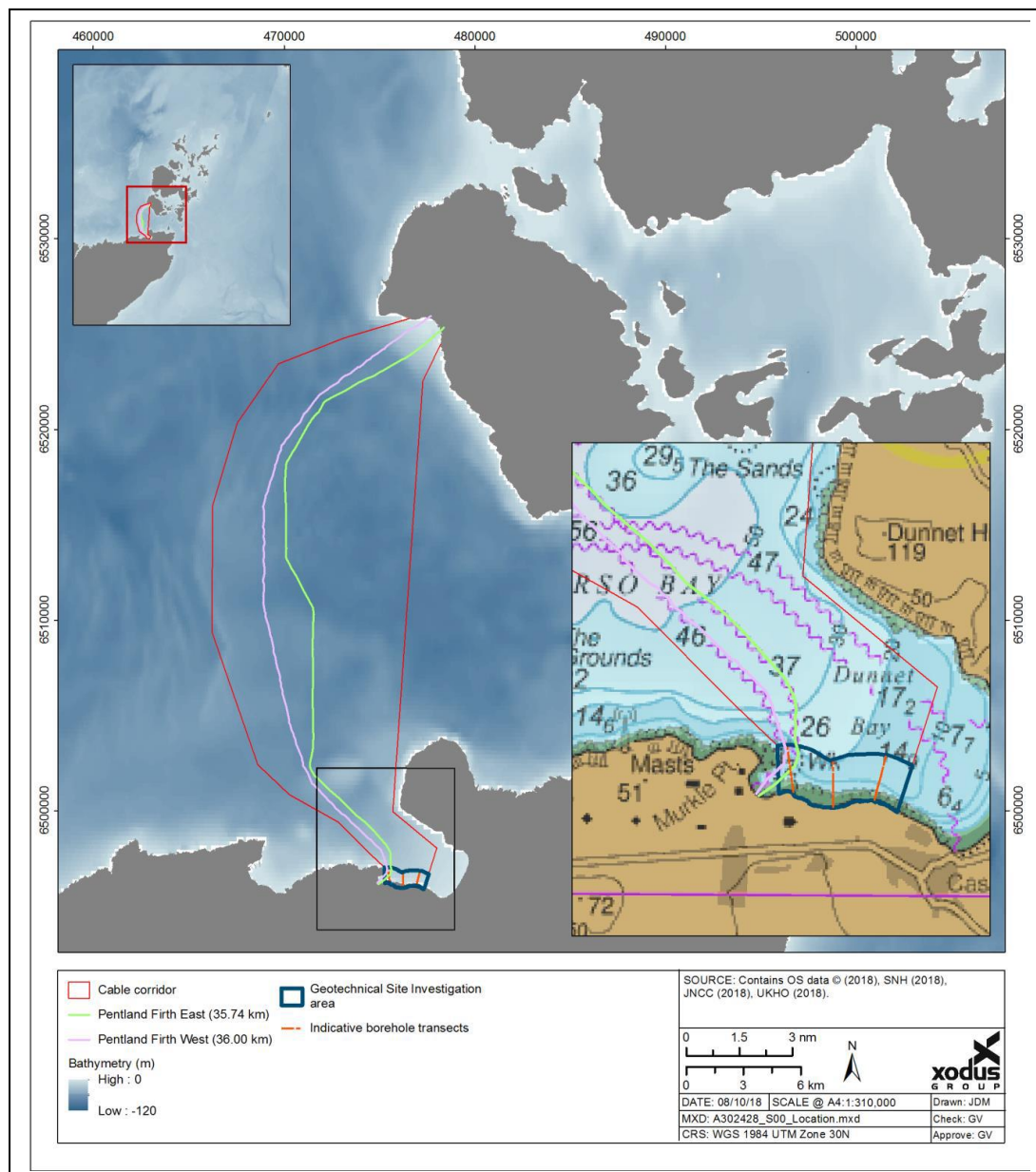


Figure 1: Proposed Cable Corridor

The metocean data for Murkle Bay and Rackwick Bay are attached in Appendix A

## 2. Navigation Risk Assessment Procedure

### 2.1 What is a Risk Assessment

A risk assessment is a written document that records a three-step procedure: -

1. Identifying the hazards in the workplace/project;
2. Assessment of the risks presented by these hazards;
3. Putting controls measures in place to reduce the risk of these hazards causing harm, to an acceptable level.



### 2.2 Terminology and Outline Procedure.

- A hazard is an unwanted and unplanned event or danger which has the potential to cause harm to persons, the environment, property, or the reputation of key stakeholders;
- Hazards shall be identified by consensus during the procedures and listed, for each aspect of the Navigational operations of the IOMFT;
- Each hazard shall be assessed and a consensus will be reached in relation to the likelihood, or probability (P) of that hazard occurring;
- Each hazard shall also be assessed and a consensus will be reached, in relation to the consequences, if the hazard were to be realised. This will include consideration of outcomes for people, environment, property, and reputation (PEPR);
- The agreed consensual values of likelihood and consequence (C) are used to determine the risk;
- A risk (R) is therefore a weighted probability of the hazard occurring / being realised, where  $R = P \times C$ ;
- The above process will produce a base line numeric risk score for each hazard;
- If the base line numeric risk score lies within one of the unacceptably high bands (see matrix in Appendix B), then further risk control measures shall be considered and applied until the residual risk score is tolerable, as defined in the matrix.

In an ideal situation, the numeric values of *C* and *P* would be known from historic data bases of similar, however this is rarely the case. Therefore, in order to ensure that these variables are assessed as accurately as they can be, in a Formal Risk Assessment (FRA), Hazard identification (HAZID) work-shop shall be held. The participants in the HAZID workshop shall be persons with expert knowledge of the operations which are being assessed and who have been involved in such operations on a day to day basis for a number of years.

## 3. Baseline Information

### 3.1 Navigational features

The principal navigational features relative to proposed corridor of the replacement cable are presented in Figure 2. This figure displays charted anchorage areas and navigational aids. The buoy and anchorage positions are taken from the Admiralty Charts of the area, with supplementary information taken from previous NRAs compiled for the Pentland Firth, informed by Admiralty Sailing Directions and Clyde Cruising Club Sailing Directions and Anchorages.

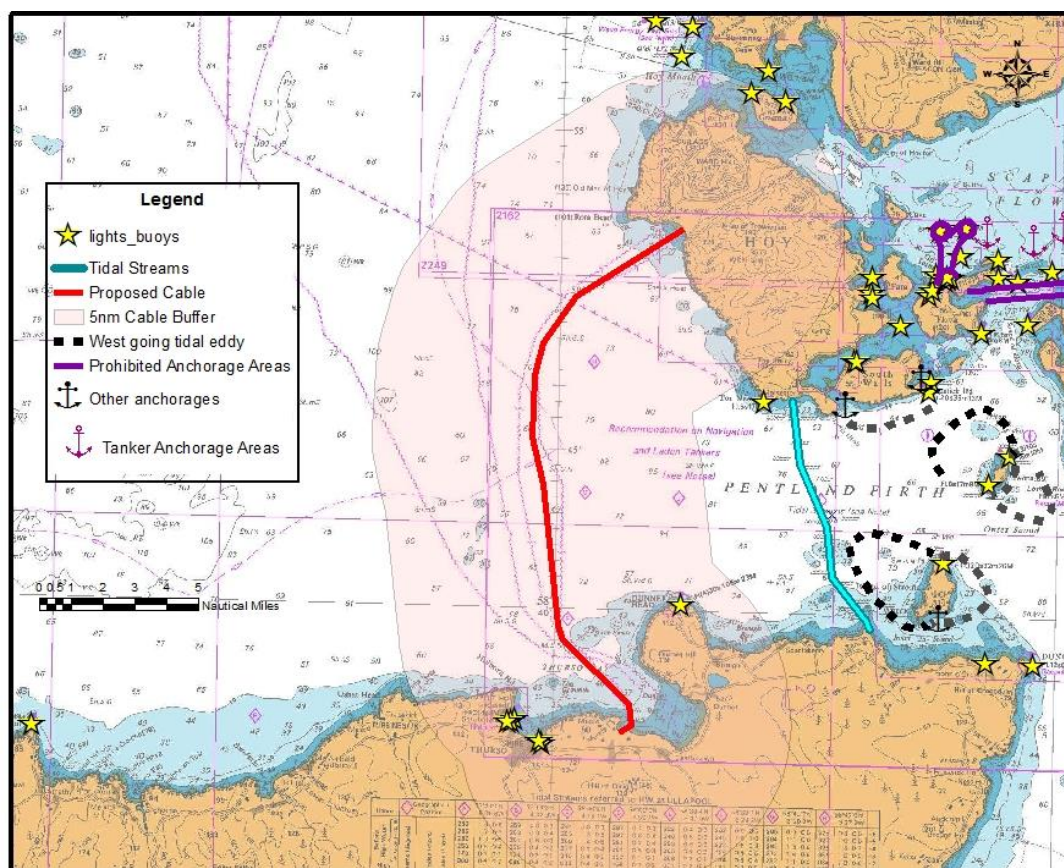


Figure 2: Navigational features

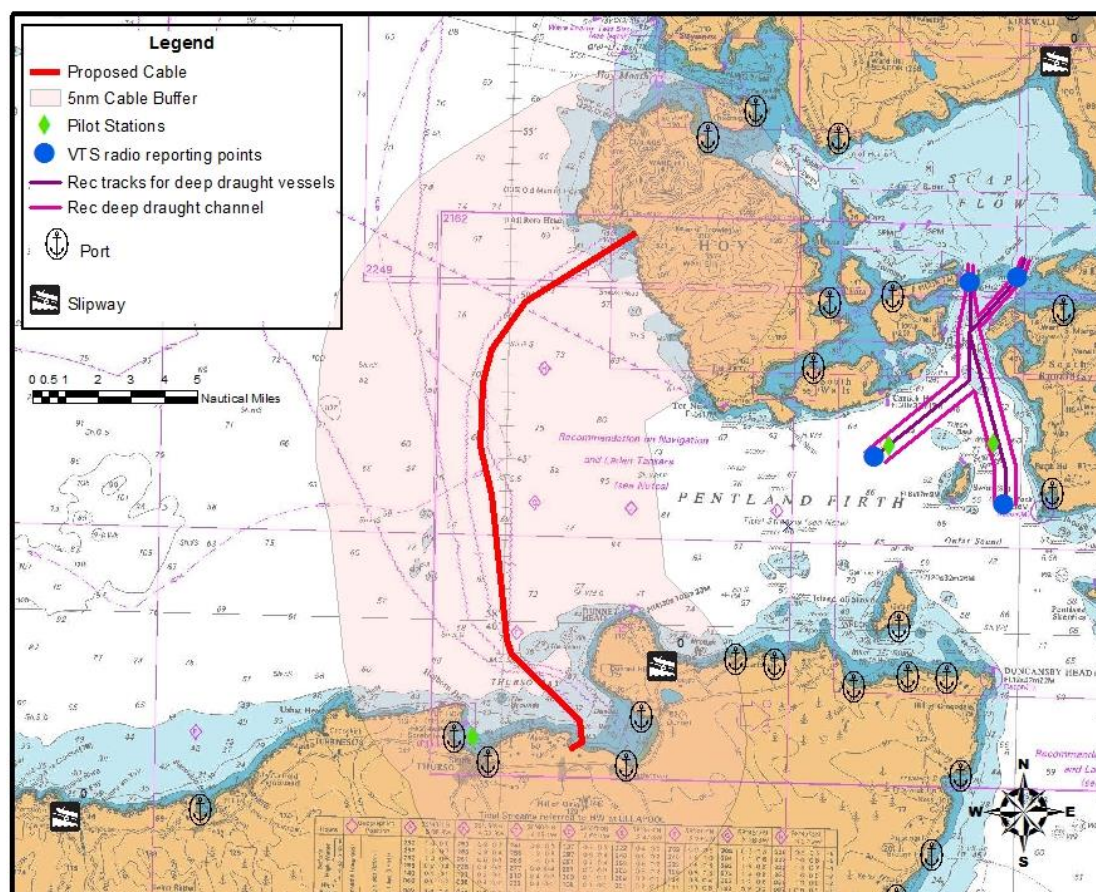
A number of prohibited anchorage areas exist in Scapa Flow, to the East of proposed corridor of the replacement cable, to protect pipelines and structures associated with the Flota Oil Terminal, and a military wreck. These are highlighted as survey vessels used for bathymetric surveys of the cable corridor and AIS vessel tracking may need to shelter in these areas.

Tidal streams with eddies and turbulence occur in the Pentland Firth and approaches to Scapa Flow in both Easterly and Westerly directions. None are noted within the 5nm buffer surrounding the cable corridor, however they may pose a risk to vessels involved in the surveying, commissioning and maintenance of the new cables.

### 3.2 Ports, Harbour Limits and Recommended Tracks

OIC Marine Services administers 29 Orkney Harbour Areas for which it is the Competent Harbour Authority. The Council exercises its jurisdiction through a Director of Marine Services. The Duty Holder for the Authority is now the Harbour Authority Sub-committee, established in July 2016. Proposed corridor of the replacement cable is at no point in the vicinity of the Limits of Orkney Harbours. However, berthing and overnighting of survey vessels may be required at anchorages within these Limits.





**Figure 3: Ports, Harbour Limits and Recommended Tracks**

Within 5nm of proposed corridor of the replacement cable, there are five ports; Scrabster, Thurso, Castletown and Dunnet on the Scottish North coast, and at Bu Point on the isle of Hoy. There is also a slipway in Brough Bay.

Pilotage rules require confirmation from Orkney Island Council Marine Services, or local harbour masters.

Approximately 10nm east of proposed corridor of the replacement cable are recommended tracks for deep-draught vessels. The channels and deep-water tracks between the Pentland Firth and Scapa Flow are those recommended by the Orkney Harbours Navigation Service for tankers under pilotage proceeding to or from the Flotta Oil Terminal. Radar surveillance of these channels is continuously maintained by VTS. There is no predicted interference with these channels during surveying operations or cable laying, however they are noted in the event that vessels require to use them in the event of adverse weather.

The harbour at Scrabster is the setting off point for the Northlink Ferries Scrabster-Stromness ferry service which runs twice at weekends during off-peak season (September to April) and three times daily in the peak season. As can be seen in Figure 3, the principal route to the west of Hoy crosses over the proposed cable route twice and is entirely within the 5nm buffer. Consultation with Northlink Ferries will be required to assess the risk to the proposed cable due to falling objects from the Ro-Ro service and dropped anchors during adverse weather, as well as impacts on the ferry service of survey vessels traversing the Pentland Firth at the same time as ferry sailings.

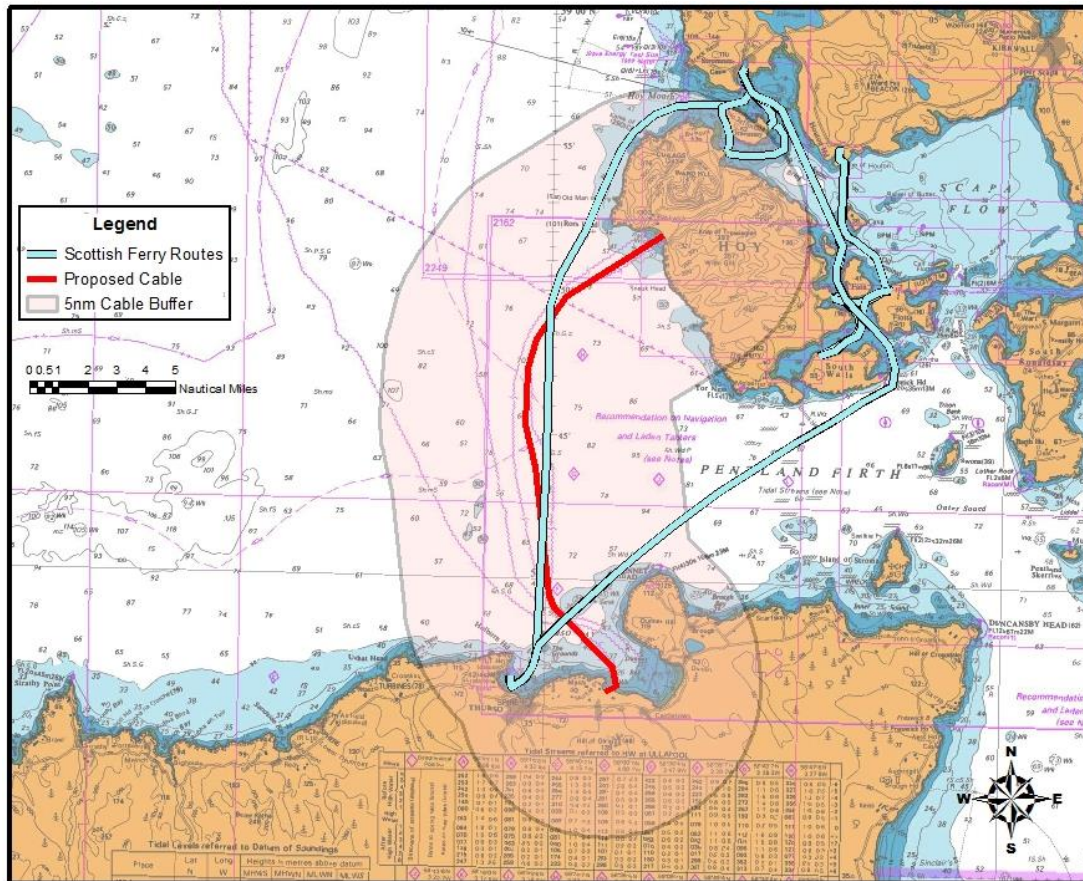


Figure 4: Ferry Routes from Scrabster

### 3.3 IMO Routeing Measures

Proposed corridor of the replacement cable lies partially within the IMO-adopted Area to be Avoided (ATBA) which surrounds most of Orkney (excluding the Pentland Firth and Scapa Flow). The ATBA was established to protect the sensitive coastline following the *Braer* incident. To avoid the risk of pollution and damage to the environment, all vessels over 5,000 GT carrying oil or other hazardous cargoes in bulk, should avoid this area.

Chart notes advise that laden tankers not bound to or from Flotta and Scapa Flow should not use the Pentland Firth in restricted visibility or adverse weather. At other times there may be a case for transiting with the tide to reduce the time spent in the Firth, although they should be aware of very strong tidal streams and sets within the area. Difficulties can be encountered when transiting either with or against the tide. Masters should ensure that a close watch is kept at all times on the course, speed and position of vessels.

The statutory regulations surrounding the burial of pipelines and cables within this region should be checked to ensure no regulatory obstacles exist to both surveying and cable laying operations.



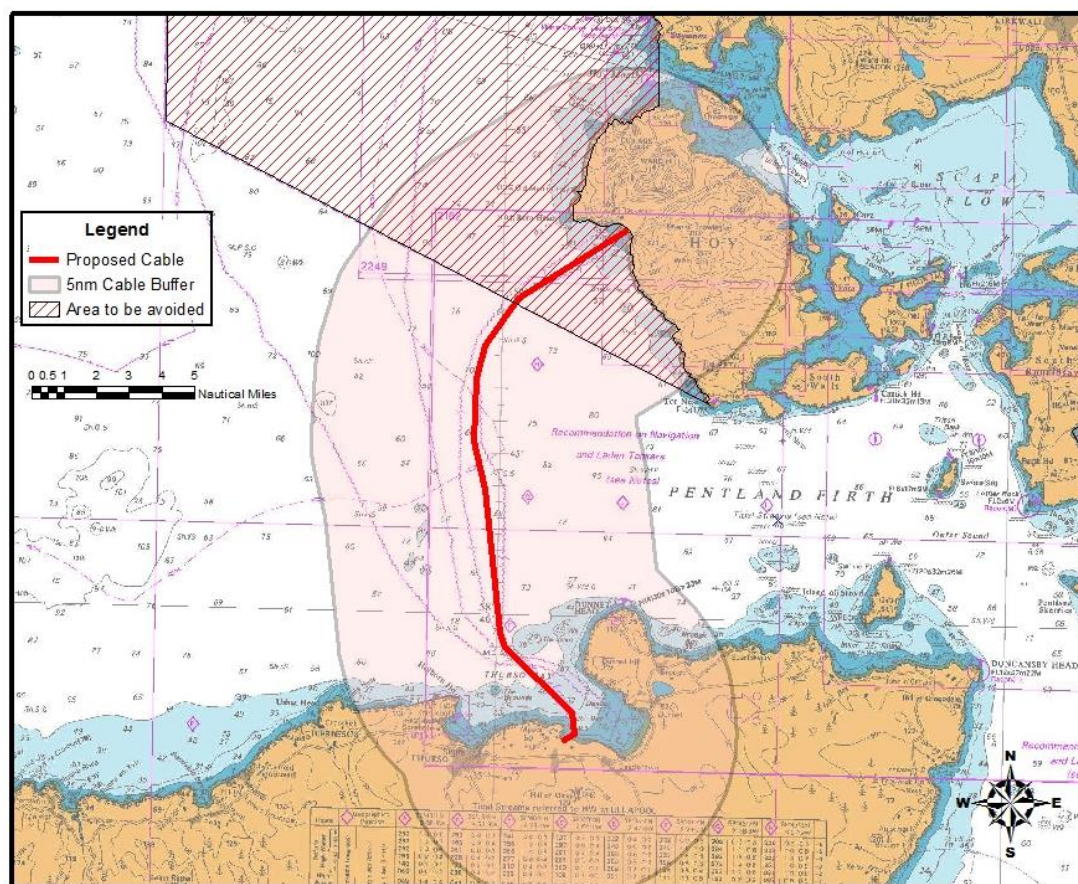


Figure 5: ATBA in the vicinity of the proposed cable

### 3.4 Wrecks

There are several protected and unprotected wrecks within the 5nm buffer surrounding proposed corridor of the replacement cable. The two protected wrecks are; HMS Pheasant, and HMT Beech.

HMS Pheasant was a WWI M-class destroyer, sunk in 1917 after contact with a mine. The wreck lies roughly in an East-West orientation at a depth of 82m roughly 1nm from the proposed landing site on Hoy. It may be necessary to exercise additional care to avoid this area during cable laying operations, and additional interest in bathymetric results may be taken by interested parties.

HMT Beech was a minesweeping trawler vessel sunk by German aircraft in 1941 in Scrabster Bay. The general water depth around the wreck is reported as 13m. Direction from Scrabster harbour master may be required for survey and cable laying vessels in order to ensure avoidance of this wreck. This site is classified as a maritime war grave.

There are 24 reported unprotected wrecks within 5nm of proposed corridor of the replacement cable. Of particular interest are two wrecks identified in Murkle Bay where the proposed cable will land on the Scottish North coast. The condition of these wrecks is not known and the effect they may have on survey and cable laying operations is unknown.



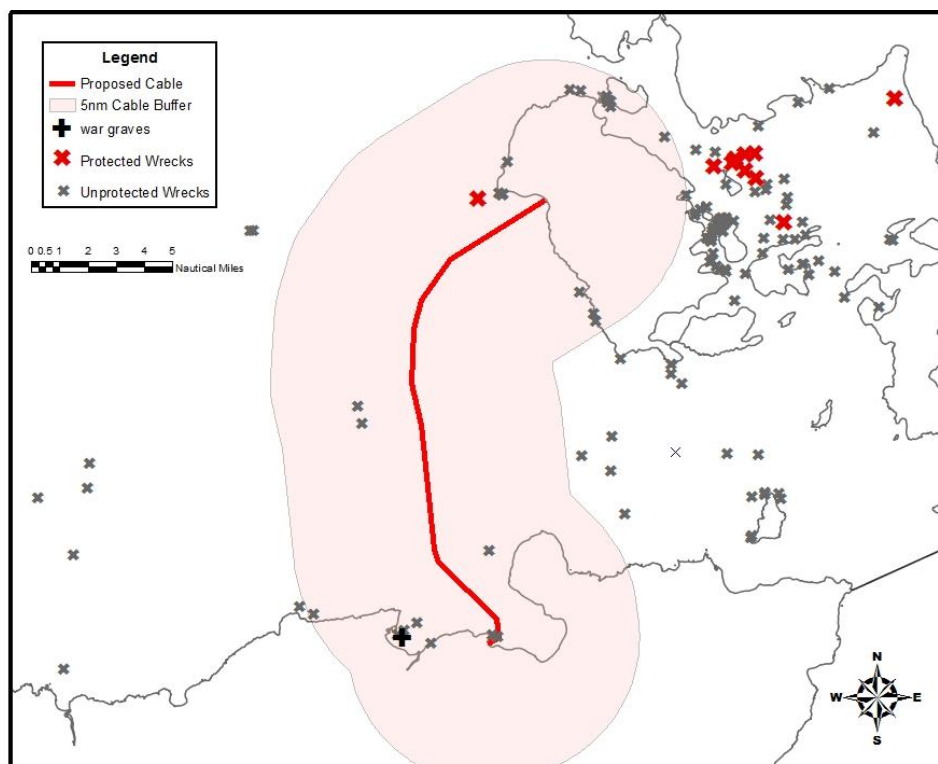


Figure 6: Identified Wrecks

### 3.5 Oil and gas Infrastructure

There are no oil and gas installations or licence blocks in the immediate vicinity of the proposed cable, however there are installations to the east of the project, in Scapa Flow, associated with Flotta Oil Terminal, which is approximately 10nm east of the area. Installations here include a tank farm, pumping station, power station and burn- off flare.

