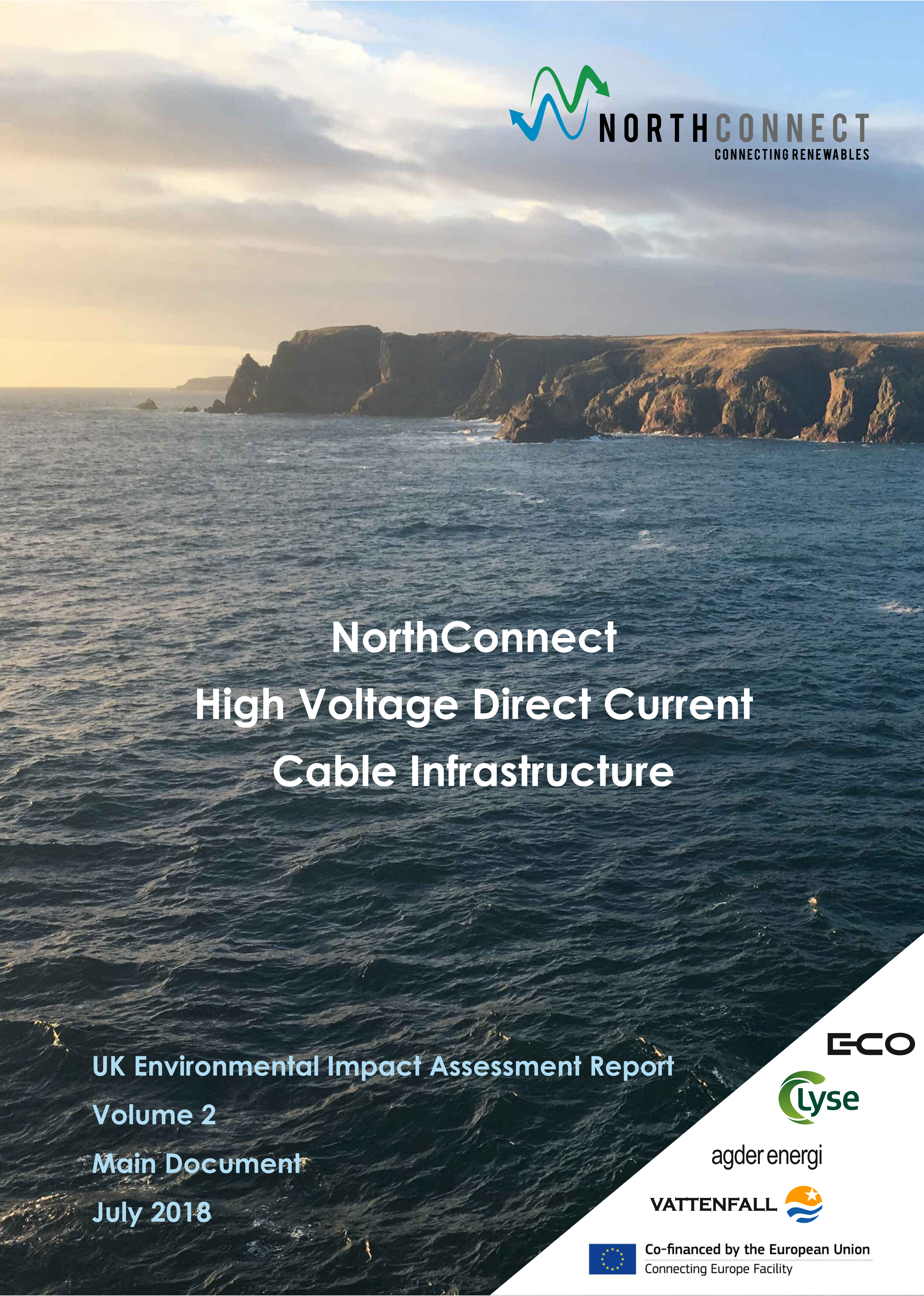

NORTHCONNECT
CONNECTING RENEWABLES

NorthConnect
High Voltage Direct Current Cable Infrastructure

UK Environmental Impact Assessment Report

Volume 2

Main Document

July 2018

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NorthConnect HVDC Cable Infrastructure EIAR: Volume 2 – Main Document

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Chapter 1: Introduction

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Contents

1 Introduction

NorthConnect is a commercial Joint Venture (JV) established to develop, build, own and operate a 1400 megawatt (MW) High Voltage Direct Current (HVDC) 'interconnector'. The interconnector will provide an electricity transmission link between Scotland and Norway. The interconnector will allow electricity to be transmitted in either direction across the North Sea.

This document is the Environmental Impact Assessment Report (EIAR) for the HVDC cable connection of the NorthConnect electricity transmission project in the UK.

The purpose of this EIAR is to support the planning application and marine licence application for the HVDC Cable Infrastructure by describing the proposed project, documenting the assessment of its likely significant effects on the environment, and detailing the mitigation measures proposed to minimise significant adverse effects. The relevant expertise and qualifications of the authors are stated in Appendix A.1.

The EIAR is split into four volumes as follows:

1. Non-Technical Summary;
2. Main Text;
3. Appendices; and
4. Drawings.

1.1 NorthConnect

NorthConnect is a project set up to develop, consent, build, and operate an HVDC electrical interconnector between Peterhead in Scotland and Simadalen in Norway (Drawing 3013). The 665km long, 1400MW interconnector will provide an electricity transmission link allowing the two nations to exchange power and increase use of renewable energy. The intention is for the HVDC interconnector to be operational by 2023.

NorthConnect is a Joint Venture (JV) project company owned by four community and state-owned partners from Norway and Sweden: Agder Energi AS, E-CO Energi AS, Lyse Produksjon AS, and Vattenfall AB. The partnership was established on 1st February 2011.

The four owner companies are illustrated in Figure 1.1.

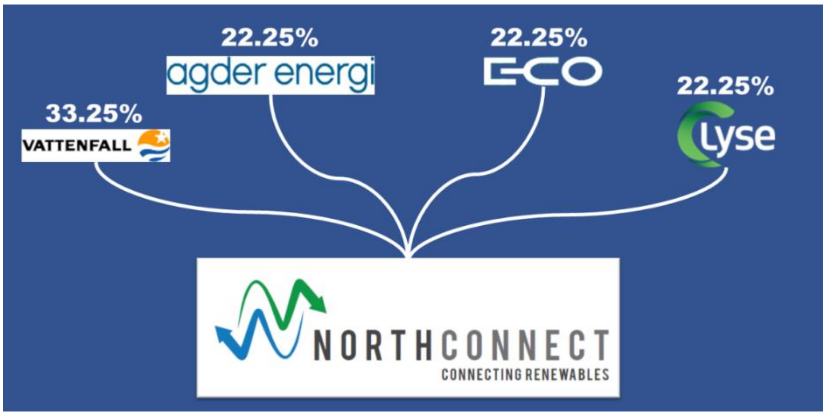

Figure 1.1 NorthConnect Joint Venture Partners.

1.2 Project Background

In the UK, electricity is normally generated, transmitted, distributed and consumed in an Alternating Current (AC) format. However, Direct Current (DC) technology allows electricity to be transmitted from point to point in much larger volumes, over greater distances with fewer transmission losses compared to an equivalent AC system. DC systems are therefore often used for high capacity interconnector projects such as NorthConnect.

The key components of the overall project are:

1. HVAC connections from the grid connection substations in Peterhead and Simadalen to new Interconnector Converter Stations.
2. Onshore Interconnector converter stations located near Peterhead, Aberdeenshire (Drawing 3022) and Simadalen in Norway along with associated infrastructure.
3. Onshore underground HVDC cabling from landfall to converter stations.
4. Landfall sites at Long Haven and Simadalen.
5. Subsea HVDC interconnector between the UK and Norway .
6. Fibre Optic cabling between the UK and Norway.

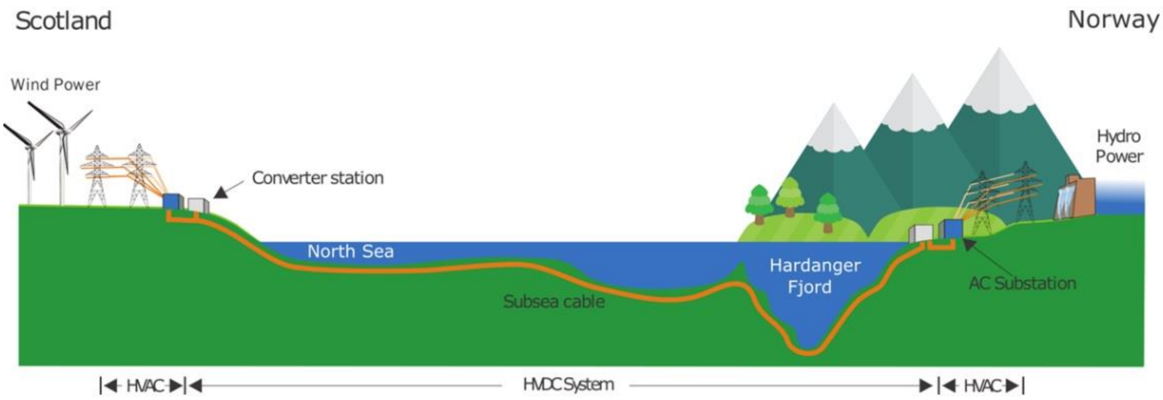

Figure 1.2 Indicative Scheme Components.

By utilising differences in the Norwegian and UK electricity markets' prices and importing / exporting energy to follow these differences, sufficient revenue can be raised for the construction and operation of the interconnector. The anticipated life of this project is at least 40 years.

1.3 Environmental Impact Assessment Report Project Coverage

The onshore HVAC cable burial from Peterhead substations to the UK Converter Stations and the construction of an onshore Converter Station at Fourfields located near Peterhead, Aberdeenshire, have been covered in a separate Environmental Statement (NorthConnect, 2015), and were granted planning permission in September 2015 by Aberdeenshire Council.

Although applications for the HVDC cable connection works alone would not automatically trigger the need for Environmental Impact Assessment (EIA) under the relevant EIA Regulations NorthConnect have elected to carry out an EIA and submit an EIA Report in respect the current planning and marine licence applications.

This EIAR focuses on the following parts of the project:

- Onshore HVDC buried cabling from the UK landfall to the converter station;
- Subsea HVDC interconnector from the UK to the UK-Norwegian median line (eastern extent of the UK Exclusive Economic Zone (UKEEZ));
- Fibre Optic cabling between the UK converter station and the UK-Norwegian median line; and
- Temporary construction requirements

1.4 The Location

The HVDC cables will connect the converter station at the Fourfields site near Boddam, Peterhead to the converter station located in Simadalen, Norway. The redline boundary for the UK elements are provided in Drawings NCFFS-NCCT-X-XG-0001-01 and Drawings NCOFF-NCT-X-XG-0001-01 to 04).

1.4.1 HVDC Cable Corridor – Onshore

The Fourfields site at NK119 412 is approximately 2.6km south of the outskirts of Peterhead; 4.5km south of Peterhead town centre; and 1km southwest of the village of Boddam (Drawing 3022). The Fourfields site is located to the south of Lendrum Terrace and Highfield, east of the Den of Boddam, Sandfordhill and Denhead and west of Stirling Hill and the Quarry. The site covers an area of approximately 37.2Ha.

The HVDC cables will be connected to the Converter station at Fourfields, and will run from the Converter station due south, crossing under the A90 and continuing to the landfall site at Long Haven, by the Longhaven cliffs (Figure 1.3), with indicative arrangements provided in Drawings NCGEN-NCT-Z-XE-0002-01 and NCGEN-NCT-Z-XD-0001-01 to 04. The cables are then routed under the cliffs to the subsea section of the project.

1.4.2 HVDC Cable Corridor – Marine

The onshore cabling will involve a horizontal directional drill (HDD) entry hole on land at Long Haven, and an exit hole approximately 200m from the cliffs. The offshore cables will be pulled onto land and the onshore and offshore cables will be joined in a jointing bay to the south of the A90.

The proposed offshore corridor for the HVDC cables will run in a north-easterly direction from the HDD exit point along the seabed to the Converter station at Simadalen, Norway (Drawings NCOFF-NCT-X-XG-0001-01 to 04). The scope of this EIAR focuses on waters up to the UK-Norwegian median line (eastern extent of UK waters).

1.4.3 Fibre Optic Cabling

A fibre optic cable will be bundled with one of the HVDC cables and as such will be installed and brought onshore as described above. The length of the optic cable route is short enough not to require an offshore repeater station, so no additional infrastructure will be required on the sea bed. Once onshore, the fibre optic cable will be routed to the converter station, along the same route as the HVDC cables. No additional infrastructure is expected for the fibre optic cabling, as it is only going to be used for site to site communications between the Scottish and Norwegian converter stations.

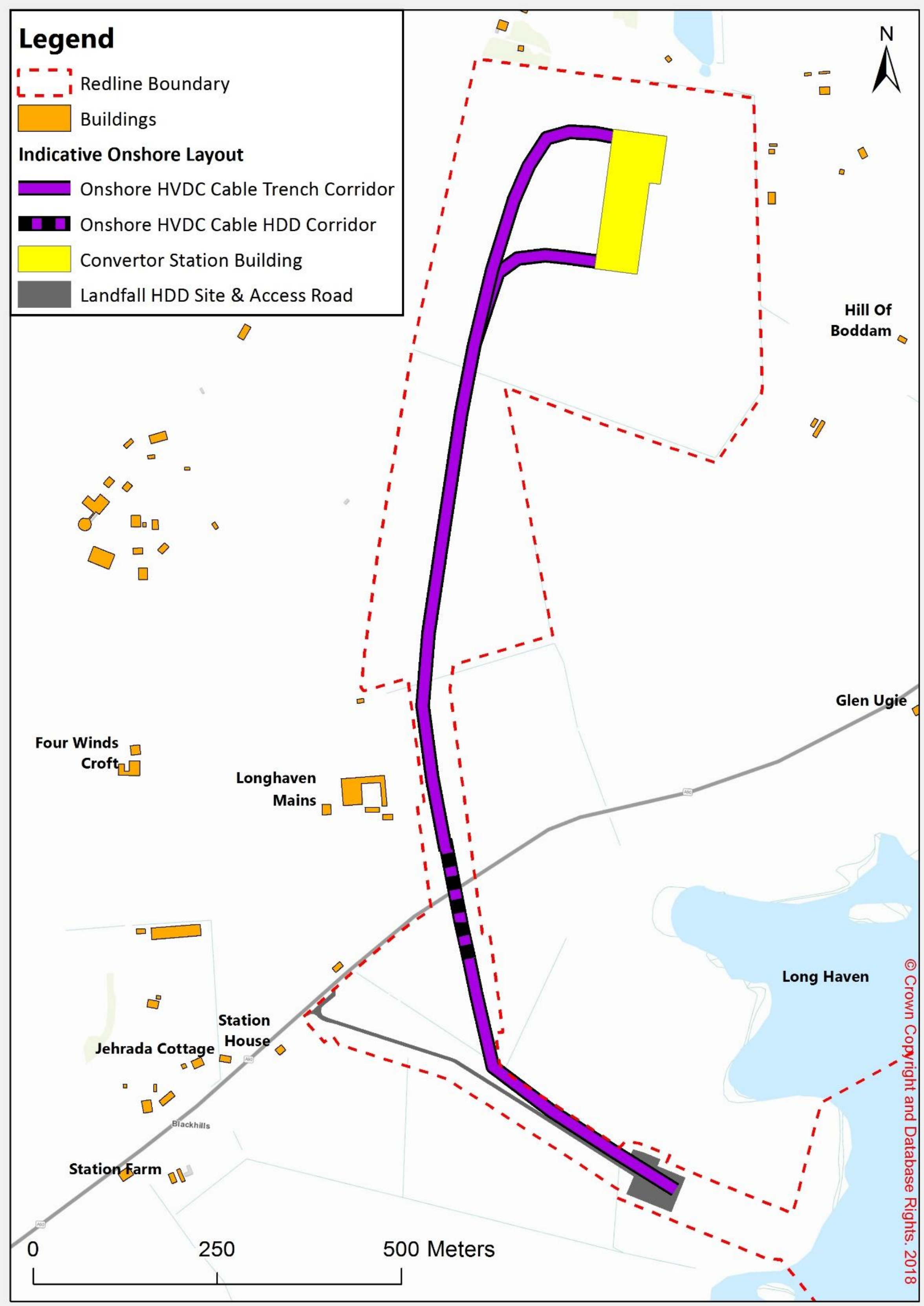

Figure 1.3: Indicative Onshore HVDC Cable Layout.

1.4.4 Temporary Construction Requirements

During the construction process, the majority of the site offices, staff welfare facilities, parking, storage and laydown areas will be provided at the Fourfields Converter Station Construction site and have already been incorporated into the approved planning consent for that element of the project.

To support the HDD and works south of the A90 further temporary construction requirements will be needed and are considered within this EIAR. These include: a temporary access road from the A90, a heavy lift drilling rig pad at the cliff HDD entry point and the A90 HDD entry point, and facilities for the HDD staff at the drilling site.

In addition, the HVDC cable corridor will require a haul road, a safety area, an area for spoil storage, a drainage ditch and boundary fencing.

1.5 Consenting and Licensing requirements

For the project to be constructed and operated, there are various consenting and licensing requirements which need to be in place.

1.5.1 Planning Consent

The HVDC cables require Planning Permission for the cable laying above Mean Low Water Spring (MLWS) from Aberdeenshire Council under the Town and Country Planning (Scotland) Act 1997. The temporary construction requirements will also be subject to planning consent from Aberdeenshire Council.

1.5.2 Marine Licence – Scottish Territorial Waters

As the HVDC Interconnector will cross the area between Scotland's Mean High Water Spring (MHWS) and the 12NM limit, it falls within the remit of the Marine (Scotland) Act 2010 (Scottish Parliament, 2010). Under Part IV of the (Marine Scotland) Act 2010 the following are "licensable marine activities":

- *"To deposit any substance or object within the Scottish marine area, either in the sea or on or under the seabed"*
- *"To construct, alter, or improve any works within the Scottish marine area"*
- *"To…remove any substance or object from the seabed within the Scottish marine area"*
- *"To carry out any form of dredging within the Scottish marine area"*

Therefore, all deposits made below MHWS and all construction below MHWS will require a Marine Licence for Marine Construction and will be sought from Marine Scotland Licensing Operations Team (MS-LOT).

1.5.3 Marine Licence – UK Waters

Executive devolution of the marine planning, conservation, marine licensing and enforcement from 12NM to 200NM through the Marine and Coastal Access Act 2009 (UK Government, 2009), allows Scottish Ministers to manage Scotland's Seas from MHWS to 200NM limit. Between 12NM and the 200NM UK Waters limit, a Marine Licence is not required for cable laying or maintaining exempt submarine cables.

The NorthConnect cables fall within this definition of "exempt submarine cable[s]". However, cable protection activities are still licensable marine activities. Separate licences are not required under each Act, but the Marine Construction Marine Licence application will provide enough information to allow the consenting body to determine the application for activities up to 200NM.

1.5.4 EIA Regulations

This EIAR is submitted in accordance with the requirements of the relevant EIA Regulations. The Town and Country (EIA) (Scotland) Regulations 2017 and the Marine Works (EIA) (Scotland) Regulations 2017, which transpose the amendments made to the EIA Directive 2011/92/EU by Directive 2014/52/EU which came into effect on 16 May 2017. Since a scoping opinion was requested prior to the 16th of May 2017, this EIAR has been prepared in accordance with the transitional arrangements set out within these regulations (including for example the continued applicability of sections of the Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011). Further details on this, and our approach to the transition, is provided in Chapter 5: Planning Policy.

1.5.5 Habitats Regulations Appraisal (HRA)

An appropriate assessment (AA) is part of the Habitats Regulations Appraisal (HRA) process under the Conservation (Natural Habitats, &c.) Regulations 1994 (UK Government, 1994). It is required when a plan or project is likely to have a significant effect on a European site. The NorthConnect development will cross the Buchan Ness to Collieston Coast Special Protection Area (SPA) and the proposed Southern Trench Marine Protected Area (pMPA) and may cause indirect effects on several adjacent European sites. There is therefore potential for the development to cause a likely significant effect on a European site, a HRA Pre-Screening Report (Dr Lucy Quinn & Jonathan Ashburner, 2018) has been produced to inform the competent authorities Screening of the project, information to inform an AA if required has been provided within topic specific chapters of the EIAR which are cross reference from the HRA-Pre-Screening Report (Dr Lucy Quinn & Jonathan Ashburner, 2018).

1.5.6 European Protected Species (EPS)

The construction activities may affect European Protected Species (EPS) listed under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) (UK Government, 1994), namely dolphins, harbour porpoises and potentially European otters. As such, the appropriate EPS Licence's will be applied for as required.

1.5.7 Pre-Application Consultation (PAC)

The NorthConnect interconnector project is categorised as a Major Development under The Town and Country Planning (Hierarchy of Developments) (Scotland) Regulations 2009. As a major development, formal Pre-Application Consultation (PAC) is required under section 35A of the Town and Country Planning (Scotland) Act 1997 and NorthConnect is required to comply with section 35B of that Act as well as the requirements set out in The Town and Country Planning (Development management Procedure) (Scotland) Regulations 2013.

The Marine Licensing (PAC) (Scotland) Regulations 2013 (Scottish Government, 2013), prescribe the marine licensable activities that are subject to PAC and, in combination with the Marine (Scotland) Act 2010 (Scottish Parliament, 2010), set out the nature of the PAC process. The NorthConnect HVDC development falls within these regulations as it involves the installation of subsea cables within the Scottish marine area which exceed 1853m in length and cross the intertidal boundary. There is no similar provision for PAC in the Marine and Coastal Access Act 2009 (UK Government, 2009).

NorthConnect have undertaken consultation in line with both the Marine and Terrestrial PAC requirements, details of which are provided in the HVDC Cable Installation Pre-Application Consultation Report (Fiona Milligan, 2018).

1.6 Marine and Planning Policy Requirements

Both onshore planning policy and marine planning policy are covered in more detail in Chapter 5: Planning and Marine Policy. The following is an overview of the policies relating to the NorthConnect development.

1.6.1 Onshore Planning Policy

The context for NorthConnect lies in international and national policy on climate change and energy generation. This is distilled into national, regional and local planning through policies on sustainability and energy, where policies exist.

The development planning system in Scotland, which provides the framework for considering planning applications, is made up of three main documents:

- The National Planning Framework (NPF);
- Strategic Development Plans (SDPs); and
- Local Development Plans (LDPs).

Other guidance on a specific planning topic may be prepared and become part of the development plan. This is called supplementary guidance.

The National Planning Framework (NPF) is a requirement of the Planning (Scotland) Act 2006 and sets out the strategy for long-term development within Scotland. The third NPF (NPF3), was published in 2014 (Scottish Ministers, 2014a), and sets out the strategy for development over the next 20 to 30 years.

All Scottish Planning Policy (SPP) (Scottish Ministers, 2014b) has been consolidated into one overall policy document and the most up to date version of the document has been published recently setting out national planning policies which reflect Scottish Ministers' priorities for operation of the planning system and for the development and use of land.

The Scottish Government provides advice and technical planning information in the form of Planning Advice Notes (PANs).

The relevant development plan applicable to the determination of the application for consent consists of the Aberdeen City and Shire Strategic Development Plan, published in March 2014 and the Aberdeenshire Local Development Plan 2017. The appropriate supplementary guidance documents will be utilised to assist with topic specific assessments.

1.6.2 Marine Planning Policy

The Scottish National Marine Plan (NMP) covering inshore waters to 12NM and offshore waters from 12-200NM was adopted in 2015. The NMP lays out Scottish Minister's policies for the sustainable development of Scotland's seas (Scottish Government, 2015).

The Scottish NMP provides General Planning Principles (GEN), most of which apply to the NorthConnect project. The NMP also lays out sector-specific objectives and policies, including objectives related to subsea cables.

In additional to the NMP, regional Marine Planning Partnerships are being developed across Scotland. NorthConnect falls within the North-East region, but the plan has not yet been established.

1.7 References

Dr Lucy Quinn & Jonathan Ashburner. (2018). NorthConnect HVDC Cable Infrastructure Habitats Regulations Appraisal: Pre-Screening Report. (NCGEN-NCT-X-RA-0007).

Fiona Milligan. (2018). HVDC Cable Infrastructure - Pre-Application Consultation Report.

NorthConnect. (2015). *NorthConnect Interconnecter Convertor Station and High Voltage Alternative Current Cable Route Environmental Statement*. Retrieved from

Scottish Government. (2015). *Scotland's National Marine Plan: A single framework for managing our seas*. Retrieved from http://www.gov.scot/Publications/2015/03/6517/downloads#res-1.

Scottish Ministers. (2014a). Scotland's Third National Planning Framework (NPF3) SG/2014/100.

Scottish Ministers. (2014b). Scottish Planning Polucy (SPP).

Scottish Parliament. (2010). Marine (Scotland) Act 2010

UK Government. (1994). *The Conservation (Natural Habitats, &c.) Regulations 1994*.

UK Government. (2009). Marine and Coastal Access Act 2009

Chapter 2: Project Description

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Contents

2 Project Description

2.1 Introduction

This chapter describes the NorthConnect project proposals, concentrating on the elements which are relevant to the UK consenting process. The chapter covers the needs case for the project, the project components, anticipated activities during construction and operation, and presents a consideration of alternatives to the proposals. As mentioned in Chapter 1, the anticipated life of this project is at least 40 years. At the end of the operational phase the HVDC cables will be appropriately decommissioned.

In addition to this Environmental Impact Assessment Report (EIAR), there are a number of other documents which have been produced to support the planning and marine license applications:

- HVDC Cable Infrastructure – UK Construction Method Statement (NorthConnect, 2018a);
- HVDC Cable Infrastructure – UK Fisheries Liaison Mitigation Action Plan (NorthConnect, 2018b);
- HVDC Cable Infrastructure – UK Marine Communications Strategy (NorthConnect, 2018c);
- HVDC Cable Infrastructure – UK Post Installation Survey Plan (NorthConnect, 2018d); and
- HVDC Cable Infrastructure – Transport Statement (Allen and Gordon, 2018).

The project description provided in this chapter aims to provide sufficient information to support the assessment, not to duplicate the other documents.

2.2 Background

2.2.1 UK Electricity Generation and Transmission System

Within the UK, the National Electricity Transmission System is operated by National Grid Electricity Transmission plc (NGET), who have responsibility for operating a transmission system which provides people with a safe and reliable energy supply. Generated electricity is fed into the transmission system and distributed around the UK as required. Currently, electricity cannot be stored efficiently in large quantities and so it is substantially only generated when required.

Although NGET are system operators (SO) for the whole of the UK, the Scottish transmission system is owned by Scottish Power Energy Networks (SPEN) and Scottish and Southern Energy Networks (SSEN). These are referred to as transmission owners (TO's) and SSEN are the TO responsible for the network at the location where NorthConnect links to the grid near Peterhead. Any generators/suppliers requiring grid connections in Scotland do so under a regulated agreement with NGET, who work in collaboration with SPEN or SSEN.

The UK power system consists of a mix of different electricity sources. At present, thermal production capacity (burning fossil fuels primarily gas with some coal) and nuclear generation dominates. Wind power, solar power, hydro and bioenergy production are currently the main alternative sources of energy. Their proportion of the electricity mix has grown rapidly over the last 10 years and continues to increase (Ofgem, 2018). Currently, onshore wind accounts for the majority of installed renewables capacity. The overall capacity for hydro and pumped storage hydro is limited in the UK, as most of the suitable sites for large scale hydro have already been developed. The marine energy sector for wave and tidal energies is still largely in the developmental stage. As such, on and offshore wind energy will be the major renewable source for the foreseeable future.

2.2.1.1 Scotland's Renewable Energy Development

In Scotland, there has been a dramatic increase over the last decade in the amount of renewable energy development and connection requirements to the electricity transmission system (Scottish Government, 2017a). This has resulted in planned and on-going large-scale improvements to the grid infrastructure, to expand upon the system's electricity transmission capacity. These improvements have included the strengthening of the existing transmission infrastructure (e.g. Dounreay to Beauly) and installation of new sections of overhead line and underground cabling (e.g. Beauly to Denny). In addition, subsea cables are required to strengthen the system including the Western Subsea HVDC project (linking Scotland to England), Caithness-Moray HVDC, Kintyre-Hunterston HVAC and links from the Western Isles, Orkney and Shetland to the UK mainland grid.

With changes in generation to more renewable sources, and the consequential change in the location of generation capacity to areas with good renewable resources, major network changes are required.

2.2.2 Norwegian Electricity Generation and Transmission System

The Norwegian power market is dominated by hydro power (approximately 96%) (NVE, 2016). A large proportion of the hydro capacity is associated with reservoirs, providing flexibility by being able to store energy until it is required. This is known as in-line or flexible storage (Norway has hardly any pumped storage capacity). This large degree of flexible production enables suppliers to quickly and cheaply follow the demand, both in the short (minute-hourly) and medium (seasonal) terms. However, reservoir capacity is finite, meaning that reservoir levels, hydro generation and its flexibility, are strongly influenced by rainfall. Currently, Norway is typically a net exporter of electricity. In the future, the surplus of electrical energy in Norway is predicted to become even higher. In cases of an extremely dry year, or in long winters, Norway may need to import electricity.

The Norwegian power system is well connected with the other Scandinavian/Nordic power systems, both physically and as a single trading market. From this connectivity, the Norwegian grid can access northern European grids and markets. The neighbouring countries have a considerably lower share of hydropower and, therefore, are less flexible. Extensive renewables projects, which will provide a power surplus, are planned for the future in Scandinavian countries.

Norway has an open electricity market, integrated with the other Nordic countries. Export and import is routine over the direct power links to Sweden, Denmark and the Netherlands. The market is handled by NASDAQ OMX Commodities Europe and Nord Pool Spot.

2.3 Needs Case

As long ago as 2002, the European Council set European Union Member States a target of having electricity interconnections equivalent to at least 10% of their (installed production) capacity by 2005. Currently, Great Britain is only half way to meeting this target. In May 2014, as part of its work on European energy security, the European Commission proposed an interconnection target of 15% for 2030. This was adopted by the European Council in its 23 October 2014 conclusions on the European Union's 2030 Climate and Energy Policy Framework (European Commission, 2014).

The European Union (EU) has set the target that 20% of Europe's energy requirements will be met by renewable sources by 2020 in the European Parliament Directive 2009/28/EC (European Parliament, 2009). The Scottish Government aims to exceed this target and is looking to achieve 100% of the demand within Scotland (gross consumption) for electricity being met from renewable sources by

2020 (Scottish Government, 2016). The Scottish Government set an interim target of 50% by 2015, which was achieved. 54% of gross energy consumption was sourced from renewables in 2016 (Scottish Government, 2017b). Hence Scotland is on track to meet the 2020 target. Further to this, Scotland continues to be a net exporter of electricity, exporting 29% of generation to other parts of the UK in 2016 (Scottish Government, 2017a). The Scottish Government updated its energy strategy at the end of 2017 (Scottish Government, 2017c). The Scottish Energy Strategy set two new targets for the Scottish energy system to achieve by 2030:

- The equivalent of 50% of the energy for Scotland's heat, transport and electricity consumption to be supplied from renewable sources; and
- An increase by 30% in the productivity of energy use across the Scottish economy.

In 2015 the equivalent of 17.8% of Scotland's heat, transport and electricity consumption was supplied by renewables. An increase of 32.2% in 15 years demonstrates the scale of the Scottish Government's ambition (Scottish Government, 2017c).

The 2017 Scottish Energy Strategy also lays out a vision for 2050, which includes six priorities, one of which is renewable and low carbon solutions in which the Scottish Government stated their intention to continue to champion Scotland's huge renewable energy resource (Scottish Government, 2017c). Another priority is System Security and Flexibility, which highlights the requirement for Scotland's energy capacity to be flexible and resilient to maintain secure and reliable supplies of energy. Scotland's energy security can be enhanced while maintaining its ability to export and import energy through the interconnection between power markets and networks using interconnectors. The importance of interconnectors in improving Scotland's energy security is highlighted in the strategy, by referring to the likely energy security and consumer benefits posed by the NorthConnect project, which provides access to alternative sources of renewables (Scottish Government, 2017c).

The 2012 Electricity Networks Strategy Group (ENSG) Report (ENSG, 2012) sets out a view of how the UK electricity transmission system needs to be reinforced to help meet these renewables targets for 2020. The electricity generation portfolio will move from the traditionally more predictable energy generation provided by coal / gas fired power stations and hydro, towards an increasing proportion from renewable sources. Consequently, the predictability in generation capacity will reduce. Investment in greater renewable capacity will therefore lead to a rise in demand for reserve generation capacity to supply the grid during periods when windfarms cannot meet demand.

Adjusting power production according to consumption by using a standby thermal plant or similar is costly and fluctuating consumption/supply leads to fluctuating prices. In periods with low consumption and high wind power production, there will be low prices. In periods with high consumption and low wind there will be a need to activate thermal units with high marginal costs, therefore, wholesale prices will be considerably higher. Providing alternative methods of balancing this system, and so stabilising prices, will be a key factor in the success of the UK's move to a low carbon power system.

The Scottish Government published the Electricity Generation Policy Statement (EGPS) 2013 (Scottish Government, 2013). This examines the way in which Scotland generates electricity, considers the changes which will be necessary to meet the targets which the Scottish Government has established, and reflects both views from industry and other stakeholders regarding developments in UK and EU electricity policy. It looks at the sources from which that electricity is produced, the amount of electricity which is utilised in Scotland and the technological and infrastructural advances and requirements which Scotland will require over the coming decade and beyond. The EGPS states:

> *"Scotland's renewables potential is such that, should the relevant technologies be developed successfully, it could deliver up to £46bn of investment and be much more than enough to meet domestic demand for electricity. The remainder could be exported to the rest of the UK and continental Europe to assist other countries in meeting their binding renewable electricity targets".* (Scottish Government, 2013).

Significant new investment will be needed both in electricity generation capacity and in the associated transmission infrastructure to facilitate the renewable goals. The transmission infrastructure will need to be improved to both deliver electricity across Scotland and to access the other markets which offer electricity generated from renewable sources.

Moving to an increased dependency on renewable electricity sources presents Scotland with a number of challenges. Windfarm productivity is dependent on when the wind blows and the wind speed, while demand for electricity varies with time of day and the time of year. In order to secure supply, especially during peak demand, the electricity transmission grid needs to be able to access power sources quickly. Thermal power generation sources (fossil fuels), mostly gas and diesel, have traditionally been used because of their ability to respond to these changes in demand quickly. The renewable option to meet future security of supply requirements may be to increase access to hydro generation because it has the same fast response time as thermal power to meet peaks in electricity demand.

The NorthConnect project proposes to provide a link between the electricity grids of Scotland and Norway. By linking wind and hydro generation resources between the two countries, NorthConnect will strengthen the security of power supply for consumers in both Scotland and Norway and will support the achievement of Scottish, Scandinavian and European renewable energy targets.

There are three key drivers associated with the NorthConnect project:

- **Security of Supply*:*** Linking the Scottish and Norwegian networks will support energy security in both regions, compensating for fluctuations when future Scottish energy demand is met by a higher proportion of wind energy. The link will also compensate for low Norwegian precipitation and low hydro storage levels, enhancing the electricity transmission infrastructure for both countries;
- **Green Battery*:*** Wind power is subject to fluctuations in production. These fluctuations make a 'Green Battery' energy storage approach attractive to ensure renewable power is available for consumers when the wind is not blowing. About half of Europe's reservoir capacity lies in Norway which also has good potential for energy storage, to provide on demand renewable electricity and the long-term realisation of a low carbon electricity supply for Europe; and
- **Reduced Price Fluctuations*:*** The project will stabilise electricity prices in the UK and Norwegian markets by leading to increased power exchange and competition in European energy markets.

In achieving this, NorthConnect will address three key cycles of power supply and demand between the two countries:

- Daily fluctuations for storage of night-time renewable generation and supplementing day-time peak demand;
- Seasonal variations with wetter winters, drier summers and possible icing up of Norwegian hydro in some years; and
- Non-seasonal weather cycles: the wind – hydro relationship that can help to balance generation and demand dependent upon weather conditions.

In parallel with this, there is emerging international cooperation in the European energy sector and the clear political goal of linking the European power systems closer together. NorthConnect will be a means to connect the two complementary and hitherto disconnected power systems of Scotland and Norway. It will provide reserve capacity to help balance the grid and will allow wider trading across Europe. The energy needs, financial and environmental drivers for interconnection are valid irrespective of the UK's changing status in the European Union.

There are additional benefits to the transmission system also. According to National Grid's assessment of Benefits of Interconnectors to Great Britain's Transmission System 2014 (National Grid, 2014), additional ancillary services that interconnectors will provide to the UK grid and consumers are:

- **Frequency response and reserve***:* The ability to address real-time frequency imbalances which demand, and generation impose on the grid system;
- **Black Start capability***:* The capability to be started quickly in a grid blackout situation in a coordinated and controllable way which enables the national grid to be brought back on line;
- **Reactive Power Reserve***:* Allows voltage control across the localised grid network due to the type of technology used for the HVDC link; and
- **Boundary Capability & Constraint Management***:* In certain market conditions, the ability to relieve constraints on the Scottish grid by exporting power to the Nordic region.

The Department of Energy and Climate Change (DECC) UK have undertaken studies which show that up to 4 gigawatt (GW) of interconnection (NorthConnect's capacity is 1.4GW) with the hydro-focussed areas of Europe would be beneficial for consumer and provide an economic boost of up to £2.5bn (DECC, 2013). NorthConnect also provides a significant socioeconomic benefit, in terms of electricity cost savings, and details of this are provided in Chapter 21: Local Community and Economy.

2.4 Consideration of Alternatives

NorthConnect have considered alternatives at every stage of the design process. Initially to identify the UK best landing point (NorthConnect, 2011), then to provide a specific location for the UK converter station, landfall point and onshore cable routing (NorthConnect, 2014). Alternative landfall locations and converter station sites in Norway were also considered. Potential cable route options across the North Sea between the two landfall points have been considered, with greater resolution provided with each step of the process (Xodus, 2012, 2015).

This section details the consideration of alternatives completed to achieve the current design.

2.4.1 UK Landfall Selection and Subsea DC Cable Routing

A preliminary study was undertaken for this project looking at the key aspects that will affect the design and viability of the scheme. A key objective of the study was to identify potential landfall options within the UK and assess these to identify a preferred option. Options were assessed against the following:

- Sub-sea and overland route requirements;
- Environmental assessment including permitting aspects;
- Technical implications of both grid connections and system configuration;
- Cost and economic appraisal;
- Option risk and particularly UK north / south revenue, tariff and underwriting risks; and
- Outline programming durations for development and construction.

This assessment first identified the preferred landfall zones adjacent to a suitable grid connection point and then undertook a review of the local options with regard to a specific landing point within the selected zones.

From an initial list of 25 potential options a screening study was undertaken that identified five potential options that were targets of more detailed appraisal. These five options were:

- Peterhead in Aberdeenshire;
- Cockenzie on the Forth Estuary;
- Hawthorn Pit in County Durham;
- Creyke Beck on Humberside; and
- A variation on Creyke Beck for routeing via the planned Round 3 Dogger Bank offshore wind farms.

The proposed locations are shown in Figure 2.1.

Figure 2.1 Straight Line Routes for Landing Point UK Options.

To undertake the assessment to select the preferred option, a weighting and scoring system was applied to each of the assessment factors. A workshop approach was taken to deploy this methodology and went through a process of assessing each option. Details of the assessment process and scoring are present in the NorthConnect Strategic Options Appraisal report (NorthConnect, 2011) and are summarised in Table 2.1.

Table 2.1 Summary of the results from the Regional Review.

Results	Peterhead	Cockenzie	Hawthorn Pit	Creyke Beck	Creyke Beck (Via Dogger)
Total Normalised, Weighted Score	54.4	48.4	48	46	45.6
Total Normalised, Weighted Score Available	66	66	66	66	66
Grand Total (%)	82%	73%	73%	70%	69%
Overall Rank	1	2	3	4	5

Category Results						
Routeing	Weighted Score	8	10	6	4	4
	Rank	2	1	3	4	4
Environmental	Weighted Score	12	8.4	8.4	7.2	6
	Rank	1	2	2	4	5
Technical	Weighted Score	9.6	9.6	9.6	12	12
	Rank	3	3	3	1	1
Cost	Weighted Score	12	9.6	9.6	7.2	9.6
	Rank	1	2	2	5	2
Risk	Weighted Score	4.8	6	9.6	10.8	10.8
	Rank	5	4	3	1	1
Programme	Weighted Score	8	4.8	4.8	4.8	3.2
	Rank	1	2	2	2	5

The output from this assessment showed the Peterhead region as clearly the preferred option. Peterhead was ranked first from a cost, economic, environmental and programme perspective. It was therefore taken forward as the preferred option for more detailed landfall and route corridor assessment within this zone.

Following the outcome of this assessment, a Grid Connection Application was made by NorthConnect for a connection point to the National Grid at Peterhead and, after receipt of a connection offer, further assessment was undertaken to identify landfall points in the general area of the substation, which is located to the south west of the port at Peterhead, approximately 1km from the outskirts of the town.

Further information on the surveys and decision-making processes specifically linked to the Interconnector converter station and HVAC cabling can be found in the ES for the NorthConnect Interconnector Converter Station and High Voltage Alternating Current Cable Route (NorthConnect, 2015). The result was that the HVDC cabling needs to connect to the approved convertor station site known as Fourfields, at NK119 412 (Drawing 3022).

2.4.2 Onshore Cabling

The cabling required for the interconnector will comprise of two HVDC cables and one ducted fibre optic cable. The onshore cable routing from the Fourfields convertor station to the subsea cabling connection at the shoreline considers the following principles:

- Where practicable, it should avoid archaeological features;
- Road crossings should be minimised;
- Infrastructure crossings should be minimised;
- The number of landowners affected should be minimised;
- Where practicable, valuable ecological assets should be avoided;

- The route should avoid disturbance to residential properties where possible; and
- The route should not be excessively long.