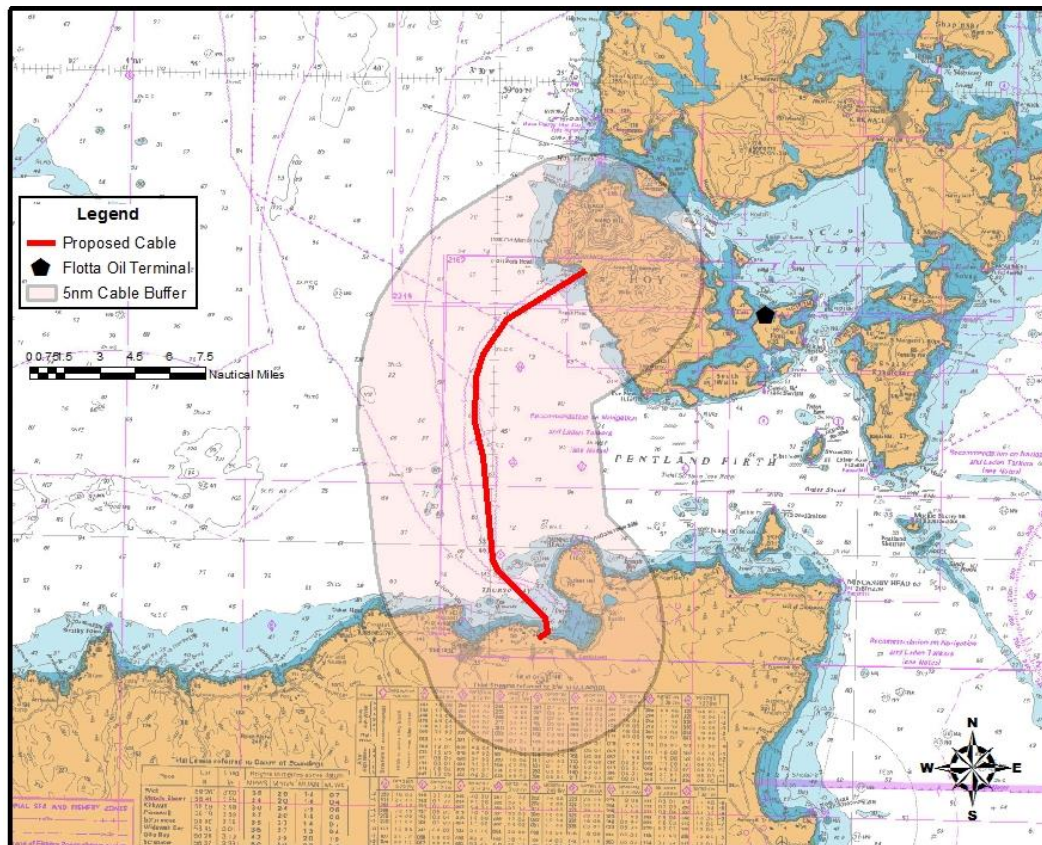


Figure 7: Oil and Gas Infrastructure

### 3.6 Recreational Dive Sites

There are 5 recreational dive sites within 5nm of proposed corridor of the replacement cable, with one closer by at the southern tip of Hoy.

The site close by the southern cable landing site is at Dwarwick Pier and is considered a suitable dive for novices with entry to the water via the slipway. Notice may need to be posted here, or at nearby dive centres with air compressors, to inform visitors of works taking place offshore, with increased risk of noise.

The next most relevant dive is at the site of HMS Pheasant (although the dive site is mapped at the south tip of Hoy). Access to this dive is by boat and so displacement of dive boats away from cable laying vessels is possible.

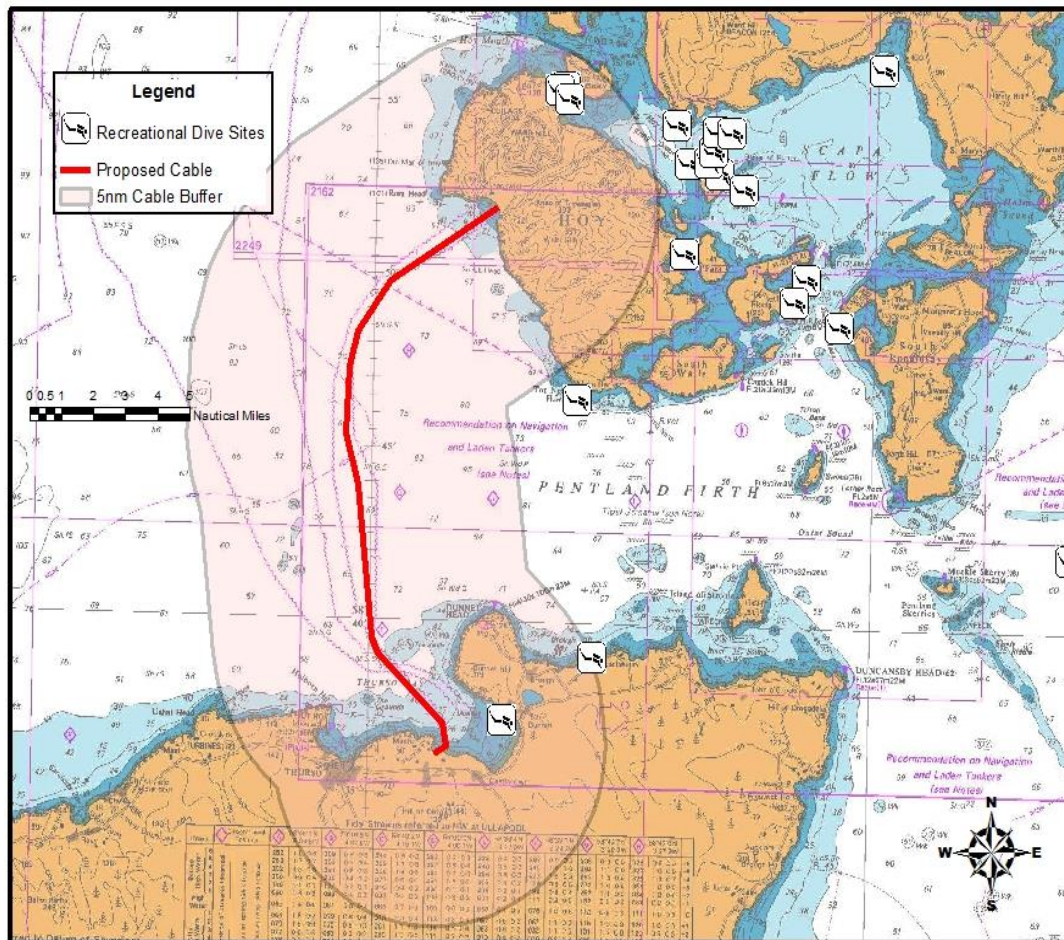


Figure 8: Recreational Dive Sites

### 3.7 Offshore Wind

There are no existing or planned offshore wind farm projects in the vicinity of the proposed cable route.

### 3.8 Offshore tidal

There are two tidal power generation projects of significance within the Pentland Firth.

Brims tidal array, directly to the east of proposed corridor of the replacement cable to the south of Hoy, is no longer in development as of 2018, with no significant installation of infrastructure in the sea.

MeyGen is currently running monitor and reporting phases of their tidal power project in the Inner Sound to the south of the Isle of Stroma. This currently comprises a single turbine on a gravity foundation and is not anticipated to impact cable laying operations directly. Vessel traffic to and from the site from local ports by maintenance, reporting and installation vessels may impact on available berths in the area as the project is reported to enter into a second phase of installation in 2019, with further turbines being put in place.



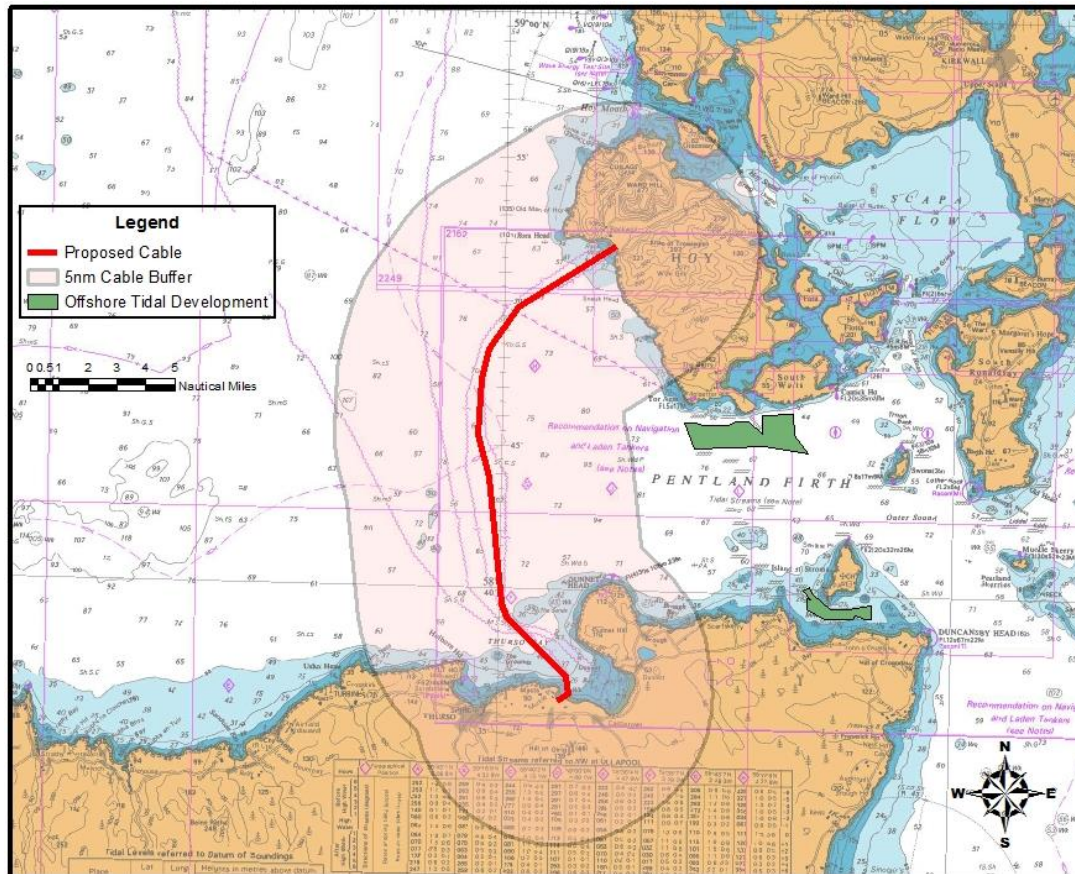


Figure 9: Tidal Power Projects in the Pentland Firth

### 3.9 Offshore Wave development

The European Marine Energy Centre (EMEC) currently runs 2 wave energy testing sites around the Orkney Isles. Billia Croo around 6nm north of proposed corridor of the replacement cable, is currently operational and provides technology developers the space to test new technologies with grid connections.

No impact is predicted on surveying or cable laying operations however, the area should be avoided to prevent collision with floating wave energy generators.

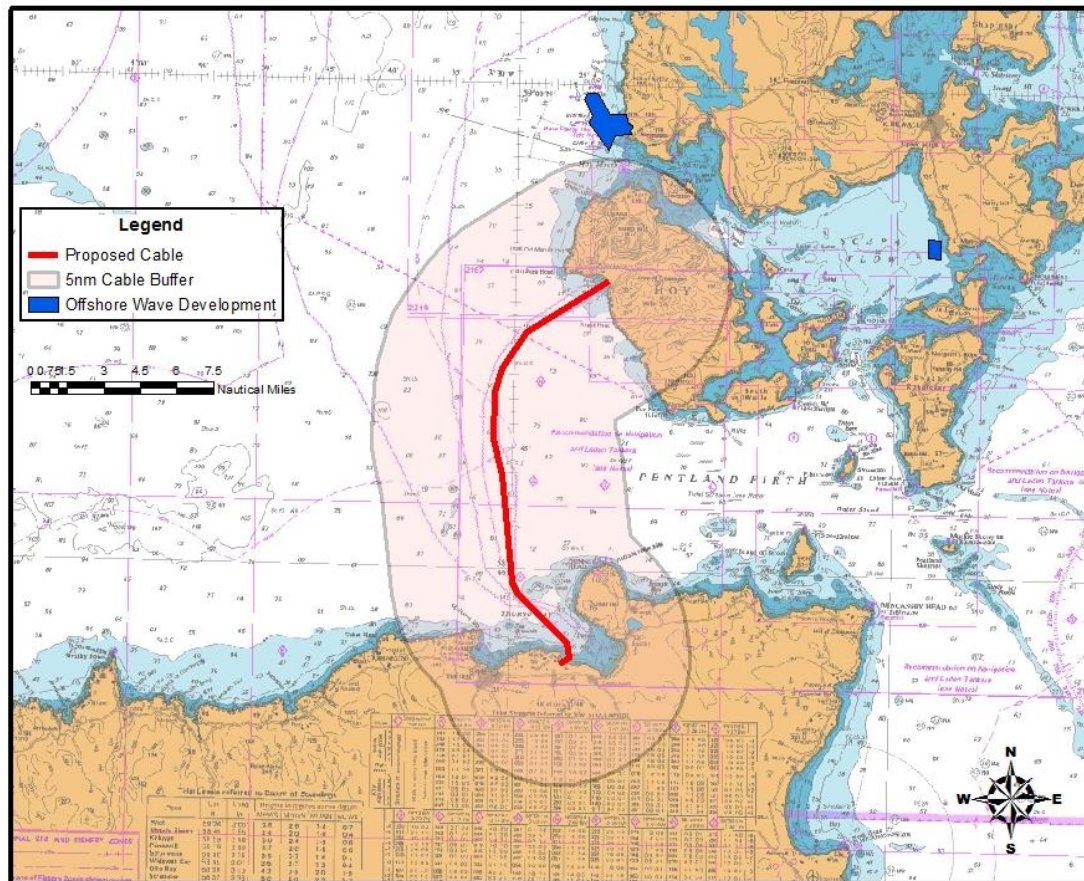


Figure 10: Wave Energy Projects

### 3.10 Dredging

Within 5nm of proposed corridor of the replacement cable there are 3 disused and a single operational dredge arising's disposal site (as of the most up to date charts in December 2018). The most significant is the larger disused dredge disposal site which lies over the proposed cable route at its southern extent and could impact on the ease of cable burial. The active site will require further monitoring to determine the effects of dredge disposal during project operations, however it lies around 1nm to the south-west of the proposed cable route.



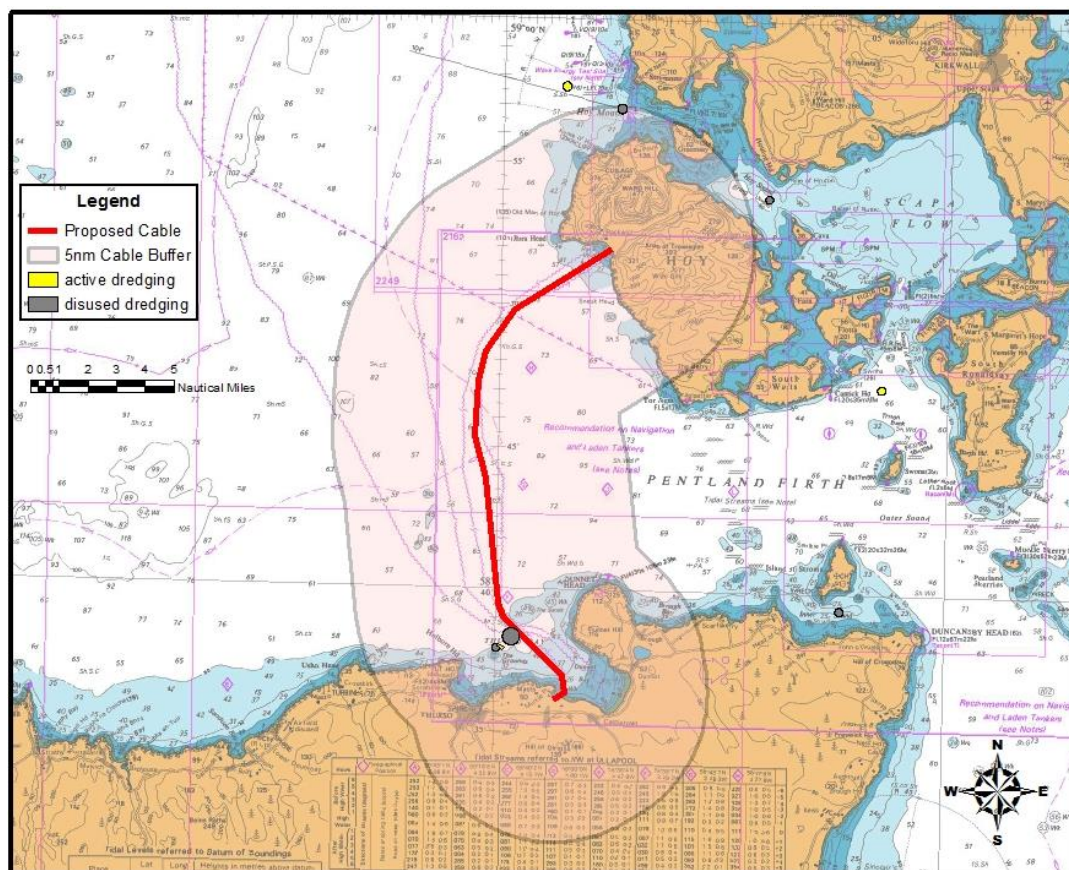


Figure 11: Dredge Disposal sites

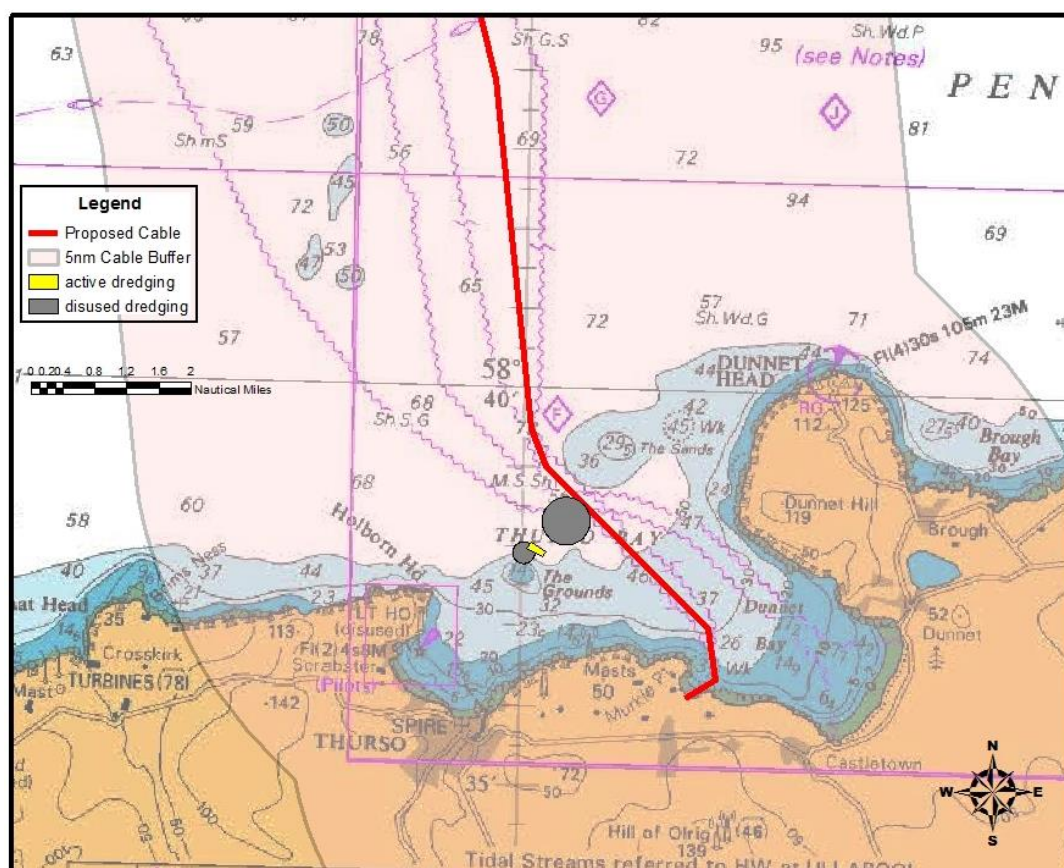


Figure 12: Dredge Disposal sites at southern end of cable



### 3.11 Cables and Pipelines

There are several existing cables and pipelines between the Orkney Isles, these are marked on Admiralty maps and mariners are advised to avoid dredging or trawling in their vicinity to ensure damage to vessels, gears and cables are prevented.

Two long distance cables run through the 5nm buffer around proposed corridor of the replacement cable, and cross over it at its southern extent as they approach their landfall on the Scottish north coast at Dunnet Bay. Care will be required during cable laying operations to avoid damage to these cables. Damage to these communication cables may incur additional costs and delay to the project, while also potentially disrupting international lines of communication.

Of particular interest are the two existing cables which this project aims to replace. They run to either side of proposed corridor of the replacement cable typically at a distance of 0.5nm from each other. They make landfall within Murkle Bay on the Scottish north coast and at Rackwick on Hoy. Care will be required where trenches are required to bury the new cables that the existing cables are not damaged. The combined capacity of these cables is 40MW.

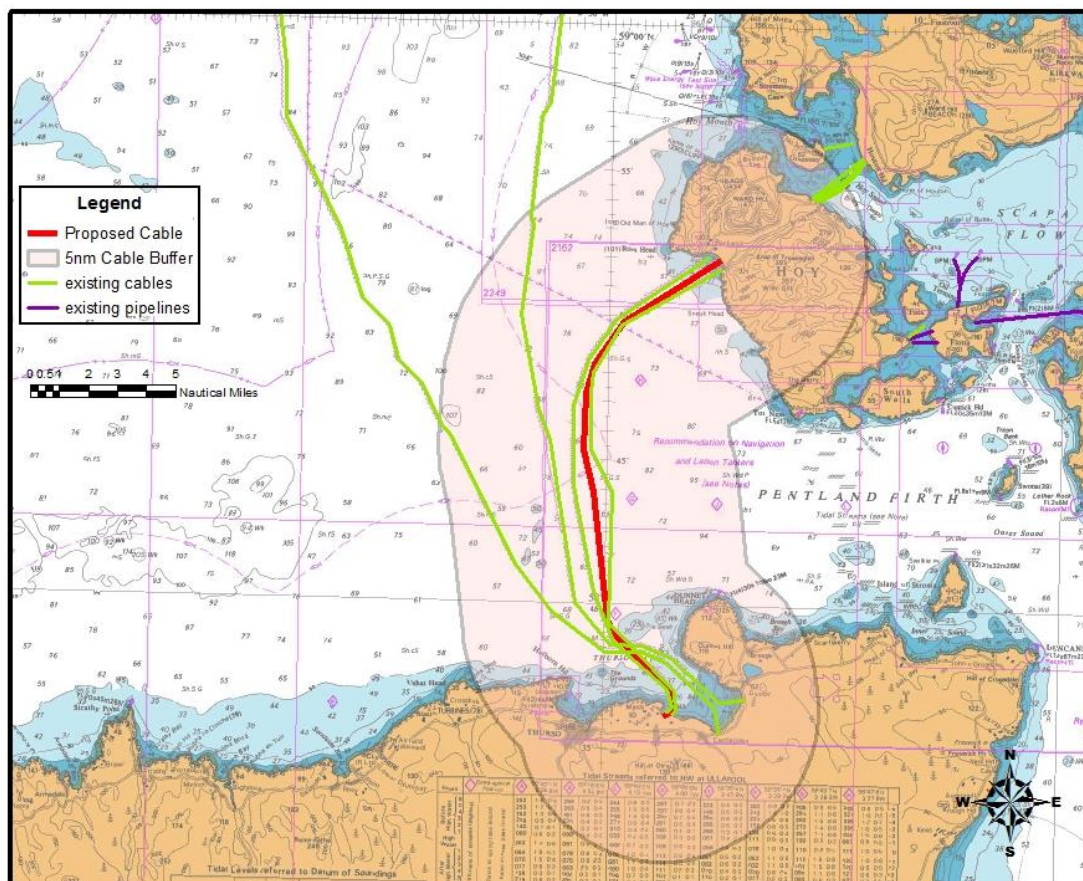


Figure 13: Existing Cables and Pipelines

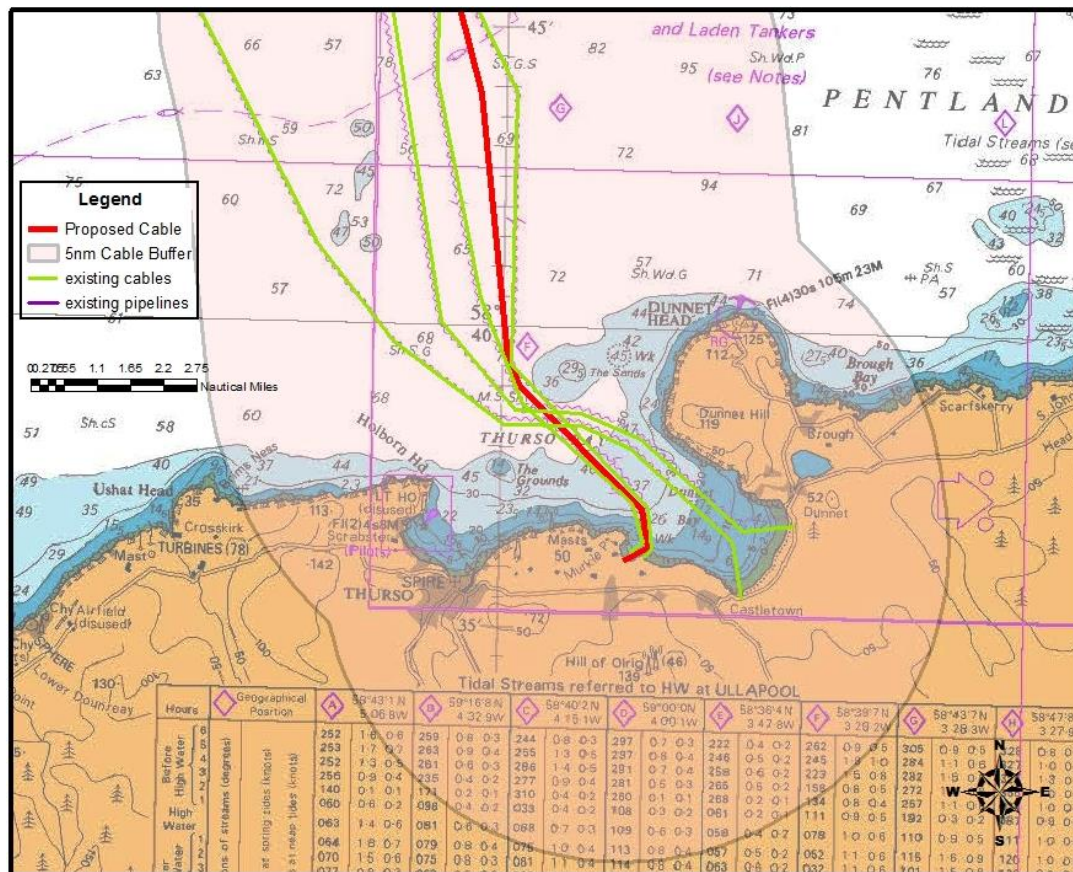


Figure 14: View on Murckle and Dunnet Bay

### 3.12 Military Exercise areas

There are no military practice areas in use by the Ministry of Defence (MoD) in the vicinity of proposed corridor of the replacement cable.