The decision-making process for this was twofold. Firstly, to decide broadly whether the cables should go from the convertor station to the sea via a northward route to the beach, or a southward route to the cliffs. Secondly, to decide the finer-scale route and exact entry point on land, which then has an exit point at sea.

The broad-scale, initial options for the HDVC onshore cabling route, identified three differing routes for the onshore cabling in a site selection optioneering study (Figure 2.1). The two northward options would take the cables from the converter station to a beach north of Sandford South. One route would cross the A90 further south, and the second would cross the A90 further north (NorthConnect, 2014). A third option was a southward option that would take the cables from the convertor station to an entry point to the sea via a HDD hole by the cliffs south of Boddam (NorthConnect, 2014). The options were assessed against the following:

- Health and Safety;
- Environmental Impact;
- Technical;
- Socio-economic; and
- Commercial.

Figure 2.1 Initial HVDC Routing Options

The results from the initial HVDC onshore cable routing options are presented in Table 2.2.

Table 2.2 Advantages and disadvantages of initial HVDC onshore cable routing options.

Route option	Advantages	Disadvantages	Total weighted score
Sandford Bay south of substation	• Route covers fields with no designated sites, so ecological impacts are of less concern.	• Health and Safety risks associated with working in the intertidal area. • Potential water quality impacts associated with potential pollution incidents during construction in the intertidal area. • Visual impacts of construction as route passes through Sandford Bay and along the A90. • Archaeological disturbance as route could require cutting through a disused railway embankment • 3 gas-line pipes and 2 electric circuit crossings would be required. • Construction access issues.	161/275
Sandford Bay north of substation	• Route covers fields with no designated sites so ecological impacts are of less concern. • No need to cut through the railway embankment so reduced archaeological impact. • No need to cross the two electrical feeds from the power station.	• As above except for the Archaeological disturbance and the electrical feed disturbance, which would not occur.	173/275
Longhaven cliff	• No service crossings identified on the route, minimising interface complexity. • Health and Safety risks lower for the construction period. • Use of HDD would lesson visual impacts during construction period. • Options available to avoid disturbing the disused railway line. • More flexible routing options available. • Shorter cabling route, hence potentially the cheapest of the three options	• Route passes through designated sites.	200/275

It was apparent that neither of the Sandford South routes would be a favourable exit to the sea. As the cliff exit at Longhaven cliffs, with the use of HDD, ranked the highest of the three options, it was taken forward.

A NorthConnect Landfall Option Study was commissioned to identify which location along the Longhaven cliffs would be most suitable. Three possible landfall options along the cliffs were considered: 1. By Longhaven cliffs between Boddam and Longhaven; 2: Between the old Cadet Barracks and the shore outside Boddam; or 3: In Boddam village (Technip, 2013). The report conclusively found that Location 1 was considered the most feasible in terms of environment, consenting, economic viability and execution schedule. At location 2, the onshore drilling location would not be as suitable as location 1 due to the topography and rocks. Location 3 was deemed unsuitable as the onshore cable installation would involve going through the local village and this disturbance to the local population could be avoided by choosing an alternative location.

Once Fourfields became the chosen location for the convertor station, an investigation of routes from the convertor station to the potential HDD onshore entry site at Longhaven cliffs was carried out. A search corridor was identified from Fourfields to the HDD onshore entry point, as seen in Drawing 3149.

The cable route survey area was then narrowed using ground investigation surveys carried out from 6th November 2017 to 7th March 2018. A total of 13 test pits and 2 bore holes were drilled within the entire HVDC onshore cable routing search corridor. The results from these surveys led to the final consenting cable corridor for the onshore cabling. An indicative cable route has been identified (Drawings NCGEN-NCT-Z-XE-0002-01 and NCGEN-NCT-Z-XD-0001-01 to 04), taking account of the following factors:

- Location of ecological receptors, to minimise disturbance;
- Location of archaeological features to prevent physical impacts;
- Ground conditions;
- Technical requirements such as cable bend radii and substrate type;
- Effects on local walking routes; and
- Accessibility for construction plant.

The exact cable route will be defined by the cable contractor, taking into account pre-construction surveys, but the route will remain within the boundaries of the consenting cable corridor as seen in Drawing NCFFS-NCT-X-XG-0001-01 and take into account the factors discussed above.

2.4.3 Horizonal Directional Drilling (HDD)

The decisions behind determining the HDD onshore entry and marine exit points are inherently linked and, as such, are considered concurrently in this section.

An HDD search area for the onshore entry was mapped and is provided in Drawing 3149.

The HDD marine exit point at sea required nearshore and subsea investigations to assess the suitable substrate for the exit. The nearshore survey took place in winter 2016 to avoid the most sensitive time for breeding seabirds along the nearby cliffs. An area for the HDD marine exit was identified as being suitable, as it was an area of gravelly sands, which is a desirable substrate for excavation. This area was in water depths of approximately 26m and allows for suitable protection of the HDD pipe and cables whilst ensuring the surrounding seabed height does not increase by more than 5% of the water depth.

A clifftop ornithology walkover in 2014 assessed which areas of the cliff had the fewest seabirds present, and this helped to inform the HDD onshore entry point (discussed further in Chapter 17 Ornithology). The Marine Survey was then integral to help inform the onshore HDD entry point, by narrowing the location along the Longhaven cliffs within which it would be possible to have the onshore and offshore HDD from a technical perspective. The initial HDD Feasibility Report, presented two possible alignment options: a Northern HDD Alignment and a Southern HDD Alignment (Riggall, 2017). The Northern Alignment would drill towards a bearing of 070° (OS Grid), whereas the Southern Alignment would drill towards 120° (OS Grid). In both these alignments, a shallow drill design and a deeper drill design were considered. At the feasibility stage, the Southern Alignment was advised as the preferable route due to having better topography for an HDD from a technical perspective.

Following this Southern Alignment option, further analysis into different design options within this alignment was then carried out. Three possible designs were considered, and a summary of these is shown in Table 2.3 and in Figure 2.3, where design 3 is in fuchsia, design 4 is in red and design 5 is in blue.

Table 2.3 Parameters of the HDD design options.

	Southern Design 3	**Southern Design 4**	**Southern Design 5**
Alignment Bearing (OS Grid)	098°	088°	108°
Entry Elevation	+38.17m ODN	+37.12m ODN	+38.38m ODN
Entry Angle	-17°	-17°	-17°
Entry Tangent Length	190.53m	183.38m	220.07m
Vertical Curve Radius	400m	400m	400m
Vertical Curve Length	153.59m	153.59m	153.59m
Exit Tangent Length	101.97m	69.35m	63.71m
Exit Angle	+5°	+5°	+5°
Exit Elevation	-24.63m ODN	-26.41m ODN	-28.10m ODN
Total Horizontal Length	435.52m	396.26m	398.70m
Total Drilling Length	446.01m	406.31m	409.10m

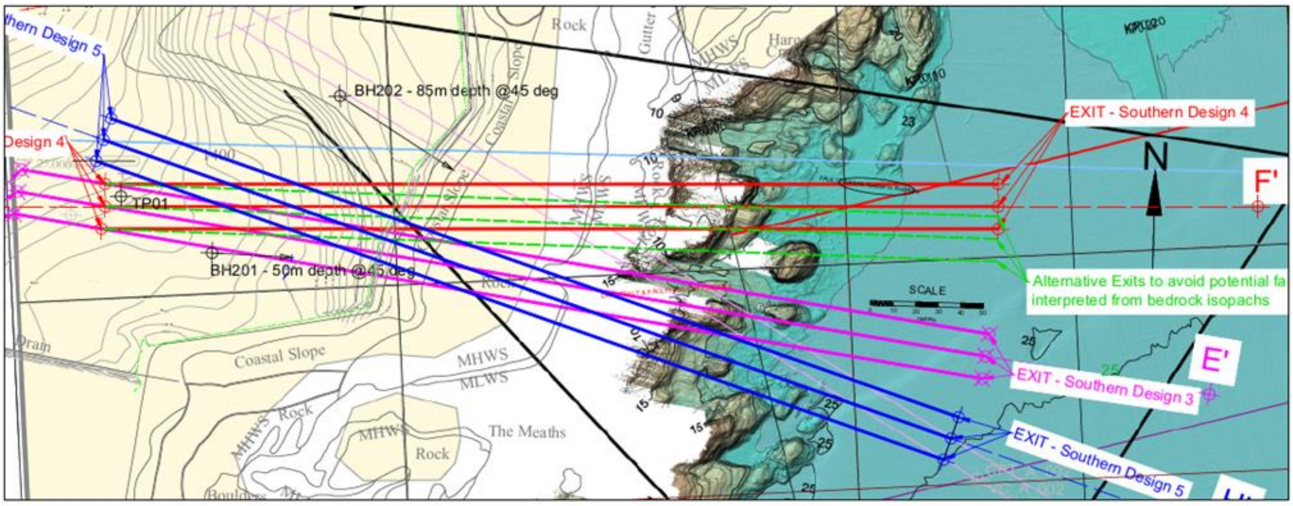

Figure 2.2 HDD Southern Alignment Options

Southern design 5 became the favoured alignment for the following reasons:

- Minimised disturbance to ecological receptors (both flora and fauna);
- Minimised disturbance to archaeological features;
- Best from a technical perspective with favourable ground substrate conditions and favourable conditions at the exit point;
- Being the best alignment for onward cabling towards the converter station; and
- Minimised disturbance to maritime users.

The onshore Landfall HDD entrance was originally chosen as being a gently sloping area towards the lower section of the Landfall field, adjacent to the clifftop path. However, to minimise potential disturbance of cliff-nesting seabirds, the onshore entry point location was moved further back from the cliffs to a location approximately 6m higher than the originally scoped location. This location was still suitable from a technical standpoint.

The favoured onshore HDD entry point and HDD marine exit point, as well as the alignment route and the section view are provided in the updated HDD Feasibility Report provided as Appendix B.1.

2.4.4 Offshore Cabling

2.4.4.1 Initial Selection of Cable Corridor from Scotland to Norway

Xodus were commissioned in 2012 to conduct a desktop options analysis for the NorthConnect offshore cable to identify the preferred route based on existing data, and the full report has been provided as Appendix B.2. The following aspects were considered in the analysis:

- Physical characteristics of the cable;
- Existing infrastructure including pipelines, cables, and offshore installations;
- Bathymetry;
- Seabed geology and sediment characteristics;
- Commercial fisheries, shipping and navigation;
- Cultural heritage and marine archaeology;
- Benthic ecology and habitat types; and
- Designated sites and protected habitats.

The objective of the study was to identify the most efficient cable route between the UK and Norwegian landfalls, considering the physical limitations and whilst minimising socioeconomic, cultural and environmental impacts.

An initial Route Option Analysis Report identified 4 potential offshore corridors between the preferred Peterhead to Samnanger or Sima landing point options (Figure 2.3).

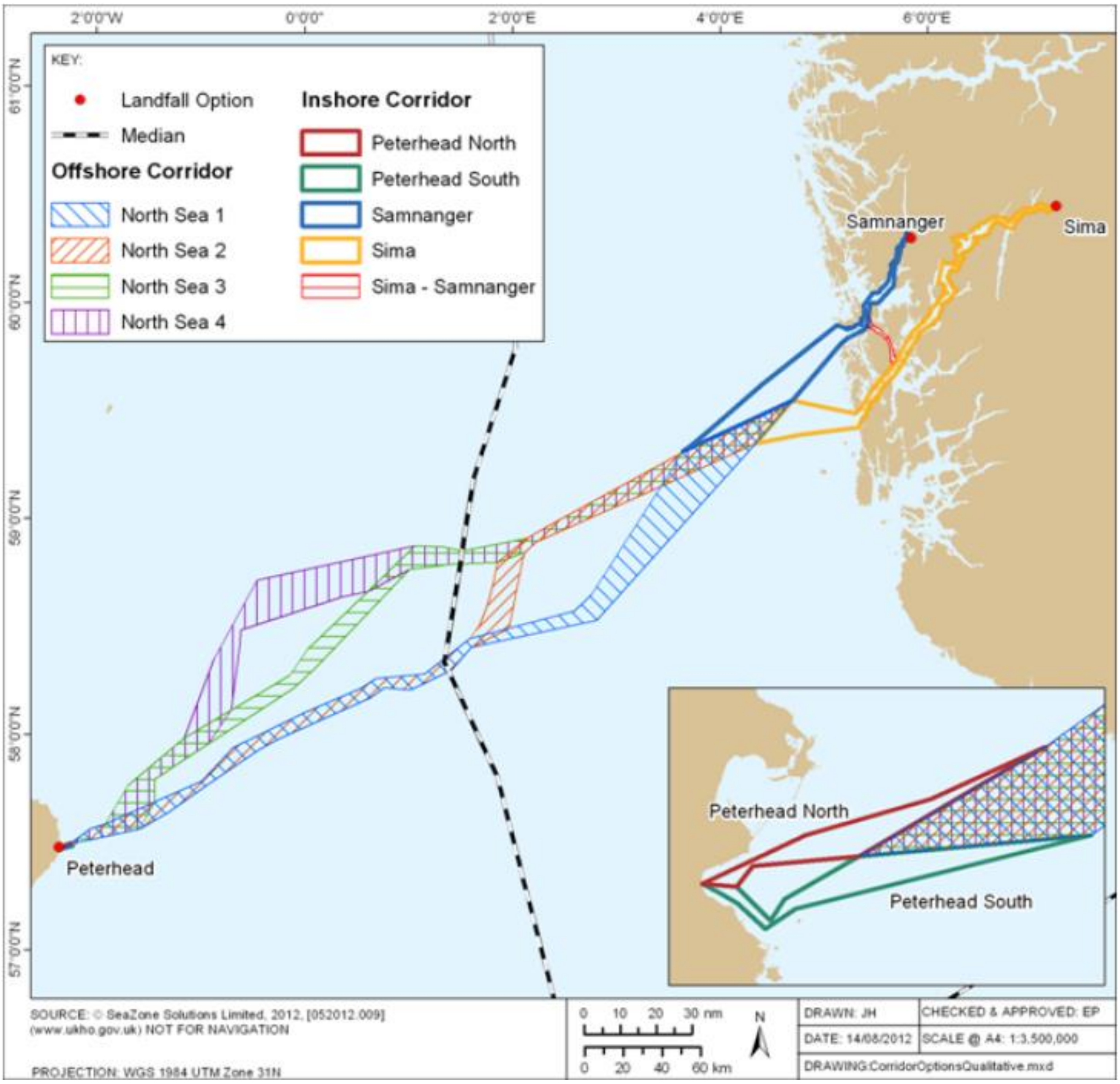

Figure 2.3 Four Proposed Offshore Cable Corridors from Scotland to Norway.

North Sea 3 and North Sea 4 options were discounted based on economic viability and technical suitability. The North Sea 2 option was discounted due to cumulative effects and likely interference with planned development projects within the Utsira High area. North Sea 1 offshore option was selected as the preferred option, with Sima later becoming the preferred Norwegian landfall option.

2.4.4.2 Selection of Broad-Scale Cable Corridor from Long Haven to Simadalen

Following this initial route option analysis study, it was confirmed that Longhaven cliffs would be the entry point for the Scottish landfall location (see section 2.4.2 above). This landfall location was then termed Long Haven, the name of an adjacent cove, in order to distinguish it from Longhaven which is a village a little distance away to the south of the landfall. A further report was commissioned to integrate the landfall location at Long Haven with the previously chosen route across the North Sea to Sima. The chosen Norwegian landfall at Sima is also now termed Simadalen to avoid confusion with a nearby power plant called Sima kraftverk. Simadalen is at the end of the Hardangerfjord, the second longest fjords in Norway.

This study took into a consideration: environmental constraints; technical requirements; safety constraints; and economic viability. Three potential routes were visualised and mapped in GIS. The three nearshore cable corridor options identified are shown in Figure 2.4.

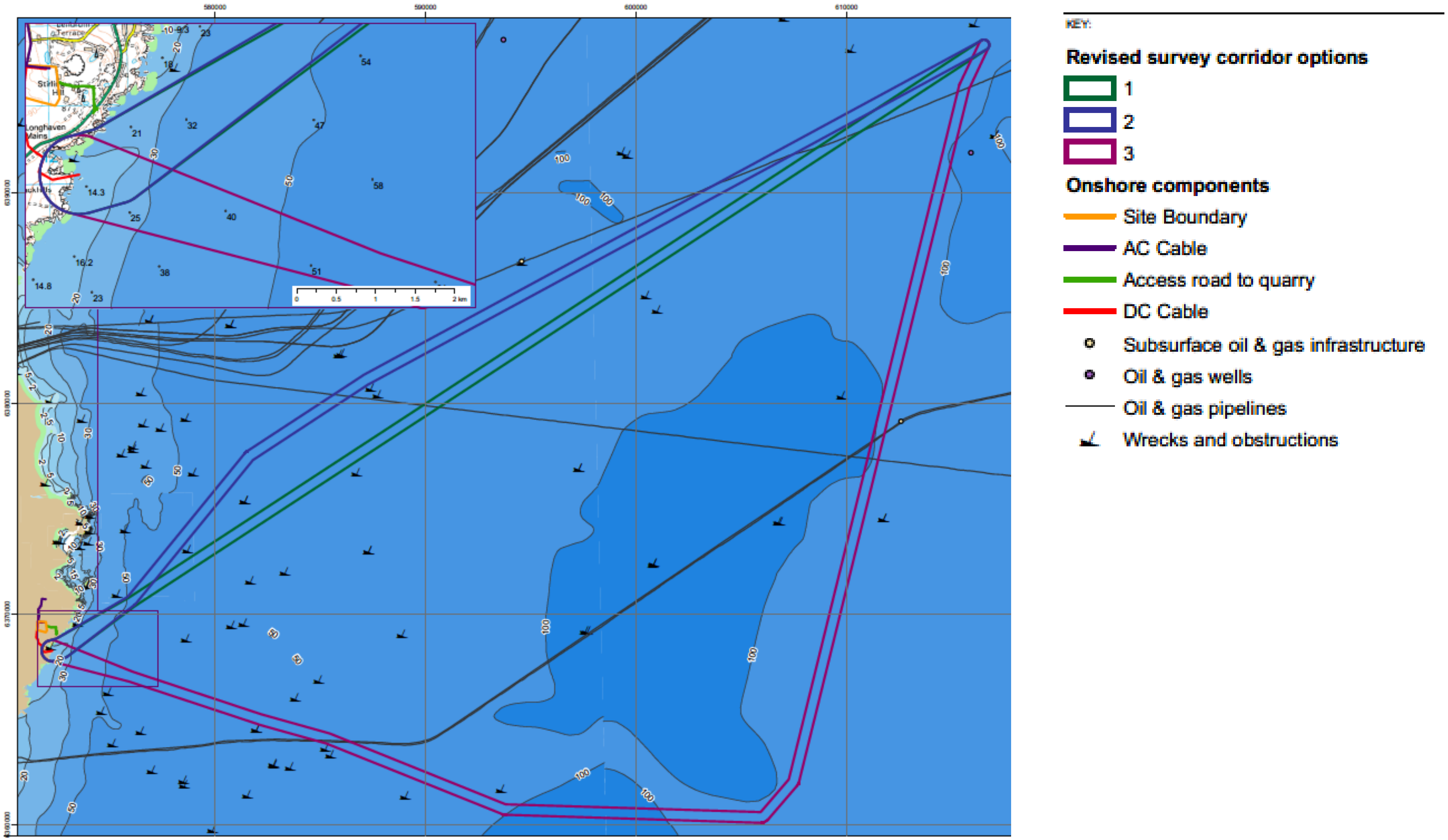

Figure 2.4 Proposed Cable Corridor Options 1, 2, 3

1. Option 1 – A direct corridor route from original cable corridor route to landing point near Long Haven;
2. Option 2 – A route option skirting to the north of potential Annex 1 environmental sensitivity;
3. Option 3 – A southern corridor route option, avoiding the proposed Hywind offshore wind development site and various potential environmental sensitivities.

The advantages and disadvantages of each route option are summarised below in Table 2.4.

Overall Route Option 3, whilst avoiding areas of environmental sensitivity, was considered least favourable due to its length and because it would pass through areas of seabed which could pose technical installation difficulties. Route Option 2 was identified as the preferred option, closely followed by Route Option 1. Whilst some potential environmental constraints were present along these two routes, these can be avoided or mitigated through survey and detailed design. Full details of this report can be found in Appendix B.3.

Table 2.4 Advantages and disadvantages of initial HVDC offshore cable routes.

Route option	Advantages	Disadvantages
Option 1	• No cable crossings along the seabed and only two pipeline crossings at the time of reporting. • Shortest route, and hence most favourable from an economic perspective.	• Crosses designated site: Southern Trench MPA; and a potential Annex 1 habitat for sandeel grounds. • Closer to Peterhead harbour with shipping activity.
Option 2	• No cable crossings along the seabed and only two pipeline crossings at the time of reporting. • Avoids Annex 1 habitat.	• Crosses designated site: the Southern Trench MPA. • Closer to Peterhead harbour with shipping activity.
Option 3	• Avoids more areas of environmental sensitivity compared to routes 1 and 2. • Route does not cross any navigational features.	• Longer cable length and hence more expensive and would cause a greater area of seabed disturbance. • Technically difficult route from a seabed perspective – route more susceptible to sand wave fields. • Would have to make more pipeline crossings along the seabed: 3 cable crossings and 4 pipeline crossings. • Slightly more fishing activity reported in the area.

2.4.4.3 Selection of Survey Corridor from Long Haven to Simadalen

Prior to conducting the marine survey operations, it was necessary to define a more precise survey corridor, since the outputs of the Xodus reports were too broad scale and surveying the whole of even just the preferred corridor would not have been financially viable. In addition, some of the data used to inform the Xodus route options had been superseded, particularly with regard to future offshore developments.

The process of defining the survey corridor was conducted by NorthConnect, in conjunction with the Marine Survey Contractor, MMT Sweden AB, through a series of workshops. The following process was used in order to define the survey corridor:

- The nominal centreline of route Option 2 from the landfall, plus the remainder of North Sea 1 out to the limit of the UK EEZ, was used as the base-case Survey Centreline (SCL);
- It was agreed that a 500m wide survey corridor would provide an appropriate compromise between reducing survey effort, whilst still providing adequate flexibility for detailed cable route engineering within the corridor. Hence a 250m buffer was then added to the SCL, in order to provide a 500m wide base-case survey corridor;
- MMT's Geographic Information System (GIS) was then utilised to conduct a detailed review of the most up-to-date information about seabed conditions, and possible challenges to cable installation, within the base-case survey corridor;
- The SCL was then modified through an iterative process in order to optimise the survey corridor with regard to the following factors, listed in order of priority:
    - Existing and proposed seabed infrastructure:
        - Existing and planned offshore installations (oil and gas, and renewables) were excluded from the survey corridor by at least 500m; and
        - Consideration was given to the preference for the NorthConnect cables to cross existing cables and pipelines at approximately 90^{o}, as opposed to obliquely;
    - Sensitive habitats and designated sites:
        - Where possible sensitive biological sites were excluded from the survey corridor, for example, the SCL was modified to exclude the Scanner Pockmark SAC;
    - Surficial and shallow geography:
        - Areas of hard sediments types were excluded from the survey corridor where possible;
    - Wrecks:
        - The SCL was modified to exclude known wrecks from the survey corridor where possible; and
    - Cable engineering properties:
        - The minimum bending radius of the indicative cable system was considered, to ensure the twists and turns of the SCL could be followed by the cables.

The output of this process was the route position list of the SCL and associated survey corridor, which provided the basis for all NorthConnect marine survey operations to date.

It should be noted that, where unexpected potential challenges to cable installation were identified during the survey operations, the survey corridor was extended at NorthConnect's discretion, in order to identify possible options for avoiding the feature. As such, within this EIAR, the term 'survey corridor' refers to the full coverage of the survey operations conducted to date.

2.4.4.4 Selection of Final Consenting Cable Corridor from Long Haven to Simadalen

Comprehensive geophysical, geotechnical, benthic and archaeological subsea surveys were carried out to further inform the cable routing during late 2016 to late 2017. After the survey, the results were utilised to refine the corridor to form the consenting corridor. A 50m buffer was applied to all wrecks and potential Annex 1 habitats identified within the survey corridor, and these have then been excluded from the UK consenting corridor. The one exception to this is the potential Annex 1 bedrock reef near the UK landfall, as the cable will be routed under it via the HDD ducts.

2.4.4.5 Final Cable Route

The consenting corridor and associated survey results will be provided to the cable supply and installation contractor. The contractor will identify their proposed cable routing, within the consented corridor. They will then carry out their own surveys of their proposed route, as described in the Construction Method Statement (NorthConnect, 2018a), to inform the final cable route.

2.5 Project Components

The interconnector uses HVDC technology because Direct Current (DC) is subject to less transmission loss than Alternating Current (AC), and there is no technology available for cabled transmission of high voltage AC power over more than approximately 110-120 km.

A description of the main components associated with the planning and marine licence application is provided in this section. This is divided into: cables; onshore cable; Landfall horizontal directional drilling (HDD); offshore cable; and temporary construction requirements. It should be noted that the development will be subject to a design and build contract and, as such, a detailed design has not yet been completed. For example, aspects of the cable installation, in both the onshore and offshore components, are dependent on the selection of the cable installer for the contract, as the main companies in the HVDC cabling field have their own proprietary technology and the differences in the components and methodologies can give rise to variations in the cable laying process. Hence, the outline design of the main elements of the HVDC interconnector have been developed by the NorthConnect team to facilitate the consenting process. Certain assumptions have had to be made and a Rochdale envelope approach taken to the assessment process, with worst case assumptions being made where appropriate.

2.5.1 Cables

2.5.1.1 HVDC Cables

There will be two HVDC cables connecting the two converter stations. The exact cable details will depend on which specialist cable manufacturer is involved, but the cables used will be Mass Impregnated (MI) in design. The conductor, which carries the current, is likely to be copper, possibly aluminium as an option, but this is intended for optimisation of the deep installation in the Norwegian fjord. The cable's nominal voltage will correspond to the connection point nominal voltage. The other layers which make up the cable have different roles to prevent the concentration of electric fields between certain layers, to ensure close connection between the layers and to provide protection from water and mechanical stresses.

Typical HVDC cable parameters are provided in Table 2.5. A cross section example of an MI HVDC cables is shown in Figure 2.6. For the onshore cabling, it will be similar in components to Figure 2.6, but without the same level of armouring. The protective armouring for the offshore cables may include galvanised steel and polypropylene layers and will be the first level of protection from hazards for the cable. The cables are also likely to be sheathed with polypropylene or polyethylene material.

Table 2.5 Indicative HVDC Cable Parameters

Cable Parameter	Quantity
HVDC export system	2 x 700 MW HVDC cables
Nominal voltage (kV)	±525
HVDC onshore cable route length (km)	2
Cable linear weight (kg/m)	52 (approximately)
Cable outer diameter (mm)	130 (approximately)
Cable minimum bending radius (m)	5
Cable duct outer diameter (mm)	560-600
Cable maximum pulling tension (kN)	315
Fibre optic linear weight (kg/m)	1.6
Fibre optic cable outer diameter (mm)	24-30
Fibre optic minimum bending radius (m)	<1
Fibre optic duct outer diameter (mm)	90
Cable trench depth onshore (m)	1.6

Figure 2.5 Indicative MI HVDC Cross-Sectional Diagram

2.5.1.2 Fibre Optic cable

The fibre optic cable will be installed so there can be instant communication between the two converter stations in Scotland and Norway. The cable is likely to be armoured with layers of steel wire and sheathed with either a polypropylene or polyethylene material for outer protection. The offshore section of the cable will be bundled with one of the HVDC cables. The fibre optic communications will be used for the control and electrical protection of the transmission system. The fibre optic cable will not have any repeaters within the marine environment and is landed at the Norwegian coastline where it will connect into the wider Norwegian fibre optic network.

The fibre optic cable will be routed to the converter station in Fourfields. The HVDC Cable Route Scoping Report (NorthConnect, 2016) suggested that a building may be required near the UK Landfall for the fibre optic cable. This is no longer thought to be the case and, as such, has not been included within this EIAR.

2.5.2 HVDC Onshore Cables

The onshore cable consenting corridor is wider than the actual onshore cable construction corridor required to allow for micro routing during detailed design. The actual construction corridor will include space for access along the route for excavation of cable and drainage trenches, storage of topsoil and soil from the trenches, delivery of materials and transport of personnel, and excavation and cable installation plant and equipment. An overview of the onshore consenting corridor and indicative cable routes is provided in Drawing NCGEN-NCT-Z-XE-0002-01, with additional indicative detail provided in Drawings NCGEN-NCT-Z-XD-0001-01 to -04.

From Joint Pit 1 to the converter station, it is assumed that the onshore HVDC cables will be laid within one trench. The width of the cable construction corridor for this section is likely to be around 20m (10m access road, 10m trench plus soil storage).

From the Landfall HDD entrance to Joint Pit 1, it is assumed the HVDC cables will be laid in two separate trenches. For this section, the construction corridor would be 30m (10m access road and 2 x 10m trenches plus soil storage).

The onshore cables trench will be approximately 1.3m deep and 4.5m wide, with an approximate distance of 1m between the two HVDC cables if both cables are within a single trench (Drawing NCGEN-NCT-Z-XE-0003-01). For a two-trench design there will be a separation of approximately 3m between the two trenches and 7m between the two cables (Figure 2.7). The depth of the cables are such that arable farming techniques can be employed in the reinstated fields without risk of interaction with the cables. All trenches will be reinstated to former levels.

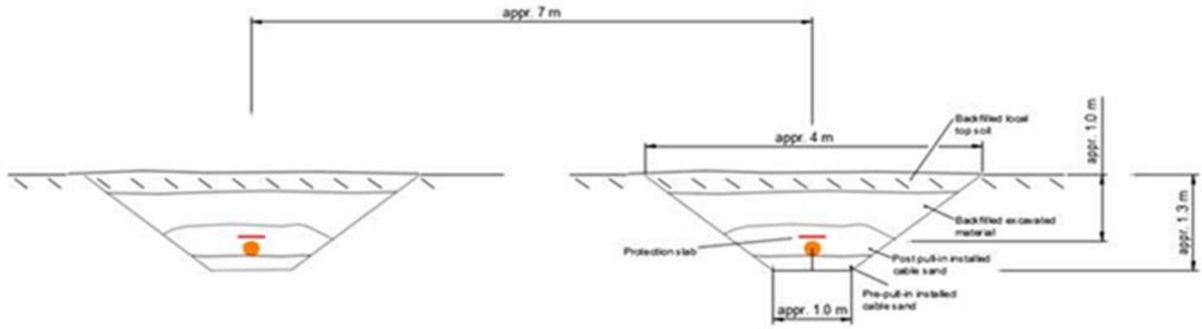

Figure 2.7: Onshore Cable Trench Cross-section a Two-Trench Design

Onshore HVDC Cables have a different armour protection composition to offshore cables, so there will be a joint pit (Jointing Pit 1) approximately 450m from the landing point to the south of the disused railway, where the transition between the two cable types will be located. Limitations on the maximum length of onshore HVDC cable that can be delivered means the maximum deliverable cable lengths are likely to be in the range of 850m – 1000m. As the proposed route is approximately 2km, a second onshore HVDC cable joint pit will be required to join the sections of onshore HVDC cables. Jointing Pit 2 will be located just to the south of Fourfields (Drawings NCGEN-NCT-Z-XD-0001-02 and NCGEN-NCT-Z-XD-0001-03).

Both joint pits are expected to be approximately 25m long by 6m wide. Each cable will be under a precast concrete slab located at least 1 m below surface level (Drawing NCGEN-NCT-Z-XE-0003-01). The joint pit will include earthing wires. The ground over the joint pits will be re-instated to former levels following the completion of the joints, such that farming activities can be resumed. In event of access to the joint be being required, the ground would be dug out to allow the concrete slab to be removed and access to the cable gained.

Link Boxes will be required at each joint pit, to connect or earth the cables outer screens at the joint bay (4 in total). The exact design will be determined by the cable contractor. They maybe above ground similar to those associated with the HVAC cable as shown in Figure 2.8.

Figure 2.8: Above Ground Link Box

It is however more likely that they will be inserted within the ground. Below ground link boxes will be no more than 1m by 1m and 0.6m deep. The box would be buried in the ground at a depth appropriate to allow access to the top/lid, while not impeding the continued farming use of the area. To avoid disruption to users of the A90 trunk road and to avoid disturbing the disused railway line, HDD will be utilised here also. The entry point will be on the southeast of the A90 next to Joint Pit 1 as shown in Drawing NCGEN-NCT-Z-XD-0001-02. The drilling distance under the A90 and the disused railway will be between 150m and 250m.

The HVDC cables pass under the landscape bunds around the converter station into the converter station site. The actual location will be determined by the final converter station design; however, it is likely that the cables will need to come into the site below the converter station platform. Depending on where the cables enter this may be 8 to 17m below the existing ground level, and 20m or greater below the final ground level when landscape bunds are installed. An indicative layout is provided in Drawing NCGEN-NCT-Z-XE-0004-01.

2.5.3 Landfall Horizontal Directional Drill (HDD)

The marine cables will be pulled ashore through ducts which will be installed into holes drilled from a point 100-120m inland from the cliffs, and under the cliffs, with a marine exit point approximately 190m offshore. The HDD onshore entrance and marine exit points are provided in Figure 2.9. The marine exit point will be in approximately 26m of water depth. There will be 3 boreholes drilled: one for each of the HVDC cables; and one for the fibre optic cable. However, all three holes will be drilled to a diameter suitable for an HVDC cable. This is to provide redundancy such that, if there is an issue with one of the HVDC ducts preventing the cable pull, there is a backup route available. In this instance the fibre optic would be bundled with an HVDC cable for pulling through the same duct.

The positioning of the likely area for the boreholes have been informed by ground investigations carried out in late 2017 to early 2018. However, the micrositing of the boreholes will be determined by the cable contractor before the commencement of the HDD operations.

Further details with regard the Landfall HDD are provided in Appendix B.1.

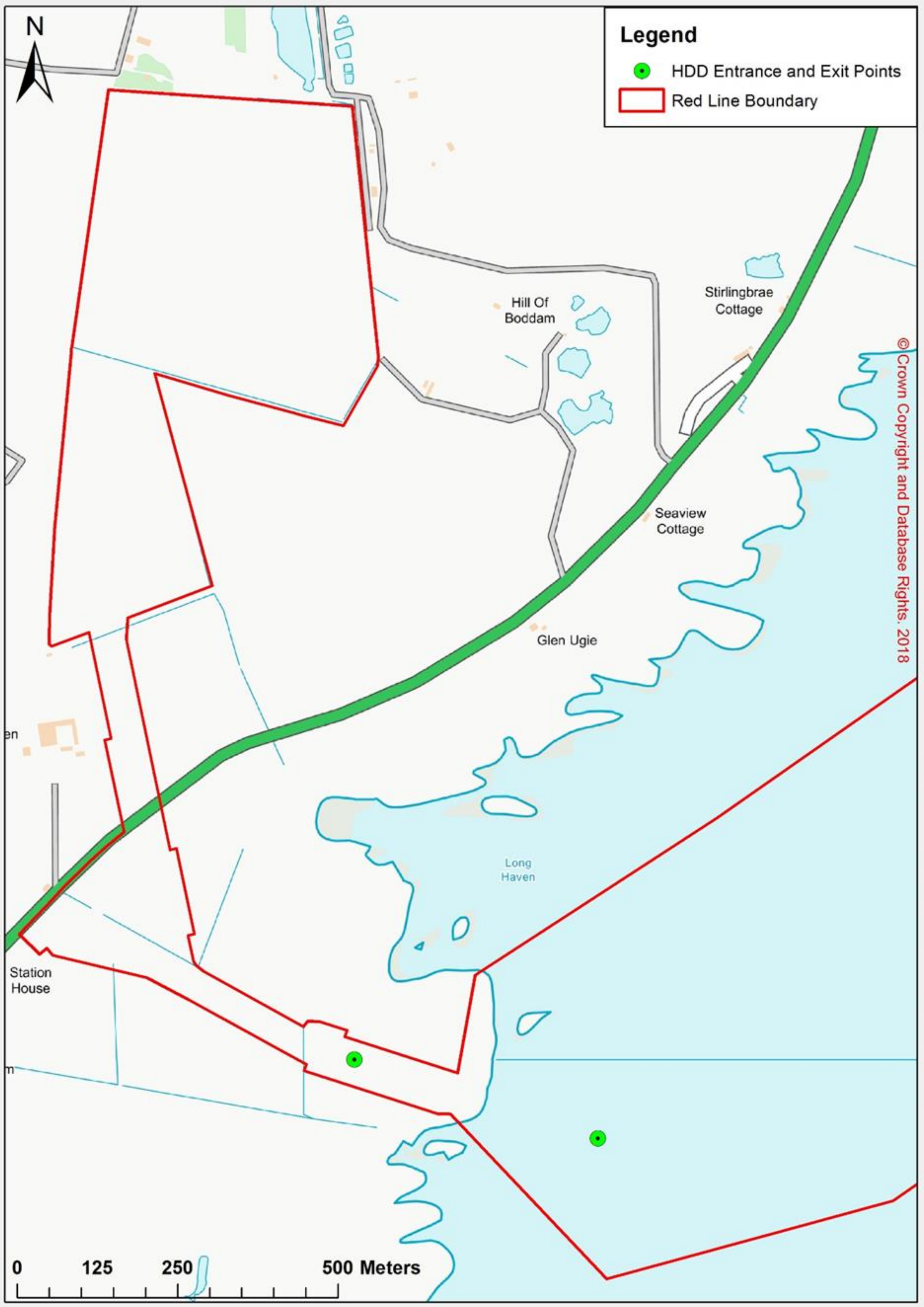

Figure 2.9: Indicative Locations of HDD Entry and Exit Points.

2.5.4 HVDC Offshore Cables

The HVDC offshore cabling will be around 665km from the UK to Norway. The offshore cabling from the HDD marine exit point to the UK median line is approximately 230 km. The cable installation will begin at both Scottish and Norwegian landfall sites and will meet in the North Sea.

It is likely that cable joints will be required at intervals of between approximately 150km to 170km for the two cables. The number of joints will be dependent mainly on the loading capacity of the installation. If cables were to be bundled, then the joint intervals would be half that of unbundled cables. Joints in the offshore cables are normally made inline, on the ship as the cable is being laid, and do not require any additional marine infrastructure.

The HDD marine exit point is located in water depths of approximately 26m. The fibre optic cable will be routed towards one of the marine HVDC cables and bundled with it for the remainder of the route. It is assumed that the two HVDC cables will be installed separately. There is, however, a small potential that they could be bundled together and laid in the same trench.

The cables will be laid in water depths varying between 26m at the UK landfall to 860m in the deepest part of the Hardangerfjord. The distances between the two HVDC cables will vary based on seabed conditions, water depth and EMF requirements. Typical separation in the North Sea will be between 20m-100m depending on the seabed conditions. In waters up to 12NM, the proposed cable corridor width will be 60m, with a cable separation of 20m as a minimum and 40m as a maximum. In waters outwith the 12NM limit, there will be a variable corridor width, with a minimum of 20m.

2.5.4.1 Cable Protection

Cable routing is the principle method of avoiding hazards and seabed assets. However, further protection beyond standard burial within a trench will be required. Where additional cable protection is required, beyond the natural backfill of sediment within a dug seabed trench, the most likely technique for cable protection is expected to be rock placement. At the HDD exit point, it is expected that concrete mattressing will be used temporarily to protect the duct until the cable is installed. Protective piping may be required for certain pipeline or cable crossings in conjunction with pre and post rock-placement.

To protect the cable from damage, the cable will be buried or protected by rock placement for the entire cable route. To identify the level of protection required, taking into account the various threats to the cable, a Cable Burial Risk Assessment (CBRA) has been completed and is included as Appendix 1 of the Construction Method Statement (NorthConnect, 2018a).

The CBRA took into account the understanding of the seabed conditions gained by the completion of the subsea survey. Primary hazards included shipping, anchorages, fishing, on-bottom stability, dredging/spoil dumping and, with particular regard to the Norwegian waters and fjords, fish farming, rockfall, submarine slopes and slide escarpments. The secondary hazard of mobile sediments was also considered. The assessment considers sections of the corridor, split by sediment type based on the survey results from the centre line of the survey corridor.

The CBRA was utilised to inform the protection level required by the NorthConnect project to reduce the risk of cable damage to a sufficient level.

Cables can be protected in four main ways:

1. They can be laid on the seabed then post-lay trenched into place. The depth the cable achieves lower than the original seabed level (OSL) is called the Depth of Lowering (DOL). The seabed material will naturally infill, the extent of which will be determined by the seabed composition;

2. The cable can be laid directly onto the seabed and rock placed onto the cable to provide protection;
3. Rock can also be utilised in conjunction with trenching, where trenching has not provided a sufficient DOL; or
4. Pre-lay trenching can be utilised where post-lay trenching is unlikely to provide sufficient DOL to minimise the need for above OSL rock placement. However, in seabed types where this is likely to be the case, natural backfill may be slow and, as such, forced backfill may be required. To prevent damage to the cable from backfill ploughing, then backfill rock placement is the preferred means to bury the cable up to OSL. The use of backfill augers or inverted plough to provide forced backfill may be considered by NorthConnect, only if the installation contractor can demonstrate relevant experience records and/or sea trials show that the cable is not jeopardised by the technique.

For the purpose of marine licencing it has been assumed that where pre-lay trenching is utilised, backfill rock placement will be required to protect the cable, but that this will not normally be above OSL. Material removed from the trench by pre-lay trenching may form berms either side of the trench, but these will naturally disperse with time.

All cables within Scottish Territorial Waters (STW) and the UK Exclusive Economic Zone (UK EEZ) were identified as requiring the top 2 protection levels (full information about protection levels is provided within the Construction Method Statement (NorthConnect, 2018a)). As such, the lowest DOL below the seabed in STW and UK EEZ (excluding crossings) is 0.4m and this should occur for no more an 10% of the cables length. For the majority of the route ≥90% the cables will be lowered and/or buried by at least 0.8m. In some seabed substrates the cable may be lowered by 1.5m.