This should be confirmed independently with MOD following the two workshops.

### 3.13 Marine Environment High Risk Areas (MEHRA's)

Tor Ness on Hoy, has been identified as a Marine Environmental High-Risk Area (MEHRA) by the UK Government, i.e., an area of environmental sensitivity and at high risk of pollution from ships. The Government expects mariners to take note of MEHRAs and either keep well clear or, where this is not practicable, exercise an even higher degree of care than usual when passing nearby.

Tor Ness has underlying statutory designations on wildlife, landscape and geological grounds, a very high concentration of vulnerable seabirds and a high level of offshore fishing activity. Figure 15 shows the Tor Ness MEHRA in relation to proposed corridor of the replacement cable and landing site on Hoy.



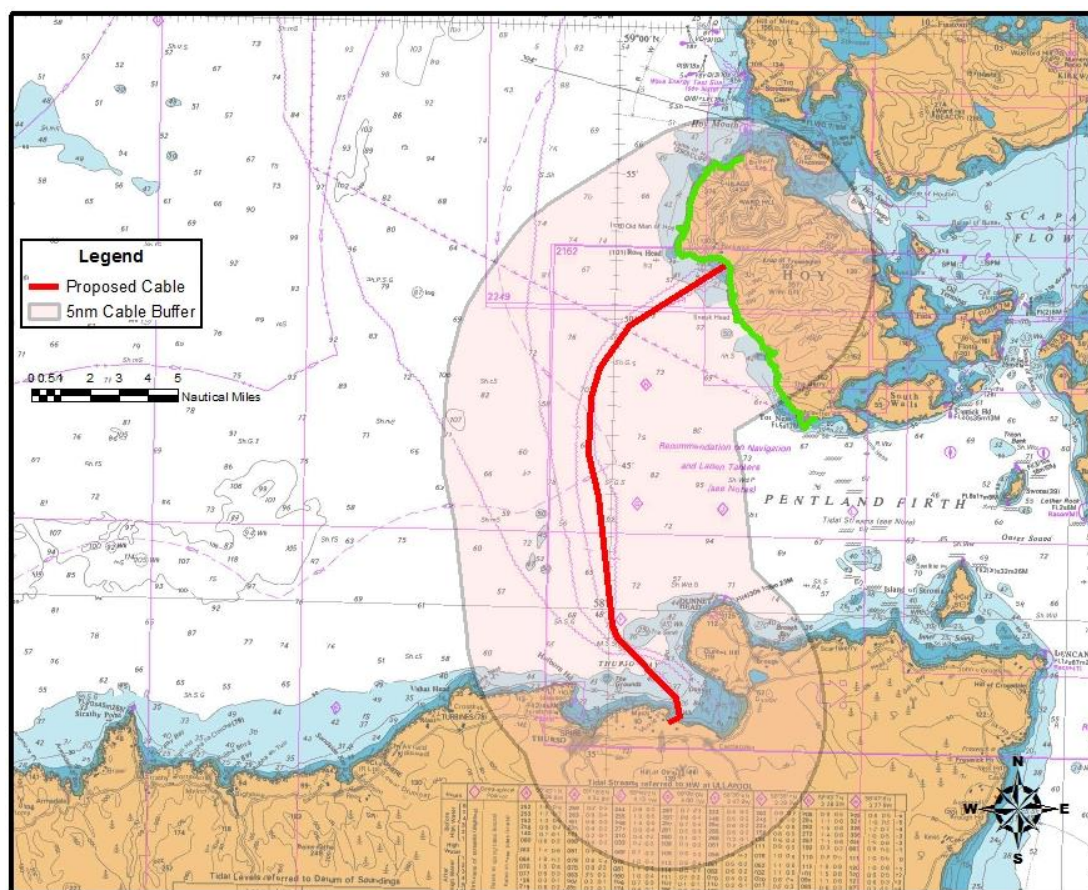


Figure 15: MEHRA

### 3.14 Sailing Directions

Sailing directions for this region are provided in Reeds Nautical Almanac (2016). Specific harbour entrance instructions are also presented in this publication

## 4. Navigation Risk Assessment Detail

A Briefing Document (Document Reference 60591722-Rep-02) was distributed to all prospective workshop participants at seven days prior to the work shop date. The purpose of this briefing document was to confirm the methodology, terminology, and process for the Navigation Risk Assessment workshop.

It was assumed that the participant have read the contents of the briefing document and were familiar with the project and the NRA procedure prior to attendance.

After this period of preparation, a Navigation risk Assessment Workshop was convened at the Naver Business Centre, Thurso, on Tuesday 26<sup>th</sup> March 2019. The attendees at the Navigation Risk Assessment workshop were:

**Table 1: List of participants in the Navigation Risk Assessment Workshop**

Name	Position /Organisation
Jill Meikle	AECOM– Workshop Facilitator
David Meikle	AECOM Regional Director Ports & Marine
Alistair Chan	AECOM Associate Director Ports & Marine
Ross Farquhar	Deputy Harbour Master Scrabster Harbour
Hugh MacKay	Mackay Underwater Technology Limited
Alda Forbes	SSE

The workshop was run by an AECOM Workshop Facilitator (WF), Jill Meikle. The process was carried out using a custom spreadsheet in order to keep a record and also to allow a rapid comparison of effects. During the one day workshop the participants used their knowledge and past experience to: -

- Identify hazards (HAZID) as an open forum and such hazards were listed and grouped by the WF;
- Individually assess the likelihood or probability of each hazard occurring using the sheet 1 of the spread sheet shown in Appendix B. This was converted to a consensus average by sheet 2 the spreadsheet shown in Appendix B;
- Individually assess the consequence of the occurrence of each hazard using the sheet 1 shown in Appendix B. This was converted to a consensus average by sheet 2 of the spreadsheet shown in Appendix B;
- Participants agreed the resulting average probability and consequence for each hazard as generated by the spreadsheet;
- Sheet 2 provided a Base line risk for each hazard;
- Risk base line scores were reviewed in turn in open forum and either accepted or if unacceptably high, then set aside to consider mitigation measures;
- For the hazards requiring mitigation, the cause and occurrences was discussed in more detail and possible mitigation measure listed;
- Mitigation measures were discussed in open forum and agreed estimates made of how such mitigation can reduce to reduce Consequence and/or Probability;
- Reduction percentages were entered in the spreadsheet sheet 3 given in Appendix B. The sheet computes the compound effect of such measures. This continued until all risks become acceptable. This was done by embedded non-linear algorithms which are based on probability functions. Particularly for likelihood when dealing with frequent hazards it is necessary to utilise high levels of risk reduction to significantly change the risk.

## 4.1 Risk Matrix and Risk Categories

As stated above, the definitions of the likelihood and consequence of a hazard occurrence are contained within an industry standard 5 x 5 matrix, which also shows the resultant risk categorisation ranging from:

- Extreme Risk;
- High Risk;
- Moderate Risk;
- Minor Risk;
- Slight Risk.

Whilst all hazards should be kept under review, it may be considered that a hazard categorised as Moderate, Minor, or slight is already As Low As Reasonably Practicable (ALARP). Hazards categorised as Extreme or High Risk must have some suitable mitigations or risk control options (RCO's) to reduce the risk score until the residual risk is ALARP.

The Risk Matrix, with the risk tolerance definitions, and an Excel scoring matrix is shown in Appendix B.

## 4.2 NRA Results – Summary

As an open forum the work shop participants agreed a list of 33 Hazards for discussion (Hazard No.14 was left blank). Appendix B contains the output from the Navigation Risk Assessment.

Hazards that were identified at the Navigation Risk Assessment workshop are listed below:

- 1 Passing (Commercial) vessel powered allision with marine cable (Construction)
- 2 Passing (Fishing) Vessel powered allision with marine cable (Construction)
- 3 Passing (Recreational) Vessel powered allision with marine cable (Construction)
- 4 Passing (Commercial) vessel drifting allision with marine cable
- 5 Passing (Fishing) Vessel drifting allision with marine cable
- 6 Passing (Recreational) Vessel drifting allision with marine cable
- 7 Passing (Commercial) vessel powered allision with cable landing site
- 8 Passing (Fishing) Vessel powered allision with cable landing site
- 9 Passing (Recreational) Vessel powered allision with cable landing site
- 10 Passing (Commercial) vessel drifting allision with cable landing site
- 11 Passing (Fishing) Vessel drifting allision with cable landing site
- 12 Passing (Recreational) Vessel drifting allision with cable landing site
- 13 Displacement of Vessels due to Avoidance of Site Leading to Increased Vessel-to-Vessel Collision Risk (Construction)
- 14 **Fishing Gear Interaction by demersal trawl**
- 15 Fishing Gear Interaction by Static Gear (Survey and Construction)
- 16 Fishing Gear Interaction by scallop dredger (Permanent Condition)
- 17 Vessel anchoring on or dragging anchor over marine cable
- 18 Loss of cable or equipment from construction associated vessels
- 19 Deliberate damage to cable (at landing sites)
- 20 Restricted search and rescue capacity in an emergency situation
- 21 Restricted oil spill response in a pollution incident
- 22 Displacement of Vessels due to Avoidance of construction vessels Leading to Increased Vessel-to-Vessel Collision Risk
- 23 Collision between passing vessel and construction vessel (at site or en route)
- 24 Dropped object (Sinking)

- 25 Man Overboard
- 26 Dredge Disposal Site - adjacent to the cable route material deposited on Cable
- 28 Nuclear Material on passing vessels
- 29 Terrorism (hi-jacking, damage to infrastructure, etc.)
- 30 Terrorism Alert (Dounreay - cause delay)
- 31 ISPS - Level of security protocol raised
- 32 Recreational Dive/surfers sites in use in reasonable proximity of the Cable
- 33 Wrecks identified and unknown in the proximity of the cable corridor
- 34 Cruise vessels anchoring in the bay in reasonable proximity to the proposed cable route

#### 4.2.1 Base Line Risk Score for Each Hazard

Individual work shop participants separately and individually assessed the likelihood and consequence of each hazard in turn, in accordance with the risk matrix. These were averaged together during the work shop to give a Base Line Risk Score for each hazard.

The results summary was as follows:

Category	Baseline scores: Nr of hazards	Comment
Extreme	5	Due to the environmental conditions on the Pentland Firth the Hazards that were extreme where associated mainly with weather and sea conditions
High	5	The Firth is a busy and sometimes unpredictable body of water. Construction in a fixed location in the Firth has created high risk hazard
Moderate	16	The Firth is a busy and sometimes unpredictable body of water. Construction in a fixed location in the Firth has created moderate risk hazard
Minor	5	These have been identified due to the activity in the firth from fishing, ferry traffic and passing traffic.
Slight	3	Due to the remoteness of the site and the communities in the vicinity slight risk from deliberate damage and passing vessels were identified at the landing sites.
<b>Total</b>	<b>34</b>	

#### 4.2.2 Mitigation

Although some risk scores were lower than others, all of the hazards were considered for mitigation.

Full details of the mitigation against each hazard can be seen from the sections of the risk spread sheet include in this report as a pdf in Appendix B. However, there were some recurrent mitigations.

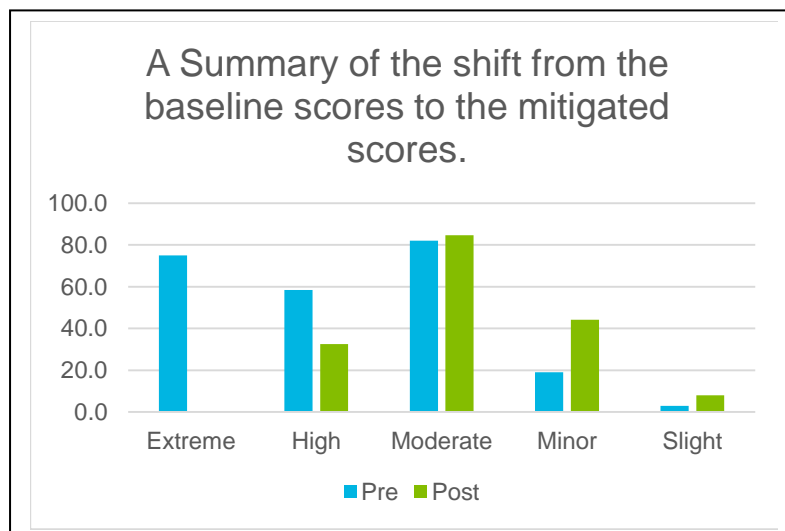


A summary of recurrent mitigations found is as follows: -

Following the workshop open forum mitigation exercise the revised risk scores were as follows: -

Category	Baseline scores: Nr of hazards	Comment
Extreme	0	The environmental conditions are well known; therefore, procedures and planning has meant the extreme risks have been mitigated.
High	3	Weather and sea condition are still unpredictable in this body of water therefore even with all the mitigation, this remains a high risk
Moderate	15	The construction activity within the Firth and landing sites have produced numerous moderate risks. These should be managed and monitored
Minor	11	The minor risk show a prevalence to low likelihood but the consequences of the risk are substantial. The NRA was unable to reduce much of the consequence. Monitoring of these risks should continue throughout the duration of the project and especially construction phase.
Slight	4	These should be noted.
Hazard removed	1	This form of fishing is not used in the area.
<b>Total</b>	<b>34</b>	

A graphical summary of the shift from the baseline scores to the mitigated scores is shown below:



#### 4.2.2.1 Discussion on Risk Mitigation

1. General. GIS information obtained by AECOM shows that there is a war grave shown in Scrabster bay that neither RF nor NM were aware of. The following text is included in this report:

*HMT Beech was a minesweeping trawler vessel sunk by German aircraft in 1941 in Scrabster Bay. The general water depth around the wreck is reported as 13m. Direction from Scrabster harbour master may be*

*required for survey and cable laying vessels in order to ensure avoidance of this wreck. This site is classified as a maritime war grave.*

2. General. Identification of Areas to be avoided on Admiralty Chart

*'The waters around Orkney (excluding the Pentland Firth and Scapa Flow) are categorised by the IMO as an Area to be Avoided (ATBA).*

*To avoid the risk of pollution and damage to the environment, all vessels over 5,000 GT carrying oil or other liquid hazardous cargoes in bulk, should avoid this area.'*

3. General – The procedures at sea provide significant mitigation to navigational risk. The Pentland Firth is a voluntarily monitored area by the MCA and Orkney Harbours. The use of a guard boat would reduce significantly the likelihood of collisions. The Firth is well monitored meaning the level of risk presented by passing or even working vessels in the area is significantly reduced.
4. General. UXO – discussion on this clarified this is of low risk and was dismissed as an overall navigational risk.
5. Risk 15. Main fishing activities hazard identified as Fishing Gear Interaction with static Gear (Survey and construction). Risk control measures to be stakeholder engagement, guard boat, VHF, Notice to Mariners (NTM), Construction Phase Plan (CPP), AIS tracking and liaison during construction work.
6. Risk 18- Timing of construction is critical as in good weather risk is less likely. Extreme and spring tides could be detrimental during construction works as equipment lost at sea would take longer to recover and if bad weather is prolonged the loss of cable and equipment could become navigational hazard.
7. General. All hazards associated with drifting or powered vessel allision with cable landing site or seabed cable, the risk control measures to be cable armour, cable protection, size of vessel is depth limited and the fact there is a shallow shoreline.
8. General. Construction vessels could increase risk to navigation through channel. This includes increase in survey vessels moving slowly in the firth.
9. General – The procedures at sea provide significant mitigation to navigational risk. The Pentland Firth is a voluntarily monitored area by the MCA and Orkney Harbours. The use of a guard boat would reduce significantly the likelihood of collisions. The Firth is well monitored meaning the level of risk presented by passing or even working vessels in the area is significantly reduced.
10. Risk 26. Hazard associated with the fact that in Thurso bay there is a dredge disposal site adjacent to the proposed cable route, the risk control measures to include Admiralty Chart, Marine Licence from Marine Scotland and Construction Phase Plan for the dredging activities.
11. General. All hazards associated with collision of vessels during surveys being carried out and during installation of the cable, the risk control measures to be stakeholder engagement, guard boat, VHF, Notice to Mariners (NTM), Construction Phase Plan (CPP), AIS tracking and liaison during survey and construction work.

## 5. Conclusion

The workshop was closed by AECOM with a brief general commentary on the above results and the participants all agreed that in their view the procedure and the results were reasonable and acceptable.

## Appendix A Metocean Data for Murkle Bay and Rackwick Bay

## 1. Metocean Data – Murkle Bay

### 1.1 Tidal Range and Storm Surge

The following tidal information is available from the Admiralty Tide Tables:

Scrabster	m CD	m OD
Mean High Water Springs (MHWS)	+5.0m CD	+2.3m OD
Mean High Water Neaps (MWHN)	+4.0m CD	+1.3m OD
Mean Low Water Neaps (MLWN)	+2.2m CD	-0.5m OD
Mean Low Water Springs (MLWS)	+1.0m CD	-1.7m OD

Table 1: Tidal Levels Scrabster. Source: Admiralty Chart No. BA2162 Pentland Firth and Approaches, 2012

In addition to regular tidal variations, total water levels include factors such as surge effects and impacts of set-up due to wind forcing. The storm surge component of the total water level is the resultant increase in sea levels caused by low pressure weather systems associated with storm events.

The following extreme water levels have been derived from the Coastal flood boundary conditions for UK mainland and islands (Project: “SC060064/TR2: Design sea levels report” published by Environment Agency in February 2011 - Table A5.1 Kinlochbervie.

Extreme Event/ Return Period (yrs)	1	2	5		10	20	50	100	200
Sea Level (m, OD)	3.19	3.28	3.41		3.51	3.61	3.74	3.84	3.94
+ Sea Rise Level (50 years*)	3.39	3.48	3.61		3.71	3.81	3.94	4.04	4.14

Table 2: Extreme Water Levels

*\*Recommends that 0.2m be added to present day levels to account for 50 years of climate change (Environment Agency, Adapting to Climate Change. Advice for Flood and Coastal Erosion Risk Management Authorities)*

### 1.2 Wind

To determine the design wind speed, BS EN 1991-1-4 2005 A1 2010 shows basic wind speed in meters per second for the British Isles. This basis wind speed can be used to determine design wind speeds at the location.

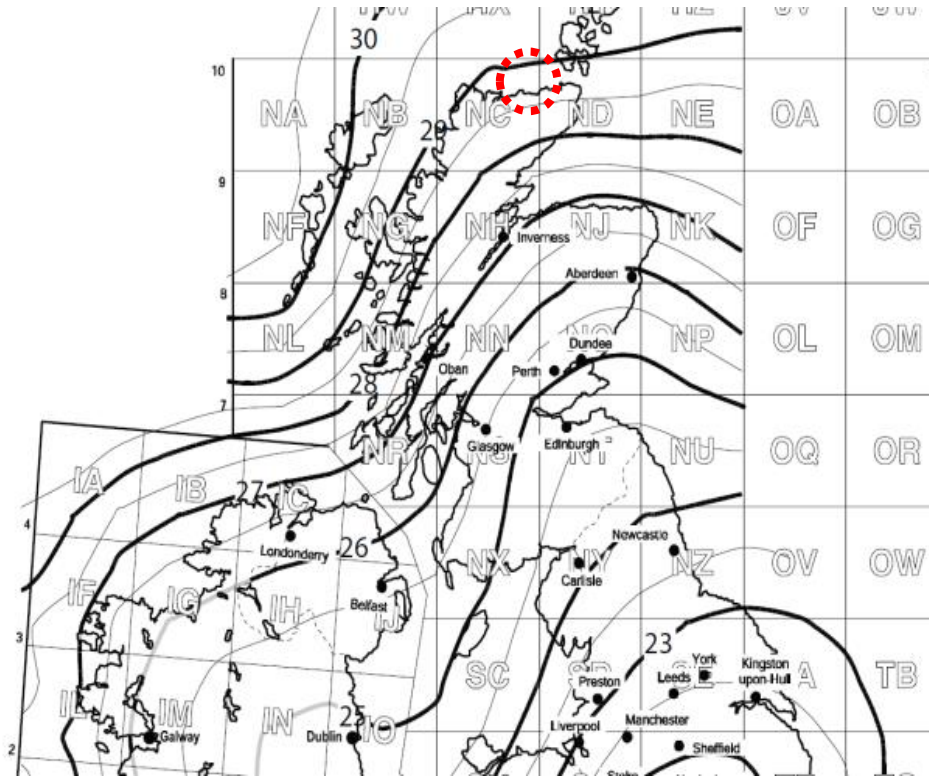


Figure 1: Value of fundamental basic wind velocity  $v_b$ , map (m/s) 50 years return period. Source: NA to BS EN 1991-1-4:2005+A1:2010.

From the figure above, it can be expected an extreme wind (50 years return period) of 28.7 m/s at the site. In order to obtain the design wind speed for the rest of the return periods (1, 5, 50, 100 year) BS 6399 Part 2 presents a wind speed ratio relative to 50 years return period. Table 3 below shows the design wind speed for the following return periods after applying the mentioned wind speed ratio.

Return Period (yr)	Wind Speed (m/s)
1	19.2
5	23.8
50	28.7
100	30.1
200	31.6

Table 3: Estimated Extreme Wind Conditions

The fundamental value of the basic wind velocity (50 year return period) shown in the table above is the characteristic 10 minutes mean wind velocity, irrespective of the wind direction and time of year, at 10m above ground.

The wind rose for Thurso, Figure 17 below, shows on how many hours per year the wind blows from the indicated direction.



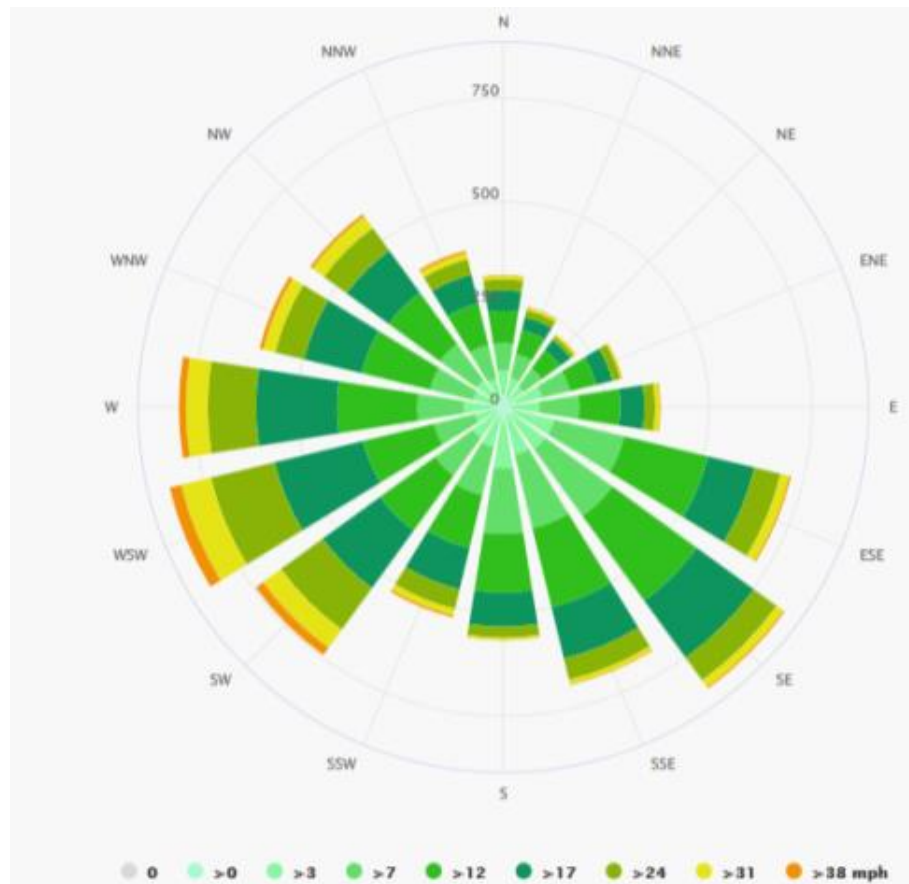


Figure 17: Thurso wind rose. Source: Meteoblue website:  
[https://www.meteoblue.com/en/weather/forecast/modelclimate/thurso\\_united-kingdom\\_2635881](https://www.meteoblue.com/en/weather/forecast/modelclimate/thurso_united-kingdom_2635881)

## 1.3 Waves

Wave heights and periods were chosen to produce the most critical combination. Wave characteristics are based on the analysis of wave hindcast and the maximum breaking wave at the site. Due to very limited data of the area, a hindcast analysis has been done according to BS EN 1991-1-4:2005 +A1 2010.