The only area of bedrock within the STW/UK EEZ consenting corridor is very close to shore and the cable will be pulled under this through the HDD ducts. It is not anticipated that any sections of the cables within the UK consenting corridor, barring those close to crossings (see below), will be laid directly on the seabed and protected solely by rock placement.

2.5.4.2 Crossings

In the UK EEZ there are a total of 18 infrastructure crossings required: 4 of these are cables; and 14 are pipelines. There are two sections of out of service telecommunications cables which will be removed and, hence, will not be crossed. Drawing NCOFF-NCT-X-XG-0008-01 shows the locations of the asset crossing that will require above OSL rock protection.

NorthConnect is following the International Cable Protection Committee (ICPC) recommendation (No. 3, Issue: 10A) for cable and pipeline crossings (International Cable Protection Committee, 2017). The crossings shall be treated individually during detailed design considering aspects such as regional constraints, requirements from the crossed infrastructure owner, practicalities regarding trenching near the crossing, volume of rock ramps, stability and top cover. The angle between the NorthConnect HVDC cables and the crossed utility shall be as close to 90 degrees as practicable and not be less than 45 degrees for a distance of minimum 200 m from the crossed asset.

NorthConnect has defined 4 standard types of crossings which form the basis for the planning of work, unless other designs are required by the crossed infrastructure owner, and these are all provided within the Construction Method Statement (NorthConnect, 2018a). One example is provided in Figure 2.10.

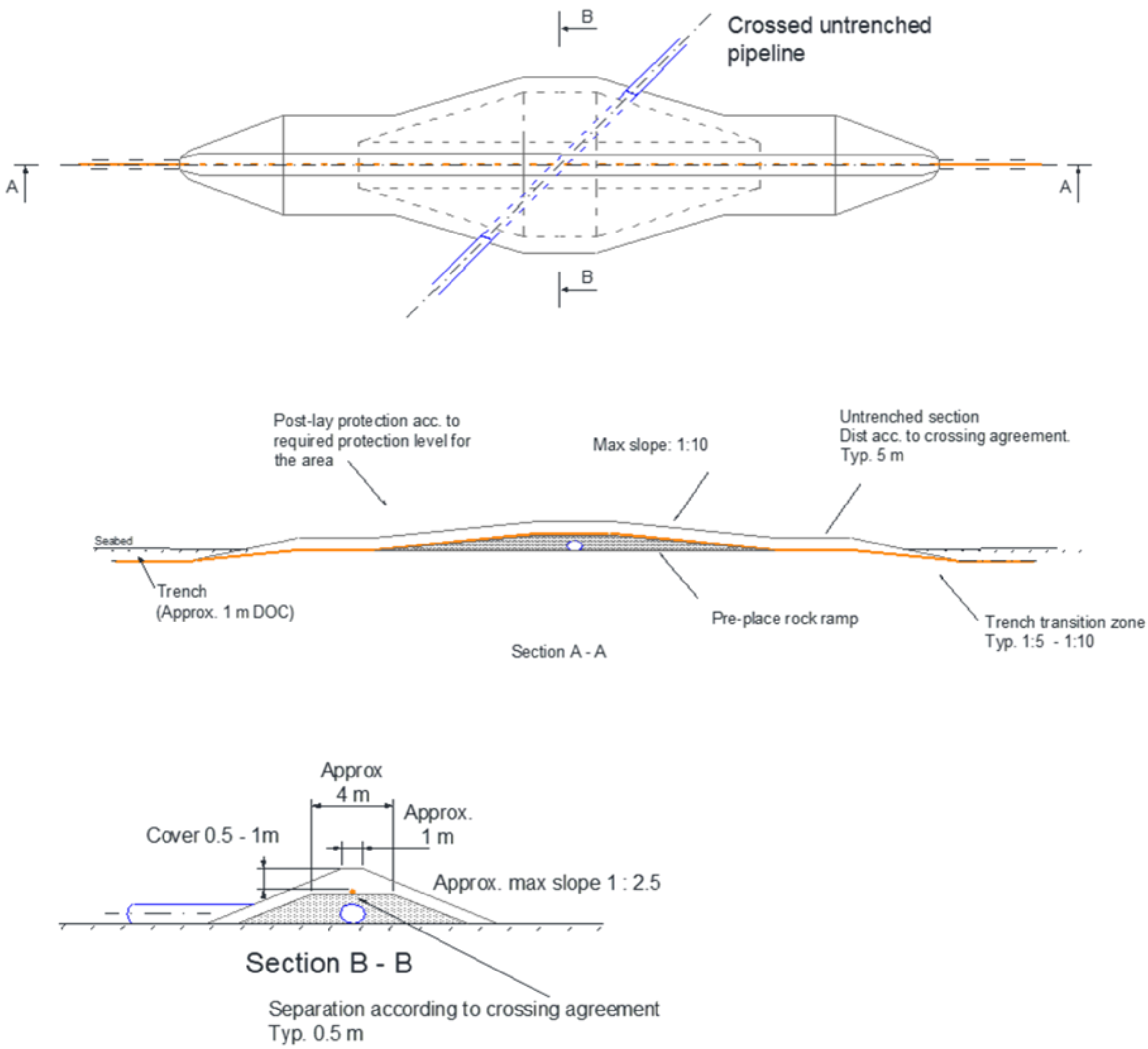

Figure 2.10: Crossings Design A - Crossing Un-trenched Pipeline

To ensure that the asset being crossed is not damaged during the HVDC Cable installation, trenching will not be carried out within the vicinity of the crossing. The distance from the asset to be crossed to the point the trenching will cease is based on the risk posed by the technique employed and the owner of the crossed infrastructure's requirements. Indicative distances are provided in the Construction Method Statement (NorthConnect, 2018a).

2.5.4.3 Cable Installation

A Cable Protection Analysis Report (CPAR) has been completed and is included as Appendix 2 of the Construction Method Statement (NorthConnect, 2018a). It considers the techniques that could be employed to provide the desired protection levels along the cable route. The five tools considered for cable installation are:

- Jet trencher;
- Chain Cutter;
- Combined Jet/Chain Cutting tool;
- Pre-lay Plough; and
- Cable Burial Plough.

The different techniques which may be used for cable laying are summarised in Table 2.6. The environmental impacts of the differing techniques are discussed in the relevant chapters within this

EIAR (Chapters 7, 14-16, 18-20, 23). For the purposes of the environmental assessment, we will consider the worst-case scenario which, in this case, would be the one that would take the longest period of time to achieve: i.e. where the cables are laid and buried separately, rather than simultaneously.

Table 2.5 Possible cable laying techniques

Cable laying technique	Technique type	Technique summary	Image example of device
Jet trenching: **Using either:** **>Tracked cable burial vehicles;** **>Free swimming ROVs**	Separate lay and burial (post-lay)	A tracked, wheeled, or free-swimming tool is applied on the cable and cuts into the seafloor using high-pressure water through jet-swords on both sides of the cable. The seabed material is put into suspension, the cable gently sinks into the trench whilst the jet trencher moves forward. The trench walls then collapse on top of the cable and suspended material settled back into the trench by natural infill.	 
Ploughing: **Using either:** **>Narrow share cable ploughs** **>Advanced cable ploughs** **>Rock ripping ploughs** **>Vibrating share ploughs**	Simulataneous lay and burial or separate lay and burial (pre-lay)	Ploughing is a versatile technique and can be used in areas with stiff clay, where jet trenching may not work. A plough cuts a trench in the seafloor using a vessel which pulls the tool along the seabed floor with great force. Pre-cut ploughs (creating a trench in advance of cable installation) and simultaneous ploughing (where the cable is installed with the ploughing) may take place. Ploughs may be equipped with jet propulsion or be vibrating ploughs. Ploughs designed for route clearance exist.	 

Cable laying technique	Technique type	Technique summary	Image example of device
Mechanical trenching (cutting): **Using either:** **>Mechanical rock wheel cutter** **>Mechanical chain excavator**	Separate lay and burial (post-lay)	A cutting chain or wheel cutter is used to create a trench. Is used for seabed conditions of stiff clay or materials with stone or bedrock. The cable is guided into the trench by a mechanical trencher. They are generally manoeuvrable devices which makes them useful for complex route sections.	 

It is anticipated that, for the majority of the cable route (~97%), jet trenching will be suitable and enable the target protection levels to be achieved. However, in areas of dense boulders (and potentially dense subsurface boulders), tills and coarse surficial sediments, pre-lay ploughing may offer a lower risk solution with greater potential for achieving the necessary target trench depths. In STW/UK EEZ the main area where jet trenching may not be suitable is between 213564E, 6378161N and 228191E and 6389279N. This is the majority of the route within STW.

NorthConnect wish to keep the range of permitted cable installation tools as wide as possible to facilitate competition from potential cable contractors, however, the contractors will be required to meet the protection levels outlined in Section 4.3.1. Cable contractors will be required to carry out sea trials, to demonstrate that they can achieve the required levels of protection in the more challenging substrates, prior to their methodology being accepted by the project.

2.5.4.4 Rock Placement

Rock placement is required for crossings as discussed in Section 2.5.4.2. It will also be required to protect cables by increasing the DOB. The amount of rock required will be determined by the cable installation method utilized. The two options utilised to calculate the rock volumes required were:

- **Option 1: Jet Trenching** for the full route, which will potentially require remedial rock placement; and
- **Option 2: Jet Trenching in combination with Pre-lay Ploughing** for the initial section in STW until the seabed conditions makes jet trenching more acceptable. It has been assumed that pre-lay ploughing will require backfill rock placement and a small amount of remedial rock placement.

Drawings NCT-X-XG-0006-01 and NCT-X-XG-0007-01 show the location of potential rock placement for each of the options considered within STW. The two options are the same outwith STW, as it is unlikely the Pre-lay Ploughing would be utilised here, and the rock placement locations are shown in Drawing NCT-X-XG-0008-01. The main difference between the two options is that the majority of rock utilised for Option 2 is backfill and, as such, will be below OSL, with an estimate of 5 to 10% of the cable lengths within STW requiring remedial rock placement. Whereas the majority of the rock required for Option 1 will be above OSL, with almost 100% of the route within STW requiring remedial rock placement above OSL. In the UK EEZ it is estimated that less than 1% of the route will require remedial rock placement (<2km).

The full rock estimate calculations can be found in the CPAR (Appendix 2 of the Construction Method Statement (NorthConnect, 2018a)), and these are summarised in Table 2.7. Option 2 requires only 4% more rock volume (3800m^3) than Option 1.

On the basis that the total rock volumes involved are similar for the two options, and that there is a preference not to change the seabed profile to minimise effects on fishing, either Option 2, or techniques that can achieve a DOL such that remedial rock is not required for the majority of the route, are preferred. Hence, it is assumed for the purpose of assessment that remedial rock placement above OSL is between 5 and 10% of the route in STW and 1% of the route from 12nm to the limit of the UK EEZ.

The anticipated rock grading to be used is 1”-5” (CP45/125mm) and D10 45mm, D50 80mm, D90 125mm, with an installed bulk density of 1.5 – 1.7 tons/ m3. Hence, the total rock requirement assuming Option 2 in STW/UK EEZ is 163,880 tonnes. 170,000 tonnes of rock placement have been allowed for within the Marine Licence.

Table 2.7: Rock Volume Estimates

Assessed Length	Remedial rock placement estimate (m^3)	Backfill estimate (m^3)	Subtotal (m^3)	Crossings estimate (m^3)	Theoretical Total (m^3)	Total including 40% contingency factor (m^3)
Full Route: Option 1 - Jetting	67600	0	67600	54200	121800	170600
Full Route: Option 2 - Jetting with Pre-lay ploughing KP0.823 - 17.891	21800	48600	70400	54200	124600	174400
KP0 to 12NM limit: Option 1 - Jetting	50400	0	50400	1800	52000	72800
KP0 to 12NM limit: Option 2 - Jetting with pre-lay ploughing KP 0.823 - 17.891	4400	48600	53000	1800	54800	76600
KP0 to UK EEZ limit: Option 1 - Jetting	52400	0	52400	13800	66200	92600
KP0 to UK EEZ limit: Option 2 - Jetting with pre-lay ploughing KP0.823 - 17.891	6600	48600	55200	13800	68800	96400

2.5.5 Temporary Construction Requirements

2.5.5.1 Construction Access

During the construction process, the majority of the site offices, staff welfare facilities, parking, storage and laydown areas, will be provided at the Fourfields Converter Station Construction site and have already been incorporated into the planning consent for that element of the project. Access to the cable corridor northwest of the A90 will primarily be from the Fourfields site which, in turn, is accessed from the A90 by an existing quarry road (Allen and Gordon, 2018).

Access to the southeast of the A90 will require a new access track to be constructed, the design for which is shown in Drawing NCGEN-NCT-Z-YX-0002-01. The justification for the design of the junction and the access track is provided in the Transport Statement (Allen and Gordon, 2018).

Staff parking will be kept to a minimum at the HDD site, personnel will arrive at Fourfields and travel together to the south of the A90 to minimise the disturbance caused by vehicle movements.

During construction, the HVDC cable corridor will include a haul road to facilitate access to the cable trench route and joint pits as per Drawing NCGEN-NCT-Z-XE-0003-01.

2.5.5.2 Works Southeast of the A90

To support the HDD and works southeast of the A90 there will be a need for:

- Laydown and HDD work area including:
  - A heavy lift drilling rig pad at the cliff HDD entry point;
  - A drilling rig pad for the A90 HDD entry point; and
  - Laydown area for the storage of pipes, drill sections and tools;
- Welfare facilities; and
- A water supply.

A potential layout for the landfall HDD temporary works area is provided in Figure 2.11.

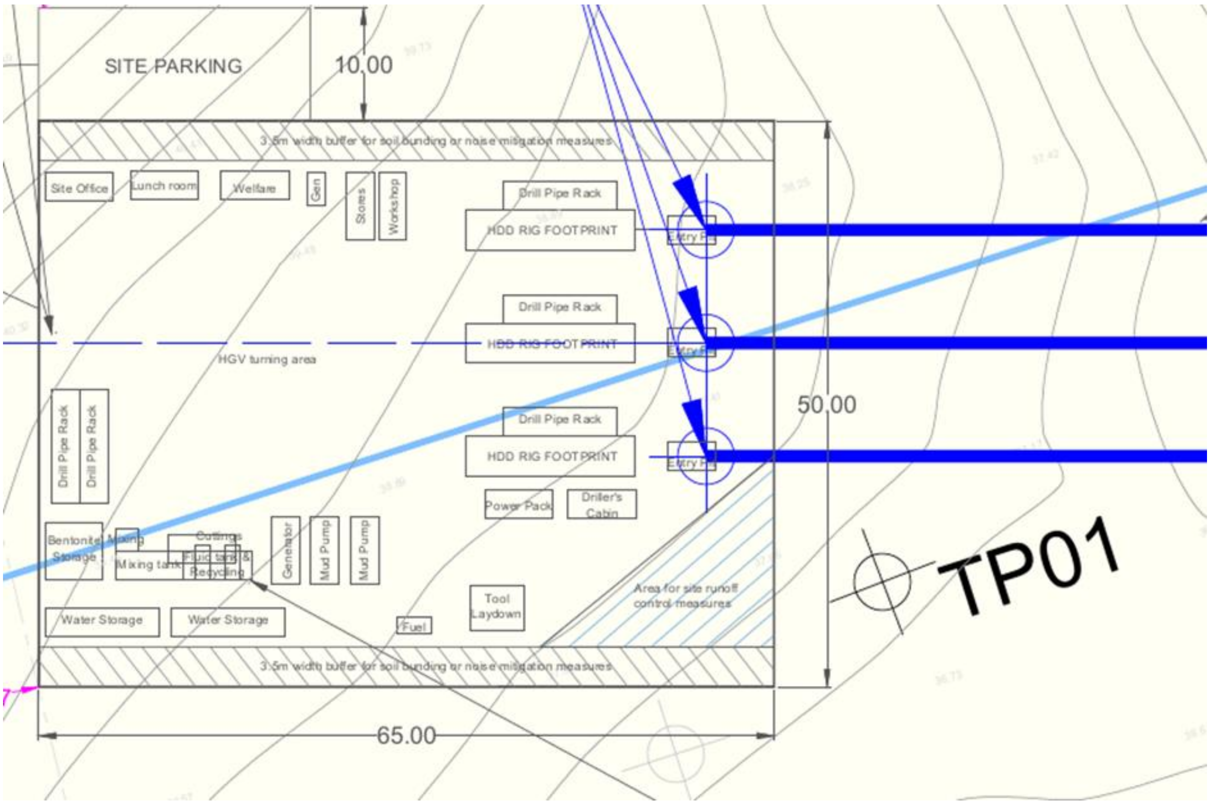

Figure 2.11 Indicative Site set-up for the Landfall HDD Works Area

The HDD Temporary Works Area will be reinstated to the previous levels once the cable has been installed, to allow it to return to its previous agricultural use.

A water supply will be required for the HDD works, so a connection will be made from the water main which runs parallel to the A90 on the seaward (south east) side. The temporary water supply will be laid adjacent to the access road.

During construction, the HVDC cable corridor will comprise a haul road, safety area, area for spoil storage, temporary surface water drainage and boundary fencing. The total construction corridor width required will be a maximum of 50m wide, although this can be narrowed over short lengths where constraints may be encountered. The cable corridor will be reinstated once construction is complete to allow activities such as farming to continue as before.

2.5.5.3 Works Northwest of the A90

The majority of the support facilities for works to the Northwest of the A90 will be from the Fourfields site. There is a potential for some laydown and welfare facilities to be required to minimise the need to cross the core path to the south of Fourfields with equipment. If required, this will most likely be within the field immediately south of Fourfields.

2.5.5.4 Rock Mattresses

Once the HDD holes are drilled and the ducts inserted, the marine exit points will need to be protected until the cables are ready to be pulled through them. Hence, concrete mattresses will be utilised to protect the holes as a temporary measure and these will be removed to allow the cables to be installed (NorthConnect, 2018a).

2.5.5.5 Guard Vessels

The Cable Lay Vessel and Trenching/Protection Vessel cannot interrupt their work and abandon the site, other than in an emergency. To prevent collisions with merchant, recreation and fishing vessels, Guard Vessels will be used to alert and redirect vessels which come too close to the working spreads. In addition, Guard Vessels will be utilised to maintain protection zones around exposed cable sections, in particular, crossings with existing cables and pipelines, between laying and trenching or between laying and rock placement activities.

NorthConnect are committed to minimising the time that protection areas are in place, preferring the prompt installation of cable protection. The cable contractor is required to protect the cable for a maximum of 3 months, however, it is assumed that the majority of the cable will be protected and hence protection zones removed in much shorter timescales.

The cables will be installed in sections; therefore, the end of each cable section be guarded until the jointing and post-lay burial operation of each joint is completed.

Full details with regard to guard vessels and communications with marine users are provided in the Fisheries Liaison and Mitigation Action Plan (NorthConnect, 2018b) and the Communications Strategy (NorthConnect, 2018c).

2.6 Project Phases

2.6.1 Construction

The following main construction activities are required to facilitate the installation of the cables:

- Onshore Enabling Works;
- Onshore Cable Installation;
- Landfall HDD;
- Offshore Preparations;
- Marine Cable Pull;
- Onshore Demobilisation and Reinstatement;
- Offshore Cable Installation; and
- Reporting.

Full details of each of these stages are provided in the Construction Method Statement (NorthConnect, 2018a). Detailed information with regard to the HDD is provided in the HDD Feasibility Report (Riggall, 2017) as Appendix B.1. To avoid duplicating the aforementioned documents, then only points which are pertinent to the EIA are discussed in this section.

2.6.1.1 Onshore Enabling Works

To prevent livestock and members of the public accessing construction areas, security/livestock fencing will be installed around work areas. The intent is not to fence the full onshore consenting corridor for the duration of the works, but rather to fence areas prior to specific access being required. Once works have been completed in an area they will be reinstated to allow fencing to be removed and access to be restored at the earliest convenience.

The road will be installed as part of enabling works, most likely through the summer months, such that the ground conditions are favourable for the works and that it is in place to allow HDD activities to be completed through the winter.

The Landfall HDD work compound will also need to be prepared and a hardstanding construction required. The topsoil and subsoil removed from the area will be utilised to form bunds to the north and south of the compound to provide some screening of the worksite in terms of noise and shelter from the winds. The east and westerly sides will need to be kept open to accommodate the cables laid inland to the west and the HDD works seawards to the east.

The onshore HVDC cables have to cross a core path which runs along the south side of the Fourfields site. Hence, it is proposed that before the other parallel path (which bisects the Fourfields site) is closed off from public access, cable ducts will be installed under the core path. This will allow the core path users to be rerouted during the duct installation via the bisecting path, and then the core path will be reinstated before the bisecting path is closed. The onshore HVDC cables can then be pulled after the construction of the Convertor building with minimal disturbance to the core path users. The duct installation will be a simple excavation of material to allow the ducts to be installed and reinstatement utilising the materials removed, as far as practicable, with appropriate re-surfacing installed.

A water supply is to be provided to the Fourfields site from the south. This pipeline will be installed in advance of the Convertor station construction and cable installation and, as far as practicable, at the same time as the cable ducts under the core path to minimise disruption.

2.6.1.2 Onshore Cable Installation

The onshore cable installation requires trenches to be dug and prepared for the cables. While the trenches and joint pits are open, there will be a need for water management and this is discussed in Chapter 10: Water Quality (Onshore). The watercourse crossings are also considered within Chapter 10. Means of escape from the open trenches in the form of ramps will be provided for mammals to avoid entrapment.

The trenches will be reinstated to their previous ground levels with any excess material being removed offsite for appropriate disposal.

The Road Crossing HDD works will be carried out in a similar way to the Landfall HDD, see Section 2.6.1.3 and Appendix B.1, however, it will be on a smaller scale and there should be no release of drilling fluids to the environment.

2.6.1.3 Landfall HDD

In addition to the Landfall HDD location and site set up being designed to minimise disturbance to ecological and recreational receptors as discussed in Section 2.4.3, the timing of works has also taken account of disturbance. The majority of the landfall HDD drilling works will be carried out through the winter months, avoiding the bird breeding season to minimise effects associated with disturbance, and further details are provided in Chapter 17: Ornithology.

The primary objective of the drilling fluid is to create a thick gel to suspend soil and rock cuttings and carry them out of the hole. In addition, the fluid hydraulically excavates soil in soft ground, powers the downhole motor in hard ground, cools the drilling equipment, clears debris from the drilling bit, seals the perimeter of the borehole in porous ground and lubricates the borehole to reduce friction on the drilling equipment. The drilling fluid, once used, is pumped into a mud recycling unit so it can be treated and reused. Waste drilling fluid will be tankered offsite for appropriately treatment and disposal.

The drilling fluid for the HDD process is likely to be a bentonite drilling fluid. Alternatives are available; however, bentonite is the most commonly used. This is a mix of water and a naturally occurring, non-toxic clay, bentonite. On occasions, additives such as natural xanthum gum and gypsum need to be added to improve the effectiveness of the fluid. Alternatives available include Ecodrill, a silicate-based drilling fluid.

The drilling fluid losses for HDD design options have been estimated and are discussed further in Chapter 11 Water Quality (offshore) and Chapter 14 Benthic Ecology. There are three stages of fluid and solid losses:

1. At the pilot hole exit;
2. During reaming; and
3. On pullback.

Fluid losses are minimised by pumping out excess fluid from the hole prior to breakout of the pilot hole into the marine environment. For each hole, the estimated total fluid losses to the sea is approximately 1000m^3 and estimated total solid losses to the sea is 6 m^3 for each hole. So, in aggregate, a total of 3000 m^3 fluid losses and 18 m^3 solid losses for the three holes.

The ducts will be installed using a pushed installation technique, which will require less days of offshore works. The ducts are pushed from land to the sea and the cables can then be pulled in through the ducts.

2.6.1.4 Offshore Preparations

As discussed in Section 2.4.4.5 there will be pre-lay surveys completed to confirm the final cable routing, and this will include both UXO, surveying and video surveys for benthic habitat confirmation purposes. The route may be revised within the consenting corridor based on the pre-survey findings to avoid obstacles or previously unmapped sensitive habitats.

Where possible, potential UXO contacts are identified during the survey, and they will be avoided by an appropriate safety buffer during the final route engineering process. If avoidance is not possible, the items of UXO will be disposed of by an appropriately licenced, explosives ordnance disposal contractor, or by the Royal Navy.

Sea trials will be carried out where there is not sufficient existing evidence to demonstrate that the proposed techniques will work. The purpose of sea trials is to prove that vessels, equipment, procedures and personnel are suitable for an efficient installation of the Submarine HVDC and fibre optic Communication Cables, maintaining the cable integrity and in accordance with principles for Health Safety Environment and Quality during all phases of the Work.

The sea trials shall be carried out in the consenting corridor close to the locations where the actual Work will take place. Upon completion of the sea trials, the seabed will be cleared of all temporary equipment deployed for the purposes of the trial.

The methods deployed are equivalent to those utilised in the actual works described below, but on a smaller scale. The trials will be over a length of 200-500m.

Once the cable route has been confirmed the seabed will be prepared to remove any debris, boulders or obstacles, such as abandoned nets and wires from its surface. This may involve a grapnel (hooked) device being dragged along the exact cable route. Alternatively, ROVs or grabs may be used to remove obstacles.

If pre-trenching is planned this will be carried out and rocks will be placed to protect existing infrastructure at crossing points, prior to cables being laid over them.

2.6.1.5 Marine Cable Pull

To allow the cables to be pulled from the offshore environment, the protective mattressing installed to protect the HDD marine exit hole will be removed. An area around the duct (pull in pipe) will be excavated and a clamp with mounting flanges installed. Preparations will be completed immediately prior to each cable being pulled.

The marine HVDC cables will be delivered in approximately 150 km long sections, hence, assuming that the HVDC cables are laid separately, the two marine HVDC cable pulls will be carried out at different times. The fibre optic cable will be pulled during one of the HVDC cable pull campaigns, as it will be bundled with it for the remainder of the route. When the cable lay vessel arrives at site, the bell mouth will be installed to guide the cable into the duct. The cable will be pulled from land. Once the cable is in place, a cap will be installed to isolate the duct from the sea. Bentonite will then be pumped into the duct to fix the cable in the duct. The marine cable on the seabed will then be protected by placing rock over the HDD marine exit point along the cable route until the cable is suitably protected by other means.

2.6.1.6 Onshore Demobilisation and Reinstatement

Once all the marine cables have been pulled onto land and jointed with the onshore cables, the onshore areas can be fully demobilised. Equipment will be removed from site, the temporary water supply removed, hardstanding materials lifted, and the field reinstated for agricultural use to its existing ground levels. The access track will be mainly removed with only a small area of tarmac (approx. 1m wide) remaining adjacent to the A90. This is to minimise the need to control traffic on the A90 during demobilisation works. The access road route will be reinstated to original levels suitable for agricultural use.

2.6.1.7 Offshore Cable Installation

Four sections of 150km long HVDC cable will be required for the STW/UK EEZ. The first cable will be pulled ashore and installed. The second cable section will either be pulled ashore and laid or attached to the end of the first section. This will depend on the timing of the delivery in relation to the bird breeding season. The third section will be attached to the first section, or pulled ashore, depending on the placement of the second section. The fourth section will be attached to the end of the second cable installed from the UK landfall.

If the HVDC cables were to be bundled, all Landfall, cable pulls would be completed in one campaign. The cables would be approximately half the length (75km) and, hence, joints will be every 75km, with each section being jointed to the end of the previous section.

In parallel, cable installation will commence at Simadalen in Norway, working eastward to join with the cables laid from the UK to the middle of the North Sea. The exact location will be determined by cable section lengths, but it is likely to be outwith the UK EEZ.

The cable will be laid, and a survey completed to identify the position of the cable touch down points. The cable will then be trenched into position and resurveyed. Rock will be placed in the following circumstances:

- To provide cable protection at crossings;
- To backfill trenches which have not naturally infilled sufficiently or where natural infilling is not expected to achieve the required DOB; or
- Remedial rock placement to provide the appropriate protection levels where DOL has not been achieved.

A rock placement survey will be completed and, where necessary, remedial works completed. A final post installation/as built survey will then be completed.

2.6.1.8 Reporting

The as-built survey results will provide the exact routes the cables have taken. This information will be shared with the appropriate bodies as detailed in the Communications Strategy (NorthConnect, 2018b).

2.6.2 Operation

Once installed and energised the HVDC and Fibre Optic cables should require minimal maintenance. Whilst the cables should not generally require significant operational maintenance once successfully installed and commissioned, they will be monitored remotely for condition and function.

Regular marine cable surveys will be carried out, as detailed in the Post Installation Survey Plan (NorthConnect, 2018d), to assess the status of the cable, cable protection and to identify any potential risks to the cable system or other users of the sea. If required, maintenance will be completed to rectify the issue identified.

If the cables were damaged in any way they would need to be accessed and repaired. Onshore, this will involve digging up the cable to gain access. On the offshore sections, the cables will be cut to allow them to be brought to the surface for repair and a new section of cable would then be jointed into the cable. The relaying of the cable will require an Ω omega loop for the cable to be laid, to manage the excess cable length. Cables will be laid and protected to their original levels.

2.6.3 Decommissioning

The lifespan of the project is 40 years. The decommissioning plan will be fully developed prior to decommissioning. The likely approach, at a strategic level, will be to remove cables where economically viable, environmentally acceptable and practicable to do so. Due to the value of the metals in the cables it is highly likely that it will be economically viable to remove the cables to allow them to be recycled. Ecological surveys may be required to ensure it is environmentally acceptable, as there is a potential that over 40 years the habitats will have changed and protected habitats or species may have colonised the area.

For the onshore components, a working corridor would be established, a trench dug above the cable, the cable removed, and the trench backfilled and restored to its former use. The impacts will be similar to those associated with construction but will be determined by the area’s ecological status and use at the time of decommissioning.

The section of cable installed in the Road Crossing HDD may be technically difficult to remove and, hence, capped and left in-situ, unless there is an overriding reason to remove it.

As with the Road Crossing HDD, the Landfall HDD cables are likely to be cut off and capped at both ends and left in situ. If they were to be removed, then the holes would need to be filled in order to prevent a hydrological link between the field and the seabed.

Offshore cables will be mainly removed. The cable would be pulled out of the trench through any sediment or rock cover, cleaned when recovered and then delivered to a certified recipient for recycling. The main exception to this will be at crossings where the crossed infrastructure is still in service. Sections that are not removed will be isolated and made safe, taking account of the operational survey results, which will have identified any associated seabed issues.

The potential effects of decommissioning the project will require a separate environmental assessment at the time and, therefore, is not considered in detail within the scope of this EIAR.

Decommissioning will be briefly covered within Chapters 14, 15, 16, 19, 20 (Benthic Ecology, Fish and Shellfish Ecology, Marine mammals, Navigation and Shipping and Commercial Fisheries, respectively).

2.7 Project Location

2.7.1 Onshore HVDC Cable

The Fourfields site where the converter station is located is approximately 2.6km south of the outskirts of Peterhead, 4.5km south of Peterhead town centre and 1km southwest of the village of Boddam (Drawing 3022). The Fourfields site is located to the south of Lendrum Terrace and Highfield, east of the Den of Boddam, Sandfordhill and Denhead and west of the Hill of Boddam and Stirling Hill Quarry.

The HVDC cable will be connected to the convertor station at Fourfields and will run from the convertor station to the onshore entrance point of the HDD at Long Haven, following a southerly direction from Fourfields and then south-east towards Longhaven cliffs. Drawings NCGEN-NCT-Z-XE-0002-01 and NCGEN-NCT-Z-XD-0001-01 to 04 show the indicative onshore cable route.

Drawing NCFFS-NCT-X-XG-0001-01 provides the onshore redline boundary and the bounding coordinates.

2.7.2 HDD Entry and Exit Holes

The proposed Landfall HDD entrance point is 100-120m inland from the seacliffs between Heathery Haven and Watery Haven as shown in Drawing NCGEN-NCT-Z-XD-0001-01. The marine exit points will be approximately 190m offshore from the cliffs as indicated in Figure 2.9.

The Road Crossing HDD entry and exit points either side of the A90 and disused railway for the Roadside HDD are shown in Drawing NCGEN-NCT-Z-XD-0001-02.

2.7.3 Offshore HVDC Cable Corridor

The cable's subsea consenting cable corridor from Long Haven to Simadalen is shown in Drawing 3013. Drawings NCOFF-NCT-X-XG-0001-01 to 04 shows a more detailed view of the UK section of the route. The detailed binding coordinates for the corridor have been provided as Appendix 01 to the marine licence application. Table 2.8 provides the main boundary points of the corridor.

Table 2.8: Main Offshore Corridor Boundary Points

ID	Latitude	Longitude
Landfall North	57° 26.962'N	001° 47.860'W
Inflection Point 1 North	57° 32.065'N	001° 38.381'W
STW North	57° 35.661'N	001° 25.652'W
Inflection Point 2 North	57° 40.565'N	001° 04.660'W
Inflection Point 3 North	58° 18.316'N	000° 57.265'E
UK EEZ North (eastern extent of corridor)	58° 25.713'N	001° 28.950'E
UK EEZ South (eastern extent of corridor)	58° 25.445'N	001° 29.201'E
Inflection Point 3 South	58° 18.046'N	000° 57.496'E
Inflection Point 2 South	57° 40.298'N	001° 04.417'W
STW South	57° 35.363'N	001° 25.571'W
Inflection Point 1 South	57° 32.635'N	001° 35.649'W
Landfall South	57° 26.824'N	001° 47.617'W

2.8 Project Programme

Figure 2.12 shows the outline programme for the whole NorthConnect project. The onshore (HVAC Cable and Converter Station) consent for the UK was given in September 2015. If the offshore HVDC Cable is approved, consents for the project should come in early 2019, with the financial investment decision being made by the end of 2019.

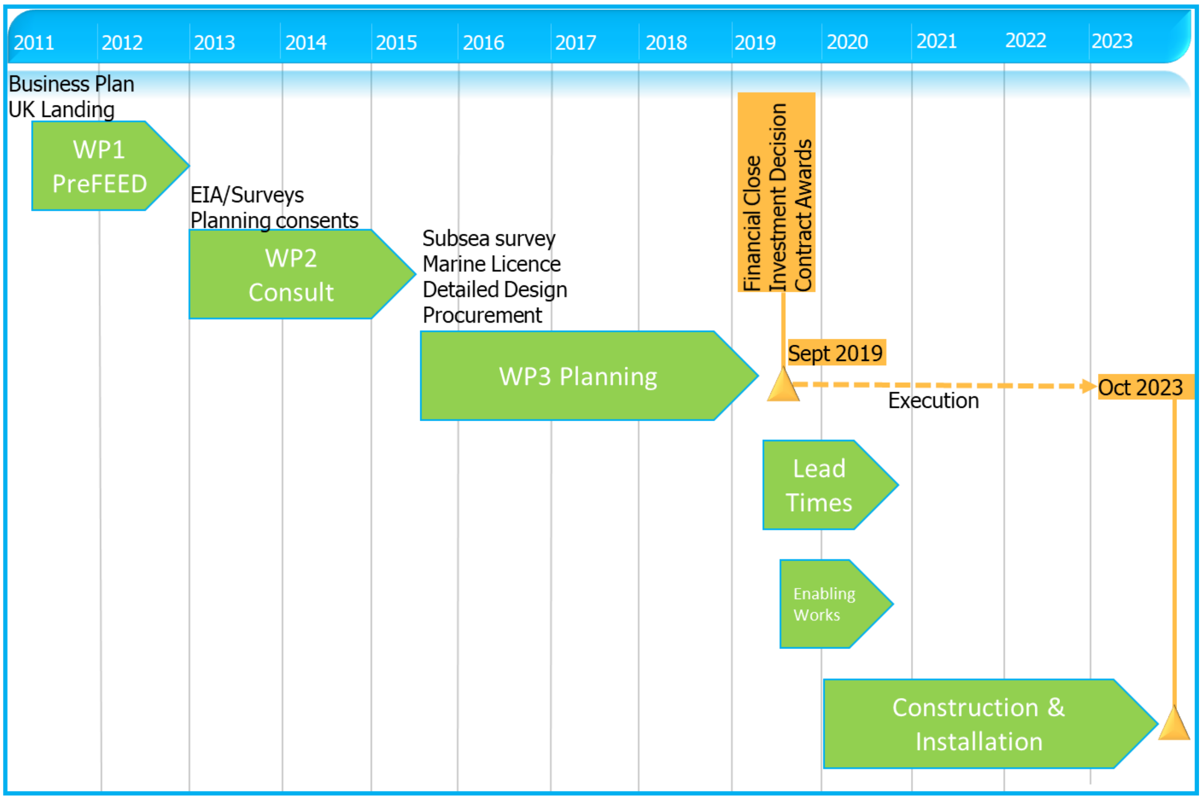

Figure 2.12 Project Programme

2.8.1 Construction Programme

The detailed programme will be developed by the main delivery contractor(s) for the project when appointed. However, approximate timings for each stage are given below in Table 2.9. As further design and then procurement of the design and build contracts is still to be undertaken, the programme has been estimated here for consenting purposes. Overall, a 54 month period of construction work is expected. Some activities are limited as to when in the year they can occur. For example, the Landfall HDD will be drilled in the winter months to avoid disturbance to breeding birds (see Chapter 17: Ornithology).

Table 2.96 Main Project Components with Approximate Timescales

Project Component	Activity	Approximate Timescales (for UK only)	Further Details
Onshore Enabling Works	Construct new junction at the A90.	6 weeks	
Onshore Enabling Works	Construct HDD Access road with water pipe from A90 water supply.	6 weeks	Preparation of access road to the HDD site, and bringing water supply for use at the HDD site.
Onshore Enabling Works	Water pipe from supply north of A90 brought to Fourfields Converter Station.	2 weeks	
Onshore Enabling Works	Ducts installed under the public footpath for the HVDC cables and the water pipe.	1 week	Path bisecting Fourfields will remain open during this time.
Onshore HVDC Cable Installation	Installation of HVDC cables onshore.	2 months	In two trenches from the cliffside HDD site to Joining Pit 1, and in one trench from the A90 HDD site to the converter station.
Onshore HVDC Cable Installation	Joint Pit construction	1 month	Two joint pits required.
Road Crossing HDD	Road Crossing HDD onshore drilling and cable pull under A90 and disused railway.	2 months	
Onshore HVDC Cable Installation	Land reinstatement	1 month	The access road may be left if the landowner prefers this to reinstatement.The fields should be reinstated to usable fields for farm animals, as before.
Landfall HDD	Site set-up	2 months	Getting the site ready for the HDD drilling. Includes setting up the plant and carpark.
Landfall HDD	Onshore drilling and HDD exit preparation.	4-6 months	This timescale is for all three holes to be drilled. May take place over two winters.
Marine Cable Pull	Cable pull site set up	4 days	Short period of time to set up for cable pull activitity.
Marine Cable Pull	Cable pull	1 week per pull	There will be two cable pulls; one for the first HVDC cable, and one for the second HVDC cable and fibre optic cable. There will be a gap inbetween each cable pull of between 4-12 months.

Project Component	Activity	Approximate Timescales (for UK only)	Further Details
Offshore Preparations	Marine Route Surveys	3 months	Carried out by the Contractor to determine fine-scale routing.
Offshore Preparations	Route Clearance, pre-trenching and pre-rockplacement at crossings	1 month	2 out of service cables in the UK EEZ will need removed. Ths activity will be timed to be in place a maximum of 4 weeks prior to the first cable installation. It is the intention to exectue the pre-rock placemnt for all crossings in one operation.
Offshore Cable Installation	Cable laying and post Cable Lay Trenching	1 month* per 170km cable.	Gap of at least 4 months inbetween each cable lay, due to cable production timings. Trenching occurs approximately 7 days after the cable laying has started. Laying and trenching will therefore be carried out concurrently on different sections of the route. This will be repeated for each HVDC cable.
Offshore Cable Installation	Trenching Survey	2 months*	A survey will take place directly after the cable has been trenched.
Offshore Cable Installation	Rock Placement Further cable protection, e.g. rock placement operations.	2 months* per 170km cable.	This will occur where the laying and trenching has not reached the minimum accepted depth of lowering, and at crossings. There will be a survey operation of the rockplacement also taking place.
Offshore Cable Installation	Post Installation Survey/As-built survey	1 month	

* The aim is to have no more than 3 months between cables being laid and them being fully protected to allow all activities (including trawl fishing) to recommence.

2.9 References

Allen and Gordon. (2018). HVDC Cable Infrastructure - Transport Statement.
DECC. (2013). *More interconnection: improving energy security and lowering bills*.
ENSG. (2012). Our Electricity transmission Network: A Vision for 2020 - an updated full report to the Electricity Network Strategy Group.
European Parliament. (2009). *Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC*. Council of the European Union.
International Cable Protection Committee. (2017). Telecommunications Cable and Oil Pipeline/Power Cable Crossing Criteria. In *Recommendation 3 No. 10A*.
NorthConnect. (2011). Strategic Options Appraisal for Landing Point UK. *Pre-FEED Report*.
NorthConnect. (2014). *Site Selection Optioneering Report* Retrieved from
NorthConnect. (2015). NorthConnect Interconnecter Convertor Station and High Voltage Alternative Current Cable Route Environmental Statement. *2*.
NorthConnect. (2016). *HVDC Cable Route Scoping Report*.
NorthConnect. (2018a). HVDC Cable Infrastructure - UK Construction Method Statement. In F. Henderson (Ed.).
NorthConnect. (2018b). HVDC Cable Infrastructure - UK Fisheries Liaison Mitigation Action Plan.
NorthConnect. (2018c). HVDC Cable Infrastructure - UK Marine Communication Strategy.
NorthConnect. (2018d). HVDC Cable Infrastructure - UK Post Installation Survey Plan. In Jonathan Ashburner (Ed.).
NVE. (2016). Norway and the European power market. In N. W. R. a. E. D. (NVE) (Ed.).
Ofgem. (2018). Electricity Generation Mix by Quarter and Fuel Source. Retrieved from https://www.ofgem.gov.uk/data-portal/electricity-generation-mix-quarter-and-fuel-source-gb
Riggall, T. (2017). Horizontal Directional Drilling (HDD) Feasibility Report. *NorthConnect Cable Landfalls, Longhaven, Peterhead, U.K.*(20160401RA-C-FR01_Rev00).
Scottish Government. (2013). *Electricity Generation Policy Statement*.
Scottish Government. (2016). Renewable Energy. Retrieved from http://www.gov.scot/Topics/Business-Industry/Energy/Energy-sources/19185
Scottish Government. (2017a). Energy in Scotland 2017 Key Facts.
Scottish Government. (2017b). *Energy Statistics Summary* Retrieved from
Scottish Government. (2017c). Scottish Energy Strategy: The Future of Energy in Scotland. Retrieved from http://www.gov.scot/Resource/0052/00529523.pdf
Technip. (2013). NorthConnect Landfall Option Study. doi:Document Number: TOWL 1076 RT ENG 001
Xodus. (2012). Desk top survey and route engineering study Route Option Analysis Report
Xodus. (2015). NorthConnect Adjustment to Route Study Addendum Route Study Report (A-100295-S00-REPT-001).

Chapter 3: Methodology

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Contents

3 Methodology

3.1 Introduction

This chapter lays out the approach and methodology that has been applied throughout the EIA process.

3.2 Overview of Approach and Methodology

One of the main purposes of the EIA process is to influence and improve design through iteration. Environmental impacts have been considered throughout the project, from the site selection and cable corridor selection through the initial design stages of the project (Chapter 2: Project Description). Where possible, environmental considerations have been incorporated within the design.

An environmental specialist has been involved throughout the process and, where necessary, appropriate topic experts have been brought in to inform the design process. The project design therefore has avoided and minimised impacts wherever possible and, as such, there are embedded ‘primary mitigation measures’ to avoid or reduce negative effects. These have been incorporated within the assessment of effects.

In addition, tertiary mitigation in the form of standard construction practices, such as those outlined in Pollution Prevention Guidance notes, are assumed to be applied in the assessment process and are captured within the Schedule of Mitigation.

This chapter sets out the process undertaken in order to provide a methodological and robust assessment of environmental impacts that is used across all chapters of the Environment Impact Assessment Report (EIAR) and meets legislative requirements.

3.3 Scoping

A scoping report was submitted to Aberdeenshire Council and Marine Scotland in April 2016. Responses to this were received in May 2016 and July 2016. The responses refined the topics to be scoped in and out. Table 3.1, is amended from the original summary table of scoping options, as presented in the scoping report (NorthConnect, 2016). Items scoped out (grey) have not been assessed through the EIA process, and those in purple and blue have been subjected to a full assessment as laid out in Section 3.4. The remainder in pink have been scoped in for transparency purposes only and, although they will be discussed in the EIAR, they may not be subject to a full assessment as laid out in Section 3.4, as it is not required due to the insignificance of the effects.

The majority of the chapters have been split into onshore and marine topics, for ease of locating relevant onshore/marine topics. However, for certain chapters it was more appropriate to retain the onshore and marine assessments within the same chapter (e.g. Archaeology and Cultural Heritage; Ornithology; and Resource Usage and Waste). Certain chapters were modified for the EIAR following the scoping and the scoping report opinions. Traffic & Access, and Landscape, Seascape, & Visual were scoped out. The Shipping chapter proposed became integrated into a Navigation and Shipping chapter, and recreational vessel usage is also included in the Local community and Economics chapter. A new Commercial Fisheries Chapter was also created. Ecological issues were divided broadly into Terrestrial ecology and Marine ecology, with further sub-divisions occurring on the marine aspects with Benthic Ecology, Fish & Shellfish and Marine Mammals having separate chapters.

Table 3.1 Summary of Topic Scoping

Topic	Onshore Cable Laying	Horizontal Directional Drilling	Offshore Cable Laying	Temporary Construction Requirements	Operations & Maintenance	Decommissioning
Seabed Quality						
Land Quality						
Air Quality						
Water Quality (onshore)						
Water Quality (offshore)						
Archaeology and Cultural Heritage						
Terrestrial Ecology						
Benthic Ecology						
Fish & Shellfish						
Marine mammals						
Ornithology						
Electric & Magnetic Fields						
Navigation & Shipping						

Topic	Onshore Cable Laying	Horizontal Directional Drilling	Offshore Cable Laying	Temporary Construction Requirements	Operations & Maintenance	Decommissioning
Commercial Fisheries						
Local community & Economics						
Noise & Vibration (in air)						
Noise & Vibration (in water)						
Resource usage and waste						
Landscape, Seascape & Visual						
Traffic & Access						

Key

	No Effect/Not Applicable – Scoped Out
	Negligible Effect – Scoped Out
	Negligible Effect – Scoped In for transparency
	Potential Effect – Scoped In
	Potential Significant Effect – Scoped In

3.4 Assessment Methodology

3.4.1 Assessment criteria

The assessment criteria being applied to this EIA are detailed within this section. For each of the environmental topics being assessed, the appropriate professional guidelines for EIA have been applied and followed as considered necessary, along with any other relevant guidance documents and best practice techniques. As a result, where the standard assessment criteria and terminology set out below are not followed for a specific environmental topic, this will be identified within the relevant environmental chapter of the EIAR, along with specific information on the preferred assessment criteria that have been applied.

The environmental assessment is conducted in two stages. The first stage characterises the nature of the impacts (positive or negative) and the second determines the level of significance of the effects. An effect results from the consequences of a change (or impact) acting on a resource / receptor. The precise nature of the effect will depend on the interaction between the degree of impact (e.g. extent, duration, magnitude, permanence etc.) and the sensitivity, value or number of the resources / receptor in each case.

3.4.2 Impacts and Effects

The EIA Regulations (Scottish Ministers, 2017a) (Scottish Ministers, 2017b) makes reference to both environmental 'impact' and 'effect'. The Regulations do not provide a definition of this terminology, but rather, they are used interchangeably. For consistency throughout this EIAR, a difference is defined, and the following terminology will be adopted for the purposes of impact assessments:

- **'Impact'**: the way in which an environmental resource / receptor is changed by the project proposals. The phrase **'potential impact'** will be used to describe any impacts which may arise as a result of the project and the **'magnitude of impact'** will be determined for each resource / receptor as part of the process (further detail below).
- **'Effect'**: the consequence of the change to (or impact upon) an environmental resource / receptor.

Taking into consideration the 'sensitivity of a resource / receptor' and the 'magnitude of impact', the overall effect is determined, along with its significance.

The assessment identifies the origins of environmental impacts, positive (beneficial) and negative (adverse), from the project and predicts their effects on resources or receptors. A resource is any environmental component affected by an impact (e.g. items of environmental capital such as habitats, aquifers, landscape, views and community facilities). A receptor is any environmental or other defined feature (e.g. human beings) that is sensitive to or has the potential to be affected by an impact.

Assessment of whether the effect of the proposed project on any particular resource or receptor was made by suitably qualified and experienced practitioners. Where possible, quantitative analysis was undertaken to support the impact assessments. Where the subject does not lend itself to quantitative analysis, qualitative analysis based on the relevant literature and similar studies is undertaken to provide a robust assessment. This will be determined for each environmental topic depending on the nature of the receptor. The initial assessment of effects takes into account primary and tertiary mitigation (see Section 3.4.6).

Each potential impact will be assessed in terms of their sensitivity or value (e.g. nature conservation value, landscape value or amenity value), followed by an assessment of the magnitude of the impact, and determination of whether or not significant effects result. For any significant effects identified, appropriate secondary mitigation measures will be identified. Taking into consideration the secondary mitigation proposed, the residual effect will then be determined for each significant effect.

3.4.3 Sensitivity/Value of Resource/Receptors

Using a set of criteria and terminology defined within each technical chapter, a sensitivity value will be assigned to a particular environmental resource or receptor. This is often categorised in accordance with EIA guidance documents for each environmental topic.

The categories used to describe value / sensitivity will be defined within the 'Assessment Methodology' section of the individual chapters.

3.4.4 Magnitude of Impact

Once a sensitivity or value has been assigned to each environmental resource or receptor, the magnitude of the impact will be identified. The magnitude of impact terminology and criteria applied are defined within each environmental chapter.

Impacts are identified as either permanent (e.g. lasting the length of the period the development is in place for, such as loss of habitat due to the construction of a new access road) or temporary (e.g. restricted to the construction period only, such as noise emissions from construction plant). A permanent impact is considered to be irreversible and from which recovery is not possible within a reasonable timescale, or for which there is no reasonable chance of action being taken to reverse. A temporary impact is reversible and from which spontaneous recovery is possible, or for which effective mitigation is both possible and an enforceable commitment has been made (CIEEM, 2016).

Temporary impacts can be further sub-divided if necessary in accordance with the following guideline, although definitions of this terminology is highly dependent on other factors depending upon the environmental topic being assessed (e.g. lifecycle of flora and fauna species):

- Short-term – less than 1 year in duration;
- Medium-term – between one to three years in duration; and
- Long-term – more than three years in duration.

As well as direct impacts (resulting from the project itself), impacts can also be indirect or cumulative. There can also be impact interactions when other projects are taken into consideration. Where this terminology is used within any assessment, the definitions for these are outlined below (as taken from 'Guidelines for the assessment of indirect and cumulative impacts as well as impact interactions' (European Commission, 1999):

- Indirect - impacts on the environment, which are not a direct result of the project, often produced away from or as a result of a complex pathway. Sometimes referred to as second or third level impacts, or secondary impacts;
- Cumulative - impacts that result from incremental changes caused by other past, present or reasonably foreseeable future actions together with the project; and
- Impact interactions - the interactions between impacts whether between the impacts of just one project or between the impacts of other projects in the areas.

3.4.5 Determination of Significant Effects

Taking both the sensitivity / value of the resource / receptor and the magnitude of impact into consideration, a determination of whether or not there are significant effects is made. Table 3.2 shows how the two elements can be combined to give an overall significance category. Topic specific tables are provided in each chapter.

Table 3.1 Categorising Significance of Effects

Magnitude of Impact	Sensitivity/Value of Receptor			
	High	**Medium**	**Low**	**Negligible**
Major/Large/High	Major	Moderate	Minor	Negligible
Moderate/Medium	Moderate	Moderate	Minor	Negligible
Minor/Small/Low	Minor	Minor	Negligible	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

Key

	Significant Effect
	Non-Significant Effect

The categories provide a threshold to determine whether or not significant effects may result from the proposals. The categorisation is shown in Table 3.3Table 3.3. Effects can be either beneficial or adverse.

Table 3.3. Categorisation and Definition of Effects

Category	Definition
Negligible	No detectable change to the environment resulting in no significant effect.
Minor	A detectable, but non-material change to the environment resulting in no significant effect.
Moderate	A material, but non-fundamental change to the environment, resulting in a possible significant effect.
Major	A fundamental change to the environment, resulting in a significant effect.

For the purposes of this EIAR, a significant effect is identified as moderate in level or higher (Table 3.2 and 3.3) and is considered to be a 'likely significant effect' in terms of EIA (significant). Mitigation is identified where practicable to avoid, minimise or reduce significant adverse effects. Effects determined as minor or lower are considered to have no likely significant effect (non-significant). Where the impact can be reduced by the application of best practice irrespective of its significance this is identified. This will assist to reduce all effects, whether they are significant in EIA terms or not.

3.4.6 Approach to Mitigation

The Institute of Environmental Monitoring and Assessment (IEMA) define three categories of mitigation in their EIA guidance for Shaping Quality Development (IEMA, 2016). These categories will be used throughout this EIAR and are outlined below:

- **Primary (Inherent) Mitigation**: Modifications to the location or design of the development made during the pre-application phase that are an inherent part of the project, and do not require additional action to be taken.
    - E.g. Identifying a key habitat or archaeological feature that should remain unaffected by the development's layout and operation;
- **Secondary (Foreseeable) Mitigation:** Actions that will require further activity in order to achieve the anticipated outcome. These may be imposed as part of the planning consent, or through inclusion in the EIAR.
    - E.g. Adoption of a Marine Mammal Protection Plan to limit the effects of disturbance through piling noise; and
- **Tertiary (Inexorable) Mitigation:** Actions that would occur with or without input from the EIA feeding into the design process. These include actions that will be undertaken to meet other existing legislative requirements, or actions that are considered to be standard practices used to manage commonly occurring environmental effects.
    - E.g. Considerate contractors' practices that manage activities which have potential nuisance effects.

As per the above IEMA categories (IEMA, 2016), all the primary and tertiary mitigation embedded in the design and construction is set out in the Project Description (Chapter 2), with topic specific elements discussed in the individual topic chapters. The primary and tertiary mitigation measures will be used when assessing the significance of effects, since both these forms of mitigation are certain to be delivered. Thus, any effects that might arise without the primary and tertiary mitigation do not need to be identified as potential effects, as there is no potential for them to arise.

Secondary mitigation measures will be proposed where practicable for any potential significant adverse effects that are identified. Mitigation measures will then be developed, as required, taking into account current guidance, precedents from similar projects, effectiveness and feasibility of solutions, and incremental costs.

It may only be possible to reduce the severity of potential adverse effects through secondary mitigation, as some cannot be eliminated entirely. Residual effects are those that remain after mitigation has taken place. Residual effects will be assessed in the same way detailed in Section 3.4.5.

To ensure that mitigation requirements are fully understood, and that each mitigation commitment is captured and transcribed into contract documentation, a Schedule of Mitigation has been drafted (Chapter 25). Construction Environmental Management Plans will be utilised to manage the mitigation through the construction process aligned to the process laid out by The Highland Council (Highland Council, 2010). An Environmental Management System (EMS) will be utilised to manage the operational impacts.

3.5 References

CIEEM. (2016). Guidelines for ecological impact assessment in the UK and Ireland: terrestrial, freshwater and coastal. In (2nd ed.): Chartered Institute of Ecology and Environmental Management.

European Commission. (1999). *Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impacts Interactions, Luxembourg*. Office for Official Publications of the European Communities.

Highland Council. (2010). *Guidance Note - Construction Environmental Management Process for large-scale projects*. Retrieved from https://www.highland.gov.uk/downloads/file/2644/construction_environmental_management_process_for_large_scale_projects

IEMA. (2016). Delivering Quality Development. 20.

NorthConnect. (2016). *HVDC Cable Route Scoping Report*.

Scottish Ministers. (2017a). The Marine Works (Environmental Impact Assessment)(Scotland) Regulations 2017.

Scottish Ministers. (2017b). *The Town and Country Planning (Environmental Impact Assessment)(Scotland) Regulations 2017*.

Chapter 4: Consultations

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4 Consultations

4.1 Introduction

This chapter presents an outline of the Environmental Impact Assessment (EIA) consultation process undertaken in relation to the development proposals. NorthConnect has engaged with key stakeholders from an early stage and throughout the EIA process, in order to inform this EIA Report (EIAR) and ensure that the development proposed is acceptable in terms of design and environmental effects.

As discussed in Chapter 1, pre-application consultation is required in support of the planning application and the marine licensing in Scottish Territorial Waters (STW). NorthConnect has undertaken consultation in line with both the marine and terrestrial requirements, details of which are provided in the HVDC Cable Installation Pre-Application Consultation Report (NorthConnect, 2018).

This chapter, therefore, concentrates on consultations with statutory and non-statutory consultees with specific regard to EIAR topics.

4.2 EIA Scoping Consultation

In April 2016, an EIA Scoping Report (NorthConnect, 2016) was submitted to Aberdeenshire Council (AC) and Marine Scotland Licensing Operating Team (MS-LOT), with a request for a formal Scoping Opinion under the EIA Regulations. The following organisations were requested to offer a scoping opinion, with those in bold being the ones who submitted responses:

- Association of District Salmon Fishery Boards (DSFB)
- Buchan Community Council (BCC)
- Chamber of Shipping (CoS)
- Crown Estate (CE)
- Health and Safety Executive (HSE)
- **Historic Environment Scotland (HES)**
- Inshore Fisheries Group (IFG)
- **Joint Nature Conservation Committee (JNCC)**
- Fisheries Office Maritime and Coastguard Agency (MCA)
- **Maritime and Coastguard Agency (MCA)**
- Marine Safety Forum (MSF)
- Marine Scotland Planning and Policy (MSPP)
- **Marine Scotland Science (MSS)**
- Ministry of Defence (MOD)
- **Northern Lighthouse Board (NLB)**
- **Royal Society for the Protection of Birds (RSPB)**
- **Royal Yachting Association Scotland (RYA Scotland)**
- Scottish Creelers and Divers Association (SCDA)
- **Scottish Environment Protection Agency (SEPA)**
- **Scottish Fishermen's Federation (SFF)**
- Scottish Fishermen's Organisation (SFO)
- **Scottish Natural Heritage (SNH)**
- Scottish Wildlife Trust (SWT)
- **Scottish Water (SW)**
- Transport Scotland (TS)
- Visit Scotland (VS)
- **Ugie District Salmon Fishery Board (UDSFB)**
- **Whale and Dolphin Conservation (WDC)**
- Ythan District Salmon Fishery Board (YDSFB)

A Scoping Opinion was received from Aberdeenshire Council on the 23rd May 2016 and from MS-LOT on the 21st July 2016. It is acknowledged that the scope and extent of the scoping report is generally acceptable and covers the main issues. Specific comments to address and incorporate into the EIA process were provided and these have been reproduced in Table 4.1.

Table 4.1 also details how NorthConnect have addressed these comments during the EIA process.

Table 4.1 EIA Scoping Opinion Comments and Responses.

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
1	MS-LOT	Effects upon fish and fisheries (including consideration of diadromous fish monitoring strategy)	Effects upon fish and shellfish ecology is assessed within Chapter 15: Fish and Shellfish. Given the predicted impacts upon diadromous fish species, there is no requirement for implementation of any additional mitigation or monitoring for these species.	Chapter 15: Fish & Shellfish Chapter 20: Commercial Fisheries	
2	MS-LOT	Cumulative impacts must consider both environmental and socio economic impacts.	Cumulative socio economic effects are included in the Local Community and Economics Chapter 21. Cumulative environmental impacts are detailed in relevant topic specific chapters, as outlined in Chapter 6: Cumulative Effects.	Chapter 6: Cumulative Effects Chapter 21: Local Community and Economics	
3	MS-LOT	A report to inform the appropriate assessment. Where HRA is required, in combination effects must be considered.	An HRA Pre-Screening Report has been provided as a stand-alone document. The pre-screening report summarises the detailed information provided in the ecology topic specific EIAR Chapters. Cumulative/in-combination effects are identified and assessed.	Chapters 13 - 17	HVDC Cable Infrastructure: UK HRA Pre-Screening Report.
4	MS-LOT	Effects on compass deviation and navigation.	EMF has been assessed in Chapter 18: EMF and Sediment Heating. Effects on compass deviation has been considered and is included in Chapter 19, Navigation and Shipping. No significant impacts were identified.	Chapter 18: EMF and Sediment Heating Chapter 19: Shipping and Navigation, Section 19.5.4.	
5	MS-LOT	Commercial Fisheries should be included as a stand-alone section rather than as part of the 'Local Community and Economy' section.	Commercial fisheries is a stand alone chapter within the EIAR. Please see Chapter 20.	Chapter 20: Commercial Fisheries	
6	MS-LOT	Section 13.4 states that underwater noise associated with cable installation is scoped out as it is not likely to have significant environmental impacts, yet table 18.1 indicates it will be included in the assessment. MS-LOT support the position that underwater noise should be scoped in for cable installation (including additional protection requirements).	Underwater noise has been retained as a stand alone chapter. Noise emissions from installation and protection operations have been assessed, and potential impacts on fish and marine mammals identified in relevant chapters.	Chapter 23: Noise (Underwater) Chapter 15: Fish and Shellfish Chapter 16: Marine Mammals	

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
7	MS-LOT	MS-LOT also notes that decommissioning has been largely scoped out based on the assumption that the cable will be left *in-situ* at the end of its operational life. If there is a requirement to remove the cable for any reason, this will be subject to separate assessment.	As detailed in Chapter 2, it is now considered likely that the cables will be removed when the project is decommissioned. It is anticipated that impacts associated with removal of the cables will be broadly similar to those resulting from installation. However, due to NorthConnect's design life, it is likely that the environmental baseline will change significantly over the lifecycle of the project and, hence, it is not possible to accurately assess the impacts at this time. As such, decommissioning will be subject to a separate assessment.	Chapter 2: Project Description Section 2.6.3	
8	AC	In terms of mitigation of any potential adverse effects associated with this proposed development, Aberdeenshire Council would suggest that following known industry best practice in terms of laying the cable at sea, would be appropriate.	Details of the HVDC cable infrastructure design and installation methods are provided in the Construction Method Statement and Chapter 2. As detailed in these documents, the project design and proposed installation methods are in line with current industry best practice guidance, and contract tenders are being issued for the works specifying said guidance and standards.	Chapter 2: Project Description	HVDC Cable Infrastructure: UK Construction Method Statement.
9	AC	A Design Statement, including cable trench reinstatement statement, and a development decommissioning plan would be beneficial in terms of identifying how any predicted adverse effects would be minimised and/or negated at all stages of the project.	Details of the HVDC cable infrastructure design and installation methods (including onshore trench reinstatement) are provided in the Construction Method Statement, and Chapter 2. Chapter 25 provides a schedule of mitigation which summarises the measures taken to minimise and negate predicted adverse effects. Decommissioning is discussed in Chapter 2, Section 2.6.3, however, due to NorthConnect's design life, it is likely that both available technology, and the environmental baseline, will change significantly over the lifecycle of the project and, hence, it is not possible to accurately assess the impacts at this time. As such, a decommissioning plan would be largely hypothetical and will, therefore, be subject to a separate assessment. This aligns with MS-LOT's feedback in row 7 of this table.	Chapter 2: Project Description Chapter 25: Schedule of Mitigation	HVDC Cable Infrastructure: UK Construction Method Statement.

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
10	AC	The environmental statement (ES) accompanying any application should fully assess any impacts of the works on the interests of all the protected areas. This should include, but not be limited to, potential impacts on habitats as a result of any pollution event and disturbance to relevant species as a result of noise, vibration and other construction activities.	Designated sites have been considered within each of the relevant chapters and the appropriate potential effects on them have been assessed.	Chapters 7-17.	
11	MSS	The scoping report correctly includes the River Dee SAC as needing consideration. In addition, adult salmon returning to the South Esk SAC, Tay SAC, Teith SAC and Tweed SAC and salmon smolts leaving these rivers will also be likely to cross the proposed cable and these SACs should be considered too.	These designated sites are considered within Chapter 15: Fish and Shellfish. No significant impacts were identified.	Chapter 15: Fish and Shellfish	
12	RSPB	To include a summary of the approach, considerations and findings of those studies, and explain the reasons for selecting the route. This would be consistent with Part 6 of Schedule 3 of The Marine Works (Environmental Impact Assessment) Regulations 2007, which require the ES to include an outline of the main alternatives considered (including alternative routes) and the main reasons for the applicant's choice.	Details of consideration of alternative landfall locations and cable routes, together with the rationale for selecting the final options are provided in Chapter 2.	Chapter 2: Project Description, Section 2.4.	
13	RSPB	Consideration should be given to the potential impact on birds associated with SPAs that use areas beyond the boundary of the designated site and within the proposed corridor areas. The potential impact of proposed routes that pass through areas that have been identified (by Scottish Natural Heritage, Joint Nature Conservation Committee (JNCC) and Marine Scotland) for further investigation as Marine Protection Areas (MPAs) should be assessed. These include the Southern Trench proposed MPA.	SPAs within and beyond the boundary of the HVDC cable corridor were laid out and considered in the baseline and relevant ones taken forward for assessment. Designated features of the Southern Trench pMPA are assessed in Chapters 7, 14 and 16.	Chapter 17: Ornithology, Section 17.4.1 and within Section 17.6. Chapter 7: Seabed Quality Chapter 14: Benthic Ecology Chapter 16: Marine Mammals.	

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
14	SFF	The SFF is concerned that the statement that there will be sufficient slack in the laid cable to allow for raising to the surface does not give much expectation of the as laid route being accurate enough or even buried to avoid interference with fishing operations.	NorthConnect is committed to ensuring the cables are overtrawlable throughout STW and UK EEZ. Cable protection will predominantly be through trenching. Where trenching is not possible, trawl friendly rock berms will be installed. The cables will be laid accurately and post installation surveys conducted. As built survey data will be provide to the UKHO for inclusion on Admiralty charts and Kingfisher Cable Awareness Charts.	Chapter 2: Project Description Chapter 20: Commercial Fisheries	HVDC Cable Infrastructure: UK Construction Method Statement.
15	SFF	The report in part 7.3.9 FISH regarding herring does not take into account the current ICES advice spawning , which is “.... that activities that have a negative impact on the spawning habitat of Herring should not occur, unless the effects of these activities have been assessed and shown not to be detrimental.”	Potential impacts on herring spawning grounds are assessed in Chapter 15: Fish and Shellfish. Considering the extent of suitable spawning habitat for herring present along the consenting corridor, and the short term and highly localised nature of the potential habitat loss or effects upon spawning individuals, no significant detrimental impacts are anticipated in the context of the wider spawning grounds and stock unit.	Chapter 15: Fish & Shellfish, Section 15.5.3 and 15.3.4.	
16	SFF	In parts 7.4.2 and 11.3.2 there is no consideration of any alternative to concrete mattresses, which may be more appropriate for mitigation to fisheries in certain areas. These are also unsubstantiated claims about reef and community growth.	No permanent concrete mattresses will be utilised in the UK EEZ. External protection will be provided where necessary through rock berms. As detailed in the Construction Method Statement, and Chapter 2, rock berms will be designed to be overtrawlable. Mattresses may be used to provide temporary protection of the HDD exit point during the installation works, however, this is in within 300m of the coast, in waters unsuitable for demersal trawling. Both beneficial and adverse ecological effects of rock placement are identified in Chapters 14: benthic Ecology and 15: Fish and Shellfish. However no effects were assessed as being significant.	Chapter 2: Project Description Chapter 14: Benthic Ecology Chapter 15: Fish and Shellfish Chapter 20: Commercial Fisheries	HVDC Cable Infrastructure: UK Construction Method Statement.

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
17	SNH	An appropriate assessment is required when a plan or project is likely to have a significant effect on a Natura site (rather than potentially affecting such a site as suggested in the Scoping Report). If installation of the NorthConnect development occurs during the breeding season of the qualifying seabirds of the Buchan Ness to Collieston Coast Special Protection Area (SPA) a significant effect is likely. We therefore agree with the Scoping Report's conclusion that an appropriate assessment is required.	The competent authority will need to carry out an HRA for the Buchan Ness to Collieston Coast SPA. We have provided information within this EIAR to inform their HRA, and provided and HRA pre-screening report to inform assessment of other designated sites.	Chapter 17: Ornithology.	HVDC Cable Infrastructure: UK HRA Pre-Screening Report.
18	SNH	This MPA [Southern Trench] has been proposed for its minke whale feature, (as well as burrowed mud, fronts, shelf deeps and geodiversity features). Although MPA proposals do not have the full policy protection given to possible MPAs, we understand that MS requires them to be taken into account in licensing decisions and so impacts on the MPA proposal should be assessed in the EA.	Southern Trench pMPA and its qualifying features are assessed in all relevant topic specific chapters. No significant adverse effects were identified.	Chapter 7: Seabed Quality Chapter 14: Benthic Ecology Chapter 16: Marine Mammals.	
19	SNH	We recommend that the effect of construction noise on marine mammals is scoped in and that an assessment of the effects of underwater noise on marine mammals is included in the EA and this should inform any relevant mitigation measures. A noise assessment would inform a decision on whether EPS licensing is necessary. A noise assessment would also inform our advice on whether construction is capable of affecting, other than insignificantly, the minke whale proposed protected feature of the Southern Trench MPA proposal.	Underwater noise has been retained as a stand alone chapter. Noise emissions from installation and protection operations have been assessed and potential impacts on fish and marine mammals identified in relevant chapters. It was identified that an EPS licence is likely to be required for the use of sub-bottom profilers during survey operations. The minke whale feature of the Southern Trench pMPA is specifically considered and no significant effects on the minke whale feature are expected.	Chapter 23: Noise (Underwater) Chapter 15: Fish and Shellfish Chapter 16: Marine Mammals	

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
20	SNH	The Scoping Report indicates that the benthic ecology survey will be undertaken in accordance with SNH advice provided to NorthConnect's consultant . We can therefore confirm our view that the proposed benthic ecology survey methodology is appropriate. As indicated in our advice of 8 March, it will be particularly important that the survey provides sufficient information to assess impact on PMFs.	The results of the survey gave sufficient information on PMFs to assess potential impacts. Section 14.4 provides a review of the survey results and Section 14.5 assesses the potential impacts to PMFs. No significant impacts were identified.	Chapter 14: Benthic Ecology, Sections 14.4 and 14.5.	Benthic Survey Report_102273-NOC-SUR-REP-ENUKNSNF
21	UDSFB	We would like our concerns about the effects of this project on Migrating Salmon and Sea Trout, in both the construction phase and in the ongoing operating stage. Please take note of our objection to the project until our fears have been addressed.	Effects upon migrating Atlantic salmon and anadromous brown trout (sea trout) are assessed within Chapter 15: Fish and Shellfish, for both the installation and operational phases. No further information is provided within the consultation response to give clarity to UDSFB's concerns and allow them to be specifically addressed. However, no significant effects on migrating salmon or sea trout have been identified during the construction or operational phases of the project.	Chapter 15: Fish and Shellfish, Sections 15.5.2 and 15.5.3.	
22	SNH	Potential impacts on habitats as a result of any pollution event and disturbance to relevant bird species as a result of noise, vibration and other construction activities.	Pollution events, noise and disturbance were all considered within the impact assessment. No significant results are expected due to the proposed development.	Chapter 17: Ornithology, Section 17.6	
23	SNH	We support the inclusion of a schedule of mitigation forming part of the ES as this will be a key document to ensure that impacts on ecological interests are minimised and legal obligations to protected species are met.	A Schedule of Mitigation has been included in Chapter 25 of this EIAR. It details all Primary, Secondary and Tertiary mitigation detailed within the topic specific chapters.	Chapter 25: Schedule of Mitigation	

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
24	SNH	We note that the scoping report acknowledges potential impacts on recreational users of the area, for example with respect to noise and landscape and visual impacts. While these will be temporary, it may be appropriate for the ES to include an assessment of these impacts along with mitigation measures to reduce any impacts.	An assessment of the effects on recreational users has been included wiithin Chapter 21 of the EIAR. This includes consideration of effects on the value of ammenity during construction works. Amenity value covers a range of issues including: changes to the soundscape, landscape and visual effects. Chapter 22 of the EIAR specifically considers noise effects on the Coastal Footpath and Local Climbing Routes.	Chapter 21: Local Community and Economy, Section21.6.1.5 Chapter 22: Noise (In-air), Section 22.6.1.2 and 22.6.1.3	
25	SNH	We advise that the ES should explore fully any impacts arising from in-combination and cumulative effects and agree with the list of other projects given in the scoping report.	Chapter 6 provides a list of projects which will be assessed for cumulative and in-combination effects. These aspects are considered in all relevant topic specific chapters.	Chapter 6: Cumulative Effects	
26	AC	Examples of the types of issues that should be addressed include: • Climate change • Local Economic Effect • Landscape Resource • Soils and geology • Visual Amenity • Ornithology • Ecology • Nature Conservation • European Protected Species • Hydrology and Water Supplies • Forestry and Tree Felling • Transport and Traffic including road safety issues and impact on local road network during and after construction work • Noise • Cultural Heritage and archaeology • Land Use • Land Ownership • Tourism and Recreation, including footpaths • Proposed mitigation measures	These issues are addressed in relevant topic specific chapters within the EIAR.	All	

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
27	AC	A Construction Environmental Management Document is a key management tool to implement the Schedule of Mitigation. We recommend that the principles of this document are set out in the ES outlining how the draft Schedule of Mitigation will be implemented. This document should form the basis of more detailed site specific Construction Environmental Management Plans which, along with detailed method statements, may be required by planning condition or, in certain cases, through environmental regulation.	As detailed in Chapter 3, an overarching CEMP will be provided for the NorthConnect construction operations and this will be informed by the Schedule of Mitigation in Chapter 25. The Schedule of mitigation will also inform the construction contracts, so the principal contractor is contractually obliged to implement the identified mitigation measures. However, due to the complex nature of the project, the CEMP will require significant input from the principal contractors detailed design and planning, so it is not possible to provide a draft at this time.	Chapter 3: Methodology Chapter 25: Schedule of Mitigation	
28	AC	For areas where avoidance is impossible, details of how impacts upon wetlands including peatlands are minimised and mitigated should be provided within the ES or planning submission.	There are no wetlands within the cable corridor, as identified by the NVC survey carried out.	Chapter 13: Terrestrial Ecology, Section 13.4.4.2	
29	AC	Landscaping with surplus peat (or soil) may not be of ecological benefit and consequently a waste management exemption may not apply. In addition we consider disposal of significant depth of peat as being landfilled waste, and this again may not be consentable under our regulatory regimes. Full details of how waste will be minimised at the construction stage should be provided.	As detailed in Chapter 2, no reuse of spoil for landscaping is proposed. No peat has been identified within the consenting corridor. Chapter 24 details how wastes will be minimised during construction.	Chapter 2: Project Description Chapter 24: Resource and Waste	
30	SNH	The environmental statement (ES) accompanying any application should fully assess any impacts of the onshore works on the interests of all the protected areas above [Buchan Ness to Collieston SPA, Buchan Ness to Collieston SAC, and Bullers of Buchan SSSI]. This should include, but not be limited to, potential impacts on habitats as a result of any pollution event and disturbance to relevant bird species as a result of noise, vibration and other construction activities.	Protected areas were assessed within this topic specific Chapters. Pollution events, noise and disturbance were all considered within the impact assessment. No significant results are expected due to the proposed development.	Chapter 8: Land Quality Chapter 13: Terrestrial Ecology Chapter 17: Ornithology	

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
31	RSPB	It is important that the ES set out measures to ensure that breeding peregrines are not disturbed during the construction and operational phases.	A peregrine falcon survey has taken place and identified the nest is beyond 500m from the HVDC onshore cable corridor. Pre-construction surveys will also take place by suitably qualified and licensed surveyor. If the peregrine nest has moved to be within the corridor, measures will be set out to ensure it is not disturbed.	Chapter 17: 17.7.1.1.1	
32	RSPB	We consider it would be appropriate for the environmental statement to include a summary of the approach, considerations and findings of this study, and explain the reasons for selecting the landing point. This would be consistent with Part II of Schedule 4 of the Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011 which require the ES to include an outline of the main alternatives considered (including alternative routes) and the main reasons for the applicant's choice.	Details of consideration of alternative landfall locations and cable routes, together with the rationale for selecting the final options are provided in Chapter 2.	Chapter 2: Project Description, Section 2.4.	
33	SEPA	Maps giving detailed information on the site layout, including details of all onshore components such as access tracks, buildings, cabling, jointing pits, drilling rig pad, rock dumps or any other shoreline works	Final site layouts cannot be confirmed until the principal contractor has been appointed and completed design, as this will depend to some extent on the nature of the equipment which is selected. However, indicative layouts have been provided by the Construction Method Statement and are also referenced in Chapter 2.	Chapter 2: Project Description	HVDC Cable Infrastructure: Construction Method Statement
34	SEPA	Information to demonstrate the on shore components of the development have been designed wherever possible to avoid engineering activities in the water environment and if there are any opportunities to provide improvements to the water environment.	As detailed in Chapter 2, NorthConnect considered numerous options for onshore cable routing and the final route corridor was selected as being the most suitable based on numerous criteria. However, it was not possible to avoid all watercourse crossings. Where watercourses are to be crossed, construction techniques will be in line with industry best practice, including the GPPs. Impacts resulting from crossing of watercourses were assessed in Chapter 10: Water Quality (Onshore), with no significant effects identified.	Chapter 2: Project Description Section 2.4 Chapter 10: Water Quality (Onshore).	

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
35	SEPA	Details of any existing groundwater abstractions within the vicinity of the onshore aspects of the development and if the proposal will include water abstraction.	Private water supplies are discussed in Chapter 8 of the EIAR. Groundwater abstraction, if required, would be in the form of dewatering of excavations only.	Chapter 8: Geology and Hydrogeology, Section 8.3.6	
36	SEPA	Identification of all aspects of site work that might impact upon the environment, potential pollution risks associated with the proposals and identify the principles of preventative measures and mitigation.	Chapter 10: Water Quality (Onshore) assessed the potential impacts arising from the site work upon the onshore water environment and identified preventive and mitigation measures. Overall no significant effects were identified. Chapter 11: Water Quality (Marine Environment) assessed potential environmental impacts from site work upon the marine water environment and identified preventive and mitigation measures. Overall no significant effects were identified.	Chapter 10: Water Quality (Onshore) Sections 10.4 and 10.5 Chapter 11: Water Quality (Marine Environment) Sections 11.5 and 11.6	
37	SEPA	Details of how waste will be minimised at the construction stage.	Waste management is considered withing Chapter 24 of the EIAR.	Chapter 24: Resource Usage and Waste	
38	SEPA	Information on surface water drainage during construction.	Chapter 10: Water Quality (Onshore) provides detail of site surface water drainage and assessed the potential impacts on water quality during construction.	Chapter 10: Water Quality (Onshore).	
39	SEPA	We advise that the applicant should, through the EIA process or planning submission, systematically identify all aspects of site work that might impact upon the environment, potential pollution risks associated with the proposals and identify the principles of preventative measures and mitigation. This will establish a robust environmental management process for the development. A draft Schedule of Mitigation should be produced as part of this process. This should cover all the environmental sensitivities, pollution prevention and mitigation measures identified to avoid or minimise environmental effects.	A Schedule of Mitigation has been included in Chapter 25 of this EIAR. It details all Primary, Secondary, and Tertiary mitigation detailed within the topic specific chapters.	Chapter 25: Schedule of Mitigation	

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
40	SEPA	A Construction Environmental Management Document is a key management tool to implement the Schedule of Mitigation. We recommend that the principles of this document are set out in the ES outlining how the draft Schedule of Mitigation will be implemented. This document should form the basis of more detailed site specific Construction Environmental Management Plans which, along with detailed method statements, may be required by planning condition or, in certain cases, through environmental regulation. This approach provides a useful link between the principles of development which need to be outlined at the early stages of the project and the method statements which are usually produced following award of contract (just before development commences).	As detailed in Chapter 3, an overarching CEMP will be provided for the NorthConnect construction operations, and this will be informed by the Schedule of Mitigation in Chapter 25. The Schedule of mitigation will also inform the construction contracts, so the principal contractor is contractually obliged to implement the identified mitigation measures. However, due to the complex nature of the project, the CEMP will require significant input from the principal contractor's detailed design and planning, so it is not possible to provide a draft at this time.	Chapter 3: Methodology Chapter 25: Schedule of Mitigation	
41	SEPA	We note "During the construction process, the majority of the site offices, staff welfare facilities, parking storage and laydown areas will be provided at the Fourfields Converter Station Construction site, and have already been incorporated into the planning consent for that element of the project." It should be made clear in the ES where aspects are part of the existing consent(s) and therefore not considered further and where they are not covered by an existing consent.	Where aspects are incorporated in the existing consent, this is detailed in all relevant topic specific chapters.	All	

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
42	SEPA	We welcome that "An extended Phase 1 Habitat Survey of the onshore HVDC cable route search area (Drawing 3149) has been completed" although this wasn't included in Appendix A of the report provided to SEPA. If there are wetlands or peatland systems present, the ES or planning submission should demonstrate how the layout and design of the proposal, including any associated hard standing and roads, avoid impact on such areas.	There are no wetlands or peatland systems within the cable corridor, as identified by the NVC survey carried out.	Chapter 13: Terrestrial Ecology, Section 13.4.4.2 Appendix D.4 and D.5	
43	SEPA	National Vegetation Classification should be completed for any wetlands identified. Results of these findings should be submitted, including a map with all the proposed infrastructure overlain on the vegetation maps to clearly show which areas will be impacted and avoided.	An NVC Survey was commissioned and carried out. Results are provided and a map was produced of the vegetation types overlaid with the HVDC cable corridor red line boundary.	Chapter 13: Terrestrial Ecology, Section 13.4.4.2 Appendix D.4 and D.5	
44	SEPA	For areas where avoidance is impossible, details of how impacts upon wetlands including peatlands are minimised and mitigated should be provided within the ES or planning submission. In particular impacts that should be considered include those from drainage, pollution and waste management. This should include preventative/mitigation measures to avoid significant drying or oxidation of peat through, for example, the construction of access tracks, dewatering, excavations, drainage channels, cable trenches, or the storage and re-use of excavated peat. Detailed information on waste management is required as detailed below. Any mitigation proposals should also be detailed within the Construction Environmental Management Document as detailed below.	There are no wetlands or peatland systems within the cable corridor, as identified by the NVC survey carried out.	Chapter 13: Terrestrial Ecology, Section 13.4.4.2 Appendix D.4 and D.5 Appendix D.4 and D.5	

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
45	SEPA	It is therefore essential that if relevant the scope for minimising the extraction of peat is explored and alternative options identified that minimise risk in terms of carbon release, human health and environmental impact. Early discussion of proposals with us is essential, and an overall approach of minimisation of peatland disruption should be adopted. If it is proposed to use some excavated peat within borrow pits or bunding then details of the proposals, including depth of peat and how the hydrology of the peat will be maintained, should be outlined in the ES or planning submission.	No peatland systems or peat extraction will need to take place as part of this project.	Chapter 8: Land Quality Chapter 13: Terrestrial Ecology	
46	SEPA	In order to meet the objectives of the water framework directive of preventing any deterioration and improving the water environment, developments should be designed to avoid engineering activities in the water environment wherever possible. The water environment includes burns, rivers, lochs, wetlands, groundwater and reservoirs. Where a watercourse crossing cannot be avoided, bridging solutions or bottomless or arched culverts which do not affect the bed and banks of the watercourse should be used.	As detailed in Chapter 2, NorthConnect considered numerous options for onshore cable routing, and the final route corridor was selected as being the most suitable based on numerous criteria. However, it was not possible to avoid all watercourse crossings. Where watercourses are to be crossed, construction techniques will be in line with industry best practice, including the GPPs. Impacts resulting from crossing of watercourses were assessed in Chapter 10: Water Quality (Onshore), with no significant effects identified.	Chapter 2: Project Description Section 2.4 Chapter 10: Water Quality (Onshore).	
47	SEPA	If the engineering works proposed are likely to result in increased flood risk to people or property then a flood risk assessment should be submitted in support of the planning application and we should be consulted	Flooding is considered in Chapter 10, with no increase in flood risk expected due to the HVDC Cable installation works.	Chapter 10: Water Quality (Onshore), Section 10.4.2	