Wave heights derived from the hindcast method were checked against the maximum breaking wave and statistics found for the area. The design height adopted shall be the smaller of either the maximum breaker height or the hindcasted wave height.

### 1.3.1 Hindcast Analysis

Hindcast analysis has been undertaken for several locations to get a better understanding of the estimated waves near the area of study.

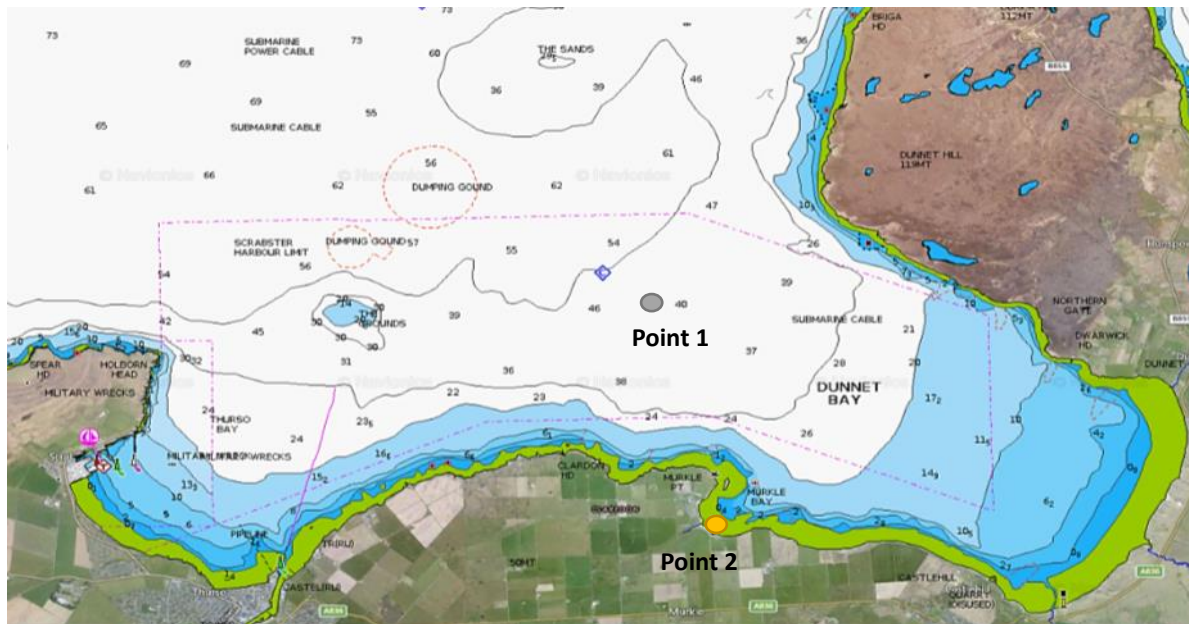


Figure 18: Hindcast analysis - Point 1 and 2 locations. Source basemap: navionics.

#### 1.3.1.1 Point near Murkle Point (P01)

At Point 1 the longest fetches are at approx. 300 to 0 degrees. The 1:200 year wind is 31.6 m/s; this results in waves of  $H_s$  between 15.7m to 26.5m. For this outline design and in order to be conservative at this stage, the coastal processes that may provoke a reduction of incident wave were not taken into consideration.

##### Return Period 100yr

Direction	0	30	60	90	120	150	180	210	240	270	300	330
	N	NNE	NEE	E	EES	ESS	S	SSW	SWW	W	WWN	WNN
Wave height (m)	<b>23.79</b>	2.13	0.64	0.94	1.14	0.93	0.75	1.25	1.49	<b>5.84</b>	<b>25.3</b>	<b>14.97</b>

##### Return Period 200yr

Direction	0	30	60	90	120	150	180	210	240	270	300	330
	N	NNE	NEE	E	EES	ESS	S	SSW	SWW	W	WWN	WNN
Wave height (m)	<b>24.92</b>	2.23	0.67	0.98	1.19	0.98	0.79	1.31	1.56	<b>6.12</b>	<b>26.5</b>	<b>15.68</b>

#### 1.3.1.2 Murkle Point (P02)

At Point 2 the longest fetches are at approx. 0 to 90 degrees. The 1:200 year wind is 31.6 m/s, this results in waves of  $H_s$  between 2.9 to 1.1m. As waves approach the coast they undergo a number of transformations such as refraction, shoaling, diffraction, dissipation due to bottom friction, wave-wave interactions and reflection. For this outline design and in order to be conservative at this stage, the coastal processes that may provoke a reduction of incident wave were not taken into consideration.

##### Return Period 100yr

Direction	0	30	60	90	120	150	180	210	240	270	300	330
	N	NNE	NEE	E	EES	ESS	S	SSW	SWW	W	WWN	WNN
Wave height (m)	<b>2.77</b>	0.95	0.98	1.05	-	-	-	-	-	-	-	0.25

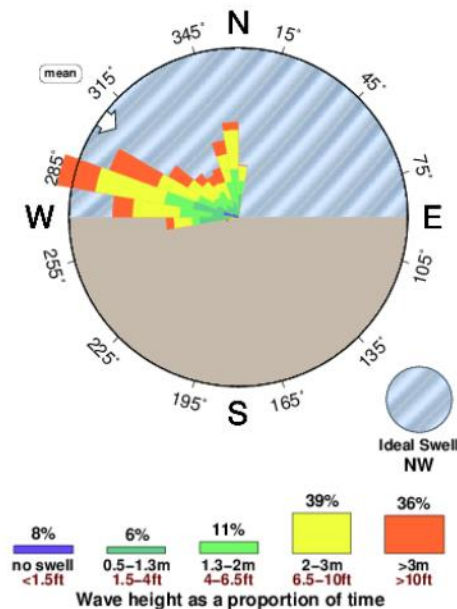
#### Return Period 200yr

Direction	0	30	60	90	120	150	180	210	240	270	300	330
	N	NNE	NEE	E	EES	ESS	S	SSW	SWW	W	WWN	WNN
Wave height (m)	2.9	1.0	1.03	1.10	-	-	-	-	-	-	-	0.26

### 1.3.2 Statistics – Murkle Point

Statistics show that the greatest wave height approaching Murkle Point with an angle of approximately 285 degrees results in wave heights greater than 3m.

Figure 19 below shows the range of swells directed at Murkle Point through an average December, and is based on 2953 NWW3 model predictions since 2006 (values every 3 hours). The wave model does not forecast surf and wind right at the shore. Therefore, this information has been used only for information as an estimate on the possible wave height reaching Murkle Point coast and to be compared with other results obtained.



75% of the wave heights are greater than 2m

17% between 0.5 to 2m

8% less than 0.5m

Figure 19: Murkle Point Swell Statistics for December. Source: [www.surf-forecast.com](http://www.surf-forecast.com)

### 1.3.3 Breaking Waves

McCowan (1894) defined a maximum wave height for solitary waves in a given water depth. This criterion is commonly used in engineering practice as a first estimate of the wave breaker height.

$$H_b = \gamma h_b$$

Where:

$\gamma=0.78$  flat seabed

$h_b$  = water depth (m)

AECOM do not hold any recent bathymetric survey of Murkle Point. The successful Contractor will have to carry out more detailed coastal modelling to derive the significant wave height and wave period for the determination of design wave loadings at the chosen shore cable landing site.

## 1.4 Currents

Currents at the site have been taken from Admiralty Chart BA2162 Pentland Firth and Approaches, 2012.

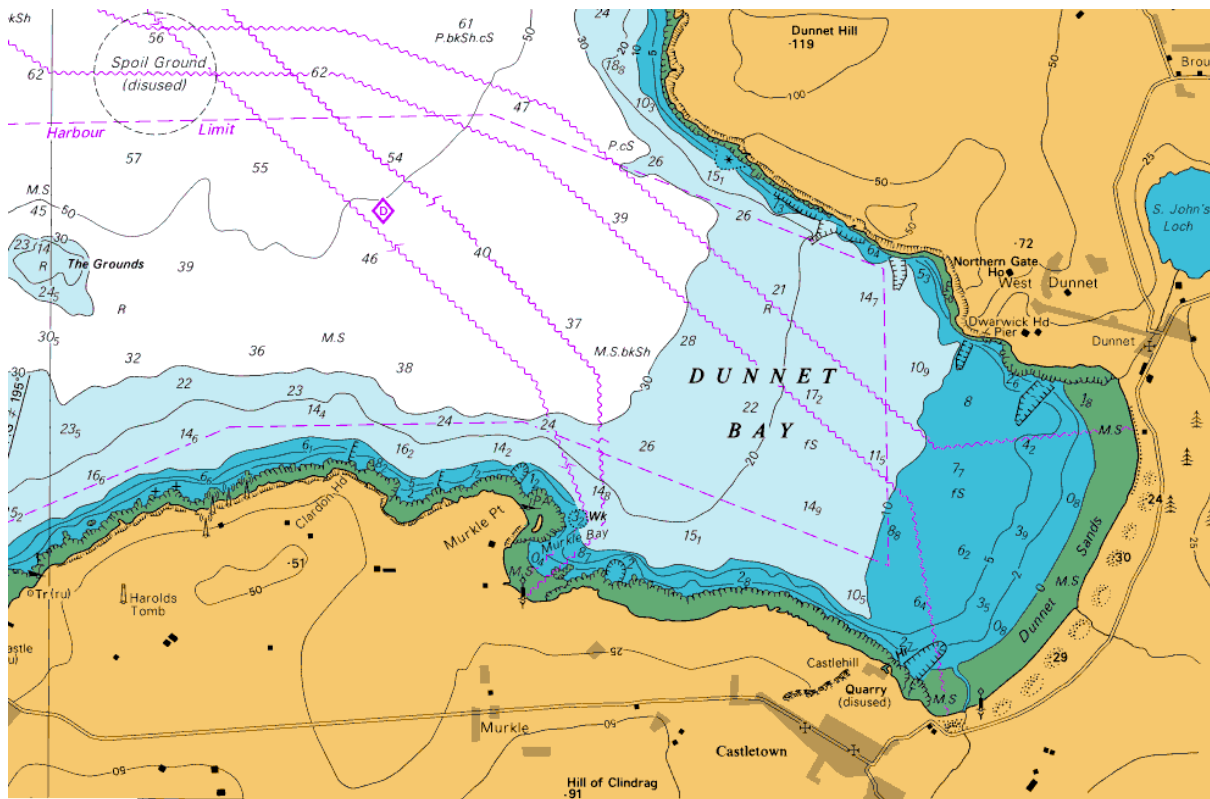


Figure 20: Tidal Streams Points. Source: Admiralty Chart BA2162 Pentland Firth and Approaches, 2012.

Table 4: Tidal Strems referred to HW at Aberdeen. Source: Admiralty Chart BA2162 Pentland Firth and Approaches, 2012.

Hours		D		
		Directions of streams (degrees)	Rates at spring tides (knots)	Rates at neap tides (knots)
Before High Water	6	100	0.4	0.2
	5		0.0	0.0
	4	307	0.1	0.0
	3	270	0.2	0.1
	2	260	0.4	0.2
	1	262	0.6	0.3
High Water	0	248	0.5	0.3
After High Water	1	215	0.2	0.1
	2	065	0.2	0.1
	3	060	0.5	0.3
	4	084	0.6	0.3
	5	088	0.5	0.3
	6	098	0.3	0.2

## 1.5 Temperature

The averages High/Low has been extrapolated from the latest Met Office set of 30-year averages, covering the period 1981-2010, for the nearest / most similar climate station to Murkle Bay.

	Location:	Altitude:	Distance:
	Strathy East (Nearest climate station to Dunnet Bay - Murkle Bay/Dunnet (Beach))	58.561, -3.990	68.0 m above mean sea level
			37.1 km from Dunnet Bay - Murkle Bay/Dunnet (Beach)

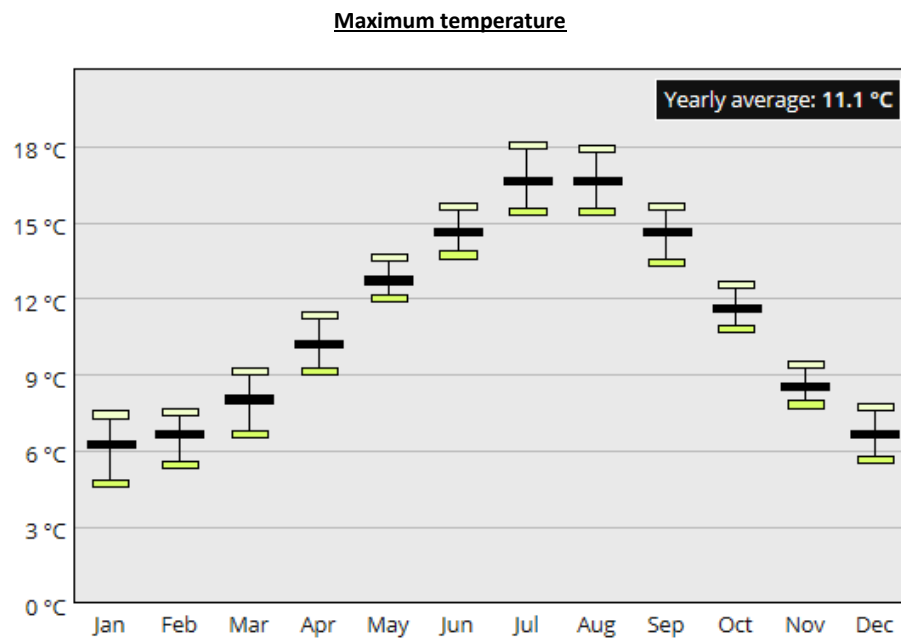


Figure 21: Maximum temperature. Source: <https://www.metoffice.gov.uk/public/weather/climate/gfmt7skdt>

### Minimum temperature

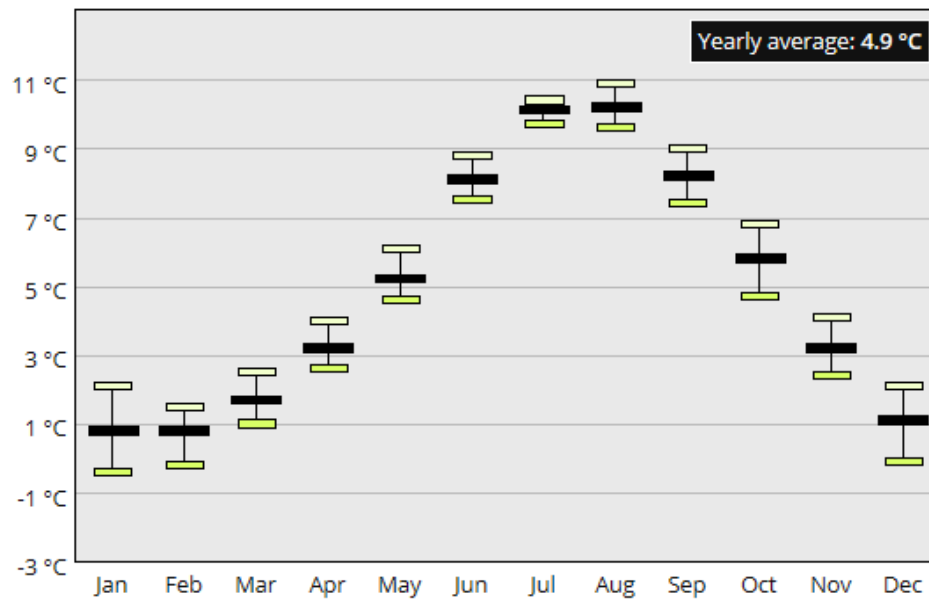


Figure 22: Minimum temperature. Source: <https://www.metoffice.gov.uk/public/weather/climate/gfnt7skdt>

## 1.6 Bathymetry

AECOM do not hold any detailed bathymetric survey for the site. For the purpose of this report, regional bathymetry was based on the Admiralty Chart BA2162 Pentland Firth and Approaches, 2012.

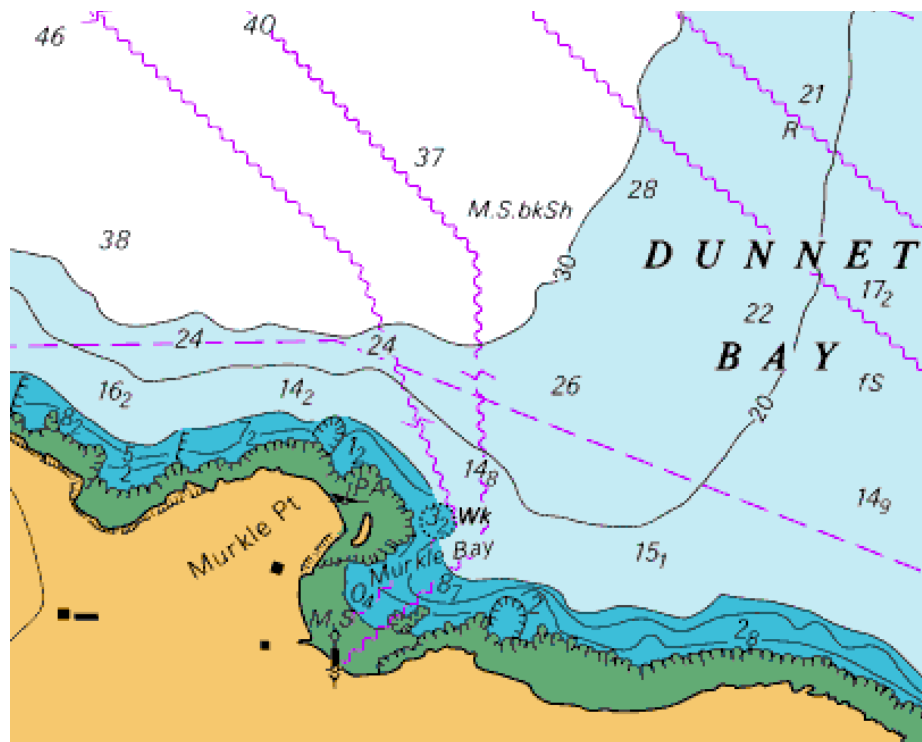


Figure 23: Murkle Bay. Source: Admiralty Chart BA2162, 2012.



## 2. Metocean data – Rackwick

### 2.1 Tidal Range and Storm Surge

The following tidal information is available from the Admiralty Tide Tables:

Stromness	m CD	m OD
Mean High Water Springs (MHWS)	+3.6m CD	+1.91m OD
Mean High Water Neaps (MWHN)	+2.7m CD	+1.01m OD
Mean Low Water Neaps (MLWN)	+1.4m CD	-0.29m OD
Mean Low Water Springs (MLWS)	+0.7m CD	-0.99m OD

Table 5: Tidal Levels Stromness. Source: Admiralty Chart No. BA2249 Orkney Islands, 2012.

In addition to regular tidal variations, total water levels include factors such as surge effects and impacts of set-up due to wind forcing. The storm surge component of the total water level is the resultant increase in sea levels caused by low pressure weather systems associated with storm events.

The following extreme water levels have been derived from the Coastal flood boundary conditions for UK mainland and islands (Project: “SC060064/TR2: Design sea levels report” published by Environment Agency in February 2011 - Table A5.1 Lerwick.

Extreme Event/ Return Period (years)	1	2	5	10	20	50	100	200
Sea Level (m, levels referenced to Local Datum)	1.52	1.57	1.64	1.69	1.73	1.79	1.83	1.87
+ Sea Rise Level (50 years*)	1.72	1.77	1.88	1.89	1.93	1.99	2.03	2.07

Table 6: Extreme Water Levels

*\*Recommends that 0.2m be added to present day levels to account for 50 years of climate change (Environment Agency, Adapting to Climate Change. Advice for Flood and Coastal Erosion Risk Management Authorities)*

### 2.2 Wind

To determine the design wind speed, BS EN 1991-1-4 2005 A1 2010 shows basic wind speed in meters per second for the British Isles. This basis wind speed can be used to determine design wind speeds at the location.

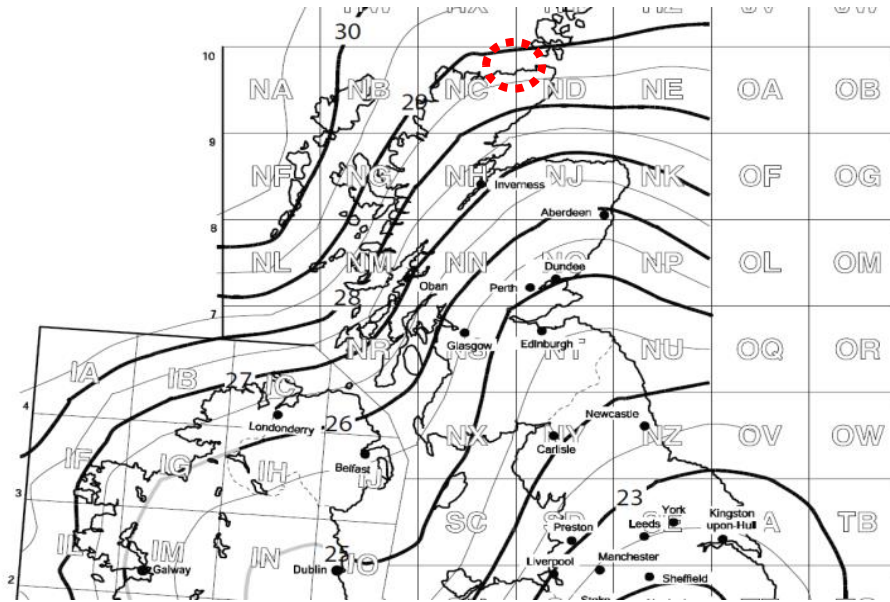


Figure 24: Value of fundamental basic wind velocity  $v_{b,map}$  (m/s) 50 years return period. Source: NA to BS EN 1991-1-4:2005+A1:2010.

From the figure above, it can be expected an extreme wind (50 years return period) of 28.9 m/s at the site. In order to obtain the design wind speed for the rest of the return periods (1, 5, 50, 100 year) BS 6399 Part 2 presents a wind speed ratio relative to 50 years return period. Table 7 below shows the design wind speed for the following return periods after applying the mentioned wind speed ratio.

Return Period (yr)	Wind Speed (m/s)
1	19.4
5	24
50	28.9
100	30.3
200	31.8

Table 7: Estimated Extreme Wind Conditions.

The fundamental value of the basic wind velocity (50 year return period) shown in the table above is the characteristic 10 minutes mean wind velocity, irrespective of the wind direction and time of year, at 10m above ground.

The wind rose for Stromness, Figure 25 below, shows on how many hours per year the wind blows from the indicated direction.

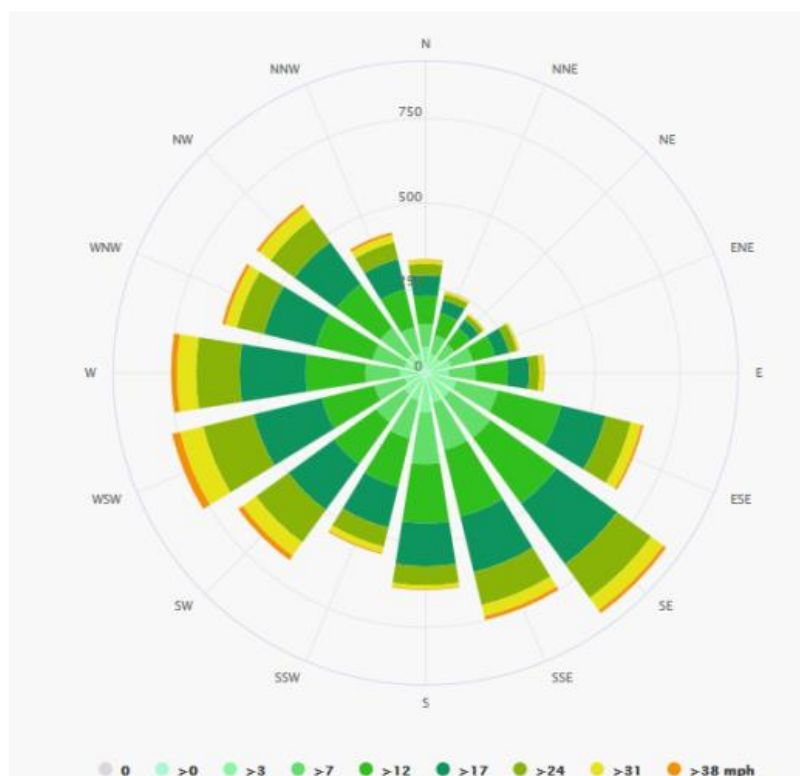


Figure 25: Stromness wind rose. Source: Meteoblue website:  
[https://www.meteoblue.com/en/weather/forecast/modelclimate/stromness\\_united-kingdom\\_2636638](https://www.meteoblue.com/en/weather/forecast/modelclimate/stromness_united-kingdom_2636638)

## 2.3 Waves

Wave heights and periods were chosen to produce the most critical combination. Wave characteristics are based on the analysis of wave hindcast and the maximum breaking wave at the site. Due to very limited data of the area, a hindcast analysis has been done according to BS EN 1991-1-4:2005 +A1 2010.

Wave heights derived from the hindcast method were checked against the maximum breaking wave and statistics found for the area. The design height adopted shall be the smaller of either the maximum breaker height or the hindcasted wave height.

### 2.3.1 Hindcast Analysis

At Rackwick point the longest fetchs are at approx. 210 to 300 degrees. The 1:200 year wind is 31.8 m/s, this results in waves of  $H_s$  between 3.8 to 35m. As waves approach the coast they undergo a number of transformations such as refraction, shoaling, diffraction, dissipation due to bottom friction, wave-wave interactions and reflection. For this outline design and in order to be conservative at this stage, the coastal processes that may provoke a reduction of incident wave were not taken into consideration.

#### Return Period 100yr

Direction	0	30	60	90	120	150	180	210	240	270*	300	330
	N	NNE	NEE	E	EES	ESS	S	SSW	SWW	W	WWN	WNN
Wave height (m)	-	-	-	-	-	0.43	2.52	3.81	5	34.07	0.47	-

#### Return Period 200yr

Direction	0	30	60	90	120	150	180	210	240	270*	300	330
	N	NNE	NEE	E	EES	ESS	S	SSW	SWW	W	WWN	WNN
Wave height (m)	-	-	-	-	-	0.45	2.64	4	5.2	35.6	0.48	-

\*Fetch at 270° is up to Canada, an estimated value of 3000km has been considered to undertake hindcast calculations.

As mentioned in section above, hindcast results shall be checked against the maximum breaking wave that the design still-water level depth and near-shore bottom slope can support. This will define the maximum wave, especially on big waves approaching the coast.

### 2.3.2 Statistics – Rackwick

Statistics show that the greatest wave heights approaching Rackwick with an angle of approximate 240-290 degrees are greater than 3m.

Figure 26 below shows the range of swells directed at Rackwick through an average December and is based on 2953 NWW3 model predictions since 2006 (values every 3 hours). The wave model does not forecast surf and wind right at the shore. Therefore, this information has been used only for information as estimation on the possible wave height reaching Rackwick coast and to be compared with other results obtained.

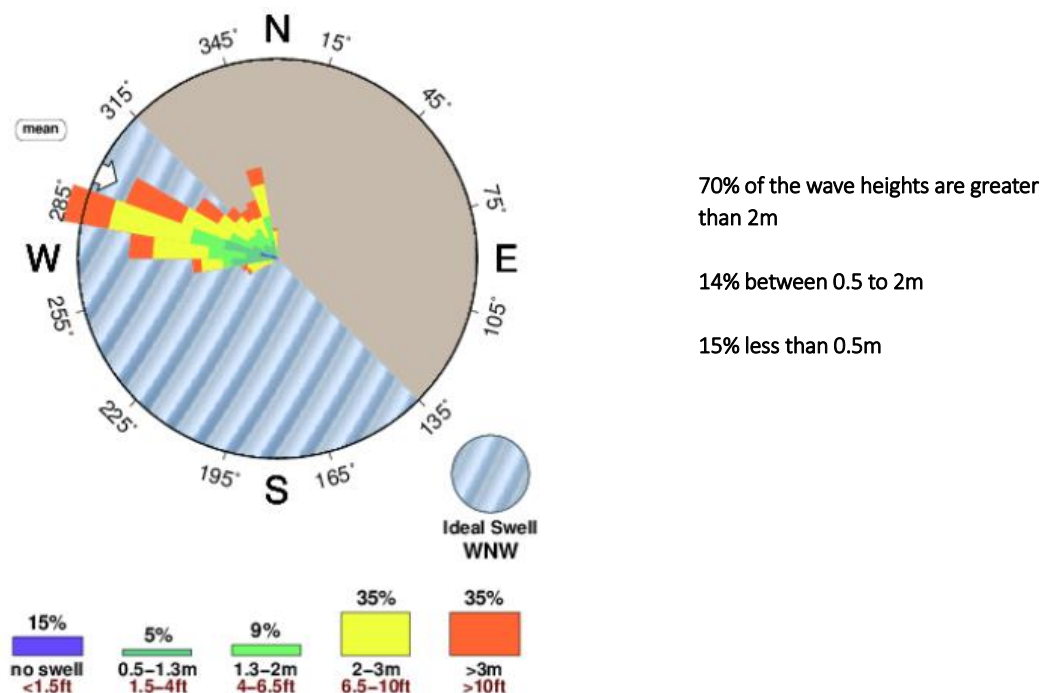


Figure 26: Rackwick Swell Statistics for December. Source: [www.surf-forecast.com](http://www.surf-forecast.com)

### 2.3.3 Breaking Waves

McCowan (1894) defined a maximum wave height for solitary waves in a given water depth. This criterion is commonly used in engineering practice as a first estimate of the wave breaker height.

$$H_b = \gamma h_b$$

Where:

$\gamma=0.78$  flat seabed

$h_b$  = water depth (m)

AECOM do not hold any recent bathymetric survey of Rackwick. The successful Contractor will have to carry out more detailed coastal modelling to derive the significant wave height and wave period for the determination of design wave loadings at the chosen shore cable landing site.

## 2.4 Currents

Currents at the site have been taken from Admiralty Chart BA2162 Pentland Firth and Approaches, 2012.

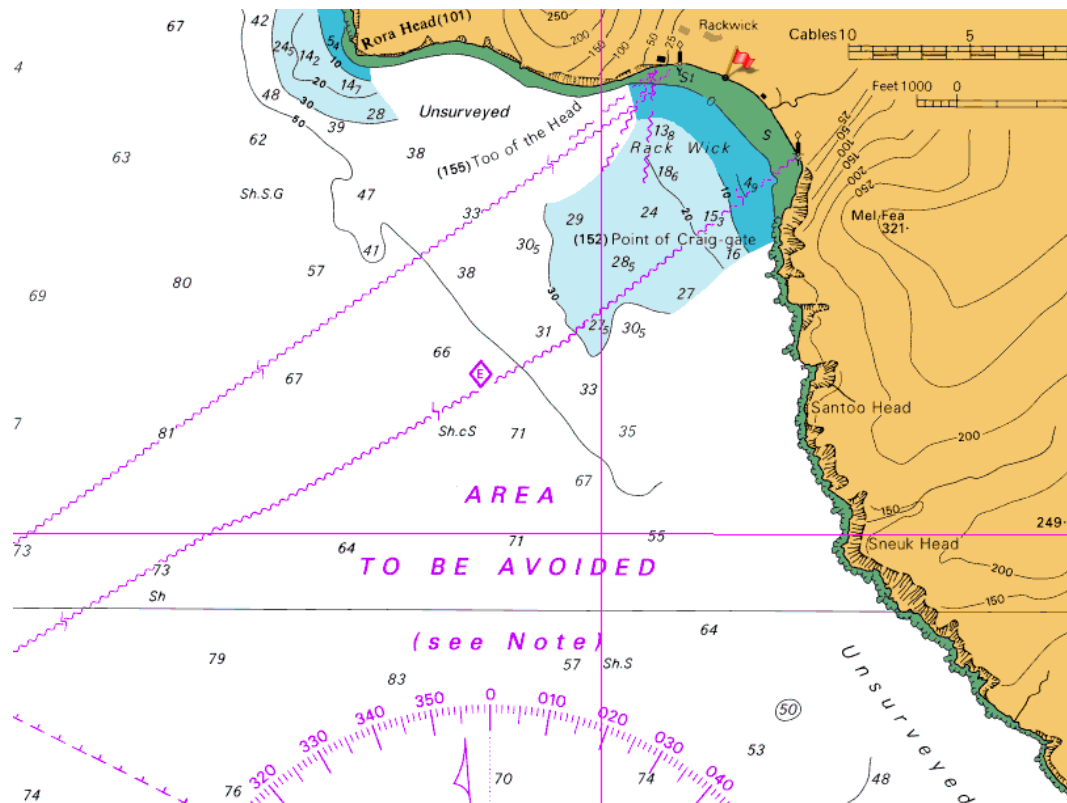


Figure 27: Tidal Streams Points. Source: Admiralty Chart BA2162 Pentland Firth and Approaches, 2012.

Table 8: Tidal Strems referred to HW at Aberdeen. Source: Admiralty Chart BA2162 Pentland Firth and Approached, 2012.

Hours		E		
		Directions of streams (degrees)	Rates at spring tides (knots)	Rates at neap tides (knots)
Before High Water	6	136	1.5	0.8
	5	130	1.0	0.6
	4	132	0.7	0.4
	3	083	0.3	0.2
	2	350	0.6	0.3
	1	333	0.8	0.5
High Water	0	323	1.0	0.6
After High Water	1	319	1.2	0.7
	2	326	0.9	0.5
	3	330	0.1	0.1
	4	134	0.4	0.2
	5	123	0.6	0.3
	6	134	1.8	1.0

## 2.4.1 Currents at approximately Midpoint of the Proposed Cable location

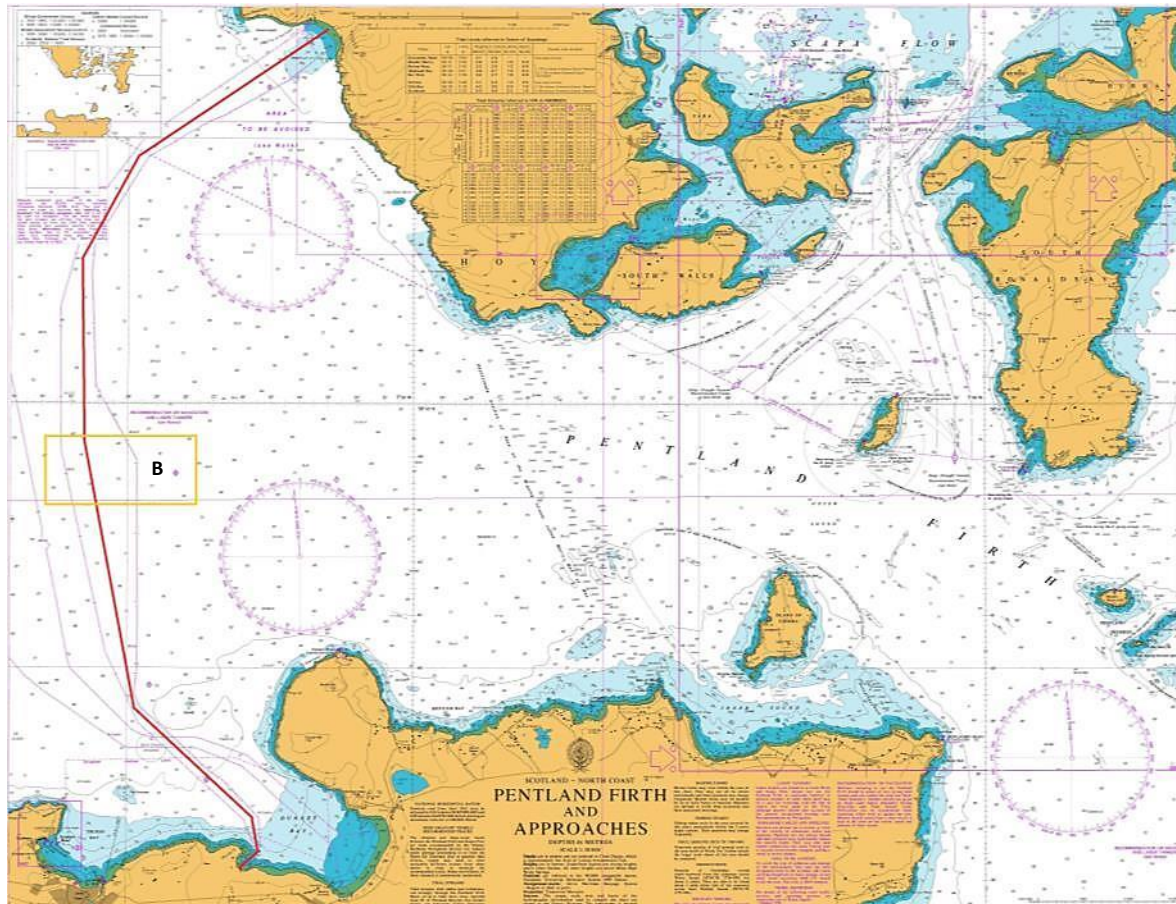


Figure 28: Admiralty Chart BA2126, 2012

Table 9: Tidal Strems referred to HW at Aberdeen. Source: Admiralty Chart BA2162 Pentland Firth and Approached, 2012.

Hours		B		
		Directions of streams (degrees)	Rates at spring tides (knots)	Rates at neap tides (knots)
Before High Water	6	116	1.4	0.8
	5	105	1.6	0.9
	4	097	1.2	0.7
	3	094	0.8	0.5
	2	066	0.2	0.1
	1	318	0.6	0.3
High Water	0	299	0.9	0.5
After High Water	1	284	1.2	0.7
	2	280	1.5	0.8
	3	268	1.4	0.8
	4	252	0.9	0.5
	5	140	0.3	0.2
	6	113	1.1	0.6



## 2.5 Temperature

The averages High/Low has been extrapolated from the latest Met Office set of 30-year averages, covering the period 1981-2010, for the nearest / most similar climate station to Rackwick.

Location:	Altitude:	Distance:
Orkney: Loch of Hundland	59.113, -3.228	28.0 m above MSL 16.7 km from Stromness

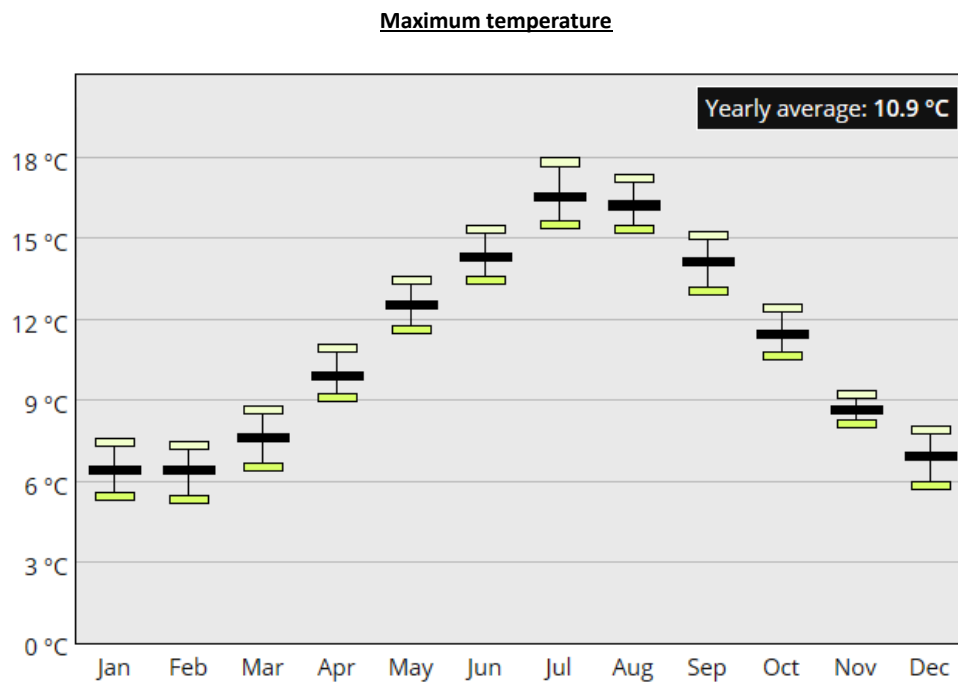


Figure 29: Maximum temperature. Source: <https://www.metoffice.gov.uk/public/weather/climate/gfmxmphm1>

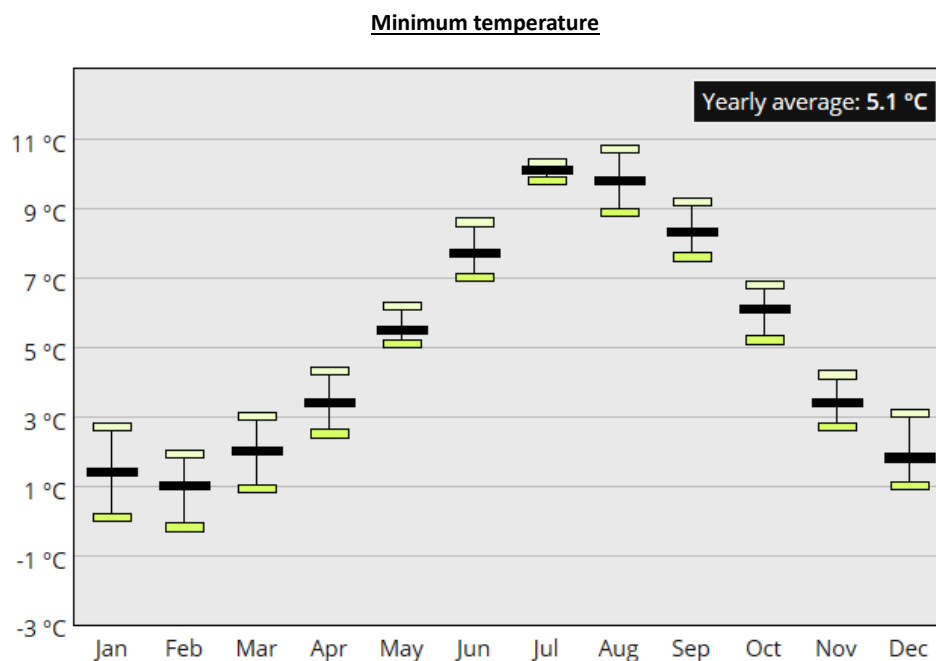


Figure 30: Minimum temperature. Source: <https://www.metoffice.gov.uk/public/weather/climate/gfmxmphm1>

## 2.6 Bathymetry

AECOM do not hold any detailed bathymetric survey for the site. For the purpose of this report, regional bathymetry was based on the Admiralty Chart BA2162 Pentland Firth and Approaches, 2012.

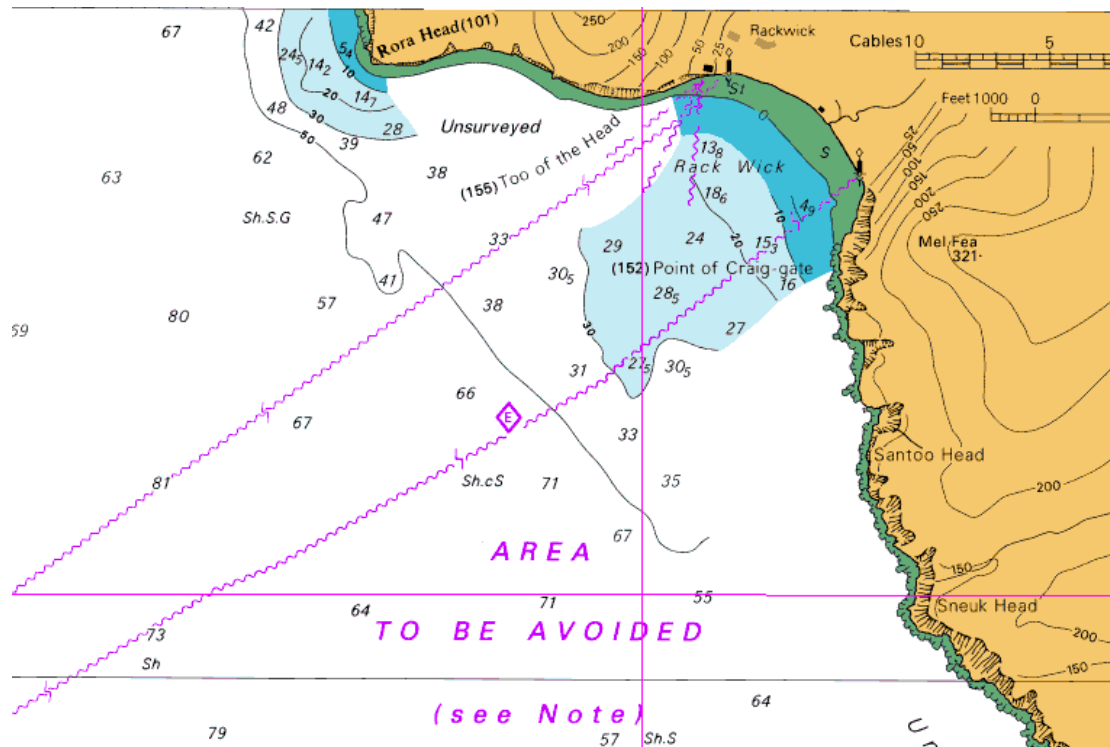


Figure 31: Rackwick. Source: Admiralty Chart BA2162, 2012

## 2.7 Historical Data available

AECOM have undertaken a desk study on available information for the area regarding metocean data. Figure 32 below shows different points near the area that provide historical data on a mean climatic year.

AECOM do not hold any historical data on extreme conditions. However, in absence of this, the information shown below will provide a better understanding of the mean/average conditions expected on site.

### Point Information

Longitude:	3.50° W
Latitude:	59.00° N
Data sampling:	1 h
Code:	1066136
First record date:	04-01-1958
Data Set:	SIMAR point

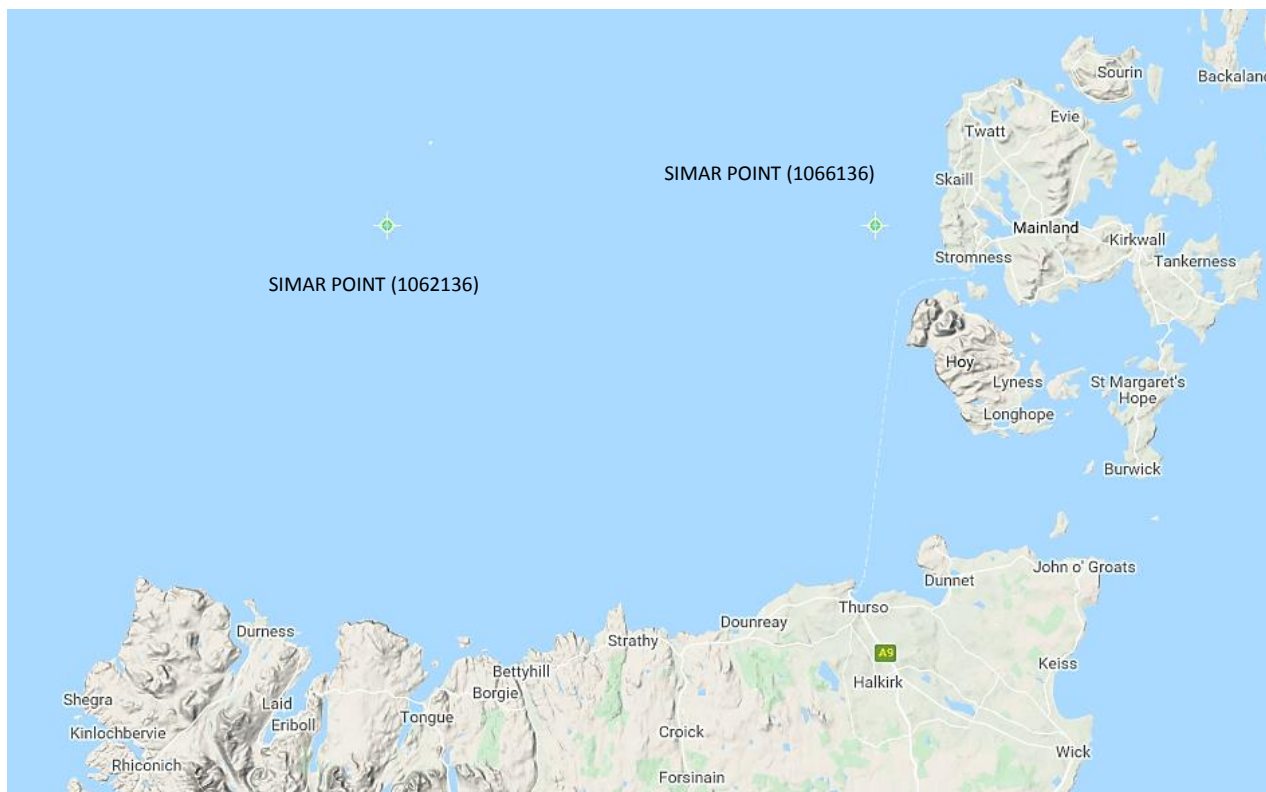
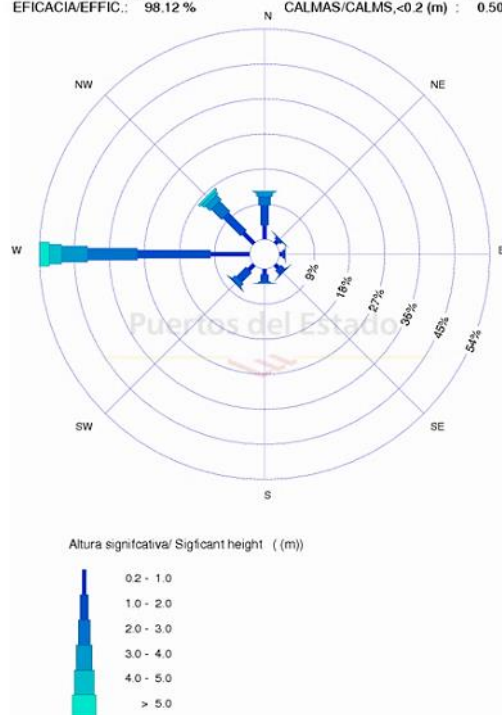


Figure 32: SIMAR Point. Source: [www.Puertos.es](http://www.Puertos.es)

**SIGNIFICANT HEIGHT ROSE at SIMAR Point 1066136 , period 1958-2019**  
 LUGAR/LOCATION: SIMAR 1066136 MUESTREO/SAMPLING: 1Hor.  
 PERIODO/PERIOD: 1958-2019 INTERVALO/INTERVAL: Global  
 EFICACIA/EFFIC.: 98.12 % CALMAS/CALMS,<0.2 (m) : 0.50 %



La eficacia del proceso de medida para el periodo seleccionado fue de un 98.12 % de datos validos.  
 Las Direcciones son Direcciones de Procedencia  
 Efficiency: 98.12 % of valid data. Angles refer to coming-from directions

Figure 33: Significant Height Rose at SIMAR Point 1066136. Source: [www.puertos.es](http://www.puertos.es)

EFICACIA: 98.05% AÑO/YEAR: 1958-2019		Tp (s)											
		<=1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	>10.0	TOTAL
Hs (m)	<=0.5	---	---	0.039	0.143	0.169	0.514	0.851	1.100	0.845	0.617	0.717	4.997
	1.0	---	---	0.066	1.648	0.671	1.110	2.441	3.236	3.214	2.909	3.542	18.837
	1.5	---	---	0.005	0.423	1.759	1.087	1.775	3.081	3.287	3.849	6.202	21.468
	2.0	---	---	0.004	0.065	0.766	1.028	1.200	1.969	2.238	2.833	6.714	16.817
	2.5	---	---	0.002	0.037	0.110	0.357	0.845	1.260	1.497	1.949	6.032	12.090
	3.0	---	---	0.002	0.025	0.057	0.124	0.335	0.805	1.007	1.219	4.788	8.361
	3.5	---	---	---	0.019	0.035	0.038	0.096	0.370	0.701	0.927	3.553	5.741
	4.0	---	---	---	0.008	0.018	0.017	0.034	0.130	0.371	0.697	2.657	3.931
	4.5	---	---	---	0.003	0.018	0.013	0.013	0.033	0.139	0.478	1.965	2.662
	5.0	---	---	---	0.002	0.006	0.005	0.005	0.010	0.030	0.243	1.503	1.804
	> 5.0	---	---	---	0.003	0.006	0.004	0.003	0.018	0.020	0.120	3.118	3.292
	TOTAL	---	---	0.119	2.376	3.613	4.297	7.598	12.013	13.350	15.842	40.791	100%

Figure 34: Hs vs Tp - SIMAR Point 1066136. Source: [www.puertos.es](http://www.puertos.es)

From results shown on Figure 34 above, the following observations can be made:

- Waves with a period  $\leq 10$ s presents 59.3%;
- Periods greater than 10s represents approx. the 41%;
- Waves greater than 3m represents the 17.5%; and
- Waves from 1.5 to 3m represents the 58.7%.