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
48	SEPA	Where water abstraction is proposed we request that the ES, or planning submission, details if a public or private source will be used. If a private source is to be used the information below should be included. Whilst we regulate water abstractions under The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended), we require the following information to determine if the abstraction is feasible in this location; • Source e.g. ground water or surface water; • Location e.g. grid ref and description of site; • Volume e.g. quantity of water to be extracted; • Timing of abstraction e.g. will there be a continuous abstraction; • Nature of abstraction e.g. sump or impoundment; • Proposed operating regime e.g. details of abstraction limits and hands off flow; • Survey of existing water environment including any existing water features; • Impacts of the proposed abstraction upon the surrounding water environment.	Water required for onshore construction works associated with the HVDC Cable will be from a connection to the Scottish Water mains. Groundwater abstraction if required would be in the form of dewatering of excavations only, and compliance with The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) will be ensured.	Chapter 24: Resource Usage and Waste, Section 24.4.1.1	
49	SEPA	We welcome the consideration of decommissioning and note "For the onshore element this would be a reversal of the installation works." SEPA is currently considering the waste regulatory position of material such as rubble, foundations and cabling which may be reused or abandoned on site during decommissioning or repowering. Any proposal to discard materials that are likely to be classed as waste would be unacceptable under current waste management licensing and under waste management licensing at time of decommissioning if a similar regulatory framework exists at that time.	As detailed in Chapter 2, it is now considered likely that the cables will be removed when the project is decommissioned. It is anticipated that impacts associated with removal of the cables will be broadly similar to those resulting from installation. However, due to NorthConnect's design life, it is likely that the environmental baseline will change significantly over the lifecycle of the project and, hence, it is not possible to accurately assess the impacts at this time. As such, decommissioning will be subject to a separate assessment.	Chapter 2: Project Description Section 2.6.3	

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
50	MS-LOT	The Communication Strategy must document clearly defined procedures for the distribution of information relating to all cable installation, protection and survey activities to the fishing industry and other legitimate users of the sea.	These procedures are provided in the Communication Strategy and Fisheries Liaison Mitigation Action Plan.	N/A	HVDC Cable Infrastructure: UK Communications Strategy HVDC Cable Infrastructure: UK Fisheries Liaison Mitigation Action Plan.
51	MS-LOT	The protection plan should clearly describe the cable route and identify areas where the cable will be buried and the estimated depth of burial. It should also identify areas where additional cable protection is likely to be required either because the cable cannot be buried, or the depth of burial is insufficient to remove the requirement for additional protection.	This information is provided in Chapter 2: Project Description. Further information is provided in the Construction Method Statement. The CMS is informed by the marine survey operations, and the associated Cable Burial Risk Assessment and Cable Protection Analysis Report.	Chapter 2: Project Description	HVDC Cable Infrastructure: UK Construction Method Statement.
52	MS-LOT	Construction method statement This document must include as a minimum · details of the staging of the works · proposed techniques for construction and plant used, etc. · Unexploded Ordnance (UXO) strategy	These details are provided in the Construction Method Statement.	N/A	HVDC Cable Infrastructure: UK Construction Method Statement.
53	MS-LOT	Post installation survey plan The document must include · the immediate post lay survey and longer term survey and inspection programme · the proposed timescales and frequency of inspections · the survey type · the proposed mitigation if spans or movement or other dangers to legitimate use of the sea are Identified.	The immediate post lay survey is considered to be part of the installation works and details are included in the Construction Method Statement. All other details are provided in the Post Installation Survey Plan.	N/A	HVDC Cable Infrastructure: UK Construction Method Statement. HVDC Cable Infrastructure: UK Post Installation Survey Plan

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
54	MS-LOT	A navigational risk assessment must be undertaken and you attention is drawn to the advice provided by the MCA to inform this process.	The Navigation and Shipping chapter and supporting baseline appendix represent the Navigational Risk Assessment for the cable. Impacts have been assessed using a risk matrix approach.	Chapter 19: Navigation and Shipping Appendix G.1 - Shipping and Navigation Baseline Conditions	
55	MS-LOT	MS-LOT is aware of the following works or proposed works that should be included in your assessment of cumulative effects in the ES (please note that this list is not exhaustive): • Aberdeen Harbour Expansion Project (Aberdeen) • Beatrice STW Offshore Wind Farm (Outer Moray Firth) • European Offshore Wind Deployment Centre (Aberdeen) • Forthwind (Methil) Offshore Wind Demonstrator (Firth of Forth) • Hywind Scotland Pilot Park Offshore Wind Farm (Offshore Peterhead) • Inch Cape STW Wind Farm (Outer Firth of Forth • Kincardine offshore Wind Farm (Aberdeen) • Moray Firth Eastern Development Area (Outer Moray Firth) • Moray Firth Western Development Area (Outer Moray Firth) • Neart na Gaoithe STW Wind Farm (Outer Firth of Forth) • Peterhead Carbon Capture and Storage Project (Peterhead to Goldeneye Field) • Peterhead Harbour Masterplan (Peterhead) • Port of Ardersier (Inner Moray Firth) • Seagreen Alpha Round 3 Wind Farm (Outer Firth of Forth) • Seagreen Bravo Round 3 wind Farm ~(Outer Firth of Forth • SSE HVDC cable, Noss Head to Portgordon (Moray Firth) • North Sea Network Link Interconnector cable (NE England – Norway)	The cumulative project list was agreed through discussions with MS-LOT. Cumulative impacts are assessed in all assessment chapters.	Chapter 6: Cumulative Effects	

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
56	MS-LOT	European Protected Species Licensing -It needs to be categorically established which species are present on and near the site, and where, before the application is considered for consent. The presence of protected species must be included and considered as part of the application process, not as an issue which can be considered at a later stage.	EPS species presence and potential impacts are assessed in the Terrestrial Ecology and Marine Mammal Ecology Chapters. An EPS licence is likely to be required for disturbance of cetaceans through the use of sub-bottom profilers during survey operations. An EPS licence may be required for otters, dependant on the findings of the preconstruction otter surveys at the UK landfall.	Chapter 13: Terrestrial Ecology Chapter 16: Marine Mammals	
57	MCA	A Navigation Risk Assessment (NRA) should be undertaken to supply detail on the possible impact on navigational issues for both Commercial and Recreational craft. The NRA should address issues such as: • Collision Risk • Navigational Safety • Visual intrusion and noise • Risk Management and Emergency response • Marking and lighting of site and information to mariners • Effect on small craft navigational and communication equipment	The Navigation and Shipping chapter and supporting baseline appendix represent the Navigational Risk Assessment for the cable. Impacts have been assessed using a risk matrix approach.	Chapter 19: Navigation and Shipping Appendix G.1 - Shipping and Navigation Baseline Conditions	
58	MCA	Electromagnetic deviation on ships' compasses. The MCA would be willing to accept a three degree deviation for 95% of the cable route. For the remaining 5% of the cable route no more than five degrees will be attained. The MCA would however expect a deviation survey post the cable being laid; this will confirm conformity with the consent condition. The developer should then provide this data to UKHO via a hydrographic note (H102), as they may want a precautionary notation on the appropriate Admiralty Charts.	Compass deviation effects will be minimised by keeping cable separation distance as short as practicable. No significant impacts were identified. Further consultation with the MCA is planned if compass deviations are expected to exceed five degrees in the final cable design.	Chapter 18: EMF and Sediment Heating Chapter 19: Shipping and Navigation, Section 19.5.4.	

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
59	MCA	The developer must ensure that 'the works' do not encroach on any recognised anchorage, either charted or noted in nautical publications, within the proposed consent area.	The cable does not encroach on any designated (or charted) anchorage areas. AIS data identified that five vessels over a one-year period anchored over the consenting cable corridor. Vessels were also seen to anchor off the coast to the north and south of the corridor. Therefore, alternative areas of sea bed with good holding ground are available for these vessels to increase their distance from the cable once installed.	Chapter 19: Navigation and Shipping, Section 19.4. Appendix G.1 - Shipping and Navigation Baseline Conditions	
60	MCA	Particular attention should be paid to cabling routes and burial depth for which a Burial Protection Index study should be completed and, subject to the traffic volumes, an anchor penetration study may be necessary.	A Cable Protection Analysis Report (CPAR) has been produced for the subsea cable survey corridor of the NorthConnect project. This has drawn upon many of the findings from the separate CBRA (Cable Burial Risk Assessment) report which included an assessment of hazards from ship anchors and fishing gear. It also incorporates information gathered from the final geophysical and geotechnical reports. As summary of the findings, and resulting installation design, is provided in the Construction Method Statement, and Chapter 2 of EIAR.	Chapter 2: Project Description	HVDC Cable Infrastructure: UK Construction Method Statement.
61	MCA	Any consented cable protection works must ensure existing and future safe navigation is not compromised, accepting a maximum of 5% reduction in surrounding depth referenced to Chart Datum.	The risk of a vessel grounding due to reduced under keel clearance associated with cable crossing points and protection methods has been assessed. The minimum water depth along the HVDC offshore cabling is at the HDD exit point where depths are 26.5m. In line with MCA guidance, it is not planned to reduce the existing water depth by more than 5% along any section of the cabling, which would correspond to approximately 1.3m at the HDD exit point. The cable protection level put in place directly at the HDD exit point will not be more than 1.3m and, thereafter, is expected to be 0.8-1m within the first 12NM. The water depth increases to over 40m within 1NM of the shore. The small fishing and recreational vessels which were generally seen in the AIS survey data to be transiting this close to shore would be at no risk of grounding (less than 5m draught).	Chapter 2: Project Description Chapter 19: Navigation and Shipping	HVDC Cable Infrastructure: UK Construction Method Statement.

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
62	MCA	Reference should be made to any Marine Conservation Zones established or planned within the development area and adjacent coastline.	Impacts on MCZs and other designated sites are assessed in the topic specific ecological chapters.	Chapters: 14,15,16, and 17	
63	MSS	Insufficient information was provided and a full scoping review regarding commercial fisheries was not possible. Additional information are required around scoped cable interactions with the fishing industry, data sources to be used as part of the desk based review, construction programme with an emphasis on the duration of spatial restriction to fisheries, a cable burial plan, areas of additional protection measures, any post-lay surveys and a fisheries liaison and mitigation plan listing past and future consultation with the fishing industry. As part of cumulative assessment, Table 4.3 refers to a series of offshore wind projects to be considered at the time of writing the ES. These projects should be explicit mentioned to allow early identification of omissions.	A detailed baseline and impact assessment for commercial fisheries in the vicinity of the consenting corridor has been undertaken in Chapter 20. This considers duration of exclusions, potential impacts from cable protection and also details on past and future fisheries liaison. A cumulative impact assessment has also been undertaken for commercial fisheries and considers a number of offshore wind options as well as other developments. This assessment takes into account details provided in Chapter 2, the Construction Method Statement, and Fisheries Liaison Mitigation Action Plan.	Chapter 2: Project Description Chapter 20: Commercial Fisheries	HVDC Cable Infrastructure: UK Fisheries Liaison Mitigation Action Plan. HVDC Cable Infrastructure: UK Construction Method Statement
64	MSS	The Scoping report mentions water quality and a seabed survey. Further investigations need to include all aspects of the physical environment though. When commenting on the physical environment, it is necessary that the following will therefore be discussed as well: hydrodynamics (for example changes to tides and currents), and coastal processes. Impacts are expected to be minor and can eventually be scoped out but they will need to be discussed first.	The nature of the marine HVDC cable infrastructure means that elevations from the existing seabed are minimal. The worst case in UK waters is at the HDD exit point where the height of the external protection may reach approximately 1.3m above the existing seabed. This is however in 26m of water depth, so results in an extremely localised depth reduction of only 5%, which will not result in any significant changes to the local hydrodynamic regime or coastal processes. Since this is the worst case, no significant changes are expected in the rest of the UK consenting corridor, hence this aspect is scoped out of the assessment.	Chapter 7: Seabed Quality, Section 7.1.	

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
65	MSS	It is expected that during the construction activities oceanographic and seabed conditions will get affected. Any impact on the water environment and possible mitigation measures need to be assessed. Also cumulative impacts will need to be discussed.	These aspects are assessed in the Chapter 7 and 11 of the EIAR. Cumulative impacts are also assessed. No significant impacts were identified.	Chapter 7: Seabed Quality Chapter 11: Water Quality (Marine Environment)	
66	MSS	All aspects of the water environment need to be taken into account and assessed to evaluate if they need to be scoped in or can be scoped out.	The water environment was scoped in and divided into onshore and marine water quality, titled Chapter 10: Water Quality (Onshore) and Chapter 11: Water Quality (Marine Environment) respectively.	Chapter 3: Methodology Section 3.3, Chapter 10: Water Quality (Onshore) and Chapter 11: Water Quality (Marine Environment)	
67	MSS	This is a very large project and there will be uncertainties related to diadromous fish in the risk assessment. What monitoring is required will require consideration. MSS understanding is that those installing large interconnector cables will contribute to diadromous fish research and monitoring mainly if not entirely through the National Research and Monitoring Strategy for Diadromous Fish.	Effects upon fish and shellfish ecology is assessed within Chapter 15: Fish and Shellfish. No significant impacts were identified on diadromous fish species. As such, there is no requirement for implementation of any additional mitigation or monitoring for these species.	Chapter 15: Fish and Shellfish	
68	NLB	We note that the connection to the UK National Grid shall be made at a convertor facility onshore and that the HVDC cable route shall be passed through Horizontally Drilled Directional ducts, breaking through to the seabed approximately 800-1000mtrs east of the MLWS mark on the coast at Boddam. We would therefore require that the UKHO is informed of the break through point and the cable route in order that all relevant charts are updated accordingly.	As detailed in the Communication Strategy and Chapter 19, the NorthConnect HVDC offshore cabling will be clearly marked on nautical charts in line with UK Hydrographic Office (UKHO) standards, with associated note / warning. As part of this, the final HDD exit point coordinates will be provided to the UKHO.	Chapter 19: Navigation and Shipping	HVDC Cable Infrastructure: UK Communications Strategy

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
69	NLB	With regards to any works being carried out in the marine environment, Northern Lighthouse Board would require that Notice(s) to Mariners, Radio Navigation Warning(s) must be promulgated prior to the commencement of any works, and also the publication in appropriate bulletins stating the nature and timescale of any marine works relating to this project.	As detailed in the Communication Strategy and Chapter 19, circulation of information via Notices to Mariners, Radio Navigational Warnings, NAVTEX, and/or broadcast warnings will be conducted in advance of, and during, the offshore works. The notices will include a description of the work being carried out.	Chapter 19: Navigation and Shipping	HVDC Cable Infrastructure: UK Communications Strategy
70	RSPB	In order to minimise the possibility of negative impacts on seabirds, any aggregations of seabirds identified through the data search or surveys should be avoided, by route selection or by timing of the operations.	The landfall site was informed in part, due to an initial survey of the cliffs which identified two quieter areas of the cliffs for seabirds. One of these quieter areas was then taken forward as the landfall site. The activity with the greatest potential for noise disturbance, the Landfall HDD drilling, has been specifically scheduled to be between September-March, to avoid the bird breeding season. The cable pull activity has also been specifically scheduled to be either at the beginning of at the end of the bird breeding season (April or August) to avoid the peak breeding period (May-July) as identified from the seabird survey data.	Chapter 17 Ornithology: Sections 17.5.1 and 17.7.1.3.1	
71	RYA Scotland	The route crosses a very important route for recreational sailors from the south to the Caledonian Canal and the Northern Islands and vice versa. This route is seasonal with few recreational vessels passing from October to April. This should be dealt with in the shipping chapter but it needs to be borne in mind that probably only about 20% of recreational craft transmit an AIS signal. Nevertheless I see no need for the project to collect new data on recreational boat movements.	Twelve months of AIS data from 2017 were used to ensure seasonal variations were fully taken into account. This confirmed the main period of activity was summer (May to August). It was also recognised that AIS represents a minority of recreational vessels (estimated at 20%). Other sources of data were reviewed where available, such as Sailing Directions.	Chapter 19: Navigation and Shipping Appendix G.1 - Shipping and Navigation Baseline Conditions	
72	RYA Scotland	There are several developments proposed for these water, which are in any case close to the busy port of Aberdeen, and it will be important to consider the cumulative effect on recreational sailors on passage up this coast.	Impacts on recreational vessels assessed in Chapter 19: Navigation and Shipping. No cumulative effects are predicted.	Chapter 19: Navigation and Shipping	

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
73	SFF	The Scottish Fishermen's Federation would expect that going forward there would be more clarity on the cable, to confirm 1 trench or 2 and the surveys should be able to divert from problematic lines to find the best line of burial.	This information is provided in Chapter 2: Project Description. Further information is provided in the Construction Method Statement. During the marine survey operations, additional survey coverage was conducted as necessary in order to identify possible routes around challenges to cable installation. Final route design is the responsibility of the principal contractor.	Chapter 2: Project Description.	HVDC Cable Infrastructure: UK Construction Method Statement.
74	SFF	On part 7.4.5 we would expect early consultation with the developers on the interaction with fishing as the cable will pass through many different fishing grounds between landfall and the median line.	As detailed in the Pre-Application Consultation report, and Chapter 20 of the EIAR, extensive consultation has occurred with local fishermen and relevant fishing organisations including SFF, SWFPA, and Buchan Inshore Fisheries Association. This process is ongoing as detailed in the FLMAP, and Communications Strategy, and will continue as the Project develops.	Chapter 20: Commercial Fisheries Table 20.1.	HVDC Cable Infrastructure: UK Pre-Application Consultation Report. HVDC Cable Infrastructure: UK Fisheries Liaison Mitigation Action Plan. HVDC Cable Infrastructure: UK Communication Strategy
75	SFF	In 15.2 Baseline we would recommend early engagement with SFF to avoid any misunderstanding about fishing activity which may occur if the developer is to rely solely on AIS, especially as AIS is not mandatory for the whole fleet.	In order to inform the baseline, consultation has occurred with local fishermen and relevant fishing organisations including SFF, SWFPA, and Buchan Inshore Fisheries Association. In addition, the baseline assessment was informed by a wide range of data sources, and not solely reliant on AIS.	Chapter 20: Commercial Fisheries	HVDC Cable Infrastructure: UK Pre-Application Consultation Report.
76	SFF	The SFF considers it insufficient to address the fishing interest on the route as part of the local community and economics study, fishing is a distinct activity and a community, separate in its activity from any other.	Commercial fisheries is a stand alone chapter within the EIAR. Please see Chapter 20.	Chapter 20: Commercial Fisheries	

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
77	SW	It is recommended that the developer confirms the location of all Scottish Water assets through obtaining detailed plans from Asset Plan Providers.	NCKS have obtained SW GIS information and, in addition, are taking trial pits to confirm the precise depth and position of the main within the verge of the A90, where the HDD access road will cross the asset. In addition, NCKS have spoken with the Strategic Planner and CSD Team Leader in relation to the development.	N/A	
78	SW	All Scottish Water assets potentially affected by the development should be identified, with particular consideration being given access to roads and pipe crossings. If necessary local Scottish Water personnel may be able to visit the site to offer advice.	The crossing point for the HDD under the A90 and access road have been identified. In addition NorthConnect are taking trial pits to confirm the precise depth and position of the main within the verge of the A90. A meeting will be take place with a SW NSO on site to discuss some specifics of the project.	N/A	
79	SW	As Scottish Water assets are located within the onshore site boundary early contact should be made with the Scottish Water Asset Impact Team (AIT) to discuss this further. The AIT can be contacted by email on service.relocation@scottishwater.co.uk . All detailed design proposals relating to the protection of Scottish Water's assets should be submitted for review and written acceptance. Works should not take place on site without prior acceptance by Scottish Water.	The NCKS Design Team are WIRS Accredited and have significant experience in working with the SW Development Operations and Asset impact Team. Following completion of the trial pits, contact will be made to agree necessary measures (where required) for protection or diversion of infrastructure.	N/A	
80	SW	It should be noted that the development will be required to comply with sewers for Scotland and Water for Scotland 3rd Editions 2015, including provision of appropriate clearance distances from Scottish Water assets.	The NCKS Design Team are WIRS Accredited and highly experienced in working for Scottish Water and in progressing developer related works including compliance with the SW Standards and Specification (including WfS3) and complying with the Asset Policy Standard - Water Mains Protection Distance.	N/A	
81	SNH	We recommend that the assessment of impacts on fish should consider impacts on species which have been listed as Priority Marine Features (PMFs) http://www.snh.gov.uk/protectingscotlands-nature/priority-marine-features/ .	Effects upon relevant Priority Marine Features are assessed within ecological topic specific chapters.	Chapter 14: Benthic Ecology Chapter 15: Fish and Shellfish Chapter 16: Marine Mammals.	

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
82	WDC	The section is not up to date with the most relevant information, I understand the white beaked dolphin pMPA has been removed by SNH due to the lack of information on this species in Scottish waters. Ideally, it would be better of the cable route could avoid the pMPA for minke whales.	White beaked dolphins were not assessed as a qualifying feature for the pMPA. Impacts on marine mammal, benthic ecology and geological features of the Southern Trench pMPA have been assessed, and no significant impacts are anticipated. Therefore a major route alteration to avoid the site is not appropriate.	Chapter 7: Seabed Quality Chapter 14: Benthic Ecology Chapter 16: Marine Mammals	
83	SNH	We note that an extended phase 1 habitat survey has been undertaken. We advise that in addition to this, detailed surveying (to NVC standard) should be carried out of any areas where habitats and/or species of natural heritage interest are identified. Any rare or nationally scarce higher and/or lower plant species within the survey area should be identified and any necessary mitigation described. Similarly, the presence of invasive non-native species (INNS) should be noted and any necessary mitigation described.	An NVC was commissioned and carried out, and species of conservation concern and INNS were identified. No rare nationally scarce higher or lower plant species within the survey area were present in the survey.	Chapter 13 Terrestrial Ecology: Section 13.4.4	
84	AC	There are several core paths and rights of way on or adjacent to this site as well as paths developed by the local community. The Land Reform (Scotland) Act 2003 also provides a right of non-motorised public access to most land and inland water and this site is subject to this. The developer should consider the impact of this proposal on the recreational interests in the area and identify any mitigation that may be necessary, including the diversion of paths, if required.	An assessment of the effects on recreational users has been included wiithin Chapter 21 of the EIAR. Works have been programmed in such away so as to ensure that there is always a path available for recreational user.	Chapter 21: Local Community and Economy, Section: 21.6.1.5	

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
85	AC	It is the opinion of this Service that the proposed development may generate excessive noise levels, dust emissions and ground vibration during the construction phase of the development. It is therefore recommend that the applicant is required to prepare and implement a schedule of mitigation in the form of a construction environmental management plan (CEMP), which will require approval by the Service prior to the commencement of development on the site.	Dust and noise emissions assessed in topic specific chapters. As detailed in Chapter 3, an overarching CEMP will be provided for the NorthConnect construction operations and this will be informed by the Schedule of Mitigation in Chapter 25. The Schedule of mitigation will also inform the construction contracts, so the principal contractor is contractually obliged to implement the identified mitigation measures. However, due to the complex nature of the project, the CEMP will require significant input from the principal contractor's detailed design and planning, so it is not possible to provide a draft at this time.	Chapter 3: Methodology Chapter 9: Air Quality Chapter 22: Noise (In-Air) Chapter 25: Schedule of Mitigation	
86	AC	Environmental issues are of obvious key importance such as those aspects of the environment that would be likely to be significantly affected. Detailed survey work would be required to inform the ES. Following analysis of the aspects of the environment which would be likely to be significantly affected, a detailed assessment of the effects themselves would be required along with mitigation measures proposed.	Numerous detailed survey operations were undertaken to inform various topic specific chapters of the EAIR where desktop studies revealed gaps in the publicly available data.	Various	
87	AC	Regarding a utility building for the fibre optic cable, and any other permanent ground surface cable infrastructure, these should be designed to assimilate into the positive local landscape character and fit with design guidance principles such as that produced for the Energetica Corridor. Design details and finishes of the utility building and any other surface infrastructure/installations should be included in a project Design Statement.	There will not be any fibre optic utility building required.	Chapter 2: Project Description	
88	AC	Historic Environment Scotland should also be consulted due to the proximity of the northern section to a Scheduled Monument.	No Scheduled Monuments were identified within the Study Area. HES have been informed about the project.	Chapter 12: Section 12.5.1.	

No.	Consultee	Scoping Opinion for Consideration in EIAR	NorthConnect Response to Scoping Opinion	EIAR Chapter/Section	Relevant Reports
89	AC	We note that the site boundary has numerous field drains within this. Should any of the cables or infrastructure cross these field drains then we would require further information on this. We also require further details of the fibre optic utility building once this is designed and located. We would require surface water drainage details for this building.	Details of watercourse crossings are provided in the CMS and Chapters 2 and 10 of the EIAR. The Fibre optic utility building is no longer required.	Chapter 2: Project Description Chapter 10: Water Quality (Onshore)	HVDC Cable Infrastructure: UK Construction Method Statement.
90	SEPA	If groundwater abstractions are identified within the 100 m radius of roads, tracks and trenches or 250 m radius from borrow pits and foundations, then either the applicant should ensure that the route or location of engineering operations avoid this buffer area or further information and investigations will be required to show that impacts on abstractions are acceptable.	There are no groundwater abstractions within the 100m of radius of roads, tracks and trenches. There are no borrow pits or foundations associated with the HVDC Cable.	Chpater 8: Geology and Hydrogeology, Section 8.3.6	
91	SEPA	The EIA process should take this waste regulatory position, and the need to demonstrate waste minimisation, into account from the outset in designing the layout and in developing the general principles for the site of decommissioning or repowering.	These aspects are addressed in Chapter 24 of the EIAR.	Chapter 24: Resource Usage and Waste	

4.1 Ongoing Consultation

Throughout the EIA process there have been discussions with Aberdeenshire Council departments, Marine Scotland and both statutory, and non-statutory, consultees. Consultation methods have included email, phone calls and face to face meetings. A communications manager and a Fisheries Liaison Officer were employed by NorthConnect to facilitate discussions with, respectively, the local community and the fishing community (both commercial and recreational).

The UK Marine Communications Strategy (NorthConnect, 2018c) and the Fisheries Liaison and Mitigation Action Plan (NorthConnect, 2018b) provide details as to how communications and consultation will continue as the project develops.

4.2 Non-Statutory Consultees

The full list of non-statutory consultees and discussions held is included with the Pre-Application Consultation report, which is being submitted with this EIAR (NorthConnect, 2018). Results from the consultations related to the EIA process are also discussed in Chapters 19, 20 and 21 of this EIAR.

4.3 Summary

NorthConnect have engaged with statutory and non-statutory consultees through the development of the project to date, and will continue to do so to build upon the good relationship the project has established with stakeholders achieved so far.

The stakeholder views and guidance has been taken into account, both in the design process and in the production of the EIAR. NorthConnect have also developed and implemented a public consultation strategy and produced a PAC report to support the Planning and Marine Licence applications.

4.4 References

NorthConnect. (2016). *HVDC Cable Route Scoping Report*.

NorthConnect. (2018). HVDC Cable Infrastructure - Pre-Application Consultation Report. In Fiona Milligan (Ed.).

NorthConnect. (2018b). HVDC Cable Infrastructure - UK Fisheries Liaison Mitigation Action Plan.

NorthConnect. (2018c). HVDC Cable Infrastructure - UK Marine Communication Strategy.

Chapter 5: Planning and Marine Policy

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Contents

5 Planning and Marine Policy

5.1 Introduction

This section provides a summary of national, regional and local planning and marine policies that will apply to the determination of the consent applications. These policies have informed the assessment of potential environmental impacts undertaken, in respect of the proposed development.

As mentioned in Chapter 1 during the course of the development of the Environmental Impact Assessment (EIA) the EIA Regulations have changed, the transition provisions and NorthConnects approach are also addressed within this Chapter.

5.1.1 EIA Regulations Transitional Provisions

A request for a scoping opinion was made before the 16th May 2017 and, as such, it was submitted under the 2007 Marine Works EIA Regulations and the 2011 Town and Country Planning EIA Regulations. Therefore, this EIA is being conducted in accordance with the transitional provisions within the 2017 Marine Works and Town and Country Planning EIA Regulations. This means that some terminologies such as 'flora and fauna' are still termed as such, rather than as 'biodiversity', the term used under the new 2017 Regulations. It also means that some additional requirements, for example to assess risk of major accidents and disasters, are not required for this EIA. This was confirmed by Marine Scotland on 9th November 2017. Whilst this EIA is being carried out under the transitional provisions, Table 5.1 demonstrates how the majority of the requirements of the new regulations are addressed in this EIAR.

Table 5.1 Summary of EIA Regulation Differences.

2017 EIA Regulations	2007/2011 EIA Regulations	How NorthConnect EIA addresses this.
"population and human health"	"human beings" and "population"	Population and human health are covered particularly in Chapter 9: Air Quality and Chapter 21: Local Community and Economics.
"biodiversity"	"flora and fauna"	Biodiversity is covered within Chapters 13-17 (Terrestrial Ecology; Benthic Ecology; Fish and Shellfish Ecology; Marine Mammals; and Ornithology).
"land, soil, water, air and climate"	"soil, water, air, climate and the landscape"	Specific chapters which encompass land and soil quality (Chapter 8), water quality (Chapters 10 and 11); air quality (Chapter 9) are included. Greenhouse gas emissions, specifically CO_2 are also considered in the air quality chapter. Landscape with material assets in 2017 EIA Regulations.
"material assets, cultural heritage and the landscape"	"material assets and cultural heritage"	Chapter 12 encompasses Archaeology and Cultural heritage, as the cables will be buried underground and therefore have no effect on the landscape, this topic was scoped out of the EIA.
"vulnerability of the works to risk...of major accidents and disasters"	"the risk of accidents"	The main risk of accidents associated with the development are associated with Navigation and as such are considered within Chapter 19 Navigation and Shipping.
"...the EIA report must be prepared by competent experts" and "the EIA report must be accompanied by a statement from the applicant outlining the relevant expertise or qualifications of those experts"		Appendix A.1 comprises a table outlining each of the authors' expertise for each of the EIA chapters.

In addition to the above in accordance to advice given from Marine Scotland, NorthConnect have ensured there has been 'enhanced transparency' during the project by ensuring website publications are up to date and any consultations are advertised online.

5.2 Onshore Planning Policy

This section sets out the planning policy context relating to the onshore elements of the proposed development which include: buried HVDC cabling; HDD requirement at the cable landfall; and temporary construction requirements. The relevant national, regional and local policy frameworks are discussed, along with other relevant material considerations.

5.2.1 National Planning Framework

Scotland's Third National Planning Framework (NPF3) (Scottish Ministers, 2014b) sets out the Scottish Government's development vision for Scotland (Scottish Ministers, 2014a). The NPF3, published in June 2014, guides Scotland's spatial development to 2030 by identifying national developments and other strategically important development opportunities in Scotland, and setting out strategic development priorities to support the Scottish Government's central purpose of promoting sustainable economic growth.

NPF3's Section 3 - A Low Carbon Place identifies a number of key themes which align to the NorthConnect project drivers as shown in Table 5.2 NorthConnect Drivers Compared to NPF3 ThemesTable 5.2 .

Table 5.2 NorthConnect Drivers Compared to NPF3 Themes

NorthConnect Driver	NPF3 – Quote
Security of Supply	Maintaining security of supplies and addressing fuel poverty remain key objectives.
Move to a Low Carbon Future	Our ambition is to achieve at least an 80% reduction in greenhouse gas emissions by 2050.
Reduced Price Fluctuation	Maintaining security of supplies and addressing fuel poverty remain key objectives.

The NPF3 spatial strategy shows where there will be opportunities for investment in the low carbon economy and highlights Peterhead as one of the hubs. Within Section 3 'A low carbon place' the Scottish Government specifically mentions international interconnectors in relation to Peterhead:

'….The area may also be the landfall for an international North Sea interconnector and could be a focus for onshore connections to support offshore renewable energy. These can support wider aspirations for growth, including the Energetica corridor where energy-driven opportunities are being used to focus investment and promote a place-based approach to development.'

A number of key National Developments are identified in NPF3 as needed to help deliver the Scottish Government spatial strategy. 'An Enhanced High Voltage Energy Transmission Network' is needed to facilitate renewable electricity development and its export. Annex A of NPF3 identifies national developments and includes statements of need for such developments. Annex A includes development consisting of:

'4. High Voltage Electricity Transmission Network:

d. new and/or upgraded offshore electricity transmission cabling of or exceeding 132 kilovolts'

In short, the development of the NorthConnect project would assist Scottish Government to meet their strategic ambitions.

5.2.2 Scottish Planning Policy

The Scottish Planning Policy (SPP) (Scottish Ministers, 2014b) sits alongside the NPF3 in the Scottish Government's planning policy series. The SPP sets out the Scottish Ministers' priorities for operation of the planning system, with regards to how nationally important land use planning matters should be addressed across the country. It is intended that the document be used in the preparation and development of plans, the design of development from concept to delivery, and the determination of planning applications.

Within the SPP there are a number of key principals which are relevant to the NorthConnect project, all of which have been considered at the planning stage and are fulfilled in the design. These aspects are summarised in Table 5.3.

Table 5.3 NorthConnect Project Rational and SPP Principles.

SPP Principals	North Connect
Promote business and industrial development that increases economic activity while safeguarding the natural and built environments as national assets.	The interconnect will help to ensure the availbility of affordable electricity to the industrial sector, and encourage the development of the Scottish renewable energy sector. As detailed in Chapter 21: Local Community and Economics, NorthConnect has a significant associated socio-economic benefit. The design process has safeguarded the surrounding environment.
Enable positive change in the historic environment which is informed by a clear understanding of the importance of the heritage assets affected and ensure their future use. Change should be sensitively managed to avoid or minimise adverse impacts on the fabric and setting of the asset, and ensure that its special characteristics are protected, conserved or enhanced.	As discussed in Chapter 12: Archaeology and Cultural Heritage, the project has been developed taking account of the historical assets in the vicinity. The project has mitigated against adverse impacts and is promoting understanding of the assets through the inclusion of interpretation boards as part of the Converter Station development.
Support the development of a wide range of electricity generation from renewable energy technologies, including the expansion of renewable energy generation capacity.	Increasing electricity interconnectivity allows a greater renewable energy contribution to the energy mix. Facilitating increased harnessing of Scotland's renewable energy resources. See Chapters 2: Project Description and 9: Air Quality for more details.
Policies and decisions should be guided by the principle of supporting climate change mitigation and adaptation.	The NorthConnect project will facilitate significant carbon savings, hence supporting climate change mitigation, see Chapter 9: Air Quality.

The SPP recognises the importance of planning decisions on both Scotland's social and economic futures, in that:

'…By locating the right development in the right place, planning can provide opportunities for people to make sustainable choices and improve their quality of life.'

and,

'…By allocating sites and creating places that are attractive to growing economic sectors, and enabling the delivery of the necessary infrastructure, planning can help provide the confidence required to secure private sector investment, thus supporting innovation, creating employment and benefiting related business.'

Peterhead has been identified by NPF3 as the right place to locate a subsea interconnector landfall. Furthermore, the design and rationale of the project aligns well to all relevant principals of the SPP.

As such, the guidance within the SPP suggests that the North Connect project will provide significant socio-economic benefits, to both the local area and Scotland as a whole.

5.2.3 Planning Advice Notes

Planning Advisory Notes (PANs) are published by the Scottish Government and supplement the planning policy documents. PANs provide point in time guidance and technical information, including best practice, on certain policy areas. As such, relevant PANs need to be considered both during a projects design, and as part of the planning considerations. The PANs relevant to the NorthConnect development include:

- PAN 1/2011: Planning and Noise (Scottish Government, 2011a)
- PAN 1/2013: Environmental Impact Assessment (Scottish Government, 2013b)
- PAN 2/2011: Planning and Archaeology (Scottish Government, 2011b)
- PAN 3/2010: Community Engagement (Scottish Government, 2010)
- PAN 51/2006: Planning, Environmental Protection and Regulation (Scottish Government, 2006a)
- PAN 60/2008: Planning for Natural Heritage (Scottish Government, 2008)
- PAN 61/2001: Planning and Sustainable Urban Drainage Systems (Scottish Government, 2001)
- PAN 68: Design Statements (Scottish Government, 2003)
- PAN 75: Planning for Transport (Scottish Government, 2005)
- PAN 79: Water and Drainage (Scottish Government, 2006b)

5.2.4 Electricity Generation Policy Statement

The Electricity Generation Policy Statement (EGPS) (Scottish Government, 2013a) examines the way in which Scotland generates electricity, and considers the changes which will be necessary to meet Scottish Government renewable energy targets. It looks at the sources from which electricity is produced, the amount of electricity required to meet Scotland's needs, and the technological and infrastructural advances which Scotland will require over the coming decade and beyond. The EGPS states that Scotland's generation mix should deliver:

'…a secure source of electricity supply, at an affordable cost to consumers; which can be largely decarbonised by 2030 and which achieves the greatest possible economic benefit and competitive advantage for Scotland'.

The EGPS highlights the Scottish Governments target of:

'…delivering the equivalent of at least 100% of gross electricity consumption from renewables by 2020 as part of a wider, balanced electricity mix'.

In order to do this, it is stated that Scotland will be:

'Seeking increased interconnection and transmission upgrades capable of supporting projected growth in renewable capacity'

This confirms the importance of interconnectors, and the relevance of the NorthConnect project:

'Our vision is to connect, transport and export Scotland's full energy potential. Scotland can and must play its part in developing onshore and offshore grid connections to the rest of the UK and to European partners – to put in place the key building blocks to export energy from Scotland to national electricity grids in the UK and Europe.'

5.2.5 Local Development Plans

5.2.5.1 Introduction

Under Section 25 of the Town and Country Planning (Natural Scotland) Act 1997 (as amended) (Scottish Parliament, 1997), the onshore components of the NorthConnect project will be determined against the policies contained within the local development plans, unless material considerations indicate otherwise. The development plan for the area comprises:

- Aberdeen City and Shire Strategic Development Plan.
- Aberdeenshire Local Development Plan.

5.2.5.2 Aberdeen City and Shire Strategic Development Plan

The Aberdeen City and Shire Strategic Development Plan (Aberdeen City and Shire Strategic Development Planning Authority, 2014), approved in March 2014, is a joint plan prepared by Aberdeen City Council and Aberdeenshire Council, which sets a clear direction for the future development of the North East. The plan replaces the Aberdeen City and Shire Structure Plan (2009). The plan recognises the importance of improving links and connections, and providing opportunities for high quality sustainable growth. The Plan covers the whole of Aberdeen City and Shire, except those areas within the Cairngorms National Park.

The plan aims to identify the challenges that Aberdeen City and Shire will face looking forward through the next 20 years. This is to allow the region to adapt to these challenges, to create its vision for the future. The plans vision for a successful and sustainable future is:

'Aberdeen City and Shire will be an even more attractive, prosperous and sustainable European city region and an excellent place to live, visit and do business'.

To achieve this vision, the main aims of the plan are to:

'provide a strong framework for investment decisions which help to grow and diversify the regional economy, supported by promoting the need to use resources more efficiently and effectively'
and
'take on the urgent challenges of sustainable development and climate change'.
The plan recognises the influence of climate change and sustainability on its own design:

'We have developed a spatial strategy which promotes development in places that meet the needs of business and, at the same time, are sustainable and take on the challenges of climate change.'

As part of the plans spatial strategy, four strategic growth areas are identified as the main focus of development in the area up to 2035. One of these four areas is the Aberdeen-Peterhead area, and within this section Peterhead is specifically cited as an area of key importance in the energy future due to its suitability for interconnectors:

'Peterhead also has the potential to be an important hub in transmitting renewable energy both within the UK and more widely as part of a European network. Its coastal location and existing connections make it an attractive choice for subsea cables and their onshore infrastructure'.

The plan sets out a number of key objectives which must be fulfilled in order to achieve the aims of the plan, and ultimately realise the overriding vision. Three of these objectives are at the heart of the rationale behind the NorthConnect Project:

- Economic Growth:

  'To provide opportunities which encourage economic development and create new employment in a range of areas that are both appropriate for and attractive to the needs of different industries,

while at the same time improving the essential strategic infrastructure necessary to allow the economy to grow over the long term.'

- Sustainable development and climate change:

  'To be a city region which takes the lead in reducing the amount of carbon dioxide released into the air, adapts to the effects of climate change and limits the amount of non-renewable resources it uses'.

- Quality of the environment:

  'To make sure new development maintains and improves the region's important built, natural and cultural assets'.

The NorthConnect Project fulfils both the aims of the Councils Strategic Development Plan and, in addition, the spatial strategy for Peterhead supports subsea energy cables and the associated onshore infrastructure. The project also satisfies three of the key objectives and, as such, will help Aberdeen City and Shire achieve their vision for the future.

5.2.5.3 Aberdeenshire Local Development Plan

The updated Aberdeenshire Local Development Plan (LDP) 2017 – Shaping Aberdeenshire, and associated supplementary planning guidance, has been adopted since April 2017 (Aberdeenshire Council, 2017). This Local Development Plan (LDP) replaces the older Aberdeenshire LDP from 2012 (Aberdeenshire Council, 2012). The LDP sets out an ambitious framework and a clear vision for the future development of the North East over the next 20 years.

The LDP is founded on the principle of supporting and encouraging sustainable development. In addition to policies relating to economic growth, sustainable communities, designated sites and housing, the plan seeks to take on the challenges of sustainable development and climate change. The LDP has introduced policies and proposals to:

- Reduce greenhouse gases from development in the area;
- Reduce the need to, and encourage active, travel;
- Protect and improve natural, built and cultural heritage;
- Avoid risks associated with flooding;
- Encourage the sensitive development of renewable energy resources; and
- Increase and diversify the economy.