#### Table of Height Monthly Maximums - 2018

Hs:	Waves Significant Height	meters
Tp:	Peak Period	seconds
Dir:	Mean Direction, "coming from"	0= North; 90= East

Punto SIMAR 1066136 Año 2018 / SIMAR Point 1066136 Year 2018					
Mes/Month	Hs Max./Max. Hs	Tp	Dir	Día/Day	Hora/Hour
Enero/January	14.64	17.74	274	27	22
Febrero/February	7.69	17.74	264	15	21
Marzo/March	4.33	9.10	285	23	19
Abril/April	3.32	17.74	263	12	16
Mayo/May	4.58	17.74	258	10	05
Junio/June	7.47	12.11	267	14	18
Julio/July	2.38	6.83	157	29	04
Agosto/August	5.74	12.11	268	18	13
Septiembre/September	6.12	14.66	284	30	01
Octubre/October	8.36	14.66	281	23	00
Noviembre/November	5.74	13.32	252	30	12
Diciembre/December	7.08	13.32	277	31	21

Figure 35: Table of Waves - Monthly Maximum Heights. SIMAR Point 1066136 Year 2018. Source: [www.puertos.es](http://www.puertos.es)

## Appendix B Output Data from Navigation Risk Assessment

RISK ASSESSMENT MATRIX: RISK CRITERIA		FREQUENCY				
		Level 1	Level 2	Level 3	Level 4	Level 5
		Rare	Unlikely	Possible	Likely	Almost certain
		One or more times greater than 200	One or more times 100 year	One or more times in 10 years	One or more times per year	Ten or more times per year
Consequences	5- Loss of vessel or severe damage to vessel. Multiple fatalities International news coverage. Serious long-term impact on environment and or permanent effects	Moderate(5)	High (10)	Extreme (15)	Extreme(20)	Extreme(25)
	4- Major damage to vessel. Single fatality. National news coverage. Significant impact on environment with short-term or long-term effects	Minor (4)	Moderate (8)	High (12)	Extreme (16)	Extreme(20)
	3- Moderate damage to vessel. Moderate/major injury. Regional news coverage. Limited impact on environment with short term or long term effects	Minor (3)	Moderate (6)	Moderate (9)	High (12)	Extreme (15)
	2- Minor or superficial damage to vessel. Minor injuries and local news coverage. Minor impact on environment with no lasting effects.	Slight (2)	Minor (4)	Moderate (6)	Moderate (8)	High (10)
	1- Insignificant or no damage to vessel/equipment. No injuries. Insignificant impact on environment	Slight(1)	Slight (2)	Minor (3)	Minor (4)	Moderate(5)
Action Key	Slight (1-2)	No action is required				
	Minor (3-4)	No additional control are required, monitoring is required to ensure no changes in circumstances				
	Moderate (5-9)	Efforts should be made to reduce risk to "As low as reasonable practicable" (ALARP) but activity may be undertaken				
	High (10-14)	Efforts should be made to reduce risk to "As low as reasonable practicable" (ALARP). Activity can only be undertaken with further additional controls				
	Extreme (15-25)	Intolerable risk. Activity no authorised				

Prepared :=.....

Nr	Hazard	Frequency (1-5)	Consequence (1-5)
1	Passing (Commercial) vessel powered allision with marine cable (Construction)	1	4
2	Passing (Fishing) Vessel powered allision with marine cable (Construction)	1	4
3	Passing (Recreational) Vessel powered allision with marine cable (Construction)	1	5
4	Passing (Commercial) vessel drifting allision with marine cable	1	4
5	Passing (Fishing) Vessel drifting allision with marine cable	1	4
6	Passing (Recreational) Vessel drifting allision with marine cable	1	5
7	Passing (Commercial) vessel powered allision with cable landing site	1	5
8	Passing (Fishing) Vessel powered allision with cable landing site	1	5
9	Passing (Recreational) Vessel powered allision with cable landing site	1	5
10	Passing (Commercial) vessel drifting allision with cable landing site	1	5
11	Passing (Fishing) Vessel drifting allision with cable landing site	1	5
12	Passing (Recreational) Vessel drifting allision with cable landing site	1	5
13	Displacement of Vessels due to Avoidance of Site Leading to Increased Vessel-to-Vessel Collision Risk (Construction)	3	5
14	Fishing Gear Interaction by demersal trawl		
15	Fishing Gear Interaction by Static Gear (Survey and Construction)	5	3
16	Fishing Gear Interaction by scallop dredger (Permananet Condition)	1	5
17	Vessel anchoring on or dragging anchor over marine cable	3	5
18	Loss of cable or equipment from construction associated vessels	3	5
19	Deliberate damage to cable (at landing sites)	1	5
20	Restricted search and rescue capacity in an emergency situation	1	5
21	Restricted oil spill response in a pollution incident	1	5
22	Displacement of Vessels due to Avoidance of construction vessels Leading to Increased Vessel-to-Vessel Collision Risk	3	4
23	Collision between passing vessel and construction vessel (at site or en route)	3	5
24	Dropped object (Sinking)	2.5	4
25	Man Overboard	3	5
26	Dredge Disposal Site - adjacent to the cable route material deposited on Cable	3	2
27	Dredge Siposal Site - present of dredger on conctruction route	3	2



RISK ASSESSMENT MATRIX: RISK CRITERIA		FREQUENCY				
		Level 1	Level 2	Level 3	Level 4	Level 5
		Rare	Unlikely	Possible	Likely	Almost certain
		One or more times greater than 200	One or more times 100 year	One or more times in 10 years	One or more times per year	Ten or more times per year
Consequences	5- Loss of vessel or severe damage to vessel. Multiple fatalities International news coverage. Serious long-term impact on environment and or permanent effects	Moderate(5)	High (10)	Extreme (15)	Extreme(20)	Extreme(25)
	4- Major damage to vessel. Single fatality. National news coverage. Significant impact on environment with short-term or long-term effects	Minor (4)	Moderate (8)	High (12)	Extreme (16)	Extreme(20)
	3- Moderate damage to vessel. Moderate/major injury. Regional news coverage. Limited impact on environment with short term or long term effects	Minor (3)	Moderate (6)	Moderate (9)	High (12)	Extreme (15)
	2- Minor or superficial damage to vessel. Minor injuries and local news coverage. Minor impact on environment with no lasting effects.	Slight (2)	Minor (4)	Moderate (6)	Moderate (8)	High (10)
	1- Insignificant or no damage to vessel/equipment. No injuries. Insignificant impact on environment	Slight(1)	Slight (2)	Minor (3)	Minor (4)	Moderate(5)
Action Key	Slight (1-2)	No action is required				
	Minor (3-4)	No additional control are required, monitoring is required to ensure no changes in circumstances				
	Moderate (5-9)	Efforts should be made to reduce risk to "As low as reasonable practicable" (ALARP) but activity may be undertaken				
	High (10-14)	Efforts should be made to reduce risk to "As low as reasonable practicable" (ALARP). Activity can only be undertaken with further additional controls				
	Extreme (15-25)	Intolerable risk. Activity no authorised				
Prepared :=.....						
Nr	Hazard			Frequency (1-5)	Consequence (1-5)	
28	Nuclear Material on passing vessels			3		4
29	Terrorism (hi-jacking, damage to infrstructure, etc)			1		5
30	Terrorism Alert (Dounray - cause delay)			1		2
31	ISPS - Level of security protocol raised			1		3
32	Recreational Dive/surfers sites in use in reasonable proximity of the Cable			1		1
33	Wrecks identified and unknown in the proximity of the cable corridor			1		1
34	Cruise vessels anchoring in the bay in reasonable proximity to the proposed cable route			2		5
35						
36						
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59						

RISK ASSESSMENT MATRIX: RISK CRITERIA		FREQUENCY				
		Level 1	Level 2	Level 3	Level 4	Level 5
		Rare	Unlikely	Possible	Likely	Almost certain
		One or more times greater than 200	One or more times 100 year	One or more times in 10 years	One or more times per year	Ten or more times per year
Consequences	5- Loss of vessel or severe damage to vessel. Multiple fatalities International news coverage. Serious long-term impact on environment and or permanent effects	Moderate(5)	High (10)	Extreme (15)	Extreme(20)	Extreme(25)
	4- Major damage to vessel. Single fatality. National news coverage. Significant impact on environment with short-term or long-term effects	Minor (4)	Moderate (8)	High (12)	Extreme (16)	Extreme(20)
	3- Moderate damage to vessel. Moderate/major injury. Regional news coverage. Limited impact on environment with short term or long term effects	Minor (3)	Moderate (6)	Moderate (9)	High (12)	Extreme (15)
	2- Minor or superficial damage to vessel. Minor injuries and local news coverage. Minor impact on environment with no lasting effects.	Slight (2)	Minor (4)	Moderate (6)	Moderate (8)	High (10)
	1- Insignificant or no damage to vessel/equipment. No injuries. Insignificant impact on environment	Slight(1)	Slight (2)	Minor (3)	Minor (4)	Moderate(5)
Action Key	Slight (1-2)	No action is required				
	Minor (3-4)	No additional control are required, monitoring is required to ensure no changes in circumstances				
	Moderate (5-9)	Efforts should be made to reduce risk to "As low as reasonable practicable" (ALARP) but activity may be undertaken				
	High (10-14)	Efforts should be made to reduce risk to "As low as reasonable practicable" (ALARP). Activity can only be undertaken with further additional controls				
	Extreme (15-25)	Intolerable risk. Activity no authorised				

Prepared :=.....

**Nr Hazard****Frequency Consequence**  
**(1-5) (1-5)**60  
61  
62  
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82



PENTLAND FIRTH SUBMARINE CABLE REPLACEMENT- THURSO NAVIGATIONAL RISK ASSESSEMENT

NAVIGATIONAL RISK ASSESSEMENTS														
Hzd Nr.	AGREED HAZARD	Workshop	Workshop	BASE LINE	HAZARD	HAZARD	MITIGATI ON	RISK Control measures	% reduce	%reduce	INDIVIDUAL		CUMULATIVE RISK SCORE MITIGATED	Result
		Survey	Survey											
		Averaged	Averaged											
		Likelihood	CON			Likelihood/Cause	CONSequence		Y/N	USER ASSESSED	USER ASSESSED			
1	Passing (Commercial) vessel powered allision with marine cable (Construction)	1.0	4.0	4.0			Y				4.0	BASELINE	4.0	Minor
					Adverse Weather	injury to Personnel	n		0	0			4.0	
					Equipment Failure	minor damage to vessel	n		0	0	4.0			
					Human error	damage to cable	n		0	0	4.0			
					Lack of awareness/experience	damage to cable laying vessel	n		0	0	4.0			
					if vessel close to shore	negligible environmental damage	n		0	0	4.0			
					if vessel close to laying vessel	disruption to elecricity supply	n		0	0	4.0			
					maneouivering error	disruption to cable laying op.	n		0	0	4.0			
					Poor Visibility		n		0	0	4.0			
					Navigational Aid Failure		n		0	0	4.0			
					Watchkeeper failure		n		0	0	MITIGATED	4.0	Minor	
2	Passing (Fishing) Vessel powered allision with marine cable (Construction)	1.0	4.0	4.0			Y				4.0	BASELINE	4.0	Minor
					Adverse Weather	injury to Personnel	n		0	0			4.0	
					Equipment Failure	minor damage to vessel	n		0	0	4.0			
					Human error	damage to cable	n		0	0	4.0			
					Lack of awareness/experience	damage to cable laying vessel	n		0	0	4.0			
					if vessel close to shore	negligible environmental damage	n		0	0	4.0			
					if vessel close to laying vessel	disruption to elecricity supply	n		0	0	4.0			
					maneouivering error	disruption to cable laying op.	n		0	0	4.0			
					Poor Visibility		n		0	0	4.0			
					Navigational Aid Failure		n		0	0	4.0			
					gear snagging		n		0	0	MITIGATED	4.0	Minor	
3	Passing (Recreational) Vessel powered allision with marine cable (Construction)	1.0	5.0	5.0			Y				5.0	BASELINE	5.0	Moderate
					Adverse Weather	injury to Personnel	y	NTM	10	0	4.8		5.0	
					Equipement Failure	minor damage to vessel	y	Guard Boat	70	0	2.4		5.0	
					Human error	damage to cable	n	VHF	0	0	5.0			
					Lack of awareness/experience	damage to cable laying vessel	n		0	0	5.0			
					if vessel close to shore	negligible environmental damage	n		0	0	5.0			
					if vessel close to laying vessel	disruption to elecricity supply	n		0	0	5.0			
					maneouivering error	disruption to cable laying op.	n		0	0	5.0			
					Poor Visibility		n		0	0	5.0			
					Navigational Aid Failure		n		0	0	5.0			
					Watchkeeper failure		n		0	0	MITIGATED	5.0	Moderate	
4	Passing (Commercial) vessel drifting allision with marine cable	1.0	4.0	4.0			Y				4.0	BASELINE	4.0	Minor
					Adverse Weather	injury to Personnel	n	Use correct bath charts	0	0			4.0	
					Equipment Failure	minor damage to vessel	n	Regular berth maintenance sonar	0	0	4.0			
					Human error	damage to cable	n	Depth sounder procedure on vessel	0	0	4.0			
					Lack of awareness/experience	damage to cable laying vessel	n	Weather updates	0	0	4.0			
					if vessel close to shore	negligible environmental damage	n		0	0	4.0			
					if vessel close to laying vessel	disruption to elecricity supply	n		0	0	4.0			
					maneouivering error	disruption to cable laying op.	n		0	0	4.0			
					Poor Visibility		n		0	0	4.0			
					Navigational Aid Failure		n		0	0	4.0			
					Watchkeeper failure		n		0	0	MITIGATED	4.0	Minor	
5	Passing (Fishing) Vessel drifting allision with marine cable	1.0	4.0	4.0			Y				4.0	BASELINE	4.0	Minor
					Adverse Weather	injury to Personnel	n	Use correct bath charts	0	0			4.0	
					Equipment Failure	minor damage to vessel	n	Regular berth maintenance sonar	0	0	4.0			
					Human error	damage to cable	n	Depth sounder procedure on vessel	0	0	4.0			
					Lack of awareness/experience	damage to cable laying vessel	n	Weather updates	0	0	4.0			
					if vessel close to shore	negligible environmental damage	n		0	0	4.0			
					if vessel close to laying vessel	disruption to elecricity supply	n		0	0	4.0			
					maneouivering error	disruption to cable laying op.	n		0	0	4.0			
					Poor Visibility		n		0	0	4.0			
					Navigational Aid Failure		n		0	0	4.0			

PENTLAND FIRTH SUBMARINE CABLE REPLACEMENT- THURSO NAVIGATIONAL RISK ASSESSEMENT

					gear snagging		n		0	0		MITIGATED	4.0	Minor
6	Passing (Recreational) Vessel drifting allision with marine cable	1.0	5.0	5.0			Y				5.0	BASELINE	5.0	Moderate
					Adverse Weather	injury to Personnel	n		0	0			5.0	
					Equipment Failure	minor damage to vessel	n		0	0			5.0	
					Human error	damage to cable	n		0	0			5.0	
					Lack of awareness/experience	damage to cable laying vessel	n		0	0			5.0	
					if vessel close to shore	negligible environmental damage	n		0	0			5.0	
					if vessel close to laying vessel	disruption to eletricity supply	n		0	0			5.0	
					maneouvering error	disruption to cable laying op.	n		0	0			5.0	
					Poor Visibility		n		0	0			5.0	
					Navigational Aid Failure		n		0	0			5.0	
					Watchkeeper failure		n		0	0		MITIGATED	5.0	Moderate
7	Passing (Commercial) vessel powered allision with cable landing site	1.0	5.0	5.0			y				5.0	BASELINE	5.0	Moderate
					Adverse Weather	injury to public	y	Cable Armour	0	10	5.0		5.0	
					Equipment Failure	minor damage to vessel	y	Cable Protection	0	30	4.8		4.8	
					Human error	damage to cable	y	Signage warnings	25	0	4.4		4.8	
					Lack of awareness/experience	damage to cable laying vessel	y	Admiralty charts	25	0	4.4		4.8	
					if vessel close to shore	negligible environmental damage	y	Size of vessel depth limited	0	30	4.8		4.6	
					if vessel close to laying vessel	disruption to eletricity supply	y	Shallow Shoreline	0	60	4.6		4.2	
					maneouvering error	disruption to cable laying op.	n		0	0			4.2	
					Poor Visibility		n		0	0			4.2	
					Navigational Aid Failure		n		0	0			4.2	
					Watchkeeper failure		n		0	0		MITIGATED	4.2	Minor
8	Passing (Fishing) Vessel powered allision with cable landing site	1.0	5.0	5.0			y				5.0	BASELINE	5.0	Moderate
					Adverse Weather	injury to public	y	Cable Armour	0	10	5.0		5.0	
					Equipment Failure	minor damage to vessel	y	Cable Protection	0	30	4.8		4.8	
					Human error	damage to cable	y	Signage warnings	25	0	4.4		4.8	
					Lack of awareness/experience	damage to cable laying vessel	y	Admiralty charts	25	0	4.4		4.8	
					if vessel close to shore	negligible environmental damage	y	Size of vessel depth limited	0	30	4.8		4.6	
					if vessel close to laying vessel	disruption to eletricity supply	y	Shallow Shoreline	0	60	4.6		4.2	
					maneouvering error	disruption to cable laying op.	n		0	0			4.2	
					Poor Visibility		n		0	0			4.2	
					Navigational Aid Failure		n		0	0			4.2	
					gear snagging		n		0	0		MITIGATED	4.2	Minor
9	Passing (Recreational) Vessel powered allision with cable landing site	1.0	5.0	5.0			Y				5.0	BASELINE	5.0	Moderate
					Adverse Weather	injury to public	y	Cable Armour	0	10	5.0		5.0	
					Equipment Failure	minor damage to vessel	y	Cable Protection	0	30	4.8		4.8	
					Human error	damage to cable	y	Signage warnings	25	0	4.4		4.8	
					Lack of awareness/experience	damage to cable laying vessel	y	Admiralty charts	25	0	4.4		4.8	
					if vessel close to shore	negligible environmental damage	y	Size of vessel depth limited	0	30	4.8		4.6	
					if vessel close to laying vessel	disruption to eletricity supply	y	Shallow Shoreline	0	60	4.6		4.2	
					maneouvering error	disruption to cable laying op.	n		0	0			4.2	
					Poor Visibility		n		0	0			4.8	
					Navigational Aid Failure		n		0	0			4.8	
					Watchkeeper failure		n		0	0		MITIGATED	4.8	Moderate
10	Passing (Commercial) vessel drifting allision with cable landing site	1.0	5.0	5.0			y				5.0	BASELINE	5.0	Moderate
					Adverse Weather	injury to public	y	Cable Armour	0	10	5.0		5.0	
					Equipment Failure	minor damage to vessel	y	Cable Protection	0	30	4.8		4.8	
					Human error	damage to cable	y	Size of vessel depth limited	0	30	4.8		4.6	
					Lack of awareness/experience	damage to cable laying vessel	y	Shallow Shoreline	0	60	4.6		4.2	
					if vessel close to shore	negligible environmental damage	n		0	0			4.2	
					if vessel close to laying vessel	disruption to eletricity supply	n		0	0			4.2	
					maneouvering error	disruption to cable laying op.	n		0	0			4.2	
					Poor Visibility		n		0	0			4.2	
					Navigational Aid Failure		n		0	0			4.2	
					gear snagging		n		0	0		MITIGATED	4.2	Minor
11	Passing (Fishing) Vessel drifting allision with cable landing site	1.0	5.0	5.0			Y				5.0	BASELINE	5.0	Moderate
					Adverse Weather	injury to public	y	Cable Armour	0	10	5.0		5.0	
					Equipment Failure	minor damage to vessel	y	Cable Protection	0	30	4.8		4.8	
					Human error	damage to cable	y	Size of vessel depth limited	0	30	4.8		4.6	
					Lack of awareness/experience	damage to cable laying vessel	y	Shallow Shoreline	0	60	4.6		4.2	
					if vessel close to shore	negligible environmental damage	n		0	0			4.2	
					if vessel close to laying vessel	disruption to eletricity supply	n		0	0			4.2	
					maneouvering error	disruption to cable laying op.	n		0	0			4.2	
					Poor Visibility		n		0	0			4.2	
					Navigational Aid Failure		n		0	0			4.2	
					Watchkeeper failure		n		0	0		MITIGATED	4.2	Minor
	Passing (Recreational) Vessel						Y				5.0	BASELINE	5.0	Moderate
					Adverse Weather	injury to public	y	Cable Armour	0	10	5.0		5.0	
					Equipment Failure	minor damage to vessel	y	Cable Protection	0	30	4.8		4.8	
					Human error	damage to cable	y	Size of vessel depth limited	0	30	4.8		4.6	
					Lack of awareness/experience	damage to cable laying vessel	y	Shallow Shoreline	0	60	4.6		4.2	