The LDP contains a number of policies applicable to NorthConnect including:

- Section 11, Policies B1 and B4 – Business Development outlines Aberdeenshire Council's support for business development and sustainable economic growth, with particular emphasis on the Energetica corridor;
- Section 13, Policy P1 – Layout, siting and design of new development sets out advice on how new development proposals will be assessed, using a process that includes public consultation and appropriate standards for design, open space, accessibility, safety, sustainability, and the provision of associated services;
- Section 15, Policy E1– Natural heritage seeks to improve and protect designated nature conservation sites and the wider biodiversity and geodiversity of the area;
- Section 15, Policy E2– Landscape conservation promotes the protection, management and planning of the landscape;

- Section 16, Policy HE1 and HE2 – Protecting, improving and conserving the historic environment supports the protection, improvement and conservation of the historic environment, and there will be a presumption against development that would have a negative effect on the quality of these historic assets; and
- Section 17, Policy PR1– Safeguarding of Resources and Areas of Search supports protecting the water environment, important mineral deposits, prime agricultural land, open space, trees and woodlands.
-

Within Appendix 8b of the LDP NorthConnect is mentioned within the Peterhead development area as a:

“possible landfall for a potential international North Sea interconnector, onshore connections to support offshore renewable energy, and major energy developments as set out in National Planning Framework 3”

This documentation states that any development within the Peterhead area should comply with Policy P4: Hazardous and potentially polluting developments and contaminated land, due to the proximity of one of more oil or gas pipelines. NorthConnect’s cable route minimises the number of oil and gas pipeline crossings. Crossings will be carried out by agreement with the asset owners following appropriate protocols to minimise risk of damage to pipelines. Appropriate response protocol’s will be in place to contain any pollution events in the unlikely event that one occurs.

5.2.6 Other Material Considerations

5.2.6.1 Energetica Supplementary Planning Guidance

The Energetica Supplementary Planning Guidance (SPG) was updated in 2017 by Aberdeen City and Shire Economic Future, a public/private partnership led by Aberdeen City Council, Aberdeenshire Council and Scottish Enterprise (Aberdeen City and Shire, 2017).

The proposed NorthConnect project is located within the Energetica Framework Area. The SPG states:

‘Within the Energetica area, as defined on the attached map, development must make a contribution to the quality of life, environmental performance and economic development targets’.

The SPG sets out a number of criteria that developments in the Energetica Framework area have to meet, including the need for an Energetica Compliance Statement. To demonstrate compliance with the Energetica SPG, all proposed developments in the corridor must have an accompanying Energetica Compliance Statement. An Energetica Compliance Statement was submitted with the planning application for the Converter Station and HVAC Cable Route. The HVDC elements of the project are all below ground and as such will have minimal effect on the surrounding area once installed, the wider benefits are associated with the project as a whole and have already been considered. It has therefore been agreed with Aberdeenshire Council that there is no need submit an additional Energetica Compliance Statement.

5.2.6.2 Peterhead Southern Gateway Environmental Improvement Masterplan

The Peterhead Southern Gateway Environmental Improvement Masterplan was commissioned by Energetica and Aberdeenshire Council, and published in May 2012 (Energetica, 2012). The Masterplan recommends in section 8 that:

‘any future development proposals for the proposed converters at Peterhead power station conform with the principles of the Peterhead Southern Gateway Landscape Masterplan and Design Guide’.

The construction for the onshore cables will only have temporary effects on the landscape, once installed all elements will be below ground. The project therefore will not contravene any of the Masterplan principles.

5.3 Marine Policy

This section sets out the marine policy context relating to the offshore elements of the proposed development which include: HVDC cable installation and protection. Marine planning is governed at the international, national and regional levels. The relevant policy frameworks are discussed, along with other relevant material considerations.

5.3.1 European Union Directives

There are a number of Directives relevant to the NorthConnect project which contribute towards governing marine management. These include:

- Marine Strategy Framework Directive;
- Water Framework Directive;
- EU's Common Fisheries Policy; and
- UN Convention on the Law of the Sea (UNCLOS).

5.3.2 The Scottish National Marine Plan (NMP)

As the HVDC Interconnector will cross the area between Scotland's MHWS and the 12 NM limit, it falls within the remit of the Marine (Natural Scotland) Act 2010 (Scottish Parliament, 2010). In combination with the executive devolution of the marine planning, conservation, marine licensing and enforcement from 12NM to 200NM through the Marine and Coastal Access Act 2009 (UK Government, 2009), allows Scottish Ministers to manage Scotland's Seas from MHWS to 200NM limit. The Scottish National Marine Plan (NMP) covering inshore waters to 12NM and offshore waters from 12-200NM was adopted in 2015. The NMP lays out Scottish Minister's policies for the sustainable development of Scotland's seas, and also lays out actions to help mitigate against the effects of climate change (Scottish Government, 2015).

5.3.2.1 NMP General Planning Principles

The Scottish NMP provides General Planning Principles (GEN), most of which apply to the NorthConnect project. These are taken from the Scottish Government (2015) document.

- GEN 2 Economic benefits: Sustainable development and use which provides economic benefit to Scottish communities is encouraged when consistent with the objectives and policies of this Plan;
- GEN 3 Social benefits: Sustainable development and use which provides social benefits is encouraged when consistent with the objectives and policies of this Plan;
- GEN 5 Climate change: Marine planners and decision makers must act in the way best calculated to mitigate, and adapt to, climate change;
- GEN 6 Historic environment: Development and use of the marine environment should protect and, where appropriate, enhance heritage assets in a manner proportionate to their significance;
- GEN 7 Landscape/seascape: Marine planners and decision makers should ensure that development and use of the marine environment take seascape, landscape and visual impacts into account;
- GEN 8 Coastal process and flooding: Developments and activities in the marine environment should be resilient to coastal change and flooding, and not have unacceptable adverse impact on coastal processes or contribute to coastal flooding;
- GEN 9: Natural heritage: Development and use of the marine environment must:
    - Comply with legal requirements for protected areas and protected species;
    - Not result in significant impact on the national status of Priority Marine Features;
    - Protect and, where appropriate, enhance the health of the marine area;

- GEN 10: Invasive non-native species: Opportunities to reduce the introduction of invasive non-native species to a minimum or proactively improve the practice of existing activity should be taken when decisions are being made;
- GEN 11 Marine Litter: Developers, users and those accessing the marine environment must take measures to address marine litter where appropriate. Reduction of litter must be taken into account by decision makers;
- GEN 12: Water quality and resource: Developments and activities should not result in a deterioration of the quality of waters to which the Water Framework Directive, Marine Strategy Framework Directive or other related Directives apply;
- GEN 13 Noise: Development and use of the marine environment should avoid significant adverse effects of man-made noise and vibration, especially on species sensitive to such effects;
- GEN 14 Air Quality: Development and use of the marine environment should not result in the deterioration of air quality and should not breach any statutory air quality limits;
- GEN 18: Engagement: Early and effective engagement should be undertaken with the general public and all interested stakeholders to facilitate planning and consenting processes; and
- GEN 19: Sound evidence: Decision making in the marine environment will be based on sound scientific and socio–economic evidence.

5.3.2.2 NMP Sub-sea Cable Policies

The NMP also lays out sector specific objectives and policies. The relevant objectives for subsea cables are as follows:

- *Protect submarine cables whilst achieving successful seabed user co-existence.*
- *Achieve the highest possible quality and safety standards and reduce risks to all seabed users and the marine environment.*
- *Safeguard and promote the global communications network.*
- *Support the generation, distribution and optimisation of electricity from traditional and renewable sources to Scotland, UK and beyond.*

The relevant Marine Planning Policies for subsea cables are:

- *CABLES 1: Cable and network owners should engage with decision makers at the early planning stage to notify of any intention to lay, repair or replace cables before routes are selected and agreed. When making proposals, cable and network owners and marine users should evidence that they have taken a joined-up approach to development and activity to minimise impacts, where possible, on the marine historic and natural environment, the assets, infrastructures and other users. Appropriate and proportionate environmental consideration and risk assessments should be provided which may include cable protection measures and mitigation plans;*
- *CABLES 2: The following factors will be taken into account on a case by case basis when reaching decisions regarding submarine cable development and activities:*
    - *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;*
- *CABLES 3: A risk-based approach should be applied by network owners and decision makers to the removal of redundant submarine cables, with consideration given to cables being left in situ where this would minimise impacts on the marine historic and natural environment and other users; and*
- *CABLES 4: When selecting locations for land-fall of power and telecommunications equipment and cabling, developers and decision makers should consider the policies pertaining to flooding and coastal protection in Chapter 4, and align with those in Scottish Planning Policy and Local Development Plans.*

5.3.2.3 NMP Transport Policies for Shipping

Relevant policies relating to shipping within the NMP are as follows:

- TRANSPORT 1: Navigational safety in relevant areas used by shipping now and in the future will be protected, adhering to the rights of innocent passage and freedom of navigation contained in United Nation Convention on the Law of the Sea (UNCLOS).
- TRANSPORT 2: Marine development and use should not be permitted where it will restrict access to, or future expansion of, major commercial ports or existing or proposed ports and harbours which are identified as National Developments in the current NPF or as priorities in the National Renewables Infrastructure Plan.
- TRANSPORT 3: Ferry routes and maritime transport to island and remote mainland areas provide essential connections and should be safeguarded from inappropriate marine development and use that would significantly interfere with their operation. Developments will not be consented where they will unacceptably interfere with lifeline ferry services.
- TRANSPORT 6: Marine planners and decision makers and developers should ensure displacement of shipping is avoided where possible to mitigate against potential increased journey lengths (and associated fuel costs, emissions and impact on journey frequency) and potential impacts on other users and ecologically sensitive areas (Scottish Government, 2015).

5.3.3 Regional Marine Plans: North-East Marine Planning Partnerships

Marine Planning Partnerships are to be made up of relevant stakeholders within each region of Scotland. For NorthConnect, this will be under the North-East region. The goal is to produce regional marine plans for all 11 regions across Scotland. Marine Scotland will be heavily involved in the support of the partnerships and will provide guidance of policy development. As of July 2018, the North-East Marine planning partnership has not yet been established.

5.4 Summary

This chapter has introduced the key planning policies that apply to applications for planning permission and marine licences with respect to the NorthConnect project. These policies have informed the design and the assessment of the project as outlined in the technical chapters.

5.5 References

Aberdeen City and Shire. (2017). Aberdeenshire Local Development Plan Supplementary Guidnace 3 Energetica.

Aberdeen City and Shire Strategic Development Planning Authority. (2014). Aberdeen City and Shire Strategic Development Plan. *Aberdeen City and Shire*.

Aberdeenshire Council. (2012). Aberdeenshire Local Development Plan.

Aberdeenshire Council. (2017). Aberdeenshire Local Development Plan. *https://www.aberdeenshire.gov.uk/planning/plans-and-policies/aberdeenshire-local-development-plan-2017/*.

Energetica. (2012). Peterhead Southern Gateway Environmental Improvement Masterplan.

Natural Scotland. (2015). The river basin management plan for the Scotland river basin district: 2015-2027. In (pp. 44). Edinburgh: The Scottish Government

Scottish Government. (2001). Planning Advice Note PAN 61: Planning and Sustainable Urban Drainage Systems.

Scottish Government. (2003). Planning Advice Note PAN 68: Design Statements.

Scottish Government. (2005). Planning Advice Note PAN 75: Planning for Transport.

Scottish Government. (2006a). Planning Advice Note PAN 51: Planning Advice Note on Planning, Environmental Protection and Regulation.

Scottish Government. (2006b). Planning Advice Note PAN 79: Water and Drainage.

Scottish Government. (2008). Planning Advice Note PAN 60 Planning for Natural Heritage.

Scottish Government. (2010). Planning Advice Note PAN 3/2010 Community Engagement.

Scottish Government. (2011a). Planning Advice Note PAN 1/2011 Planning and Noise.

Scottish Government. (2011b). Planning Advice Note PAN 2/2011 Planning and Archaeology.

Scottish Government. (2013a). Electricity Generation Policy Statement.

Scottish Government. (2013b). Planning Advice Note PAN 1/2013 Environmental Impact Assessment.

Scottish Government. (2015). *Scotland's National Marine Plan: A single framework for managing our seas*. Retrieved from http://www.gov.scot/Publications/2015/03/6517/downloads#res-1.

Scottish Ministers. (2014a). Scotland's Third National Planning Framework (NPF3) SG/2014/100.

Scottish Ministers. (2014b). Scottish Planning Polucy (SPP).

Scottish Parliament. (1997). Town and Country Planning (Scotland) Act Statutory Instrument 2002/410.

Scottish Parliament. (2010). Marine (Scotland) Act 2010

UK Government. (2009). Marine and Coastal Access Act 2009

Chapter 6: Cumulative Effects

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Contents

6 Cumulative Effects

6.1 Introduction

Cumulative effects are described as the combined effect of the development and of other projects, taken together (SNH, 2013). In Scotland's National Marine Plan (Scottish Government, 2015) they note that a:

> *"Cumulative impact on a resource and ecosystem service may occur because of a series of developments or activities of the same type or from the combined effects of a mix of different types of activities".*

This chapter identifies other planned developments that require consideration within this Environmental Impact Assessment Report (EIAR). Developments already built are considered as part of the existing baseline conditions and, as such, are not discussed. As discussed in Chapter 1, the High Voltage Direct Current (HVDC) cable infrastructure is not the only part of the NorthConnect project. The HVDC cables cross the whole North Sea to Norway. From a Scottish and UK perspective, the whole project also includes the Interconnector Converter Station at the Fourfields site, and the high voltage alternating current (HVAC) onshore cable route from the converter station to the substation, which have already been granted planning permission. Some aspects of these previously consented elements of the NorthConnect project will support the onshore HVDC cable installation, specifically access tracks and laydown areas to the northwest of the A90.

As part of the Converter Station and HVAC cable infrastructure EIA process, the cumulative effects were identified and considered, however, the details of the HVDC cable infrastructure were not fully developed at that point (NorthConnect, 2015). These will be revisited in this EIAR where necessary, to take account of the more specific information now available with regard to the HVDC infrastructure and installation methods.

The assessment of the various 'inter-project' cumulative effects or 'interaction' effects for each specific environmental topic has been undertaken within each of the individual EIA chapters.

6.2 Methodology

6.2.1 Identifying Onshore Projects

In early 2016 during the scoping process, Aberdeenshire Council's eplanning website was reviewed to identify projects in the planning process at that stage. There were 48 planning applications listed for Boddam & District Community Council. The eplanning website was again reviewed in September 2017 to identify if there were any additional projects that should be added to the cumulative assessment process during the EIAR production. Applications with the potential for in-combination or cumulative effects were identified.

Prior to submission, a review of applications up to July 2018 was carried out to check if there were any new projects that could have a cumulative impact.

6.2.2 Identifying Marine Projects

In order to identify marine projects with the potential for cumulative effects, Marine Scotland's Marine Licensing website was reviewed during the scoping process and considered four project types: Offshore wind; Wave and Tidal; Construction and National Renewables Infrastructure Projects (NRIP); and Cables.

Those projects which were on the north or east coasts of Scotland were considered for further investigation. Expert advice was sought on a number of topics including: Fish and Shellfish; Benthic Ecology; Commercial Fisheries; EMF; and Navigation and Shipping, which aided understanding of whether or not any cumulative effects would be likely to occur.

The Marine Licensing website was again accessed in September 2017 to identify any additional projects which may have needed assessment. Multiple projects in pre-application, application and post-determination stages were identified. Discussions were then held with Marine Scotland to agree the list of projects for cumulative consideration.

Prior to submission, the Marine Scotland websites were revisited to identify any new projects that could have a cumulative impact.

6.3 Identified Projects

6.3.1 Onshore Projects

The planning applications lodged within the last three years (from September 2014 to September 2017) on the ePlanning website (Aberdeenshire Council, 2017) for Boddam & District Community Council are summarised in Table 6.1. A total of 53 planning applications and enquiries were recorded.

Table 6.1 Summary of Planning Applications for Boddam & District Community Council.

Application Type or Status	Number
Application to address non-compliance of previously consented planning permission.	1
Enquiries superseded by full applications.	3
Residential <3 house development, garage, shed or alteration/modification to house.	19
Residential 3 house development or larger.	2
Small to medium non-residential applications including: change of use, demolition, signage, carparks and warehouses.	18
Medium to large non-residential.	10

The two large (3 house development or larger) residential projects and the 10 medium to large non-residential projects are considered within Table 6.2, to identify whether they should be considered within the EIAR with regard to cumulative effects. One of the two large residential projects comprised 5 plots put in separately for planning application but, as they are within the same development, they are considered as a whole.

One project was identified for consideration with regard to cumulative effects and agreed through the scoping process was the 1.4GW Interconnector Converter Station and HVAC cable connection to Peterhead Power Station. This is part of the overall NorthConnect project and, as such, was already going to be considered.

The review of developments proposed between October 2017 and July 2018 identified no major residential developments and three medium to large non-residential developments:

- APP/2018/1392: Installation and Operation of 31 High-Speed Diesel Generators up to 18MW at Peterhead Power Station;
- APP/2018/0042: Erection of Petrol Filling Station, Drive Thru Café at the Buchan Gateway, Invernettie; and

- APP/2018/0042: Erection of 2 Class 6 Sheds and Formation of Hardstanding at Upperton.

The closest of the three medium to large developments is the installation and operation of diesel generators by Scottish and Southern Enterprise at the power station, which is approximately 1.5km from Fourfields and further from the rest of the cable routes. None of the developments are likely to have cumulative effects with the NorthConnect HVDC Cables and infrastructure.

Table 6.2 Consideration of onshore projects for inclusion in the Cumulative Assessment.

Reference / Status	Status	Proposal	Approximate distance from Consenting Corridor	In/Out	Reason
APP/2017/1801 APP/2016/3193 APP/2016/3194 APP/2016/3195 APP/2016/3196	Approved	Erection of 5 Dwelling houses at Lendrum Terrace, Boddam, AB42 3BB.	600m	Out	• Planning consent was granted in November 2016 for plots 2-5 and July 2017 for plot 1. • Would not be using joint roads for access. • No cumulative effects would arise once the houses are built.
APP/2015/0081	Approved	Erection of 3 Dwelling houses at Buchan Braes Boddam, AB42 3AR.	1.6km	Out	• The development is more than 1km away and was approved in January 2015, hence it will likely be constructed before HVDC installation is started. As such, it is unlikely there will be any cumulative construction effects. • No cumulative effects would arise once the houses are built.
APP/2016/3059	Approved	Erection of Poultry Building at Springhill, Boddam, AB42 3AF.	1.8km	Out	• The building will be erected approximately 2km from the consenting corridor. As such, there is unlikely to be any cumulative effects • No cumulative effects would arise once the poultry building is built.
APP/2016/2867	Approved	Erection of Restaurant and Hotel Lodge, and associated infrastructure.	3.2km	Out	• The development is over 3km from the closest part of the HVDC consenting corridor; hence it is unlikely that there will be cumulative construction effects, even if they were to be constructed concurrently. • If this development is in place prior to the NorthConnect construction phase there is a potential for the construction staff to utilise the proposed facilities which would be a benefit to both projects.
APP/2015/0739	Approved	Erection of Retail Shops, Restaurants, Hotel, Petrol Filling Station , Associated Access, and Landscaping.	3.2km	Out	• The development is over 3km from the closest part of the consenting corridor; hence it is unlikely that there will be cumulative construction effects even if they were to be constructed at the same time. • If this development is in place prior to the NorthConnect construction phase there is a potential for the construction staff to utilise the proposed facilities which would be a benefit to both projects.
APP/2014/3263	Approved	Erection of Outdoor Car Sales Area & Sales Office, Invernettie Roundabout	3.2km	Out	• The development is over 3km from the closest part of the consenting corridor; hence it is unlikely that there will be cumulative construction effects even if they were to be constructed at the same time.

Reference / Status	Status	Proposal	Approximate distance from Consenting Corridor	In/Out	Reason
APP/2016/2389 APP/2015/1978 ENQ/2014/2928	Approved	Extension to Quarry, Stirlinghill Quarry Boddam Peterhead,	300m	Out	• Development immediately to the east of Fourfields. • Projects will utilise the same access road. • Cumulative effects are primarily associated with the Converter Station, access to cable route North of A90, and laydown, this has already been considered within the Converter Station and HVAC cable route EIA (NorthConnect, 2015).
APP/2015/1121 ENQ/2014/2818	Approved	1.4GW Interconnector Convertor Station and HVAC Cable Connection to Peterhead Power Station	*Adjacent To*	In	• This is part of the overall NorthConnect Project, the cumulative effects will be considered.
APP/2015/0903 ENQ/2014/2784	Approved	Construction and Operation of a Carbon Capture, Compression and Conditioning Plant including infrastructure, Peterhead Power Station, Boddam	2.5km	Out	• Construction period was expected to be 2017 to 2020, and hence likely that large construction works will coincide with the NorthConnect installation works. However, the UK government have withdrawn funding for the project, hence its future is uncertain. • The onshore components of the project are unlikely to have any cumulative effects with the HVDC cable installation.
APP/2014/1437	Approved	Formation of new 400kV electricity substation and associated infrastructure. Newton of Sandford, Boddam	1.7km	Out	• NorthConnect are likely to connect into this substation, as such the projects are inter-related. • Cumulative effects associated with the Converter Station and HVAC cable construction and operation have already been considered (NorthConnect, 2015). • It is unlikely that the HVDC cable installation will have any additional in combination effects.

6.3.2 Marine Projects

Current marine renewable energy, construction, cable and National Renewable Infrastructure Plan projects are listed on Marine Scotland's Marine Licensing website (Scottish Government, 2017a, 2017b). Each project type has been considered in turn in Table 6.4 and projects which could have in-combination or cumulative effects are identified.

Table 6.3 Summary of offshore project proposals by type.

Project Type	Number
Offshore wind pre-applications	6
Offshore wind post-determination	14
Wave projects: pre-application	3
Wave projects: post-determination	2
Tidal projects: pre-application	4
Tidal projects: in application phase	2
Tidal projects: post-determination	6
Construction, cable and NRIP projects: pre-applications	10
Construction, cable and NRIP projects: in application phase	4
Construction, cable and NRIP projects: post-determination	14

Projects identified which were completed by the final search date were not considered for scoping in or out. Four offshore windfarm projects in pre-application were for alternative designs for a project already in post-determination. In this instance, the amended design in pre-application is what was considered as part of the cumulative assessment scoping.

In addition to the identified projects, the NorthConnect HVDC cabling from the UK EEZ to the Norwegian fjord is considered during the cumulative assessments.

The following projects were narrowed down for further consideration in the cumulative assessment:

- Moray East/West Offshore Windfarm Development;
- Inch Cape Offshore Windfarm;
- Neart na Gaoithe Offshore Windfarm;
- Seagreen Phase 1 Windfarm;
- Beatrice Offshore windfarm;
- European Offshore Wind Development Centre EOWDC, Aberdeen Bay;
- Hywind Scotland Pilot Park Offshore Windfarm;
- Kincardine Offshore Windfarm;
- Aberdeen Harbour Dredge and Harbour Extension Project;
- Peterhead Port Authority Harbour Masterplan;
- East Coast HVDC Link Interconnector; and
- North Sea Network Link Interconnector Cable.

These projects were narrowed using the following criteria:

- Whether the timing of construction is likely to overlap with the NorthConnect project;
- Whether the project was within 150km of the consenting corridor; and
- Whether any operational effects of the project were likely to have a cumulative effect with the installation phase of the NorthConnect HVDC cable infrastructure:

- Particularly related to shipping and navigation, and commercial fisheries.

The July 2018 review of the Marine Scotland website identified no new offshore wind projects, although 2 had moved from pre- application to the application and determination stage. Similarly, there were no new tidal projects, but one had been determined and hence moved into the post determination phase.

There has been one new wave project, submitted and determined during 2018, which is for a small scale 26.2KW device to be deployed in Shetland by Scottish Sea Farms. No cumulative effects would be expected with the HVDC Cables due to distance and the small scale of the works.

One new hybrid energy project has entered the pre-application stage. The proposed wind and wave development is immediately west of the Dounreay Trì Floating Wind Demonstration. The current plan is to install Phase 1 during 2019-2020, with a second Phase in 2022-23. Hence, there is a potential to have overlapping construction/installation activities. However, due to the location and distance from the HVDC Cable installation, no cumulative effects are predicted.

There are currently 6 projects in construction and in the application and determination stage and 15 in the pre-application stage, this is a significant increase on September 2017. However, they all relate to projects on the west coast and/or with regard to harbours. Harbour projects have very localised effects and, as there are no new developments in the immediate vicinity of the cable route, no cumulative effects are predicted from these.

From a cables perspective there are two projects in pre-application and one in the application determination phases which have not previously been considered.:

- West Orkney to Caithness AC Link;
- SSE- Western Isles Connector; and
- Shefa – East of Ayre of Cara, Orkney.

The West Orkney to Caithness AC link project is due to start construction in 2020, however, it is more than 150km away from the NorthConnect project and, as such, cumulative effects are unlikely.

Due to location, the Western Isles cable is unlikely to have any cumulative effects with the NorthConnect project, even if construction periods overlapped.

Shefa is a fibre optic cable more than 150km from the NorthConnect cable route, hence, no cumulative effects are expected.

Table 6.4 Consideration of offshore projects for inclusion in the Cumulative Assessment.

Project Type	Status	Proposal	Approximate distance from Consenting Corridor	In/Out	Reason
OFFSHORE WIND	pre-application	Forthwind Offshore Windfarm (Demonstration Array) Methil: 2 6MW turbines	175km	Out	Linked to the post-determined 2B Energy Methil Wind turbine demonstration, and the post-determined Fife energy park offshore demonstration wind turbines. Due to distance from the closest part of the HVDC cable corridor, the inshore nature of this development, and no overlap in construction periods between this and NorthConnect means it is excluded from further assessment.
OFFSHORE WIND	Post-determination	Fife energy park offshore demonstration wind turbines: 1 7MW turbine	175km	Out	Linked to the Forthwind Methil Windfarm and the 2B energy Methil wind turbine demonstration. Excluded from cumulative assessment as construction period will not overlap with NorthConnect project.
OFFSHORE WIND	Post-determination	2B Energy Methil Wind turbine demonstration project: 2 6MW turbines	175km	Out	Linked to the Forthwind Methil Windfarm and Fife energy park offshore demonstration, see above. Excluded from cumulative assessment as construction period will not overlap with NorthConnect project.
OFFSHORE WIND	Pre-application	Moray East/West Offshore Windfarm Development 100 9.5MW turbines/90 8-15MW turbines	100km	In	Moray Offshore Windfarm (East) Limited had consent granted for a previous design in 2014 and in September 2017 was been awarded a Contract for Difference. The Moray West windfarm is still under consultation. It is likely the construction period may overlap with the NorthConnect project and therefore will be considered as part of cumulative effects. However, it is highly unlikely that both these developments will be constructed at the same time and therefore we consider the Moray East/West windfarm developments as one project.
OFFSHORE WIND	Alternative design is pre-application	Inch cape offshore windfarm: 72 turbines	110km	In	Construction would begin in 2020 and would therefore overlap with NorthConnect, as such, it should be considered as part of the cumulative assessment.
OFFSHORE WIND	Alternative design is pre-application	Neart na Gaoithe offshore Windfarm: 56 8MW turbines	130km	In	Funding has been secured and the first phase is set to be in 2018 and is planned as a four year construction period. Therefore, overlap in construction period is likely with NorthConnect and as such it will be considered for cumulative effects.

Project Type	Status	Proposal	Approximate distance from Consenting Corridor	In/Out	Reason
OFFSHORE WIND	Current Design in Pre-Application	Seagreen Phase 1 Windfarm	110km	In	Seagreen Alpha and Bravo windfarm projects were in the post-determined stage. However, an amended design has been proposed as Seagreen Phase 1 windfarm. Consent has not yet been given for this new proposal, and funding has not yet been secured to build the windfarm, so it is difficult to assess whether or not this will go ahead. However, as a conservative approach it is scoped in, assuming that it will go ahead, and the construction periods would overlap with NorthConnect.
OFFSHORE WIND	Post-Determination	Beatrice Offshore Windfarm: 84 turbines	100km	In	Due to be operational by 2019, so the construction phases may overlap slightly. Due to the distance between the projects, direct cumulative effects are unlikely. However, there may be operational effects related to boat movements, and the presence of the turbines, and as such the project is scoped in.
OFFSHORE WIND	Post-Determination	Dounreay Trì Floating Wind Demonstration	210km	Out	This project has now halted, though the consents are still valid. Due to the large distance between it and NorthConnect, it will not be considered further for any cumulative effects.
OFFSHORE WIND	Post-Determination	European Offshore Wind Development Centre (EOWDC), Aberdeen Bay	40km	In	This project is currently in the construction phase, and is due to be completed by 2018-2019. Whilst the construction phases are unlikely to overlap, there may be operational cumulative effect due to its proximity to the consenting corridor. Therefore, it is included in the assessment.
OFFSHORE WIND	Post-Determination	Hywind Scotland Pilot Park Offshore Windfarm	20km	In	This windfarm is currently completed and operational. However, due to the proximity of the project to the NorthConnect consenting corridor, there is the potential for cumulative effects during the operational phase. Therefore, it will be considered as part of the cumulative assessments.
OFFSHORE WIND	Post-Determination	Kincardine Offshore Windfarm, 8 6MW Floating Turbines	50km	In	The construction of the turbines is due to be completed before the start of the NorthConnect project, however the project's EIA found significant effects on Commercial fisheries during both operation and construction phase. This, combined with the relatively close distance to the consenting corridor resulted in it being conservatively included in the cumulative assessment.
TIDAL	Pre-Application	Ness of Duncansby Tidal Array, 30 Tidal Devices	150km	Out	Construction is anticipated to take place during 2021-22. Due to the distance from the consenting corridor, and the fact there should not be an overlap in construction periods, it is excluded from cumulative assessment.

Project Type	Status	Proposal	Approximate distance from Consenting Corridor	In/Out	Reason
TIDAL	Post-Determination	GSK Montrose Tidal Array, 15 Tidal Devices, <1MW	90km	Out	Refused consent by MS-LOT and so not considered further.
CONSTRUCTION	Application and Determination	Cromarty Firth Port Authority Invergordon Phase 4	160km	Out	The construction phase is due to finish by June 2020 and therefore there would only be a short overlap in construction phases with NorthConnect. There are no significant operational effects on any receptors relevant to the NorthConnect project (i.e. marine mammals), and therefore does not need to be considered as a cumulative effect. This is also combined with the fact that the development is over 150km from the consenting corridor.
CONSTRUCTION	Post-Determination	Aberdeen Harbour Dredge and Harbour Extension Project	40km	In	Dredging is due to be finished by 2018, construction is due to end 2020. This should mean that there is only limited overlap between the Aberdeen harbour extension and the NorthConnect project construction phases. In addition, due to the proximity of this project and the potential for increased shipping traffic in the area, it will be considered for potential cumulative effects during its operation.
CONSTRUCTION	Post-Determination	Peterhead Port Authority Harbour Masterplan	3km	In	This is close to the NorthConnect offshore cabling. However, it is due to be completed prior to NorthConnect starting installation, therefore cumulative construction effects are not considered. However, due to the proximity of this project and the potential for increased shipping traffic in the area, it will be considered for potential cumulative effects during its operation.
CONSTRUCTION	Pre-Application	Rosyth International Container Terminal	210km	Out	Funding is still being sought for the development. If it goes ahead, the construction period for the development may overlap with the NorthConnect project. However, due to the large distance between the works and the consenting corridor it will not be considered further.
NRIP	Pre-Application	Port of Dundee: Expansion and Marine Aggregate Extraction	150km	Out	It is expected that the construction works will be completed by the time NorthConnect begins construction. The project is also 150km from the consenting corridor so is not included in the cumulative assessment.

Project Type	Status	Proposal	Approximate distance from Consenting Corridor	In/Out	Reason
NRIP	Pre-Application	Port of Leith: 21st Century Gateway Port.	200km	Out	No funding has been secured for this project and no consent has been given. There is limited information available on the timescales that would be involved in this project. Due to the distance between the projects, even if the construction phases overlap, it would not need to be considered as part of the cumulative assessment, hence is scoped out.
NRIP	Post-Determination	Port of Ardersier Ltd: Offshore Renewables Masterplan.	175km	Out	This project had received full consent from the Scottish government in 2014, however the project has since been suspended, as such this will not be considered as part of the cumulative effects. Further to this, the distance between this site and the NorthConnect project is more than 150km with no predicted effects on relevant receptors.
CABLES	Pre-Application	East Coast HVDC Link Interconnector	<1km	OUT	Indications from SHET is that 2025 is the likely construction period for this project, which would mean there is unlikely to be an overlap with the NorthConnect HVDC project during the construction period. Following advice from MS-LOT, this project can be excluded from cumulative assessment.
CABLES	Post-Determination	Caithness to Moray HVDC Link.	100km	Out	This project is currently in construction and is on schedule to be completed by 2018. As the construction time periods with NorthConnect will not overlap. Further to this, due to the distances involved between the project it is highly unlikely for there to be any combined operational effects between the cables, as cable operational effects are more localised in manner. Hence this is not included in the cumulative assessment.
CABLES	Post-Determination	North Sea Network Link Interconnector cable (NE England – Norway)	130km	In	The construction timeline has the subsea cable installation starting in 2018 and finishing in 2022, as such there could be an overlap between when the NorthConnect cable installation would begin. Therefore, it will be considered in the cumulative assessment.
CABLES	Consented	Havfrue Fibre Optic Cable	~150km	Out	This project will run a cable from Kristiansand, Norway, to the United States of America. The cable will cross the NorthConnect consenting corridor in Norwegian waters, and due to be constructed in 2019. Due to the fact there a very limited overlap in construction periods, and the cable crossing will be in Norwegian waters, this project does not require further consideration within any cumulative assessment.

6.4 Assessment of Cumulative Effects

The assessment of cumulative effects resulting from the projects identified in Section 6.3 is detailed in the relevant topic specific chapters. The assessments are in line with the methodology laid out in Chapter 3 and topic specific methodology provided in each chapter. Many of the potential cumulative effects will only occur if the construction periods of the various other projects overlap with the installation of the NorthConnect HVDC Cable Infrastructure. Where it is uncertain whether a construction overlap will occur, the assessments use a precautionary approach and assume that they will overlap.

6.5 References

Aberdeenshire Council. (2017). Planning Applications, Appeals and Enforcements. Retrieved from https://upa.aberdeenshire.gov.uk/online-applications/

NorthConnect. (2015). NorthConnect Interconnecter Convertor Station and High Voltage Alternative Current Cable Route Environmental Statement. *2*.

Scottish Government. (2015). *Scotland's National Marine Plan: A single framework for managing our seas*. Retrieved from http://www.gov.scot/Publications/2015/03/6517/downloads#res-1.

Scottish Government. (2017a). Current Construction, Cable and National Renewables Infrastructure (NRIP) Projects. Retrieved from http://www.gov.scot/Topics/marine/Licensing/marine/current-construction-projects

Scottish Government. (2017b). Current Marine Renewable Energy Projects. Retrieved from http://www.gov.scot/Topics/marine/Licensing/marine/scoping

SNH. (2013). *A handbook on environmental impact assessment. Guidance for Competent Authorities, Consultees and others involved in the Environmental Impact Assessment Process in Scotland*. Retrieved from www.snh.gov.uk/docs/A1198363.pdf.

Chapter 7: Seabed Quality

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7 Seabed Quality

7.1 Introduction

This chapter describes the seabed conditions and processes along the proposed marine HVDC cable consenting corridor, as identified in drawings NCOFF-NCT-X-XG-0001-01 to NCOFF-NCT-X-XG-0001-04. Any potential effects on seabed quality caused by the installation. Mitigation measures are suggested where necessary and any predicted cumulative effects are assessed.

Marine hydrology and coastal processes were not assessed for this project. This is due to the fact that the marine cable infrastructure is not expected to result in any significant changes to hydrology or coastal processes. The marine cables will be buried for the majority of the UK consenting corridor (as detailed in the Construction Method Statement (NorthConnect, 2018)), and as such have no potential to affect hydrological conditions. In areas where burial is not possible, external protection such as rock berms will be used to protect the cables. While rock berms will be elevated from the seabed, the height of the berms are very small relative to the water depths in the UK consenting corridor. The worst case is at the horizontal directional drilling exit point, where the existing water depth is approximately 26m, and external protection may be elevated by approximately 1.5m. This equates to an extremely localised depth reduction of approximately 5%, which will not result in any significant change to the local hydrology or coastal processes.

It is noted that the operation and decommissioning phases were scoped out of the assessment, in agreement with Marine Scotland, as detailed in Chapter 3: Methodology.

7.2 Sources of Information

7.2.1 Policy Framework

The Scottish National Marine Plan provides specific policies and objectives for the installation of subsea cables (Scottish Government, 2015). The relevant marine plan policies for seabed quality include:

- **CABLES 2**: Which states that:
  - *The following factors will be taken into account on a case by case basis when reaching decisions regarding submarine cable development and activities:*
    - *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.*

7.2.2 Key Reference Documents

The following documents formed the basis of this assessment:

- Final Survey Report: NorthConnect – UK Nearshore, North Sea, and Norwegian Ford Survey – Rev. C. (MMT, 2018)
- Benthic Survey Report: NorthConnect – UK Nearshore, North Sea, and Norwegian Ford Survey – Rev. A. (MMT, 2018) ; and
- Unexploded Ordnance (UXO) Threat and Risk Assessment with Risk Mitigation Strategy for Cable Installation – Rev 2. (6 Alpha, 2017).

7.3 Assessment Methodology

7.3.1 Baseline Data Collection

7.3.1.1 Marine Surveys

The MMT Sweden AB Final Survey Report: NorthConnect – UK Nearshore, North Sea, and Norwegian Fjord Survey (MMT, 2018) (hereafter 'The Survey Report') details the methods and findings of the combined geophysical and geotechnical surveys along the UK Nearshore and North Sea Sections of the subsea cable corridor. The results in this report are based upon interpretations of geophysical data as well as the geotechnical investigations. For the geophysical survey, a combination of Side Sonar Scan (SSS), and Multi Beam Echosounder (MBES) inputs provided information on the bathymetry and surficial geology. A Sub Bottom Profiler (SBP) allowed investigation of the shallow geology and stratigraphy, while the Magnetometer provided information on ferrous objects located on or just below the seabed. The geotechnical investigation included vibro-coring (VC), and Cone Penetration Testing (CPT). The results of the geotechnical survey provided detailed information on the geological and engineering properties of the sediments present within the survey corridor. This in turn allowed the interpretation of the geophysical survey results to be ground-truthed.

Within the UK Exclusive Economic Zone (UK EEZ), the survey corridor was divided into two sections: the UK Nearshore corridor; and the UK North Sea corridor. The UK Nearshore survey corridor extended from the UK landfall at Long Haven Bay, to approximately 4km along the survey corridor. The UK North Sea corridor extended from the end of the nearshore corridor to the limit of the UK EEZ. The survey methodology employed in the Nearshore and North Sea surveys differed slight, and further details are provided below.

The UK Nearshore Survey corridor is located south of Peterhead. The survey corridor is approximately 500 m wide and reaches approximately 4 km from the coast at Long Haven Bay. The geophysical survey was conducted in two phases. Firstly, a hull MBES survey was conducted as close to shore as possible. Then a geophysical survey with WROV (Work Class Remotely Operated Vehicle) mounted MBES, SSS, SBP and magnetometer, following nine survey lines with a separation of 65 m, was completed. Additional crosslines were run close to shore in order to fill gaps in the coverage resulting from the complex coastline. The geotechnical sampling programme included VCs and CPTs. Four sampling sites in total were selected. Two sites along the survey route and two sites near each of the HDD exit points. Each site was sampled with both the VC and CPT. The VC was fitted with a barrel and liner length of 3 m and the CPT with a coil length of 6 m.

The North Sea survey work included hull mounted MBES and remotely operated towed vehicle (ROTV) mounted SSS and SBP. A magnetometer was towed 10.7 m behind the ROTV. The survey included three survey lines with 125 m line spacing covering a 500 m wide corridor. Additional survey lines were run in challenging areas to widen the corridor, in order to locate the optimal conditions for cable installation. SSS range was set to 100 m for the high frequency (HF) data and 150 m range for the low frequency (LF) data. The LF data was only processed where HF data was not available (nadir and wing lines (WL) outer range). The geotechnical sampling programme included VCs and CPTs. A total of 27 sampling sites were selected, and were sampled using either the VC, CPT or both. The total number of VCs and CPTs in the UK North Sea survey corridor was 19 and 18 respectively. The VC was fitted with a barrel and liner length of 3 m and the CPT with a coil length of 6 m.

7.3.1.2 Chemical Analysis

Full details of the chemical assessment sampling and analysis methodologies are provided in the Benthic Survey Report (MMT, 2018). A summary is provided below, and all supporting literature references can be found in the full report.

Samples for chemical analysis were taken at 17 locations within the UK Consenting Corridor during the benthic survey operations as shown in Figure 7.1. The samples were analysed for metals, and hydrocarbons, including polycyclic aromatic hydrocarbons (PAHs), and total petroleum hydrocarbons (TPH).

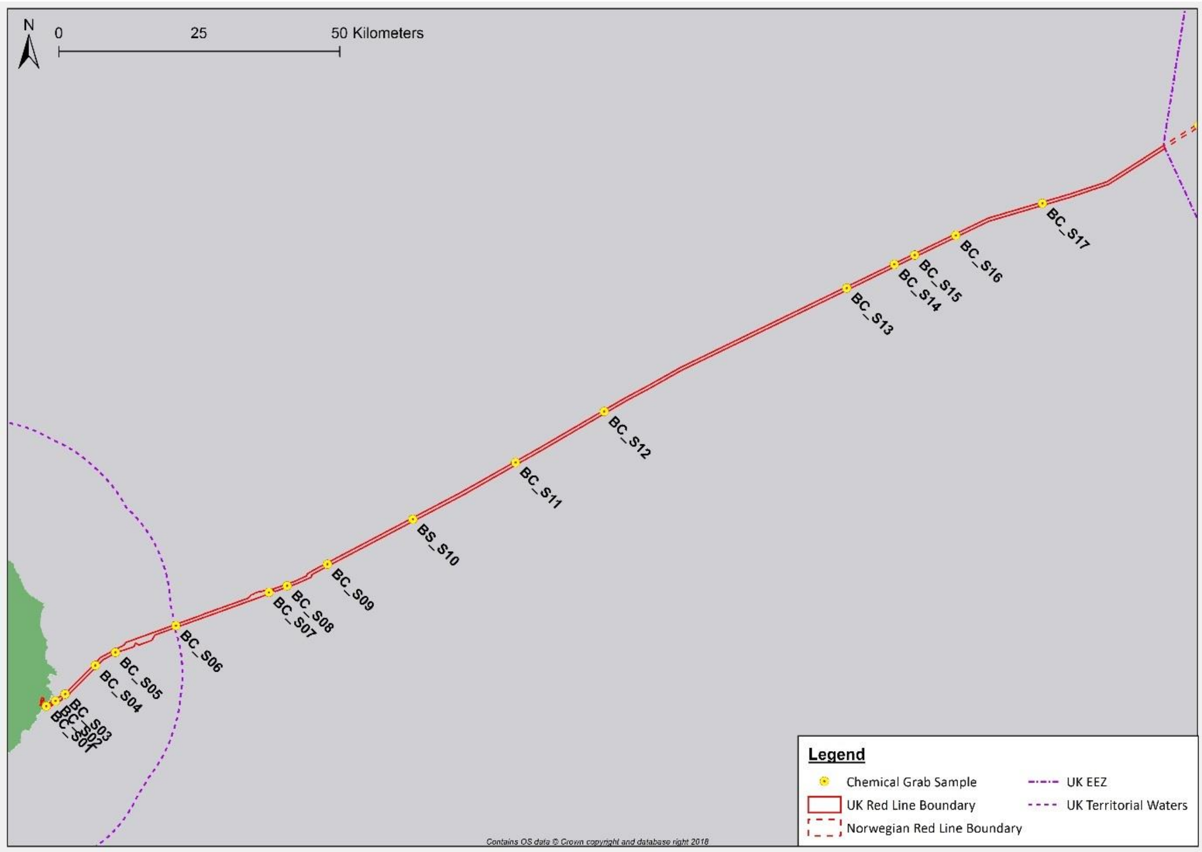

Figure 7.1. Chemical Analysis Sample Locations within UK Waters

To minimise risk of sample contamination, undisturbed sediments were collected with a plastic spoon for the metals, and a metal spoon for the hydrocarbon samples. The grab sampler was thoroughly cleaned using a seawater hose between samples and sample locations. Samples collected for hydrocarbon analysis were stored in 120 ml amber glass jars with Polytetrafluoroethylene (PTFE) inner lid caps, while one litre plastic containers were used for the metal analysis samples. All samples were stored in a refrigerator according to the analysing lab's recommendations, both before and during shipment for analysis.

The TPH analysis was conducted via Gas Chromatography-Flame Ionisation Detector (GC-FID). An overview of the hydrocarbon analysis with detection limits is presented in Table 7.1. The metal suite is also presented in Table 7.1, and used the following methods: hydrofluoric acid and boric acid extraction; followed by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS), of which Arsenic (As), Copper (Cu), Lead (Pb), Tin (Sn) are accredited by United Kingdom Accreditation Service (UKAS).

In order to put the results of the chemical analysis results into context, assessment criteria are required to evaluate the potential environmental effects which could result from the level of contamination identified. The preference would be to utilise the OSPAR Environmental Assessment Criteria (EAC), however, these have not yet been developed for PAHs and some metals. Therefore, the assessment criteria developed by the United States Environmental Protection Agency (USEPA) and/or the Canadian Council of Ministers of the Environment (CCME) are used as guidelines. In addition, the Dutch National Institute for Public Health and the Environment (RIVM) criteria for aquatic sediments were used for TPH, as there are no CCME or USEPA contamination threshold values regarding TPH. Details of the assessment criteria are provided in Table 7.2.

Table 7.1. Parameters for chemical analysis of sediment samples.

Chemical Contaminant	Detection Limits (µg/g)	Method of Analysis
	Hydrocarbons	
Total Oil Content by GC-FID plus Saturates by GC-FID	0.001	Documented in-house method using marine specification by GC-FID, TPHSED
PAHs: 2 to 6 ring aromatics by GC-MS*	0.001	Documented in-house method using DTI specification by GS-MS, PAHSED
	Metals	
As¥	1	Hydrofluoric acid and boric acid extraction followed by ICP-MS
Cadnium (Cd)	0.1	Hydrofluoric acid and boric acid extraction followed by ICP-MS
Cu¥, Pb¥	2	Hydrofluoric acid and boric acid extraction followed by ICP-MS
Mercury (Hg)	0.01	Hydrofluoric acid and boric acid extraction followed by ICP-MS
Selenium (Se), Sn¥	0.5	Hydrofluoric acid and boric acid extraction followed by ICP-MS
Nickel (Ni), Valadium (V), Zinc (Zn)	1	Hydrofluoric acid and boric acid extraction followed by ICP-MS
Chromium (Cr)	1.5	Hydrofluoric acid and boric acid extraction followed by ICP-MS

** = UKAS accreditation (16 USEPA + Dibenzthiophene and Benzo(e)pyrene only).*

¥ = UKAS accreditation

Table 7.2. Summary of sediment contamination assessment criteria.

Criteria	Source	Definition	Application
Threshold Effect Level (TEL)	CCME	A concentration above which adverse effects may occasionally occur.	Used for metals only, as not available for PAHs or TPH.
Effect Range Low (ERL)	USEPA	A concentration, below which adverse effects on organisms are rarely observed.	Used for PAHs where no TEL criteria are available.
Probable Effect Level (PEL)	CCME	The probable effect range within which adverse effects frequently occur.	Used for metals and PAH, not available for TPH.
Dutch Target Value	RIVM	A level below which there is sustainable sediment quality.	Used for TPH where no other criteria are available.

7.3.1.3 UXO Desktop Study and Survey Operations

Full details of the UXO desktop study are provided in the UXO threat and Risk Assessment report (6 Alpha, 2017). A summary is provided below, and all supporting literature references can be found in the full report.

The study consisted of a desk-based collation and review of readily available documentation and records, generated by detailed archive research relating to the possibility of encountering UXO and/or dangerous Explosive Ordnance (EO) related paraphernalia, within the survey corridor. The risk management methodology was based on best practice for UXO risk management within the marine environment, in accordance the Construction Industry Research and Information Association's (CIRIA's) publications, covering the management of offshore UXO risk, as well as fulfilling the legal requirements associated with UK and EU Law. The following sources of information were consulted in order to inform the study:

- Royal Navy (Diving Units);
- The National Archives, Kew;
- Naval Historical Centre, Portsmouth;
- UK Hydrographic Office, Taunton;
- Archaeology Data Service; and
- The "6 Alpha Azimuth ©" data-base which contains digitised historic maps, aerial photographs and records.

In addition, the magnetometer used during the geophysical survey operations (as detailed in section 7.3.1.1) identified magnetic contacts that had the potential to be UXO. Magnetic contacts with the potential to be UXO were visually inspected using an ROV. However, a dedicated UXO survey was not conducted in UK waters and the distance between the survey lines meant that the magnetometer coverage only comprised a small percentage of the Consenting Corridor. As such, there is the potential to miss UXO located between the magnetometer lines.

7.3.2 Impact Assessment Methodology

This assessment has been undertaken primarily using a qualitative assessment based on analysis of baseline data, statutory and general guidance, combined with professional judgment. The assessment follows the methodology provided within Chapter 3: Methodology, with the significance of effect being determined through a combination of sensitivity / value of a receptor and the magnitude of impact. The sensitivity / value of the receptor under consideration are defined in accordance with the criteria set out in Table 7.3, while the magnitude of impact criteria is set out within Table 7.4. The significance of effect then follows the matrix set out in Table 7.5.

Table 7.3 Environmental Value of Seabed Geology and Sediments.

Value	Criteria	Example
Very high	Very high importance and rarity, international scale and very limited potential for substitution.	• International designated sites with geological / geomorphological qualifying interest. • Internationally important geological and geomorphological formations. • All inorganic/organic contaminants below TEL/ERL values.
High	High importance and rarity, national scale, and limited potential for substitution.	• National designated sites with geological / geomorphological qualifying interest. • Nationally important geological and geomorphological formations. • Majority of inorganic/organic contaminants below TEL/ERL values.
Medium	High or medium importance and rarity, regional scale, limited potential for substitution.	• Regionally important geological and geomorphological formations. • Inorganic/organic contamination between TEL/ERL and PEL values. • Dutch Target value exceeded.
Low (or Lower)	Low or medium importance and rarity, local scale.	• Geological and geomorphological formations on relevant to interpretation at a local scale. • Occasional exceedances of PEL or Dutch Intervention Value.
Negligible	Very low importance and rarity, local scale.	• Area of commonly encountered geology. Changes will not result in any loss to the scientific understanding of geological processes, or any loss to geological integrity. • Significant contamination present: PEL or Dutch Intervention value exceeded in a wide area.

Table 7.4. Magnitude of Impacts Descriptions

Magnitude of Impact	Criteria
Major	• Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements (Adverse). • Large scale or major improvement of resource quality; extensive restoration or enhancement; major improvement of attribute quality (Beneficial).
Medium	• Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements (Adverse). • Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality (Beneficial).
Low	• Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements (Adverse). • Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring (Beneficial).
Negligible	• Very minor loss or detrimental alteration to one or more characteristics, features or elements (Adverse). • Very minor benefit to or positive addition of one or more characteristics, features or elements (Beneficial).
No change	• No loss or alteration of characteristics, features or elements; no observable impact in either direction.

Table 7.5. Significance of Effects Categories

Magnitude of Impact	Value of Receptor				
	Very High	**High**	**Medium**	**Low**	**Negligible**
Large	Major	Major	Moderate	Minor	Negligible
Medium	Major	Moderate	Moderate	Minor	Negligible
Low	Moderate	Minor	Minor	Negligible	Negligible
Negligible	Minor	Negligible	Negligible	Negligible	Negligible

Key

(orange)	**Significant Effect**
(blue)	**Non-Significant Effect**

7.3.3 Identification and Assessment of Mitigation

Mitigation measures have been identified in line with best practice to prevent, minimise and mitigate impacts.

7.3.4 Assessment of Residual Effects

Where mitigation has been identified, the magnitude of the impact will be reassessed as per Table 7.4 and the overall significance of effect reassessed in line with Table 7.5 to understand the resultant residual effect.

7.3.5 Limitations of the Assessment

Chemical analysis and geotechnical sample data are only of specific locations and sampling depths within the seabed strata. From this, trends and extrapolations can be made to establish the level of risk associated with the assessment, but a residual risk will always remain that ground conditions between two points may differ greatly from those measured at the two points in question. However, considering the concurrent interpretation of the geophysical survey data, this residual risk is estimated as being relatively low.

7.4 Baseline Information

7.4.1 Designated Sites

The only site designated for geological seabed features in the vicinity of the consenting corridor is the Southern Trench proposed Marine Protected Area (pMPA). The geological features for which this site is designated include sub-glacial tunnel valleys and moraines, as well as submarine mass movement – slide scars (SNH, 2014). However, a review of the data confidence assessment for the site indicates that the sub-glacial tunnel valleys and slide scars are located in the northern reaches of the designated site, far from the consenting corridor (SNH, 2014). Some moraine features are present within the southern end of the designated site, however, these are not crossed by the consenting corridor (SNH, 2014). The absence of the geological features for which the Southern Trench pMPA is designated within the consenting corridor is confirmed by the results of the Marine Survey Report (MMT, 2018). As such the installation and operation of the proposed NorthConnect interconnector do not have the potential to affect the site's designated features, and hence will not be considered further.

7.4.2 Bathymetry and Geology

Full details of the bathymetric and geological conditions within the consenting corridor are provided in the Survey Report (MMT, 2018). A summary is provided below, and all supporting literature references are included in the full Survey Report.

The UK Nearshore survey corridor which extents approximately 4km north east of the UK landfall, is characterised by a rocky seabed with very steep to steep seabed gradients, followed by a smooth seabed surface with very gentle to gentle seabed gradients. Within the first 1.5km of the survey corridor the water depth increases from 6.7m close to the coast, to 42.0m. The surficial geology shows outcropping BEDROCK at the coastal cliffs, followed by gravelly SAND and silty fine SAND. The shallow geology is characterised by loose, fine surficial sediments overlying dense, sandy sediments. Both units may locally contain pebbles, cobbles, and boulders. BEDROCK and TILL is seen as an underlying unit close to shore.

The outer section of the nearshore corridor, from 1.5km north east of the UK landfall to the limit of the nearshore corridor, 4km north east of the landfall, is characterised by a coarser seafloor. The area is dominated by gentle seabed gradients but increase to moderate, steep, or very steep where bedrock outcrops, or where large ripples, megaripples, or boulders are present. The water depth increases from 42.0m at the start of this section, to 59.6m at the north eastern end of the nearshore corridor. The surficial geology is dominated by SAND and GRAVEL but locally, areas with till and coarse sediments are present at the seabed surface. Boulder fields, classified as high-density boulders, dominate almost the entire section. The shallow geology shows surficial gravelly and sandy sediments where pebbles, cobbles and boulders are common. Underlying units are stiff to very stiff CLAY, overlying a dense sand, which overlie TILL deposits. BEDROCK occasionally outcrops.

The UK North Sea survey corridor can be categorised into 2 main sections based primarily on the surficial geology:

- The seabed at the start of the UK North Sea Survey corridor, from approximately 4km north east of the UK landfall to 50km along the survey corridor, is characterised as very gentle to gentle with steeper gradients associated with a variety of mobile sediment features (ripples, large ripples, megaripples and sandwaves) and outcropping bedrock. Water depths within this section range from approximately 60m in the south west to 113m in the north east. Maximum seabed gradients along the corridor are up to 11° and are associated with the mobile sediment features and bedrock present in the southwestern half of this section. The geology comprised of mixed coarse sediments including BEDROCK, gravelly SAND and sandy GRAVEL. Sediments begin to fine towards the northeast, away from the UK coastline. Boulder fields (occasional, numerous and high density) are present throughout. The underlying geology is characterised by the presence of acoustically chaotic to heterogeneous CLAY or acoustically heterogeneous, laterally discontinuous SAND, at or near the seabed. The SAND underlies the CLAY when not present near the seabed. Acoustically transparent more recent CLAY is observed towards the southwest of this section; and then
- The second section extends from 50km north east of the UK landfall to the limit of the UK EEZ, and into Norwegian waters. Here a smooth, featureless seabed with very gentle gradients overall defines the bathymetry in this section. Water depths range between approximately 97m and 157 m, with maximum gradients along the corridor of 16° associated with pockmarks. Seabed sediments comprise mixed SILT and SAND with extensive pockmarks, which locally increase in concentration to the northeast. Limited discrete areas of SAND or mixed SAND and GRAVEL are also observed as a minor sediment fraction. Trawl marks are extensive throughout

this section. The subsurface geology comprises of a predominately layered sequence of SAND, SILT and CLAY, that onlap and overlie a topographically irregular glacial CLAY surface. Towards the northeast a transition in to a transparent recent CLAY overlies SAND, before the CLAY pinches out with a layered SAND unit overlying interbedded glaciomarine to marine CLAY, SILT and SAND in a massive unit.

In general, the geological and geomorphological features identified within the UK consenting corridor are considered to be common in the North Sea region. No features of geological or geomorphological interest were identified during the survey operations.

It is noted that all areas of exposed bedrock identified by the survey to the east of the HDD exit location have been excluded from the consenting corridor. This is through a combination of the challenges they pose to cable installation, and the benthic habitat value as detailed further in Chapter 14: Benthic Ecology.

7.4.3 Sediment Quality and Contamination

Full details of the chemical assessment analysis results are provided in the Benthic Survey Report (MMT, 2018). A summary is provided below, and all supporting literature references can be found in the full report.

7.4.3.1 Inorganic

Concentrations of metals from sediment samples along the consenting cable corridor were generally low, as shown in Table 7.6. Cells highlighted in yellow in Table 7.6 indicate exceedance of TELs. None of the metal concentrations exceeded the PEL threshold within Scottish Territorial Waters (STW) or the UK EEZ. Levels of lead, cadmium, mercury, and chromium did not exceed TELs at any sample location.

However, three samples S03-S05, within the STW exceeded the arsenic TEL of 7.24µg/g, the highest being 14.9µg/g at S03. This is well below the arsenic PEL of 41.6µg/g. Nickel levels of 16.2µg/g present in S05 within the STW, also exceeded TEL of 15.9µg/g, but were below the PEL of 42.8µg/g. No other metal concentrations were identified to exceed TELs in the STW.

In the region between STW and the limits of the UK EEZ, levels of lead and cadmium increased, with higher concentrations in areas containing high fractions of silt and clay (S13-S17). No sample contained concentrations of lead or cadmium exceeding TELs. S08 contained 10µg/g of arsenic, above the TEL of 7.24µg/g but well below PEL of 41.6µg/g. The maximum concentration of copper of 90.9µg/g was identified in S06, exceeding the TEL value of 18.7µg/g. The TEL value for nickel of 15.9µg/g was exceeded in 6 samples between the STW and the limit of the UK EEZ, at locations S06, and S13 to S17. The maximum recorded nickel value was 30.6µg/g, at location S06. S13 was the only sample to exceed the TEL of Zinc with 135µg/g. Generally, Zinc concentrations were higher closer to the limits of the UK EEZ compared to STW.

Table 7.6. Metal Concentrations from Grab Samples in UK Waters.

Metals											
Site No.	**ARSENIC**	**COPPER**	**LEAD**	**TIN**	**CADMIUM**	**SELENIUM**	**MERCURY**	**CHROMIUM**	**NICKEL**	**VANADIUM**	**ZINC**
Units	µg/g										
TEL	**7.24**	**18.7**	**30.2**	**N/A**	**0.7**	**N/A**	**0.13**	**52.3**	**15.9**	**N/A**	**124**
PEL	**41.6**	**108**	**112**	**N/A**	**4.2**	**N/A**	**0.7**	**160**	**42.8**	**N/A**	**271**
S01	4.5	5.4	17.8	0.8	<0.1	<0.5	0.01	20.4	8.4	32.4	30.1
S02	5	3.8	6.7	0.7	<0.1	<0.5	0.01	11.9	5.9	26.9	17.2
S03	14.9	4.1	10.4	<0.5	<0.1	<0.5	0.01	9.1	8	36.9	23.5
S04	10.9	8.4	13.1	0.9	0.2	<0.5	<0.01	13.8	7	32.4	103.5
S05	11.7	15.5	20.4	<0.5	0.3	<0.5	<0.01	29.8	16.2	39	93.9
S06	7.1	90.9	13.4	<0.5	0.3	<0.5	<0.01	18.2	30.6	35.8	119.9
S07	5	9.5	9.6	<0.5	0.2	<0.5	<0.01	14	4.4	28.7	85.6
S08	10	8	11.4	<0.5	0.1	<0.5	<0.01	17	4.6	37.2	78.2
S09	4.3	9.1	10	<0.5	0.1	<0.5	<0.01	15.3	3.9	24.3	88.1
S10	3	7	11.3	0.6	0.4	<0.5	<0.01	22.9	8.4	29.9	77.1
S11	2.7	10.9	10.2	0.6	0.2	<0.5	<0.01	21.6	8.4	26.2	80.9
S12	2.8	10.7	11.1	0.9	0.4	<0.5	0.01	30.5	11.6	35.5	92.9
S13	5.1	13.5	20.1	1.5	0.5	0.9	0.02	49.1	21.7	53.2	135
S14	6.6	17	26.4	1.9	0.4	1.1	0.03	49.3	22.9	56	95.5
S15	5.1	10.9	25.3	1.6	0.4	<0.5	0.02	46	20.4	54.1	65.3
S16	4.9	9.6	21.7	1.6	0.4	<0.5	0.02	46.4	20.5	52.9	113
S17	4.1	9.1	16.7	1.6	0.4	0.9	0.02	37.9	16.5	44.9	77.1

7.4.3.2 Organic

The PAH concentrations in the UK consenting corridor are shown in Table 7.7, along with the ERL and PEL and ERL. Levels of PAHs were generally very low at all sample location within the STW and UK EEZ, and often fell below the limit of detection. No sample locations had recorded PAH levels which exceeded the ERL or PEL levels. The highest PAH concentrations were found at grab sample locations S01 and S02, S12, and S14 to S17.

Table 7.7. Polycyclic Aromatic Hydrocarbon Concentrations from Grab Samples in UK Waters.

Site No.	Polycyclic Aromatic Hydrocarbons																	
	NAPHTHALENE	ACENAPHTHYLENE	ACENAPHTHENE	FLUORENE	PHENANTHRENE	DIBENZOTHIOPHENE	ANTHRACENE	FLUORANTHENE	PYRENE	BENZO[A]ANTHRACENE	CHRYSENE	BENZO[B]FLUORANTHENE	BENZO[K]FLUORANTHENE	BENZO[E]PYRENE	BENZO[A]PYRENE	INDENO[123,CD]PYRENE	DIBENZO[A,H]ANTHRACENE	BENZO[GHI]PERYLENE
Units	**ng/g (dry weight)**																	
ERL	**160**	**N/A**	**N/A**	**N/A**	**240**	**190**	**85**	**600**	**665**	**261**	**384**	**N/A**	**N/A**	**N/A**	**430**	**240**	**N/A**	**85**
PEL	**391**	**128**	**88.9**	**144**	**544**	**N/A**	**245**	**1494**	**1398**	**693**	**846**	**N/A**	**N/A**	**N/A**	**763**	**N/A**	**135**	**N/A**
S01	1.5	<1	<1	<1	4.6	<1	1.7	10.7	10.4	6.7	8	8.2	4.4	-	8.2	6.9	1	7.3
S02	1.2	<1	<1	<1	4.9	<1	1.4	5.7	5.4	3.2	3.9	4.3	2.6	-	3.7	4	<1	4.2
S03	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	<1	<1	<1	<1
S04	<1	<1	<1	<1	1.0	<1	<1	1.7	1.4	<1	1.4	1.4	1.0	1.2	<1	1.4	<1	1.5
S05	<1	<1	<1	<1	1.1	<1	<1	1.3	1.1	<1	1.3	3.6	1.3	2.4	2.5	4.2	<1	3.7
S06	<1	<1	<1	<1	1.3	<1	<1	2.6	2.3	2.0	2.6	4.3	2.0	3.2	3.4	4.9	<1	4.1
S07	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.7	<1	<1	<1	1.8	<1	1.7
S08	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.5	1.1	1.1	<1	2.4	<1	2.0
S09	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.7	<1	1.2	<1	2.6	<1	2.3
S10	<1	<1	<1	<1	1.5	<1	<1	1.8	1.7	1.3	1.8	5.2	2.7	3.4	2.1	6.5	<1	5.9
S11	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	2.2	<1	1.4	<1	3.1	<1	2.8
S12	2.2	<1	<1	1.1	7.0	<1	<1	7.9	5.6	4.6	7.4	27.9	8.7	16.2	7.9	45.4	5.9	36.8
S13	<1	<1	<1	<1	2.3	<1	<1	3.4	2.4	1.7	2.5	9.0	4.9	6.9	3.3	14.3	1.9	12.4
S14	4.0	<1	<1	1.7	11.0	1.2	1.4	13.0	9.4	7.9	12.7	44.0	19.3	26.4	12.7	75.6	9.6	59.3
S15	2.2	<1	<1	1.1	7.1	<1	<1	8.3	6.1	4.7	7.4	27.8	11.0	16.9	8.1	43.8	5.5	35.0
S16	4.5	<1	<1	1.8	10.9	1.2	1.7	13.4	9.9	8.1	12.3	45.0	20.4	27.1	13.8	74.0	9.5	60.5
S17	2.5	<1	<1	1.2	7.3	<1	1.0	8.8	6.5	5.3	7.8	28.7	11.2	17.8	9.2	51.8	6.2	39.9

The Total Petroleum Hydrocarbons (TPH) values from the sample locations in the UK consenting corridor are presented in Table 7.8. The Dutch Target Value was not exceeded at any grab sample location. The TPH concentration was markedly higher at grab sample locations S12 and S14 to S17, the same stations were the PAH concentrations and several metal concentrations were elevated.

Table 7.8. Total Petroleum Hydrocarbon Concentrations from Grab Samples in UK Waters

Total Petroleum Hydrocarbons						
Site No.	**TOTAL PETROLEUM HYDROCARBON**	**TOTAL ALKANES**	**PRISTANE**	**PHYTANE**	**PRISTANE/ PHYTANE RATIO**	**CARBON PREFERENCE INDEX**
Units	**ng/g**				**N/A**	**N/A**
Dutch Target Value	**50,000**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
S01	7,105.0	172.8	4.49	2.62	1.7	3.8
S02	10,706.9	297.3	2.7	4.2	0.6	3.15
S03	2,520.8	53.3	<1	<1	-	1.78
S04	2,693.9	103.0	18.9	2.4	7.8	2.4
S05	2,873.5	153.7	10.8	2.4	4.5	3.5
S06	1,652.8	139.1	12.6	1.3	9.5	3.6
S07	2,993.1	93.3	21.3	<1	-	4.0
S08	2,223.6	135.9	11.0	1.4	8.0	3.6
S09	2,626.4	113.4	29.2	1.1	25.6	3.9
S10	3,721.5	165.6	10.2	3.0	3.4	2.8
S11	2,074.5	86.8	7.4	<1	-	3.5
S12	13,348.3	654.6	19.9	7.6	2.6	2.2
S13	5,399.0	300.9	16.6	4.3	3.8	3.4
S14	20,170.5	924.2	28.1	14.4	2.0	2.2
S15	16,788.1	735.2	27.5	8.3	3.3	2.7
S16	19,590.6	996.4	25.9	10.7	2.4	2.2
S17	16,928.7	813.4	17.4	7.8	2.2	2.3

7.4.4 UXO

The UXO desktop study assessed and identified the risk of UXO encounter within the UK consenting corridor. Full details are provided in the UXO desktop Study Report (6 Alpha, 2017), and a summary for STW and the UK EEZ are provided below.

No anomalies or records were noted during the Marine Survey that were interpreted as potentially historic unexploded ordnance from historic conflict (MMT, 2018). However, this report noted that, due to the limitations of the single towed magnetometer system, a further survey for UXO was appropriate.

7.4.4.1 Scottish Territorial Waters

It is possible that unexploded bombs (UXB) may be in Peterhead and/or its adjacent shoreline region as remnants from aerially deployed World War II bombs. High Explosive (HE) bombs are more likely to affect the UK near-shore end of the consenting corridor, than further offshore. No World War II minefields are known to be present within the most westerly 5km of the consenting corridor, however, it was noted that munitions can migrate both across the seafloor and within mobile sediments.

Defensive measures were taken to protect the beaches in the Peterhead area from amphibious assault, which included barbed wire entanglements, pillboxes containing machine gun positions, antitank obstructions, and minefields. Intentions to strongly defend Peterhead can be confirmed by the fact that at least two defensive coastline pillboxes and one long-range coastal artillery battery were located within the Peterhead area. Artillery projectiles and dumped munitions are considered to present a relatively low risk in first 5km of the consenting corridor.

The assessment identified that the main UXO threat items in the most westerly 5km of the consenting corridor are primarily: HE and incendiary bombs; ferrous metal sea mines; torpedoes; shipwreck related munitions; depth charges and mortars; artillery projectiles; and conventional dumped munitions; together with a background threat posed by non-ferrous metal sea mines, anti-invasion devices, and land mines.

The region from 5km along the consenting corridor to the limit of STW has been classed as having a medium to high probability of UXO encounter. It was found that there is a high likelihood of sea mines, munitions relating to wrecks, and training areas (Artillery projectiles and training munitions). There is the possibility of naval battles (depth charges, torpedoes and artillery projectiles) and aerial bombing (HE bombs) having taken place. There is a remote possibility of munitions dumping.

7.4.4.2 UK EEZ (Excluding STW)

The consenting corridor in the region between the STW limit and approximately 105km along the corridor from the UK landfall is classed as having a high probability of UXO encounter. Further offshore, between 105km and the limit of the UK EEZ, the probability is reduced to low.

The UXO risk in the offshore reaches of the consenting corridor is dominated by sea mines, munitions relating to wrecks, and training areas (Artillery projectiles and training munitions). There is the possibility of naval battles (depth charges, torpedoes and artillery projectiles) and aerial bombing (HE bombs) having taken place. It is noted that nine known mine lays are located within 40km of the consenting corridor in UK EEZ, which formed part of a North Sea German Minefield, situated close to the limit of the UK EEZ, three of which are located in close proximity to the consenting corridor.

7.4.5 Identification of Receptors

As detailed in Section 7.4.2 the bathymetric and geomorphological features identified during the marine survey operations within the UK consenting corridor are considered to be common within the North Sea region, and no features of geological or geomorphological are present. As such, it can be said that the features present are commonly encountered, and only likely to be relevant to the interpretation of geology on a local scale. Changes to these features will not result in any loss to the scientific understanding of geological processes, or any loss to geological integrity. As such, the value of the bathymetric and geological features present within the UK consenting corridor is assessed as **low to negligible**, according to the criteria set out in Table 7.3.

With regard to sediment quality, Section 7.4.3 outlines that the chemical analysis of grab samples conducted during the surveys operations found that, generally, contamination levels were very low. PEL levels were not exceeded at any site for organic or inorganic contaminants, and TPH levels were below the Dutch Target Value at all sites. All PAHs were also below the ERL criteria at all sites. Some heavy metals, notably arsenic and nickel, were present at levels exceeding the TEL criteria at 10 of the 17 sample locations, however, PEL levels were not exceeded. As such, it can be said that the sediments within the UK consenting corridor are relatively pristine, and their value is assessed as **high to very high**, with regard to contamination levels, as per the criteria set out in Table 7.3.

7.5 Impact Assessment

The potential impacts of the project during the installation phase have been assessed to determine their magnitude of impact upon the geological receptors described in Section 7.4, and the subsequent significance of effect.

The assessment is based on the information available to date in relation to methods of installation of the NorthConnect marine HVDC cables. Some aspects of the installation works are not yet finalised, as discussed in Chapter 2: Project Description, and so, as a precautionary approach, a series of worst-case assumptions have been made for the purposes of the assessment. The various worst-case assumptions for the purposes of the assessment are:

- **Number of cables and bundling arrangements** – there will be two High Voltage Direct Current (HVDC) cables laid in up to two trenches (either bundled and laid in one trench, or laid separately in two trenches). The fibre-optic cable will be laid in the same trench as one of the HVDC cables (or both if bundled). The assessment will consider unbundled cables in two trenches as a worst-case for cable trenching and installation, and associated effects on geological features;
- **Micro-siting of the cables within the consenting corridor and cable separation distances** – the separation distance between the cables, if not laid bundled, is likely to vary along the consenting corridor. Separation will be a minimum of 20 m and a maximum of 40 m within STW. Separation will then likely be a minimum of 20 m and maximum of the entire consenting corridor beyond STW to the UK EEZ limit;
- **Cable depth of lowering along the consenting corridor** – the minimum depth of lowering will be 0.4 m in hard substrates and 0.5 m in soft substrates, with an aim to achieve a 0.8 m depth of lowering if possible, and a likely maximum depth of lowering of 1.5 m. The maximum depth of lowering will be used for the assessment as a worst case;
- **Cable burial methods** – a combination of jet-trenching, mechanical trenching or ploughing may be required to protect the cables. Burial will be assumed to be via natural infill rather than active infilling techniques as a worst-case for habitat recovery times. Within UK waters (to the limit of the EEZ), rock placement will be in the region of 25m either side of the 4 cable crossings and 70m either side of the 14 surface laid pipeline crossings and, at a worst-case for lateral extent, using a 1:3 slope. Rock placement at the HDD exit point will be to a depth of 0.8 m for a 70 m distance at a 1:3 slope;
- **Cable trench** – methods of trenching will generate disturbance of the seabed around the trench and, depending upon the method used, the trench and excavated material footprint will be a maximum of 5 m distance either side of the centre-line of the cable (a total of 10 m width) as a worst-case; and
- **HDD** – a number of different drilling materials could be used, but it is assumed that the drilling fluid will solely comprise Bentonite.

7.5.1 Installation

7.5.1.1 Disturbance and Loss of Seabed Features

The surficial and shallow geology within the consenting corridor will be disturbed, and may be permanently lost as a result of seabed preparation, laying and trenching of the cable and from cable protection such as rock placement. Cable protection will be used in areas where the cable cannot be buried to the required depth (such as at crossing points with other cables or pipelines).

The cables will be approximately 230km long within UK waters. A 'worst-case scenario' has been assumed for this assessment that an area of seabed up to 10m wide along the length of each cable laid may be disturbed during trenching (5 m either side of each cable). The surficial geology within an area of approximately 2.3 km^2 for each cable will therefore be affected during the seabed preparation and cable laying phase. The shallow geology may be affected to the depth of lowering, which is not likely to exceed 1.5m in the UK consenting corridor.

The trenches will be naturally infilled in the majority of the consenting corridor. Natural infilling allows the trench to be filled in over time by the collapse of the trench walls and settling of suspended material. In some areas the trenches may be rock backfilled during the installation process (see Chapter 2: Project Description and the CMS for details). In areas where the trench is allowed to naturally back fill, changes to the surficial and shallow geology are considered temporary, since the natural infilling process will result in the seabed returning to a similar condition to pre-installation. However, where backfilling rock placement is employed, this will involve the placement of rock to fill the cable trench and restore the seabed to the original level. The required backfill rock placement therefore results in a permanent change to the seabed.

The removal of the two out of service cables will disturb around a 4 km length of seabed within the consenting corridor. Assuming a 10m disturbance width, this will result in a total disturbed area of approximately 0.04km^2.

The rock placement at crossing points will be up to a 1 m burial depth for the four cable crossings and 2 m burial depth for the 14 surface laid pipeline crossings. The area affected by crossings rock placement in UK waters will therefore be a maximum of approximately 300 m^2 for each cable crossing, 1,680 m^2 for each surface laid pipeline crossing, and 336 m^2 at the HDD exit point, giving a total of approximately 0.025km^2. As detailed in the Construction Method Statement (NorthConnect, 2018), crossing designs are subject to agreement with the relevant asset owners, hence the figures utilised here, based on standard designs, are subject to change.

Rock will also be placed as cable protection on areas of rocky ground or hard substrate along the consenting corridor, where it is not possible to adequately protect the cables via trenching alone. A worst-case prediction is that remedial rock placement may be required for approximately 2% of the of the length of the cables in the UK EEZ, which equates to a total affected area of approximately 0.5km^2 assuming 1m berm heights, and a 1:3 slope. The installation of rock berms will result in permanent changes to the bathymetry and surficial geology within the affected area of seabed.

Due to the extremely localised nature of the potential effects of the seabed preparation and cable installation phase on the seabed bathymetry and geological features, the magnitude of the effect is assessed as **low**. As detailed in Section 7.5.1, the value of the bathymetric and geomorphological features within the UK consenting corridor is assessed as **low to negligible**, and hence the resulting impact is assessed as **negligible: non-significant**.

7.5.2 Release of Hazardous Substances

The installation of the marine HVDC cables will require the use of vessels and ROVs. The ROVs will be operating in close proximity to, and within, the seabed. A mechanical failure of an ROV, vessel, or other associated equipment could result in a release of hazardous substances which may reach the seabed. A release of oils or other potential pollutants into or onto the seabed has the potential to result in both short and long-term impacts on sediment quality, through contamination of the sediments.

The magnitude of potential impacts arising from a release of contaminants would depend on the nature and quantity of material released into the environment. There is the potential for a spill of hazardous material to have long term major impacts, through a reduction of seabed quality on a regional scale. However, as detailed in Chapter 11: Water Quality (Marine Environment), all vessels working on the project will be compliant with the conventions of the International Maritime Organisation (IMO), including the International Convention for the Prevention of Pollution from Ships (MARPOL). Compliance with the MARPOL convention provides rigorous pollution prevention and incident response procedures, which significantly reduces or removes the risk of a release of hazardous substances occurring. As such, it is considered extremely unlikely that release of hazardous material of a scale with the potential to negatively impact sediment quality will occur. Due to the extremely low risk of a loss of containment occurring at a scale that could result in a reduction of sediment quality, the potential effect is assessed as **negligible**. As detailed in Section 7.5.1, the value of the seabed within the UK consenting corridor is assessed as **high to very high**, and in light of the very low levels of contamination, hence, the resulting impact is assessed as **minor: non-significant**.

7.5.3 Unexploded Ordnance

There is the potential that the equipment used during seabed preparation, cable laying, trenching, and protection operations could come into contact with items of UXO. If this should occur, the UXO may be inadvertently detonated. The primary impacts of inadvertent UXO detonation are risks of injury to personnel on the installation spread, as well as damage to equipment and vessels. Secondary risks include localised destruction and disturbance of seabed features in the vicinity of the detonation, as well as releases of harmful substances from damaged vessels or equipment.

As detailed in Section 7.4.4, no items of UXO were identified during the marine survey operations, however, it is acknowledged that there was not 100% MAG coverage of the consenting corridor, since the survey line spacing was too great. As such, it is possible that items of UXO are present between survey lines that would not have been identified. Furthermore, the UXO desktop study found that the risk of UXO encounter is medium to high for much of the UK consenting corridor.

Due to the risk of UXO encounter identified during the desk top study, and the lack of MAG coverage during the initial marine surveys, the installation contractor will be required to conduct a UXO survey prior to the installation works commencing. The UXO survey will utilise a multipin gradiometer deployed on an ROV, and the survey coverage will be 100% of the contractor’s cable route corridor. It is noted that the contractor’s cable route corridor will be considerably smaller than the consenting corridor, as it will only include the final cable routes and an appropriate buffer, to be advised by a UXO specialist. Visual inspections of magnetic contacts may be conducted in order to confirm whether the item is possible UXO. Where possible potential UXO contacts are identified during the survey, they will be avoided by an appropriate safety buffer during the final route engineering process. If avoidance is not possible, the items of UXO will be disposed of by an appropriately licenced explosives ordnance disposal contractor, or by the Royal Navy. The installation contractor will be required to perform a UXO risk assessment, in order to demonstrate that the risk of inadvertent UXO detonation during the seabed preparation and cable installation operations is as low as reasonably practicable.

It is therefore considered that the risk of inadvertent UXO detonation is extremely low, hence, the magnitude of this effect is assessed as **low**. The value of the seabed receptors is assessed as **low to negligible**, hence the resulting impact is **negligible: non-significant**.

7.6 Mitigation Measures

As no effects were considered to be significant under the provisions of the EIA Regulations, then no secondary mitigation is required to be implemented.

7.7 Residual Effects

No effects were assessed to be of moderate or greater significance. As such, no mitigation measures were required and there was no reduction in the residual significance of effects.

7.8 Cumulative Effects

The potential impacts on seabed quality associated with the seabed preparation and installation of the NorthConnect marine HVDC cables are extremely localised in nature. This will also be true of the seabed quality impacts resulting from the other marine developments detailed in Chapter 6: Cumulative Effects. With the exception of the Norwegian section of the NorthConnect project, the closest marine development to the UK consenting corridor is the Peterhead Port Authority Harbour Masterplan, which is 3km to the north of the consenting corridor at its closest point. All other projects are located 20km or more from the consenting corridor. As such there is no potential for any interaction between the NorthConnect seabed quality impacts, and those resulting from the other marine developments. The cumulative effects are therefore assessed as **no-change**.

With regard the Norwegian section of the NorthConnect project, the Norwegian operations may be conducted concurrently, and adjacent to the UK installation works. The installation techniques used in Norwegian waters will be analogous to those described here, and in the supporting chapters. As such, the seabed quality impacts associated with the seabed preparation and cable installation works in the Norwegian EEZ will be the same as those expected in the UK EEZ, hence the resulting cumulative effects are assessed as **non-significant**.

7.9 Summary of Effects

This chapter has assessed the potential environmental impacts on seabed quality resulting from the seabed preparations and installation of the proposed NorthConnect marine HVDC cables. No impacts were assessed as being significant under the terms of the EIA Regulations. A summary of the assessment is provided in Table 7.9 below.

Table 7.9. Summary of Seabed Quality Impacts Assessment

Receptor and Value Relevant Species		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Southern Trench pMPA	High	Installation	No Change expected for the qualifying geological features of this site, since the features are not proximal to the consenting corridor. Not assessed further.						
Bathymetric and Geological Seabed Features	Low to Negligible	Installation	Disturbance and loss of seabed features during cable trenching operations.	Low Negative Localised Long Term	Certain	Negligible: non-significant	No Specific mitigation required.	Low Negative Localised Long Term	Negligible: non-significant
		Installation	Disturbance and loss of seabed features and changes to bathymetry through use of rock placement.	Low Negative Localised Permanent	Certain	Negligible: non-significant	No Specific mitigation required.	Low Negative Localised Permanent	Negligible: non-significant
		Installation	Disturbance and loss of seabed features through inadvertent UXO detonation.	Low Negative Localised Permanent	Very Unlikely	Negligible: non-significant	Pre-installation UXO route survey to be conducted, items of UXO avoided or disposed of.	Low Negative Localised Permanent	Negligible: non-significant
Seabed Sediments (Low Contamination)	High to Very High	Installation	Reduction in sediment quality through contamination from loss of containment of hazardous substances by installation spread.	Negligible Negative Localised Permanent	Very Unlikely	Minor: non-significant	Pollution prevention as per Chapter 11: Water Quality.	Negligible Negative Localised Permanent	Minor: non-significant
		Installation	Reduction in sediment quality through contamination from loss of containment of hazardous substances following inadvertent UXO detonation.	Negligible Negative Short Term Reversible	Very Unlikely	Minor: non-significant	Pre-installation UXO route survey to be conducted, items of UXO avoided or disposed of.	Negative Negligible Short Term Reversible	Minor: non-significant

7.10 References

6 Alpha. (2017). Unexploded Ordnance (UXO) Threat Risk Assessment with Risk Mitigation Strategy for Cable Installation - Revision 2.

MMT. (2018). Final Survey Report: NorthConnect - UK Nearshore, North Sea, and Norwegian Ford Survey - Revision C.