PENTLAND FIRTH SUBMARINE CABLE REPLACEMENT- THURSO NAVIGATIONAL RISK ASSESSEMENT

12	drifting allision with cable landing site	1.0	5.0	5.0	if vessel close to shore	negligible environmental damage	n		0	0			4.2	
					if vessel close to laying vessel	disruption to elecricity supply	n		0	0			4.2	
					maneouvering error	disruption to cable laying op.	n		0	0			4.2	
					Poor Visibility		n		0	0			4.2	
					Navigational Aid Failure		n		0	0			4.2	
					Watchkeeper failure		n		0	0			4.2	
							y				15.0	MITIGATED	4.2	Minor
13	Displacement of Vessels due to Avoidance of Site Leading to Increased Vessel-to-Vessel Collision Risk (Construction)	3.0	5.0	15.0			y					BASELINE	15.0	Extreme
					Communication Failure	injury to public	y	CPP	20	0			14.5	
					Failure to comply with Colregs	minor damage to vessel	y	VHF	50	0			13.5	
					Fatigue	minor environmental damage	y	Lighting	10	0			14.8	
					Human Error	minor injury to crews	y	Guard boat	75	0			12.0	
					Increased Vessel Density		y	NTM	10	0			14.8	
					Lack of awareness/experience		y	AIS tracking	30	0			14.2	
					Lack of Passage Planning		y	Stakeholder Engagement	20	0			14.5	
					Poor Visibility		n		0	0			8.3	
					Watchkeeper Failure		n		0	0			8.3	
							n		0	0			8.3	Moderate
14	Fishing Gear Interaction by demersal trawl	0.0	0.0	0.0			Y				0.0	BASELINE	1.0	#N/A
					Failure to Promulagte Information	loss of gear	n		0	0			1.0	
					Equipment Failure	disruption to fishing operations	n		0	0			1.0	
					Fishing Vessel attracted to site	injury to crew members	n		0	0			1.0	
					Human Error	negligible environmental impact	n		0	0			1.0	
					Lack of awareness/experience	damage to fishing vessel	n		0	0			1.0	
						damage to cable	n		0	0			1.0	
						disruption of electricity supply	n		0	0			1.0	
							n		0	0			1.0	
							n		0	0			1.0	
							n		0	0			1.0	#N/A
15	Fishing Gear Interaction by Static Gear (Survey and Construction)	5.0	3.0	15.0			Y				15.0	BASELINE	15.0	Extreme
					Failure to Promulagte Information	loss of gear	y	Stakeholder Engagement	35	0			14.4	
					Equipment Failure	disruption to fishing operations	y	Guard Boat	75	0			12.6	
					Fishing Vessel attracted to site	injury to crew members	y	VHF	50	0			11.7	
					Human Error	negligible environmental impact	y	NTM	25	0			11.4	
					Lack of awareness/experience	damage to fishing vessel	y	CPP	10	0			11.2	
						damage to cable	y	AIS tracking	15	0			11.0	
						disruption of electricity supply	y	liaison during construction work	20	0			10.7	
							n		0	0			10.7	
							n		0	0			10.7	
							n		0	0			10.7	High
16	Fishing Gear Interaction by scallop dredger (Permanenet Condition)	1.0	5.0	5.0			Y				5.0	BASELINE	5.0	Moderate
					Failure to Promulagte Information	loss of gear	n	Admiralty charts	10	0			5.0	
					Equipment Failure	disruption to fishing operations	n		0	0			5.0	
					Fishing Vessel attracted to site	injury to crew members	n		0	0			5.0	
					Human Error	negligible environmental impact	n		0	0			5.0	
					Lack of awareness/experience	damage to fishing vessel	n		0	0			5.0	
						damage to cable	n		0	0			5.0	
						disruption of electricity supply	n		0	0			5.0	
							n		0	0			5.0	
							n		0	0			5.0	
							n		0	0			5.0	Moderate
17	Vessel anchoring on or dragging anchor over marine cable	3.0	5.0	15.0			Y				15.0	BASELINE	15.0	Extreme
					Adverse Weather	damage to cable	y	Admiralty Chart	70	0			12.4	
					Equipment Failure	surfacing of cable	y	AIS tracking	30	0			11.6	
					failure to promulgate information	disruption of electricity supply	y	Cable protection	0	20			11.4	
					Human Error		n		0	0			11.4	
					incident in proximity to site		n		0	0			11.4	
					Lack of awareness/experience		n		0	0			11.4	
					Navigational Aid Failure		n		0	0			11.4	
					Poor holding ground		n		0	0			11.4	
							n		0	0			11.4	
							n		0	0			11.4	High
18	Loss of cable or equipment from construction associated vessels	3.0	5.0	15.0			Y				15.0	BASELINE	15.0	Extreme
					adverse weather	minor environmental impact	y	CPP	80	0			11.5	
					vessel collision	allision with passing vessel	y	Guard Boat	0	60			10.6	
					Equipment Failure	disruption to cable laying operation	y	VHF	0	20			10.4	
							n		0	0			10.4	
							n		0	0			10.4	
							n		0	0			10.4	
							n		0	0			10.4	
							n		0	0			10.4	
							n		0	0			10.4	
							n		0	0			10.4	High
							y				5.0	BASELINE	5.0	Moderate



PENTLAND FIRTH SUBMARINE CABLE REPLACEMENT- THURSO NAVIGATIONAL RISK ASSESSEMENT

19	Deliberate damage to cable (at landing sites)	1.0	5.0	5.0	vandalism	damage to cable	n		0	0		MITIGATED	5.0	Moderate
					vessels attracted to site (curiosity)	disruption of electricity supply	n		0	0			5.0	
						reduced life of cable landing	n		0	0			5.0	
							n		0	0			5.0	
							n		0	0			5.0	
							n		0	0			5.0	
							n		0	0			5.0	
							n		0	0			5.0	
							n		0	0			5.0	
20	Restricted search and rescue capacity in an emergency situation	1.0	5.0	5.0	incident in proximity to site	Restricted search and rescue	n		0	0	5.0	BASELINE	5.0	Moderate
							n		0	0			5.0	
							n		0	0			5.0	
							n		0	0			5.0	
							n		0	0			5.0	
							n		0	0			5.0	
							n		0	0			5.0	
							n		0	0			5.0	
							n		0	0			5.0	
21	Restricted oil spill response in a pollution incident	1.0	5.0	5.0	incident in proximity to site	restricted oil spill response	n		0	0	5.0	BASELINE	5.0	Moderate
							n		0	0			5.0	
							n		0	0			5.0	
							n		0	0			5.0	
							n		0	0			5.0	
							n		0	0			5.0	
							n		0	0			5.0	
							n		0	0			5.0	
							n		0	0			5.0	
22	Displacement of Vessels due to Avoidance of construction vessels Leading to Increased Vessel-to-Vessel Collision Risk	3.0	4.0	12.0			Y				12.0	BASELINE	12.0	High
					Communication Failure	minor damage to vessels	y	Stakeholder Engagement	20	0	11.6		11.6	
					Failure to comply with Colregs	minor injuries to crew members	y	Guard Boat	80	0	9.2		8.8	
					Fatigue	minor environmental impact	y	VHF	25	0	11.5		8.3	
					Human Error	negligible disruption to cable laying	y	NTM	25	0	11.5		7.8	
					Increased Vessel Density		y	CPP	80	0	9.2		5.0	
					Lack of awareness/experience		y	AIS tracking	25	0	11.5		4.5	
					Lack of Passage Planning		y	liaison during construction work	25	0	11.5		4.0	
					Poor Visibility		n		0	0			4.0	
Watchkeeper Failure		n		0	0		4.0							
23	Collision between passing vessel and construction vessel (at site or en route)	3.0	5.0	15.0			y				15.0	BASELINE	15.0	Extreme
					Communication Failure	minor damage to vessels	y	Stakeholder Engagement	20	0	14.5		14.5	
					Failure to comply with Colregs	minor injuries to crew members	y	Guard Boat	80	0	11.5		11.0	
					Fatigue	minor environmental impact	y	VHF	25	0	14.4		10.4	
					Human Error	negligible disruption to cable laying	y	NTM	25	0	14.4		9.8	
					Increased Vessel Density		y	CPP	80	0	11.5		6.3	
					Lack of awareness/experience		y	AIS tracking	25	0	14.4		5.7	
					Lack of Passage Planning		y	liaison during construction work	25	0	14.4		5.0	
					Poor Visibility		n		0	0			5.0	
Watchkeeper Failure		n		0	0		5.0							
24	Dropped object (Sinking)	3.0	4.0	12.0			Y				12.0	BASELINE	12.0	High
					Human Error	small object dropped and sinks	y	CPP	75	0	9.6		9.6	
					Equipment Failure	negligible impact on vessel operation	y	NTM	0	25	11.6		9.3	
					Inadequate work procedures	negligible environmental impact	y	Retrieve item immediately	0	80	9.9		7.6	
					Inadequate maintenance	negligible impact on cable operations	y	VHF	0	25	11.6		7.3	
							y	Training and experience	50	0	10.8		6.4	
							n		0	0			6.4	
							n		0	0			6.4	
							n		0	0			6.4	
25	Man Overboard	2.5	5.0	12.5			Y				12.5	BASELINE	12.5	High
					adverse weather	Man overboard during construction	y	Life Jackets	0	50	11.8		11.7	
					Human Error	quick recovery	y	Training and experience	50	20	10.8		10.1	
					Fatigue	loss of life	y	Expediant Recovery, Correct recovery equipment	0	80	10.8		8.6	
							y	CPP	50	0	11.0		7.4	

PENTLAND FIRTH SUBMARINE CABLE REPLACEMENT- THURSO NAVIGATIONAL RISK ASSESSEMENT

25	Main Overboard	2.0	3.0	12.0		y	SafetyCulture	30	0	11.7	MITIGATED BASELINE	6.8	Moderate
						n		0	0			6.8	
						n		0	0			6.8	
						n		0	0			6.8	
						n		0	0			6.8	
						n		0	0			6.8	
26	Dredge Disposal Site - adjacent to the cable route material deposited on Cable	3.0	2.0	6.0		Y				6.0	MITIGATED BASELINE	6.0	Moderate
						y	Admiralty Chart	70	0	5.0		5.0	
						y	Marine Licence	99	0	2.0		2.0	
						y	CPP for dredger	80	0	4.6		2.0	
						n		0	0			2.0	
						n		0	0			2.0	
						n		0	0			2.0	
						n		0	0			2.0	
						n		0	0			2.0	
						n		0	0			2.0	
						n		0	0			2.0	
27	Dredge Siposal Site - present of dredger on construction route	3.0	2.0	6.0		y				6.0	MITIGATED BASELINE	6.0	Moderate
						y	Stakeholder Engagement	20	0	5.8		5.8	
						y	Guard Boat	80	0	4.6		4.4	
						y	VHF	25	0	5.8		4.2	
						y	NTM	25	0	5.8		3.9	
						y	CPP	80	0	4.6		2.5	
						y	AIS tracking	25	0	5.8		2.3	
						y	liaison during construction work	25	0	5.8		2.0	
						n		0	0			2.0	
						n		0	0			2.0	
						n		0	0			2.0	
28	Nuclear Material on passing vessels	3.0	4.0	12.0		Y				12.0	MITIGATED BASELINE	12.0	High
						y	Guard Boat	0	60	10.8		10.8	
						y	VHF	0	60	10.8		9.6	
						y	NTM	0	70	10.4		8.0	
						y	AIS tracking	0	60	10.8		6.9	
						n		0	0			6.9	
						n		0	0			6.9	
						n		0	0			6.9	
						n		0	0			6.9	
						n		0	0			6.9	
						n		0	0			6.9	
29	Terrorism (hi-jaking, damage to infrstructure, etc)	1.0	5.0	5.0		Y				5.0	MITIGATED BASELINE	5.0	Moderate
						n		0	0			5.0	
						n		0	0			5.0	
						n		0	0			5.0	
						n		0	0			5.0	
						n		0	0			5.0	
						n		0	0			5.0	
						n		0	0			5.0	
						n		0	0			5.0	
						n		0	0			5.0	
						n		0	0			5.0	
30	Terrorism Alert (Dounray - cause delay)	1.0	2.0	2.0		Y				2.0	MITIGATED BASELINE	2.0	Slight
						n		0	0			2.0	
						n		0	0			2.0	
						n		0	0			2.0	
						n		0	0			2.0	
						n		0	0			2.0	
						n		0	0			2.0	
						n		0	0			2.0	
						n		0	0			2.0	
						n		0	0			2.0	
						n		0	0			2.0	
31	ISPS - Level of security protocol raised	1.0	3.0	3.0		y				3.0	MITIGATED BASELINE	3.0	Minor
						n		0	0			3.0	
						n		0	0			3.0	
						n		0	0			3.0	
						n		0	0			3.0	
						n		0	0			3.0	
						n		0	0			3.0	
						n		0	0			3.0	
						n		0	0			3.0	
						n		0	0			3.0	
						n		0	0			3.0	
						Y				1.2	MITIGATED BASELINE	1.1	Slight

PENTLAND FIRTH SUBMARINE CABLE REPLACEMENT- THURSO NAVIGATIONAL RISK ASSESSEMENT

32	Recreational Dive/surfers sites in use in reasonable proximity of the Cable	1.1	1.1	1.2			n		0	0			1.1	
							n		0	0			1.1	
							n		0	0			1.1	
							n		0	0			1.1	
							n		0	0			1.1	
							n		0	0			1.1	
							n		0	0			1.1	
							n		0	0			1.1	
							n		0	0			1.1	
33	Wrecks identified and unknown in the proximity of the cable corridor	1.1	1.1	1.2			Y				1.2	BASELINE	1.1	Slight
							n		0	0			1.1	
							n		0	0			1.1	
							n		0	0			1.1	
							n		0	0			1.1	
							n		0	0			1.1	
							n		0	0			1.1	
							n		0	0			1.1	
							n		0	0			1.1	
34	Cruise vessels anchoring in the bay in reasonable proximity to the proposed cable route	2.0	5.0	10.0			Y				10.0	BASELINE	10.0	High
							y	Admiralty Chart	70	0	7.4		7.4	
							y	AIS tracking	30	0	9.2		6.6	
							y	Cable protection	0	20	9.8		6.5	
							n		0	0			6.5	
							n		0	0			6.5	
							n		0	0			6.5	
							n		0	0			6.5	
							n		0	0			6.5	
							n		0	0		MITIGATED	6.5	Moderate



### **3 Combined Kirkwall and Thurso Navigation Risk Assessment Workshops Summary March 2019**

# Pentland Firth East Submarine Cable Replacement

Combined Kirkwall and Thurso Navigational Risk  
Assessment Workshops Summary March 2019

Project number: 60591722  
60591722-REP-05  
27<sup>th</sup> March 2019



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# 1. Location and Scope of the Navigation risk Assessment

The proposed corridor of the replacement cable is shown in

Figure 1. It is proposed to follow the path set by the existing pair of cables which are no longer fit for purpose. This path can be seen to follow a ridge on the seafloor, representing the shallowest route between Murkle Bay on the North coast of Scotland and the island of Hoy.

A five nautical mile (nm) buffer is considered around the proposed corridor of the replacement cable for the purposes of hazard identification relevant to the project.

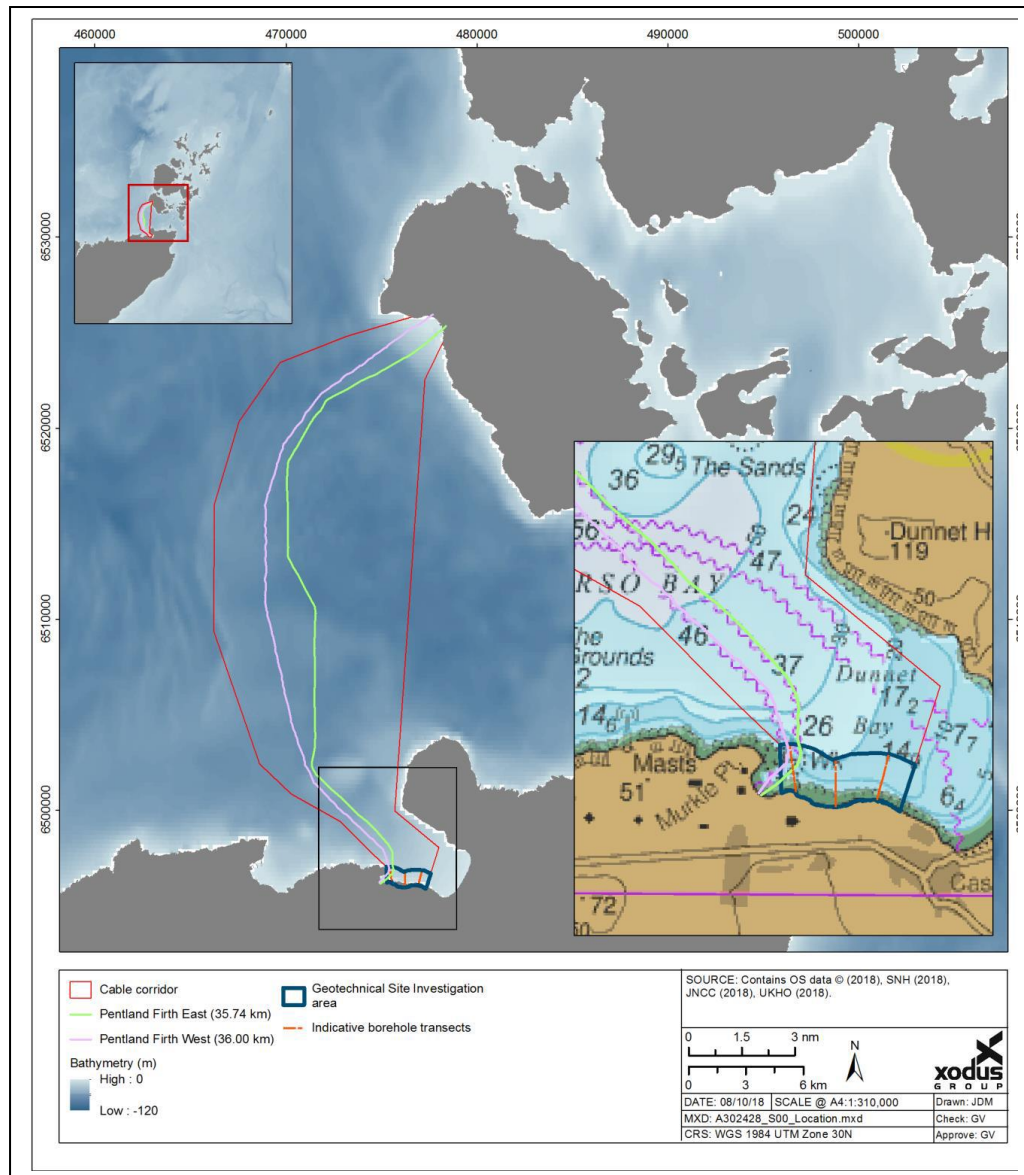


Figure 1: Proposed Cable Corridor

## 2. Navigation Risk Assessment Workshop Summary

### 2.1 Kirkwall 19<sup>th</sup> February 2019

A Navigation Risk Assessment Workshop was convened at the Magnus Centre, Kirkwall, on Tuesday 19<sup>th</sup> February 2019. The attendees at the Navigation Risk Assessment workshop were:

**Table 1: List of participants in the Navigation Risk Assessment Workshop**

Name	Position /Organisation
Jill Meikle	AECOM– Workshop Facilitator
David Meikle	AECOM Regional Director Ports & Marine
Alistair Chan	AECOM Associate Director Ports & Marine
Fiona Mathieson	Orkney Fisheries
Brian Archibald	Orkney Council
Douglas Manson	Orkney Council
Stephen Barnes	Orkney Ferries
Chris Tait	Northlink Ferries
Alda Forbes	SSE

The workshop was run by an AECOM Workshop Facilitator (WF), Jill Meikle. The process was carried out using a custom spreadsheet in order to keep a record and also to allow a rapid comparison of effects.

#### 2.1.1 NRA Results – Summary

As an open forum the work shop participants agreed a list of 23 Hazards for discussion.

Hazards that were identified at the Navigation Risk Assessment workshop are listed below:

- 1 Passing (Commercial) vessel powered allision with marine cable (with Protection)
- 2 Passing (Fishing) Vessel powered allision with marine cable (with Protection)
- 3 Passing (Recreational) Vessel powered allision with marine cable (with Protection)
- 4 Passing (Commercial) vessel drifting allision with marine cable (with Protection)
- 5 Passing (Fishing) Vessel drifting allision with marine cable (with Protection)
- 6 Passing (Recreational) Vessel drifting allision with marine cable
- 7 Passing (Commercial) vessel powered allision with cable landing site
- 8 Passing (Fishing) Vessel powered allision with cable landing site
- 9 Passing (Recreational) Vessel powered allision with cable landing site
- 10 Passing (Commercial) vessel drifting allision with cable landing site
- 11 Passing (Fishing) Vessel drifting allision with cable landing site
- 12 Passing (Recreational) Vessel drifting allision with cable landing site
- 13 Construction activity - Displacement of Vessels due to Avoidance of Site Leading to Increased Vessel-to-Vessel Collision Risk
- 14 Fishing Gear Interaction by demersal trawl (Rackwick)
- 15 Vessel anchoring on or dragging anchor over marine cable
- 16 Loss of cable or equipment from construction associated vessels
- 17 Deliberate damage to cable (at landing sites)
- 18 Experience of staff, available on passing ships during the construction phase (Exxon Valdez)

- 19 Tidal Conditions
- 20 Collision between passing vessel and construction vessel (at site or en-route)
- 21 Dropped object (Floating)
- 22 Man Overboard
- 23 Adverse Environmental conditions (wind, Wave, current, etc.) - Construction

### 2.1.2 Base Line Risk Score for Each Hazard

Individual work shop participants separately and individually assessed the likelihood and consequence of each hazard in turn, in accordance with the risk matrix. These were averaged together during the work shop to give a Base Line Risk Score for each hazard.

The results summary was as follows:

Category	Baseline scores: Nr of hazards	Comment
Extreme	2	Due to the environmental conditions on the Pentland Firth the Hazards that were extreme where associated mainly with weather and sea conditions
High	4	The Firth is a busy and sometimes unpredictable body of water. Construction in a fixed location in the Firth has created high risk hazard
Moderate	4	The Firth is a busy and sometimes unpredictable body of water. Construction in a fixed location in the Firth has created moderate risk hazard
Minor	11	These have been identified due to the activity in the firth from fishing, ferry traffic and passing traffic.
Slight	2	Due to the remoteness of the site and the communities in the vicinity slight risk from deliberate damage and passing vessels were identified at the landing sites.
<b>Total</b>		<b>23</b>

### 2.1.3 Mitigation

Although some risk scores were lower than others, all of the hazards were considered for mitigation.

A summary of recurrent mitigations found is as follows: -

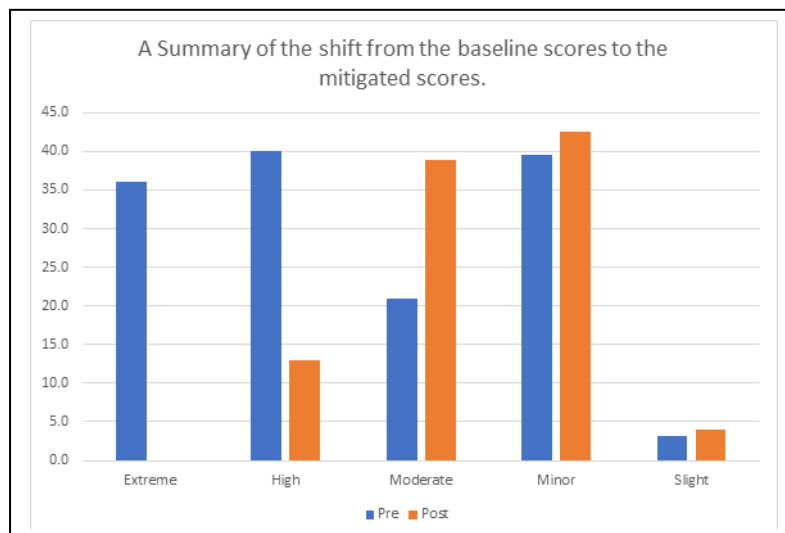
Following the workshop open forum mitigation exercise the revised risk scores were as follows: -

Category	Baseline scores: Nr of hazards	Comment
Extreme	0	The environmental conditions are well known; therefore, procedures and planning has meant the extreme risks have been mitigated.
High	1	Weather and sea condition are still unpredictable in this body of water therefore even with all the mitigation, this remains a high risk



Moderate	8	The construction activity within the Firth and landing sites have produced numerous moderate risks. These should be managed and monitored
Minor	12	The minor risk show a prevalence to low likelihood but the consequences of the risk are substantial. The NRA was unable to reduce much of the consequence. Monitoring of these risks should continue throughout the duration of the project and especially construction phase.
Slight	2	These should be noted.
Hazard removed	0	
<b>Total</b>	<b>23</b>	

A graphical summary of the shift from the baseline scores to the mitigated scores is shown below:



## 2.1.4 Discussion on Risk Mitigation

1. Tanker anchorage area shown are highly unlikely as they are not well sheltered.

2. Braer Area to be avoided – Post meeting note – Clarification sent by Stephen Barnes,

*‘The waters around Orkney (excluding the Pentland Firth and Scapa Flow) are categorised by the IMO as an Area to be Avoided (ATBA).*

*To avoid the risk of pollution and damage to the environment, all vessels over 5,000 GT carrying oil or other liquid hazardous cargoes in bulk, should avoid this area.’*

3. UXO – discussion on this clarified this is of low risk and was dismissed as an overall navigational risk.

4. Risk 2 - White fish trawling is undertaken this was perceived as low risk as vessels are passing and not working.

5. Risk 13 - Risk reduction provided by Notice to Mariners, sip communication (VHF) and escorts for larger vessels.

6. Risk 14 - Potential additional risk presented by BREXIT due to fisherman working in area that do not have local knowledge and experience and could be insufficiently trained and lack of understanding of Pentland firth operating during construction and trawling the area of the cable in it permanent position.
7. Risk 16 - Timing of construction is critical as in good weather risk is less likely. Extreme and spring tides could be detrimental during construction works as equipment lost at sea would take longer to recover and if bad weather is prolonged the loss of cable and equipment could become navigational hazard.
8. Risk 20 - Master operating in the Pentland Firth are under pressure passing through the firth to complete Paperwork and also skipper the vessel. This could mean that inexperience staff are operating the vessel as masters have to complete multiple duties. This should not happen as the Pentland Firth and the Minch require their full attention.
9. Risk 24 - Construction vessels could increase risk to navigation through channel. This includes increase in survey vessels moving slowly in the firth.
10. General – The procedures at sea provide significant mitigation to navigational risk. The Pentland Firth is a voluntarily monitored area by the MCA and Orkney Harbours. The use of a guard boat would reduce significantly the likelihood of collisions. The Firth is well monitored meaning the level of risk presented by passing or even working vessels in the area is significantly reduced.

## 2.2 Thurso 26<sup>th</sup> March 2019

A Navigation risk Assessment Workshop was convened at the Naver Business Centre, Thurso, on Tuesday 26<sup>th</sup> March 2019. The attendees at the Navigation Risk Assessment workshop were:

**Table 2: List of participants in the Navigation Risk Assessment Workshop**

Name	Position /Organisation
Jill Meikle	AECOM– Workshop Facilitator
David Meikle	AECOM Regional Director Ports & Marine
Alistair Chan	AECOM Associate Director Ports & Marine
Ross Farquhar	Deputy Harbour Master Scrabster Harbour
Hugh MacKay	Mackay Underwater Technology Limited
Alda Forbes	SSE

The workshop was run by an AECOM Workshop Facilitator (WF), Jill Meikle. The process was carried out using a custom spreadsheet in order to keep a record and also to allow a rapid comparison of effects.

### 2.2.1 NRA Results – Summary

As an open forum the work shop participants agreed a list of 33 Hazards for discussion (Hazard No.14 was left blank).

Hazards that were identified at the Navigation Risk Assessment workshop are listed below:

- 1 Passing (Commercial) vessel powered allision with marine cable (Construction)
- 2 Passing (Fishing) Vessel powered allision with marine cable (Construction)
- 3 Passing (Recreational) Vessel powered allision with marine cable (Construction)
- 4 Passing (Commercial) vessel drifting allision with marine cable
- 5 Passing (Fishing) Vessel drifting allision with marine cable
- 6 Passing (Recreational) Vessel drifting allision with marine cable
- 7 Passing (Commercial) vessel powered allision with cable landing site

- 8 Passing (Fishing) Vessel powered allision with cable landing site
- 9 Passing (Recreational) Vessel powered allision with cable landing site
- 10 Passing (Commercial) vessel drifting allision with cable landing site
- 11 Passing (Fishing) Vessel drifting allision with cable landing site
- 12 Passing (Recreational) Vessel drifting allision with cable landing site
- 13 Displacement of Vessels due to Avoidance of Site Leading to Increased Vessel-to-Vessel Collision Risk (Construction)
- 14 **Fishing Gear Interaction by demersal trawl**
- 15 Fishing Gear Interaction by Static Gear (Survey and Construction)
- 16 Fishing Gear Interaction by scallop dredger (Permanent Condition)
- 17 Vessel anchoring on or dragging anchor over marine cable
- 18 Loss of cable or equipment from construction associated vessels
- 19 Deliberate damage to cable (at landing sites)
- 20 Restricted search and rescue capacity in an emergency situation
- 21 Restricted oil spill response in a pollution incident
- 22 Displacement of Vessels due to Avoidance of construction vessels Leading to Increased Vessel-to-Vessel Collision Risk
- 23 Collision between passing vessel and construction vessel (at site or en route)
- 24 Dropped object (Sinking)
- 25 Man Overboard
- 26 Dredge Disposal Site - adjacent to the cable route material deposited on Cable
- 28 Nuclear Material on passing vessels
- 29 Terrorism (hi-jacking, damage to infrastructure, etc.)
- 30 Terrorism Alert (Dounreay - cause delay)
- 31 ISPS - Level of security protocol raised
- 32 Recreational Dive/surfers sites in use in reasonable proximity of the Cable
- 33 Wrecks identified and unknown in the proximity of the cable corridor
- 34 Cruise vessels anchoring in the bay in reasonable proximity to the proposed cable route

## 2.2.2 Base Line Risk Score for Each Hazard

Individual work shop participants separately and individually assessed the likelihood and consequence of each hazard in turn, in accordance with the risk matrix. These were averaged together during the work shop to give a Base Line Risk Score for each hazard.

The results summary was as follows:

Category	Baseline scores: Nr of hazards	Comment
Extreme	5	Due to the environmental conditions on the Pentland Firth the Hazards that were extreme where associated mainly with weather and sea conditions
High	5	The Firth is a busy and sometimes unpredictable body of water. Construction in a fixed location in the Firth has created high risk hazard
Moderate	15	The Firth is a busy and sometimes unpredictable body of water. Construction in

		a fixed location in the Firth has created moderate risk hazard
Minor	4	These have been identified due to the activity in the firth from fishing, ferry traffic and passing traffic.
Slight	4	Due to the remoteness of the site and the communities in the vicinity slight risk from deliberate damage and passing vessels were identified at the landing sites.
<b>Total</b>	<b>33</b>	

### 2.2.3 Mitigation

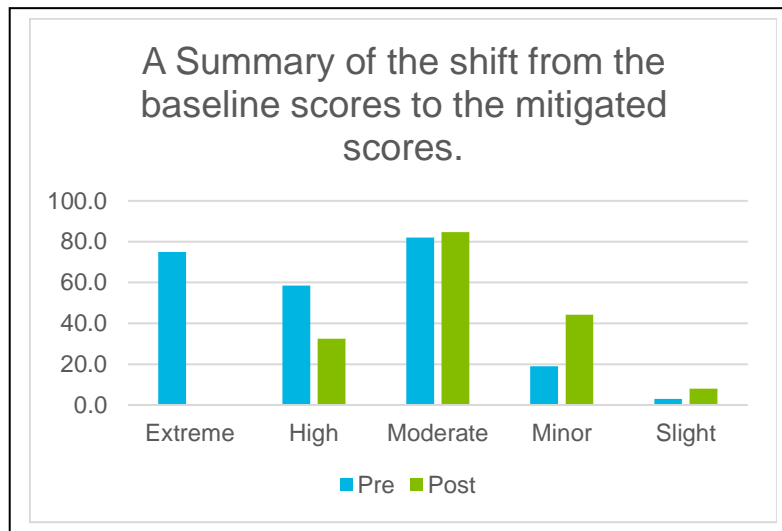
Although some risk scores were lower than others, all of the hazards were considered for mitigation.

A summary of recurrent mitigations found is as follows: -

Following the workshop open forum mitigation exercise the revised risk scores were as follows: -

Category	Baseline scores: Nr of hazards	Comment
Extreme	0	The environmental conditions are well known; therefore, procedures and planning has meant the extreme risks have been mitigated.
High	3	Weather and sea condition are still unpredictable in this body of water therefore even with all the mitigation, this remains a high risk
Moderate	14	The construction activity within the Firth and landing sites have produced numerous moderate risks. These should be managed and monitored
Minor	10	The minor risk show a prevalence to low likelihood but the consequences of the risk are substantial. The NRA was unable to reduce much of the consequence. Monitoring of these risks should continue throughout the duration of the project and especially construction phase.
Slight	6	These should be noted.
Hazard removed	0	
<b>Total</b>	<b>33</b>	

A graphical summary of the shift from the baseline scores to the mitigated scores in shown below:



## 2.2.4 Discussion on Risk Mitigation

1. General. GIS information obtained by AECOM shows that there is a war grave shown in Scrabster bay that neither RF nor NM were aware of. The following text is included in this report:

*HMT Beech was a minesweeping trawler vessel sunk by German aircraft in 1941 in Scrabster Bay. The general water depth around the wreck is reported as 13m. Direction from Scrabster harbour master may be required for survey and cable laying vessels in order to ensure avoidance of this wreck. This site is classified as a maritime war grave.*

2. General. Identification of Areas to be avoided on Admiralty Chart

*'The waters around Orkney (excluding the Pentland Firth and Scapa Flow) are categorised by the IMO as an Area to be Avoided (ATBA).*

*To avoid the risk of pollution and damage to the environment, all vessels over 5,000 GT carrying oil or other liquid hazardous cargoes in bulk, should avoid this area.'*

3. General – The procedures at sea provide significant mitigation to navigational risk. The Pentland Firth is a voluntarily monitored area by the MCA and Orkney Harbours. The use of a guard boat would reduce significantly the likelihood of collisions. The Firth is well monitored meaning the level of risk presented by passing or even working vessels in the area is significantly reduced.
4. General. UXO – discussion on this clarified this is of low risk and was dismissed as an overall navigational risk.
5. Risk 15. Main fishing activities hazard identified as Fishing Gear Interaction with static Gear (Survey and construction). Risk control measures to be stakeholder engagement, guard boat, VHF, Notice to Mariners (NTM), Construction Phase Plan (CPP), AIS tracking and liaison during construction work.
6. Risk 18- Timing of construction is critical as in good weather risk is less likely. Extreme and spring tides could be detrimental during construction works as equipment lost at sea would take longer to recover and if bad weather is prolonged the loss of cable and equipment could become navigational hazard.
7. General. All hazards associated with drifting or powered vessel allision with cable landing site or seabed cable, the risk control measures to be cable armour, cable protection, size of vessel is depth limited and the fact there is a shallow shoreline.
8. General. Construction vessels could increase risk to navigation through channel. This includes increase in survey vessels moving slowly in the firth.
9. General – The procedures at sea provide significant mitigation to navigational risk. The Pentland Firth is a voluntarily monitored area by the MCA and Orkney Harbours. The use of a guard boat would reduce significantly the likelihood of collisions. The Firth is well monitored meaning the level of risk presented by passing or even working vessels in the area is significantly reduced.

10. Risk 26. Hazard associated with the fact that in Thurso bay there is a dredge disposal site adjacent to the proposed cable route, the risk control measures to include Admiralty Chart, Marine Licence from Marine Scotland and Construction Phase Plan for the dredging activities.
11. General. All hazards associated with collision of vessels during surveys being carried out and during installation of the cable, the risk control measures to be stakeholder engagement, guard boat, VHF, Notice to Mariners (NTM), Construction Phase Plan (CPP), AIS tracking and liaison during survey and construction work.





## **Appendix F: Cost Benefit Analysis**

## Cost Benefit Analysis Model

### The Final Cost Benefit Analysis (CBA) Recommendation

The **Final CBA Recommendation** for the 33kV submarine electricity cable **Pentland Firth East - Hoy** is Option 2B:

- Rock placement<sup>1</sup> – Approximately 3,300m
- Burial through Post Lay Jetting - Approximately 10,200m
- Cable surface laid on the seabed – Approximately 22,300m
- New cable removed at the end of its economic life.

This was deemed to be the best value solution based on the available information because it addressed the following risks, impacts and needs of stakeholders:

- Installation method should limit the risk marine users.
- Rock placement maybe required at strategic locations to further stabilise the cable due to the high tidal flows.
- This scenario has higher engineering installation costs relative to the baseline; however, this is deemed necessary to reduce conflict with other marine users and to protect our infrastructure.

The **Final CBA Recommendation** scenario has an overall societal value of **minus £20,005,523**. This includes consideration of impacts on health and safety, socio-economic, environmental and wider economic and engineering impacts. It should be noted that the final **Project Description** may not fully reflect the CBA recommendation which is developed to inform the design process and highlight where societal value is impacted. However, the CBA recommendation should indicate the maximum societal impact that the project could have on society.

Option 2P should continue to be given consideration throughout the final detailed design phase, although with a higher cost to society, this option would achieve significantly higher amounts of burial which would potentially provide greater cable protection and align with the National Marine Plan suggestion that burial of new submarine cables should be maximised as far as possible. The variance between Option 2B and 2P is approximately £400k in terms of societal value; this represents a 2% increase when both are considered against the baseline installation.

### Background

Scottish Hydro Electric Power Distribution plc (SHEPD) undertook early engagement with the general public and stakeholders who have an interest in the Pentland Firth East - Hoy submarine electricity cable. Their views have shaped the installation methods that have been modelled and ultimately how the submarine electricity cable will be installed in the marine environment<sup>2</sup>.

<sup>1</sup> The current CBA model has consulted on the use of rock placement as an installation method. However, based on the final engineering design assessment, it was identified that the use of "Rock Filter Bags" instead of rock placement would achieve the required design stability requirement but with a reduced environmental and health and safety impact. Therefore the use of Rock Filter Bags should be noted as a further positive benefit in addition to the current predicted CBA Societal value using rock placement.

<sup>2</sup> The main Pre-Application Consultation Report provides detail of this.

SHEPD collaborated with stakeholders to develop the CBA model. The model helps SHEPD understand the impacts that different engineering decisions around cable installation can have on the safety of mariners, energy costs for communities we serve, on local and national economic activity and on the natural environment<sup>3</sup>.

The CBA Model allows us to make informed judgements guided by a clear set of values - ensuring that every decision is as ethical, responsible and as balanced as it can be. The CBA model assigns financial values across the following key categories for each cable installation method and design:<sup>4</sup>

- Health and safety
- Socio-economic
- Environmental
- Wider economic and engineering

These values are then aggregated to estimate the ‘**societal value**’<sup>5</sup> of each solution. The best value<sup>6</sup> solution becomes the option that we recommend in this summary.

### Approach taken to arrive at the final recommendation

The starting point for the CBA process is Scotland’s National Marine Plan (NMP) (2015) which highlights the following policies, in Chapter 14, which need to be taken into account on a case by case basis for reaching a decision regarding the development and activities involved in installing a submarine electricity cable:

- Cables should be suitably routed to provide sufficient requirements for installation and cable protection.
- New cables should implement methods to minimise impacts on the environment, seabed and other users, where operationally possible and in accordance with relevant industry practice.
- Cables should be buried to maximise protection where there are safety or seabed stability risks and to reduce conflict with other marine users and to protect the assets and infrastructure.
- Where burial is demonstrated not to be feasible, cables may be suitably protected through recognised and approved measures (such as rock or mattress placement or cable armouring) where practicable and cost-effective and as risk assessments direct.
- Consideration of the need to reinstate the seabed, undertake post-lay surveys and monitoring and carry out remedial action where required.

SHEPD then complete three phases of modelling:

#### *Phase one*

This looks at the parameters which permit different types of installation. Each scenario is developed based on the installation methods permitted by the seabed type and depth of sediment. At this point only one method is applied within each section of the model.

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<sup>3</sup> For details of why and how the Cost Benefit Analysis Model was created see <http://news.ssen.co.uk/media/266234/CBA-Model-Statement-Executive-Summary.pdf>

<sup>4</sup> The Submarine Electricity Cables Cost Benefit Analysis Method Statement can be found here: <https://www.ssen.co.uk/CBAFULL/>

<sup>5</sup> Societal value is the cost or benefit to society which includes the private costs / benefits plus any external costs / benefits. Private costs / benefits in the CBA model would be regarded as the economic and engineering category and the external costs would be noted as the Health and Safety, Socio-economic and the Environment categories.

<sup>6</sup> We define best value as the method(s) of installation which satisfy all current legislation and provides a sustainable balance of economic, safety and wider social and economic impacts with the highest societal value.

### Phase two:

**Hybrid solution(s)** are then modelled which include elements of both burial and protection that are feasible. A process of engagement is then conducted to identify if these scenarios are practicable, cost effective and address the possible risks through the PAC Events.

### Phase three:

**Hybrid solution(s)** are refined and then entered the CBA model to obtain estimated societal value. During the phase three analyses a sensitivity analysis is carried out on key assumption to understand how the value of impacts may vary.

The **Final CBA Recommendation** will then be made for the scenario which represents the overall best value solution.

## Modelling Pentland Firth East – Hoy

Initially, 43 different CBA models were developed to identify the best value solution. During phase 2, this reduced to 16 models when further survey information<sup>7</sup> became available. The other 25 models were discounted because the cost to society being far higher than remaining 16 models. Sensitivity analysis around the life expectancy of the model which showed the highest societal value is shown in phase 3.

### Pentland Firth East - Hoy: Phase one

Scenarios included Option 1A surface lay 100% of the route; and Option 1B Jetting 28% of the route. It has been identified through initial surveys that large portions of burial should be achievable due to the majority of the route being of a sandy or sandy-gravel make up. There are large sections of sand wave fields where burial should be achievable. The beach and immediate inshore area is covered in boulders and additional protection such as cast iron half shells or HDPE pipe (Euro-Duct) may be required even if buried. The initial burial assessment identifies that it would be technically feasible to obtain high percentages of burial for the new proposed route.

### Pentland Firth East - Hoy: Phase two

Phase two of the analysis then sought to identify scenarios beyond the initial assessment scenarios (Phase 1 output) where burial only was considered by adding additional protection which may be practicable, cost-effective and address marine user risk.

Table 1 provides an overview of the 16 scenarios that were considered in this phase of the analysis.

**Table 1** Practicable and cost effective burial and protection scenarios

Option	Scenario methods	Total Societal Value	Net change^ (£)	Net Change^ (%)
	Baseline Surface lay 100% (36.237km) (this was the installation method used for the existing cable)	-£19,008,479		
2A	Surface Lay 62% (22.3km) / Rock placement 9%(3.3km) / Mass Flow 28% (10.2km)	-£20,302,149	-£1,113,966	6%
2B	Surface Lay 62% (22.3km) / Rock placement 9%(3.3km) / Jetting 28% (10.2km)	-£20,005,523	-£817,339	4%
2C	Surface Lay 78% (27.9km) / Rock placement 22%(7.9km) /	-£21,537,257	-£2,349,074	12%

<sup>7</sup> The CBA analysis was re-run following a detailed route survey. The survey provided new details about seabed depth and seabed type. This has changed the proposed length and corridor from the initial design submitted to Ofgem as part of the RIIO-ED1 Reopener.

	No Burial			
2D	Surface Lay 91% (32.5km) / Rock placement 9%(3.3km) / No Burial	-£20,442,063	-£1,253,880	7%
2E	Surface Lay 87% (31.1km) / Rock placement 13%(4.6km) / No Burial / HDD 0.26% (0.1km)	-£20,378,661	-£1,190,478	6%
2F	Surface Lay 72% (25.8km) / Rock placement 13%(4.6km) / Jetting 15% (5.2km) / HDD 0.26% (0.1km)	-£20,657,306	-£1,469,123	8%
2G	Surface Lay 82% (29.3km) / Rock placement 18%(6.4km) / No Burial / HDD 0.26% (0.1km)	-£20,726,259	-£1,538,076	8%
2H	Surface Lay 82% (29.4km) / Rock placement 18%(6.4km) / No Burial	-£21,017,856	-£1,829,673	10%
2I	Surface Lay 76% (27.3km) / Rock placement 18%(6.4km) / Mass Flow 6% (2.1km)	-£21,266,134	-£2,077,951	11%
2J	Surface Lay 76% (27.3km) / Rock placement 18%(6.4km) / Jetting 6% (2.1km)	-£21,205,137	-£2,016,954	11%
2K	Surface Lay 54% (19.2km) / Rock placement 18%(6.4km) / Jetting 28% (10.2km)	-£21,561,207	-£2,373,024	12%
2L	Surface Lay 55% (19.9km) / Rock placement 9%(3.3km) / Jetting 37% (13.4km)	-£20,921,712	-£1,733,529	9%
2M	Surface Lay 64% (23.3km) / Rock placement 7%(2.6km) / Jetting 28% (10.2km)	-£20,551,293	-£1,363,110	7%
2N	Surface Lay 70% (25.3km) / Rock placement 2%(0.7km) / Jetting 28% (10.2km)	-£20,157,994	-£969,811	5%
2O	Surface Lay 9% (3.2km) / Jetting 91% (33km)	-£21,059,796	-£1,871,612	10%
2P	Surface Lay 37% (13.2km) / Jetting 63% (22.8km)	-£20,409,653	-£1,221,470	6%

<sup>^</sup>The net change is compared to the baseline assumption of end to end surface lay.

Within the sixteen scenarios considered in Table 1, no scenarios reduced societal value below that of the baseline surface lay. However, seven scenarios which utilised the protection method of rock placement along with burial were identified as the possible hybrid scenarios.

Based on this analysis it was therefore identified that these eight scenarios were practicable and cost-effective. The option with greatest societal benefit was taken forward into Phase 3.

The **Hybrid Scenario** which was deemed to address the concerns of stakeholders, including marine users and electricity customers, whilst providing the greatest societal benefit was:

#### Option Scenario methods

2B Surface Lay 62% (22.3km) / Rock placement 9%(3.3km) / Jetting 28% (10.2km)<sup>8</sup>

The length of rock placement protection in this scenario is 9%. This was amongst the lowest volume tested and focused on the areas identified by stakeholders of greatest risk and the engineering need to stabilise the cable. The survey information and contractor experience reveals that post lay jetting would be the burial method with the highest level of success. Therefore, jetting is taken forward into phase 3 as it returns a higher societal benefit.

<sup>8</sup> Option 1 A which is 100% surface lay shows a minus 1% societal value (versus the baseline) simply because the new cable is shorter than the existing cable and so has the same value as the existing cable if modelling like for like. Additionally, protection will be required to extend cable life.



### **Pentland Firth East - Hoy: Phase three**

Based on the process of engagement, including the pre applications consultation events, the **Hybrid solution** was refined and challenged to identify the best value solution using the societal value as an indicator of value before a **Final CBA Recommendation** was made.

Table 2 shows summarises sensitivity testing around the life expectancy of a cable installed as per Option 2B; and compared this to the installation method used for the existing cable which operated for 37 years. The table shows that as cable life is extended, the societal value increases. If the new cable is in operation for as long as the existing cable, installation Option 2B achieves around the same societal value in year 35. Given that protection is being proposed on the sections of the existing cable that have seen the most damage, there would be an expectation that the new cable life expectancy could be increased to 45 years which would give an even greater positive societal value over the life of the cable as seen in option 3C.

**Table 2 Sensitivity test /10 year increase in life expectancy**

Option	Scenario methods	Total Societal Value	Net change^ (£)	Net Change^ (%)
	Baseline Surface lay 100% (36.237km) (this was the installation method used for the existing cable)	-£19,008,479		
3A	Surface Lay 62% (22.3km) / Rock placement 9%(3.3km) / Jetting 28% (10.2km) <b>[Life expectancy set at 25 years]</b>	-£20,985,414	-£1,797,231	9%
3B	Surface Lay 62% (22.3km) / Rock placement 9%(3.3km) / Jetting 28% (10.2km) <b>[Life expectancy set at 35 years]</b>	-£19,716,489	-£528,306	3%
3C	Surface Lay 62% (22.3km) / Rock placement 9%(3.3km) / Jetting 28% (10.2km) <b>[Life expectancy set at 45 years]</b>	-£18,824,489	£363,694	-2%

^The net change is compared to the baseline assumption of end to end surface lay.

## **Interpretation of results**

Phase one of the CBA model shows surface laying the new Pentland Firth East - Hoy submarine electricity cable results in the highest societal value (i.e. lowest net cost). When compared to the baseline of the original cable this shows a positive societal benefit, largely because this is a shorter route.

Phase two shows combinations of protection scenarios in compliance with the National Marine Plan hierarchy of installation and the need to consider the views of other stakeholders and marine users. Surface lay remains the scenario with highest societal value but to address the need of stakeholder's option 2B would be recommended.

Phase three shows the impact of other possible outcomes to the recommended option (Option 2B) compared to the baseline assumption of 100% surface lay. The sensitivity testing examined if the cable life expectancy was greater or lesser than expected what societal benefit this would produce. The results from this were that as life expectancy increased the overall societal benefit also increased.

## **Recommendation**

The CBA model considers the societal value of different installation methods for the Pentland Firth - Hoy submarine electricity cable. SHEPD understand that other externalities not modelled need to be considered.

These include marine planning policy, final engineering design requirements including shore end protection and the cumulative impact of our submarine electricity cables on other legitimate marine users and so we propose that option 2B which is a combination of 22.3km of surface lay, 10.2km of burial via post lay jetting and 3.3km of rock placement along the cable route is put forward for further design consideration.

The submarine cable is broken into 9 section lengths within the CBA model; which when combined equals the total length of the cable. Consequently, Option 2B is represented within the model by modelling sections and applying a percentage value to each type of protection:

- sections 1, 8 and 9 as Rock Placement which is the equivalent of 9% of the total route (or 3.3km)
- sections 2 and 3 as Jetting which is the equivalent of 28% of the total route (or 10.2 km)
- sections (4,5,6&7) as surface laid which is the equivalent of 62% of the total route (or 22.3km)

The physical locations where burial, protection or surface lay will take place will be derived at the detailed design stage (Project Description) to mitigate the risk to other marine users and minimise the environmental impacts at a micro siting basis. Regardless of where the installations are installed the overall percentage of the cable which is installed using the specific methods, will still represent the percentages used within the CBA model.

Whilst the marine licence CBA has identified Option 2B to have the lowest societal impact verses the baseline of a surface laid cable, the National Marine plan suggests that burial should be maximised as far as possible for replacement subsea cables. Therefore, Option 2P will continue to be investigated throughout the final detailed design stage which would provide a greater level of burial whilst having only a small impact (2 percent) on the overall societal value of option 2B. Option 2B has a societal value of **-£20,005,523** compared with Option 2P of -£20,409,653. The total variance between both options is approximately **£400k**.

Under both options there may be the requirement for additional protection or burial for stability of the replacement cable, this will be further determined throughout the detailed design phase which is beyond the scope of the CBA analysis.