MMT. (2018). Benthic Survey Report: NorthConnect - UK Nearshore, North Sea, and Norwegian Ford Survey - Revision A.

NorthConnect. (2018). HVDC Cable Infrastructure - UK Construction Method Statement. In F. Henderson (Ed.).

Scottish Government. (2015). *Scotland's National Marine Plan: A single framework for managing our seas*. Retrieved from http://www.gov.scot/Publications/2015/03/6517/downloads#res-1.

SNH. (2014). Scottish MPA Project, Data confidence assessment, Southern Trench MPA proposal.

Chapter 8: Geology and Hydrogeology

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Contents

8 Geology and Hydrogeology

8.1 Introduction

The chapter provides a background baseline description of the existing geology and soil features of the area in relation to the HVDC cabling activities. It then assesses the key issues raised regarding the effects associated with construction activities which could impact land quality. Operational effects on land quality and possible decommissioning effects were scoped out of the assessment.

8.1.1 Planning Framework

8.1.1.1 National

The (NPF3) sets as one of the four key priorities for the Scottish Government the protection and promotion of Scotland's key environmental resources, whilst supporting their sustainable use (Scottish Ministers, 2014a). The Scottish Planning Policy (Scottish Ministers, 2014b) identifies two principles guiding policies and decisions relating to land quality. These are:

'Having regard to the principles for sustainable land use set out in the Land Use Strategy; and

Avoiding over-development, protecting the amenity of new and existing development and considering the implications of development for water, air and soil quality'.

It is stated in the Scottish Planning Policy that:

'The planning system should seek to protect soils from damage such as erosion or compaction' and that 'Local nature conservation sites designated for their geodiversity should be selected for their value for scientific study and education, their historical significance and cultural and aesthetic value, and for their potential to promote public awareness and enjoyment'.

8.1.1.2 Local

Under the Aberdeenshire Local Development Plan (Aberdeenshire Council, 2017) there are a number of policies which are relevant to the land use topic.

- Policy PR1 relates to, 'Protecting Important Resources, which covers mineral resources, prime agricultural land."
- Policy P1, 'Layout, siting and design of new development', particular requirements are imposed on new developments on land that is contaminated or suspected of contamination.
- Policy P4, 'Hazardous and potentially polluting developments and contaminated land', developments which pose and unacceptable danger to the public or the environment will be refused development under this policy.
- Policy E1 relates to 'Natural Heritage', stated that the Council will *'not allow new development where it may have an adverse effect on a nature conservation site designated for its biodiversity or geodiversity importance,'* exceptions to this are identified.
- Policy C3 sets out requirements to protect any peat rich soils as Carbon sinks and stores.

Additionally, the Scottish Executive has issued advice to planning authorities on the development of contaminated land, in the form of Planning Advice Note 33 Scottish Executive, 2000 (Scottish Government 2000). Part of the PAN 33 discusses the need for land to be "suitable for use", particularly:

"ensuring that land is made suitable for any new use, as planning permission is given for that new use"; and

"limiting requirement for remediation to the work necessary to prevent unacceptable risks to human health or the environment in relation to the current use of the land for which planning permission is being sought".

8.1.2 Guidance and Reports

The following sources of information were utilised:

- Ground Investigation method:
  - BS EN 1997-1:2004+A1:2013: Eurocode 7: Geotechnical Design. General rules. British Standards Institution;
  - BS EN 1997-2:2007 Eurocode 7. Geotechnical design. Ground investigation and testing. British Standards Institution;
  - BS EN ISO 14688-1:2002+A1:2013. Geotechnical investigation and testing – Identification and classification of soil: Part 1: Identification and description. British Standards Institution;
  - BS EN ISO 14688-2:2004 +A1:2013. Geotechnical investigation and testing – Identification and classification of soil: Part 2: Principles for a classification. British Standards Institution;
  - BS 5930: 2015: Code of practice for ground investigations. British Standards Institution;
  - BS EN ISO 14689-1:2003. Geotechnical investigation and testing – Identification and classification of rock: Part 1: Identification and description. British Standards Institution;
  - BS 1377-1:2016: Methods of test for soils for civil engineering purposes. General requirements and sample preparation. British Standards Institution;
  - BS 10175 :2011+A2:2017 *Investigation of potentially contaminated sites. Code of practice.* (British Standards Institute, 2017); and
  - BS EN ISO 22475-1:2006. Geotechnical investigation and testing. Sampling methods and groundwater measurements. Technical principles for execution. British Standards Institution.

- Key References:
  - Scottish Geodiversity Forum (Scottish Geodiversity Forum 2018);
  - SNH Sitelink website (SNH 2017);
  - Environmental Reclamation Services Ltd: *"North Collielaw & Denend, Peterhead, Desk Study"*, REP01-REV02, November 2013;
  - LQM: The LQM/CIEH S4ULs for human health risk assessment 2015. Land Quality Press (S4UL3283);
  - Environment Agency: UK soil and herbage pollutant survey 2007;
  - The James Hutton Institute. The National Soil Inventory of Scotland (NSIS 1978-88);

- The Macaulay Institute for Soil Research (now the James Hutton Institute), *"Land Capability for Agriculture (LCA) in Scotland"*, Aberdeen, 1981; and
- Structural Soils Ltd. Peterhead, Scotland - Factual Report on Ground Investigation (Project No: 541286), May 2018.

8.2 Assessment Methodology

8.2.1 Baseline Data collection

Detailed Ground Investigation (GI) studies have been undertaken in line with the general requirements set out in the British Standards detailed in Section 8.1.2. The GI was carried out by Structural Soils Ltd under the instruction and supervision of consulting engineers Gutteridge Haskins and Davey Ltd (GHD) and covered the routes of HVDC cabling as well as the Convertor Station site. Superficial deposits encountered across the site were broadly consistent in terms of soil type although thickness varied. Therefore, for the purposes of this EIAR, all soils tested for contaminants are considered relevant to the HVDC cabling and so are included as part of this assessment. The ground investigations took place between 6th November 2017 and 7th March 2018 (Structural Soils Ltd, 2018).

8.2.1.1 Trial pits

Trial pit excavations were carried out using a tracked excavator to depths of between 0.7 and 4.0 metres below ground level (mbgl). Soil was removed in layers by the excavator driver, under instruction from the geotechnical engineers, so that relevant observations and measurements could be made at various depths, and at any visible changes in ground characteristics. The physical soil characteristics were documented from site observation, and several samples were taken and sent for analysis in order to gain detailed understanding of physical and chemical characteristics of soils for cable installation. The location of the pits is shown in Appendix C.1 and a summary of their locations is in Table 8.1. Those with environmental sample analysis are marked *.

Table 8.1 Trial Pit Locations.

Trial Pit	Location (Easting, Northing)	Summary location information
TP101*	E412002:N841241	Located within Fourfields Site.
TP102	E411989:N841178	Located within Fourfields Site.
TP103	E411842:N841187	Located within Fourfields Site.
TP104*	E411871:N841262	Located within Fourfields Site.
TP105	E411844:N841317	Located within Fourfields Site.
TP106	E411875:N841336	Located within Fourfields Site.
TP107	E411836:N841404	Located within Fourfields Site.
TP108	E411880:N841411	Located within Fourfields Site.
TP109	E411940:N841451	Located within Fourfields Site.
TP109SA	E411943:N841452	Located within Fourfields Site.
TP110*	E412060:N841323	Located within Fourfields Site.
TP111	E412063:N841265	Located within Fourfields Site.
TP112	E412020:N841472	Located within Fourfields Site.
TP113	E411805:N841477	Located within Fourfields Site.
TP114	E411786:N841366	Located within Fourfields Site.
TP115	E411784:N841240	Located within Fourfields Site.
TP116	E411866:N841127	Located within Fourfields Site.
TP117	E412065:N841119	Located within Fourfields Site.
TP201	E412102:N839976	Located by the Land Fall site.

Trial Pit	Location (Easting, Northing)	Summary location information
TP202	E412031:N840038	Located by the Land Fall site.
TP301	E411938:N840082	On route from HDD site up to disused railway line.
TP302	E411851:N840133	On route from HDD site up to disused railway line.
TP303	E411823:N840213	On route from HDD site up to disused railway line.
TP304	E411800:N840280	Southside of disused railway line.
TP305*	E411724:N840501	North of A90 in field adjacent to Mains of Longhaven.
TP306	E411704:N840580	On route north to Fourfields.
TP308*	E411702:N840787	On route north to Fourfields.
TP309	E411710:N840875	On route north to Fourfields.
TP310	E411719:N840970	On route north to Fourfields.
TP311	E411727:N841060	On route north to Fourfields.

8.2.1.2 Boreholes

Boreholes were sunk within the Fourfields site and along the HVDC cable corridor at specific locations to inform the design of the HDD works both at the A90 crossing and the landfall. The principle aim was to establish rock depth and groundwater characteristics, but also to gain further understanding on soil and rock characteristics. Both vertical and directional drilling were undertaken to maximum depths of (or vertical equivalent depth for inclined boreholes) of 26.4 and 64.2mbgl respectively.

The boreholes were sunk vertically and at an incline at some locations by rotary open hole and core drilling using Hycat Low Pressure Tracked rig, a Massenza M-I-4 rig, Comacchio GEO 601. Competent bedrock was proven in each borehole by coring at least 5m of rock. A conventional double tube core barrel was employed for the maximum recovery of rock core in conjunction with either an air, air-mist or water flushing medium. Core samples were packed carefully and placed within core boxes labelled to indicate the depth below ground surface of each core run. Each box was labelled with the site name, contract number, borehole number and depth of core runs.

Upon completion, selected boreholes within Fourfields were installed with a 50mm high-density polyethylene (HDPE) pipe for future monitoring of groundwater level. This comprises 2-5mm washed gravel surrounding the slotted section of the pipe, which allows groundwater to enter the pipe whilst keeping it clear from blockages. Bentonite seals were placed above and below the response zone and concrete installed around the plain section at the top of the pipe to prevent surface infiltration. Each installation was capped with a bolted metal raised headworks and marked with a triangular timber post arrangement so that agricultural vehicles are aware of their locations.

On completion, the remaining exploratory holes were backfilled with arisings / bentonite pellets as required. The borehole locations are shown in Appendix C.1, and their locations are summarised in Table 8.2.

Table 8.2 Borehole locations.

Borehole	Location (Easting, Northing)	Summary location information
BH101	E412046:N841211	Located within Fourfields Site.
BH102	E411969:N841229	Located within Fourfields Site.
BH102A	E411964:N841224	Located within Fourfields Site.
BH103	E411811:N841233	Located within Fourfields Site.
BH103A	E411877:N841234	Located within Fourfields Site.
BH104	E411866:N841313	Located within Fourfields Site.
BH105	E411891:N841382	Located within Fourfields Site.
BH105A	E411886:N841387	Located within Fourfields Site.
BH106	E411888:N841449	Located within Fourfields Site.
BH107	E411961:N841444	Located within Fourfields Site.
BH108	E412045:N841378	Located within Fourfields Site.
BH109	E411928:N841262	Located within Fourfields Site.
BH110	E411933:N841332	Located within Fourfields Site.
BH111	E411937:N841400	Located within Fourfields Site.
BH112	E412007:N841266	Located within Fourfields Site.
BH113	E411990:N841381	Located within Fourfields Site.
BH114	E411963:N841303	Located within Fourfields Site.
BH201	E412143:N839952	Located by the Landfall site. To determine the ground conditions for the landfall HDD.
BH202	E412197:N840022	Located by the Landfall site. To determine the ground conditions for the Landfall HDD.
BH301	E411782:N840331	Immediately north of the disused railway line. To determine the ground conditions for the Road Crossing HDD.
BH302	E411758:N840402	Immediately north of the A90. To determine the ground conditions for the Road Crossing HDD.

8.2.1.3 Logging, sampling and *in-situ* testing

In all trial pits and boreholes, the stratigraphy and depths in mbgl of soil, rock and groundwater conditions were logged on standard log sheets. An initial soil/rock description was also recorded of each soil/rock type, including the observed density description. Descriptions and properties were to be later confirmed during core logging and refined by further laboratory testing of disturbed and undisturbed samples. The following samples and measurements were undertaken where possible at each trial pit or borehole sample depth:

For physical soil and rock characteristics or index properties:

- Bulk disturbed samples
- Small disturbed samples (1l Plastic tub)
- Undisturbed rock core

For various chemical (contamination) soil and water testing:

- 1l plastic tub
- Glass jar
- Glass vial
- Plastic and glass containers for water samples

A soakaway test was attempted in P109SA however the infiltration rate was not able to be calculated due to rise in water level.

Groundwater depth monitoring in borehole installations was undertaken regularly between 15 December 2017 and 3 April 2018 on 26 separate occasions.

A geophysical survey was undertaken to seek to determine the depth to bedrock and the possible presence of a potential fault at the cable landing site. The geophysical techniques employed were that of Electrical Resistivity Imaging, Seismic refraction, and Surface Wave Ground Stiffness (SWGS). In addition, electrical resistivity tests have been undertaken at the converter station site and thermal resistivity tests have been undertaken along the HVDC and HVAC cable alignment, in order that adequate earthing and heat dissipation can be designed for electrical equipment.

8.2.1.4 Laboratory testing

Samples for potential geotechnical testing were returned to MATtest, a UKAS accredited laboratory, and those for potential geo-environmental testing were sent to Envirolab Limited, a MCERTS and UKAS accredited testing laboratory. The following tests were carried out in accordance with MCERTS/UKAS standards where noted in Appendices D and E of the Structural Soils Factual Report:

Physical Testing / Index Properties:

- Geotechnical laboratory testing was generally carried out in accordance with the relevant part of BS1377: 1990, Methods of Test for Soils for Civil Engineering Purposes, or, where superseded, by the relevant part of BS EN ISO 17892:2014 Geotechnical investigation and testing – Laboratory Testing of Soil;
- Soil classification. (Bs 5930 “Code of Practice for Site Investigations”, 1999; BS EN, “Eurocode 7: Geotechnical design”, 1997);
- Particle size distribution;
- Moisture content;
- Organic matter content;
- Water absorption and particle density;
- Liquid and plastic limits;
- Particle density;
- Compaction tests;
- Consolidation tests;
- Undrained shear strength of cohesive soils;
- Resistance to fragmentation;
- Magnesium sulphate soundness;
- pH, chloride, sulphate, sulphur, magnesium;
- Cercher abrasivity; and
- Uniaxial compression and point load strength of rock.

Contamination Testing Suites:

- Total metals (dissolved metals in waters);
- Inorganics;
- Aromatic compounds;
- Polycyclic aromatic hydrocarbons (PAH);
- Benzene, Toluene, Ethylbenzene and Xylene (BTEX) and Methyl Tert-butyl ether (MTBE);
- Total petroleum hydrocarbons (TPH); and
- Asbestos.

The contamination tests each measured either the *Detected Concentration* level of a particular chemical or compound, or defaulted to the limit of detection, i.e. the lowest concentration at which a contaminant can be detected by the testing method. The limits of detection used by the laboratory were fit for purpose.

The results of the soils chemical analysis were compared to appropriate generic human health risk assessment criteria in line with UK policy. LQM/CIEH S4ULs have been used as a basis for a generic quantitative risk assessment. These generic assessment criteria (GAC) are based on the Contaminated Land Exposure Assessment (CLEA) exposure model and represent, for a particular land-use, the average concentration of a substance in soil at or below which human exposure can be considered to represent a minimal or tolerable level of risk. Non-exceedance indicates that soil contaminant levels are such as not to compromise human health. Exceedance can indicate that further assessment or remedial action may be needed.

The proposed use of the site is industrial although the CLEA standard commercial/industrial exposure model may not be sufficiently protective in this instance as there are likely to be areas of the Site, such as along the cable routes, which will be accessible to the public following development. Therefore, the GAC for public open space has been used as a conservative screen. The results for metals analysis have also been benchmarked against Scotland's Soil Inventory for rural soils. Soil analysis results from the previous investigation were also included in the assessment as they provide further evidence of the general ground conditions encountered. As well as the determinants listed above, the previous investigation scheduled analysis for suites of pesticides and insecticides, Volatile Organic Compounds (VOCs) and Semi-volatile organic Compounds (SVOCs).

8.2.2 Impact Assessment Methodology

This assessment has been undertaken primarily using a qualitative assessment based on analysis of baseline data, statutory and general guidance, combined with professional judgment. The assessment follows the methodology provided within Chapter 3: Methodology with the significance of effect being determined through a combination of sensitivity / value of a receptor and the magnitude of impact. The sensitivity / value of the receptor under consideration are defined in accordance with the criteria set out in Table 8.3, while the magnitude of impact criteria is set out within Table 8.4. The significance of effect then follows the matrix set out in Table 8.5.

The Macaulay Institute for Soil Research maps show the LCA in Scotland (Macaulay Institute for Soil Research, 1981). The LCA classification is used to rank land on the basis of its potential productivity and cropping flexibility. This is determined by the extent to which the physical characteristics of the land (soil, climate and relief) impose long term restrictions on its use. The LCA is a seven class system. Class 1 represents land that has the highest potential flexibility of use whereas Class 7 land is of very limited agricultural value. These categories have been used in the characterisation of the different receptors sensitivity in Table 8.3.

Table 8.3 Environmental Value of Geology, Soils and Land Use Receptors

Value	Criteria	Example
Very high	Very high importance and rarity, international scale and very limited potential for substitution.	• SSSIs with geological / geomorphological qualifying interest. • Soils with a very high likelihood of readily transmitting contaminants to nearby sensitive receptors or over a large distance (e.g. granular deposits in saturated zone or in continuity with river systems etc.) H1 soils as defined by the Environment Agency groundwater vulnerability classification system. • Agricultural land use / soil quality of LCA Class 1, 2, and 3.1 (prime agricultural land).
High	High importance and rarity, national scale, and limited potential for substitution.	• Regionally Important Geological and geomorphological Sites (RIGS). • Local Geodiversity Sites (LGS). • Soil sensitivity to pollution: soils with a moderately high potential to transmit contaminants to other receptors or over a significant distance (e.g. mixed cohesive and granular deposits of alluvium). H2/H3 soils as defined by the Environment Agency groundwater vulnerability classification system. • Agricultural land use / soil quality of LCA class 3.2, 4.1 and 4.2 (moderate).
Medium	High or medium importance and rarity, regional scale, limited potential for substitution.	• Soils with an intermediate potential to transmit contaminants (e.g. Glacial Clays with occasional sand bands). Soils of intermediate (I1 or I2) leaching potential as defined by the Environment Agency groundwater vulnerability classification system. • Sites of Interest to Natural Science (SINS: also referred to as Study of Environmentally Sensitive Areas(SESA). • Local Nature Conservation Sites (LNCS) • Agricultural land use / soil quality of LCA Class 5.1, 5.2 and 5.3 (poor).
Low (or Lower)	Low or medium importance and rarity, local scale.	• Soils with a low potential to transmit contaminants (e.g. competent clay). Soils of low (L) leaching potential as defined by the Environment Agency groundwater vulnerability classification system. • Agricultural land use/soil quality of LCA Class 6.1, 6.2, 6.3 and 7 (very poor).
Negligible	Very low importance and rarity, local scale.	• Land not agricultural – e.g. hardstanding cover.

Table 8.4 Magnitude of Impacts and Descriptors

Magnitude of Impact	Criteria	Example
Major	• Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements (Adverse). • Large scale or major improvement of resource quality; extensive restoration or enhancement; major improvement of attribute quality (Beneficial).	• Change in soil quality or ground gas regime for a large area (>20ha) of land, sufficient to alter land use (e.g. remediation of 20Ha of industrial land sufficient to enable mixed residential / commercial use). • Permanent loss of any area of agricultural land (LCA Class 1, 2 and 3.1). • Generation of large volumes of non-inert waste materials for disposal off-site to landfill.
Medium	• Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements (Adverse). • Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality (Beneficial).	• Change in soil quality or ground gas regime for a moderate area of land (<20ha) to a degree sufficient to alter land use in localised portions of the site or to a degree requiring a change in management / mitigation measures for site use.
Low	• Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements (Adverse). • Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring (Beneficial).	• Measurable but relatively small scale rock volume removed. • Measurable but relatively small scale change in an area of contaminated land or ground gas regime, but insufficient to alter end land use. • Comparatively small area of SINS / SESA sites affected. • Permanent loss of any area of agricultural land (LCA Class 3.2, 4.1 or 4.2).
Negligible	• Very minor loss or detrimental alteration to one or more characteristics, features or elements (Adverse). • Very minor benefit to or positive addition of one or more characteristics, features or elements (Beneficial).	• Very limited mass of contamination mobilised – just detectable. • Very limited change in area of agricultural land. • Very limited volume of rock removed.
No change	• No loss or alteration of characteristics, features or elements; no observable impact in either direction.	• No change.

Table 8.5 Significance of Effects Categories

Magnitude of Impact	Value				
	Very High	**High**	**Medium**	**Low**	**Negligible**
Large	Major	Major	Moderate	Minor	Negligible
Medium	Major	Moderate	Moderate	Minor	Negligible
Low	Moderate	Minor	Minor	Negligible	Negligible
Negligible	Minor	Negligible	Negligible	Negligible	Negligible

Key

	Significant Effect
	Non-Significant Effect

8.2.3 Identification of Mitigation

Mitigation measures have been identified in line with best practice to prevent, minimise and mitigate impacts.

8.2.4 Assessment of Residual Effects

Where mitigation has been identified, the magnitude of the impact will be reassessed as per Table 8.4 and the overall significance of effect reassessed in line with Table 8.5 to understand the resultant residual effect.

8.2.5 Limitations of the Assessment

Trial pits and boreholes provide sample data only of specific locations and sampling depths within the ground strata. From this, trends and extrapolations can be made to establish the level of risk associated with the assessment, but a residual risk will always remain that ground conditions between two points may differ greatly from those measured at the two points in question. However, given the extent of the coverage obtained by the exploratory positions and the general uniformity of soils encountered, this residual risk is estimated as being relatively low.

8.3 Baseline Information

The results informing this Baseline Information are drawn from a desk study of the information sources listed in 8.1.2, and also from the physical ground investigation findings.

8.3.1 Designated Sites

Table 8.6 details designated sites with a geological feature within the areas.

Table 8.6: Designated Sites

Site	Approximate Distance from Cable Corridor	Relevant designated Interests	Feature's latest assessed condition
Bullers of Buchan Coast SSSI	Crossed at HVDC cable landfall.	Coastal geomorphology of Scotland Maritime cliff	Favourable maintained
Skelmuir Hill, Stirling Hill, Dudwick Local Nature Conservation Site	Crosses the HVDC landfall and HVDC cable corridor.	Pre-glacial Buchan Graves Formation. Den of Boddam Glacial Meltwater Channel included in the nature conservation site.	N/A
Hill of Longhaven SSSI	3km west of HVDC cable corridor	Quaternary of Scotland	Unfavourable declining
Moss of Cruden SSSI	7km west of HVDC cable corridor.	Quaternary of Scotland	Favourable maintained
Collieston to Whinnyfold Coast SSSI	7km south of HVDC cable corridor.	Dalradian	Favourable maintained

8.3.2 Geology

The British Geological Survey (BGS) onshore digital map DiGMapGB-50 (BGS, 2017)) were consulted to gain a general understanding of the geological conditions in the area.

BGS mapping indicates that the superficial geology of the Site consists of Head 1 – Gravel, Flinty, polymict deposit of the Quaternary period comprising poorly sorted gravel, sand and clay depending on upslope source and distance from source. No superficial deposits are indicated in the south of the site.

The mapping for the general area indicates glacial drift of Pleistocene Age, fluvioglacial and glacial sand and gravel and glacio-lacustrine deposits. Recent drift overlay includes coastal deposits of a very thin to absent alluvium associated with watercourses on the coast resulting from erosion. Over much of the inland area, glacial deposit comprises diamicton (otherwise known as boulder clay) of mainly red Hatton Till formation. These Hatton Till formation deposits are frequently very variable and fissured in nature, with sediment type varying rapidly horizontally and vertically. In general, there appears to be an increase in thickness north and east of the site location.

The BGS records of the area also indicate that the underlying bedrock of the area is dominated by Peterhead Pluton granite which creates a ragged coastline, highly sculpted/fractured cliffs and sea stacks. In general, the granite, understood to belong to pre-Lower Old Red Sandstone Age, is a coarsely crystalline red rock, resting unconformably on the old platform of slates and schists. The strata consist mainly of conglomerates and sandstones, associated with lenticular bands of andesite indicating contemporaneous volcanic action.

Peterhead Pluton Granite is quarried at the Stirling Hill Quarry, located to the east of the Fourfields site. The granite here is blasted, graded and sold principally for use in road stone and other civil engineering purposes (commonly referred to as Type 1 and Type 2 aggregates), but there are also concrete batching facilities at the quarry which uses the granite for concrete aggregate to supply local civil and structural engineering uses.

Through the exploratory hole observations, logging and the laboratory soil classification and PSD testing, the soil and rock types encountered across the two HDD sites can be identified and categorised into the approximate stratigraphy shown in Table 8.7. The sample descriptions are mapped to the appropriate BGS lithology description, and then also assigned a simplified geotechnical grouping for engineering purposes, and further interpretation within the project engineering studies and design. This is a summary table of the generalised encountered stratigraphy at the study site. The full details of soil depths, height and descriptions at each exploratory location are presented in Trial Pit and Borehole log sheets within the factual report (Structural Soils Ltd, 2018). The findings were inconsistent with the anticipated geology from BGS mapping for the area of investigation where superficial deposits were expected. There was no evidence of the Head 1 gravels nor the fluvioglacial and glacial sand and gravel and glacio-lacustrine deposits nor alluvium.

Table 8.7 Encountered Generalised Geology on the HVDC Cable Corridor (including the two Western Fields of Fourfields).

Sample Descriptions	BGS Area-Wide Lithology	Depth (mbgl)	Geotechnical Grouping
Firm (occasionally soft) dark brown slightly sandy gravelly CLAY with frequent rootlets. Gravel is angular to subrounded fine to coarse of granite, quartz, schist and flint.	N/A – Topsoil / ploughing layer	Typically 0-0.3m	Topsoil
Firm brownish red slightly sandy gravelly CLAY with lenses of sand, medium cobble content and low boulder content. Gravel is angular to subrounded fine to coarse of granite and quartz. Cobbles and boulders are subangular and subrounded of granite.	Hatton Till - Diamicton, Unsorted glacial deposits of clay, sandy clay, sand with pebbles and boulders	Typically from 0.3 to between 0.45 and 3.1m	Glacial till
Soft brown slightly sandy slightly gravelly CLAY with low cobble content. Gravel is angular to subrounded fine to coarse of granite, quartz and schist. Cobbles are subangular to subrounded of granite.		Typically from 0.3 to between 0.7 and 3.6m	
Brownish red clayey gravelly fine to coarse SAND with pockets of clay (20-200mm) with low cobble content. Gravel is angular to subrounded fine to coarse of granite, quartz, schist and flint. Cobbles are angular to subrounded of granite.		From 0 – 1.6m	
Weak pinkish brown distinctly weathered GRANITE.	Peterhead Pluton Granite: conglomerate, with subsidiary horizons of sandstone and clay.	From 0.5-64.2m at the landfall, 0.9 to 11.6m on cable route and 1.6 to 23.3m in western fields of Fourfields	Granite Bedrock
Medium strong to strong pinkish grey partially weathered GRANITE.			
Very strong to extremely stong partially unweathered greyish pink GRANITE fractures are subhorizontal (30° to 50°) closely to medium closely space tight to partially open with minor reddish brown clay infill and some orangish brown staining on surfaces.			

Note: Examples of Hatton Till and rock sample descriptions are given to show the range of soil and rock types encountered. Several other descriptions were logged which varied slightly or were different combinations of the above.

8.3.3 Topsoil

The topsoil was encountered extending to depths between of 0 and 0.7m but typically from surface to around 0.3m at all trial pit and borehole locations considered as part of the HVDC cabling works. There was a sharply defined change in all cases, presumably at ploughing depth, to the underlying undisturbed ground beneath.

The soil is a typical clayey topsoil medium of mixed lithologies.

8.3.4 Glacial Till

These were the predominant drift geology strata from the Hatton Till Formation (Diamicton) encountered across all test locations except at TP202 at the landfall where rock was shallow at 0.5m. The deposits were generally undifferentiated and ranged from slightly gravelly sand, to firm to stiff and very stiff, sandy, slightly gravelly clay. These strata covered the full depth from below the topsoil to the rock level at between 0.65 to 3.00 metres below ground level.

8.3.5 Granite Bedrock

The Peterhead Pluton Granite was encountered in the vast majority of trial pits and in all boreholes considered within the HDD areas and the HVDC cable corridor. The trial pits where rock was not encountered were all located within the western fields of Fourfields. Bedrock was recorded from 0.5mbgl and drilled to a maximum depth of 64.2mbgl at the landfall. Along the HDD cable route, rock was recorded from 0.9 and drilled to a maximum of 11.6mbgl. In western fields of Fourfields, bedrock was recorded from 1.6 to a maximum depth of 23.3mbgl. Rock varied in strength and weathering within and between boreholes.

8.3.6 Hydrogeology

The BGS classify the regional bedrock aquifer to be of low productivity (0.1-1 l/s) characterised by fracture flow processes within an unnamed igneous intrusion of late Silurian to early Devonian age. The interactive map of the 2008-2015 River Basin Management Plan (RBMP) published by SEPA indicted that the groundwater body in the area is part of the, *“Peterhead bedrock and localised sand and gravel aquifer”*. The groundwater body beneath the Site is classed as 2C by SEPA, being characterised as a low productivity aquifer where flow is virtually all through fractures and other discontinuities. These rocks have negligible intergranular porosity and, therefore, can store groundwater only within fractures. All groundwater flow is through fractures, along bedding planes, joints or fault lines. Small amounts of groundwater is however possible in the near surface weathered zones and secondary fractures, and there are also rare springs. This groundwater body was classified with an overall status of ‘good’ in 2016 and is also a Drinking Water Protected Area with a Pass status. The site is also located in a Nitrate Vulnerable Zone.

During the ground investigation, groundwater was encountered at depths between 1 to 2mbgl, mainly as seepages, in the HDD cable route trial pits coinciding with the boundary between glacial till and weathered rock. More shallow groundwater was encountered at the landfall site between 0.2 and 0.35mbgl either in weathered rock or perched on glacial till. Groundwater was only encountered in one trial pit in the western fields of Fourfields (TP104) with a moderate flow recorded in gravel of granite. It is possible therefore that limited groundwater could be encountered during the excavation works, particularly in the southern most stretches of the route.

Groundwater strikes were only recorded occasionally in boreholes although the method of drilling (and flushing) could have prevented such observations. Strikes were recorded within destructed granite in BH110 and BH111 at 6m and in till at 0.35m in BH302.

Post drilling groundwater level monitoring was undertaken in 16 boreholes installations (14no. from the current investigation and 2no. from the previous investigation). All borehole level monitoring data has been assessed to provide information on the likely local groundwater regime. Groundwater levels were monitored between 15/12/17 and 3/4/18 on between 9 and 25 occasions, depending on the borehole. Groundwater levels were recorded at between 0.25 and 3.78mbgl (except for BH109 which is discussed below). Taking into account existing ground levels, the response zone for the installations and the observations made during trial pitting, it would appear that there is a limited potential groundwater body within the near surface weathered rock zones and that groundwater flow in the Fourfields Site appear to be to the north east, generally following surface topography.

Groundwater levels in BH109 were consistently recorded slightly above ground level indicating artesian conditions. The response zone for the borehole was within extremely weak to weak weathered deconstructed granite from 4.5 to 18mbgl. Similar boreholes in this area did not show artesian conditions. This borehole had a confining layer of glacial till (4.2m thick) and it is considered that the borehole may have intercepted fracture flow.

The Hatton Till Formation deposits may have sand and gravel lenses of local importance to private water supplies. Three wells are located within a 1km radius of the Fourfields site. One is in the vicinity of the currently derelict Denend Farm buildings, one is beside the residential properties at Lendrum Terrace and the other is adjacent to the property Highfields. None are within 100m of the HVDC Cable or associated infrastructure.

A hydrological study was also carried out to understand any hydraulic continuity between the site and the Braeside Fishery Pond (currently non-operational) situated beyond the northern boundary of the site within the property of Highfields (Envirocentre 2015). The study concluded the pond is fed by the natural catchment draining to the pond from within Highfields property, potentially some springs within the base of the pond at around the level of the near surface weathered rock / glacial till interface zone referred to above, and augmented by a field ditch to the south west which is routed into the pond from the Fourfields site. The latter intake route would be lost due to the converter station development, but the study recommended that could be easily replaced by surface water routing from elsewhere on the site to the pond if required. However, in addition to this, there is also another piped intake from the larger field ditch to the south east of the pond which would not be affected by the project and, although not operational at present, it could simply be re-commissioned to supplement flow into the fishery pond.

Groundwater samples from 8no. boreholes (BHs 101, 103, 104, 105, 106, 108, 102 and 109) were analysed for general water quality. The results of the analyses (except total petroleum hydrocarbons (TPH)) were directly compared to relevant assessment limits which protect the resource potential of the water body (HMSO 2017). There are currently no assessment limits for TPH and therefore the results have been compared to WHO drinking water guidelines (WHO 2008). Groundwaters recovered from the selected boreholes were all found to have concentrations of analytes below the relevant assessment limit. This is consistent with the SEPA overall classification of the Peterhead bedrock aquifer as ‘good’.

8.3.7 Agricultural classification

According to the Land Capability for Agriculture (LCA) in Scotland maps (Macaulay Institute for Soil Research, 1981), the majority of the HVDC cable corridor belongs to the LCA Class 3.2, Land Capable of Supporting Mixed Agriculture as,

"land capable of producing a moderate range of crops with an increasing trend towards grass within the rotation".

The majority of the HVDC cable corridor and HDD cliffside activities therefore sits within current improved grassland fields.

From the LCA map there appears to be a small section of the HVDC corridor which passes through Class 3.1, Land Capable of Supporting Arable Agriculture as,

"land capable of producing a moderate range of crops with high yields of cereals and grass; potatoes and other vegetables are also grown".

Currently, the Fourfields are is utilised for crops with the remainder of the land that the HVDC corridor passes under being utilised for grazing of animals. The amount of land classified as 3.1 appears to be small from the LCA map in relation to the rest of the corridor. Furthermore, it should be noted that once the HVDC cables are installed, the fields will be returned back to agricultural use. The design of the cable route (see Chapter 2: Project Description) has been an iterative process and has ensured that the minimal amount of agricultural land will be affected, even temporarily, by the HVDC cabling.

8.3.8 Contamination

8.3.8.1 Historic Land Use

From historic maps of the area, the cliffside HDD is west of a disused quarry site. Therefore, there is a possibility that the development may encounter contaminated spoil and waste from quarrying operations. The cable route also crosses the line of a former railway with associated cuttings and embankments (running SW-NE just south of the A90) and therefore the development may encounter made ground associated with this feature, there are no surface signs of contamination associated with the railway line. However, made ground was not encountered in any of the exploratory positions during this investigation and therefore the risk of encountering such wastes is considered to be low. The only other previous known use of the Site is for agricultural use.

8.3.8.2 Contamination Testing

The results of the 12 soil samples from both investigations were compared to appropriate generic assessment criteria. No samples were found to contain concentrations above the GAC. Indeed, the vast majority of the results for inorganics, BTEX and MTBE, VOCs and SVOCs, PAH, TPH) and Pesticides/insecticides were found to be below the limit of detection for the method used.

Detectable concentrations of metals were recorded in all samples. Metals are generally naturally occurring in soil, and the detected concentrations of the metals were generally consistent with background concentrations recorded in rural soils in Scotland. Therefore, there is not considered to be a contamination source present which could present a risk during or on completion of the proposed installation works.

8.3.9 Valuation of receptors

Table 8.8 presents a summary of the valuation of the features relevant to assessing land quality.

Table 8.8: Valuation of Geological and Land-use Features.

Receptor	Evaluation Rationale	Site receptor Value
Designated Sites for Geological Features		
Bullers of Buchan Coast SSSI	The landfall crosses the SSSI. However, because the cables will run through the cliffs and under the designated coastal geomorphology and maritime cliff, the geological feautres of this designated site will not be affected by the installation. Nevertheless, due to the proximity of the designated features to the cliffside HDD, it will be included for further assessment.	Very high
Skelmuir Hill, Stirling Hill, Dudwick Local Nature Conservation Site	As this LNCS crosses the HDD sites, it will be included for further assessment.	Medium
Hill of Longhaven SSSI	This is 3km from the HDD and therefore no effects are expected on the designated features, as the HVDC cable effects will be localised in nature. It is therefore excluded from further assessment.	Excluded from further assessment.
Moss of Cruden SSSI	This is 7km from the HDD and therefore no effects are expected on the designated features, as the HVDC cable effects will be localised in nature. It is therefore excluded from further assessment.	Excluded from further assessment.
Collieston to Whinnyfold Coast SSSI.	This is 7km from the HDD and therefore no effects are expected on the designated features, as the HVDC cable effects will be localised in nature. It is therefore excluded from further assessment.	Excluded from further assessment.
Other Land Quality Features		
Groundwater	Groundwater of good quality was present in the boreholes and was encountered as seepages in a number of trial pits within the weathered rock strata. The presence of groundwater and surface water features mean that groundwater as a land asset will be considered for impact assessment in respect of its inherent quality and possible pollution pathways.	High.
Soil	LCA class 3.2 and 3.1 are present.	High.
Bedrock	Due to the fact the cliffside HDD will be drilling through bedrock, this should be considered as a receptor.	Medium.
Hydrogeology	Potentially important on a regional scale.	Medium

8.4 Impact Assessment

8.4.1 Construction

8.4.1.1 Change of Land-Use

The HDD site set up will involve setting up a 65m by 50m site with an additional 10m by 23m for parking. Topsoil will be removed which will then be stockpiled to the sides for reinstatement after completion of the works. The secure working area within the fields, where the HVDC cabling and HDD activities will be located, will not be able to be used as agricultural or grazing fields whilst the cable installation activities take place. The changes involved with the cable route and the HDD site set up will be temporary in nature, as the surface of the site will be restored to its former use on completion.

Jointing Pits 1 and 2 are expected to be 25m long by 6m wide. The jointing bays will have a protective concrete slab to avoid damage during future excavations but buried 1.0m below the surface. The ground over the joint pits will be reinstated following completion of the joints. Though the concrete slab and joint pit underneath the soil will mean a permanent effect on the soil environment, the land use can remain the same when the topsoil has been replaced. Therefore, grazing may continue as before.

The cable route construction corridor covers a total area of 10Ha. Within this, the topsoil strip for the haul road, drainage and cable trenches has an area of 0.4Ha and will remove approximately 2,200m^3 of topsoil. The cable trenches themselves at a further 1.3m deep will generate a further 5,500m^3 of glacial till and 1,000m^3 of rock. The topsoil and glacial till removed during construction will be stored and, once the cables have been installed, the ground will be reinstated, and the land returned to its former use.

The Buchan Ness to Collieston SSSI is designated for its coastal geomorphology and is **very high** value receptor. The Landfall HDD will pass under the SSSI having no or **negligible** impact on the coastal geomorphology leading to a **minor**, **non-significant** effect.

The Skelmuir Hill, Stirling Hill, Dudwick LNCS is a **medium** valued receptor and it will be temporarily affected by having the HVDC cabling and associated joint pits within the boundary of the LNCS, and also the temporary access road passing through it. However, the effects will be reversible. As such, the magnitude of impact is **low**, leading to an overall **minor**, **non-significant** effect.

The soil receptor, valued as a **high** receptor, will be temporarily affected by the HDD site set up works, cable and joint pit installation, and also the temporary access road. As the land will largely be returned to its former usage and as LCA classes 3.1 and 3.2 after the installation works, the magnitude of impact is **low**. The effects on the soil receptor is therefore defined as being a **minor**, **non-significant effect**.

8.4.1.2 Land Contamination Disturbance

From both observations and testing during the ground investigations, no evidence of old quarry workings, railway land or associated contaminated ground has been found. The concentrations observed in the soils tested are consistent with rural background concentrations. Therefore, the land is not considered to presents a material risk to human, plant or animal health. It is not recommended that any isolation or remediation measures would be required in relation to these, and the storage and reinstatement of the excavated materials during construction should not pose any increased risk of exposure for receptors.

On this basis, the magnitude of the impact from existing land contamination is deemed to be **no change**, making the significance of the effect on all receptors **no change**, **non-significant**.

8.4.1.3 Release of Hazardous Substances

As identified in Chapter 24: Resources Usage and Waste, there will be fuel, oils and chemicals stored on site which, if released, could be harmful to the environment. It is assumed that they will be appropriately stored and utilised, however, there is still a risk of loss of containment. The harm caused will be determined by the material and the volume reaching ground or groundwater. The relatively low permeability of the superficial deposits will limit migration of contaminants to some extent.

Table 10.4.1.1 in Chapter 10: Water Quality (Onshore) identifies potential pollution sources and scenario's the most significant scenario is catastrophic failure of the refuelling bowser which could be up to 5m^3 of diesel.

The Bullers of Buchan SSSI geological features will be highly unlikely to be affected by any pollution incident, due to the nearest part of the installations works, the landfall HDD site, being more than 125m from the SSSI. Therefore, the magnitude of effect of any pollution incident on this **very high** value receptor will have a **negligible** impact magnitude leading to a **negligible**, **non-significant** effect.

The Skelmuir Hill, Stirling Hill, Dudwick LNCS is a **medium** valued receptor. However, pollution incidents impact on the pre-glacial Buchan Gravels formation would be expected to be of **negligible** magnitude. This is because the quantities of any pollutant spills would be relatively small, localised and recoverable. The geological features of interest may not even be present in the HVDC cable installation area. Overall the effect on the LNCS is **negligible** and **non-significant**.

If a loss of containment of a hazardous substance was to reach the groundwater, a **high** valued receptor, became polluted this could lead to a **medium** magnitude impact leading to a **moderate**, **significant** effect.

The soil receptor, valued as a **high** receptor, would be temporarily affected if a pollution event were to occur. However, the impact would be localised in nature. Therefore, it is deemed to be of **low** magnitude of impact leading to a **minor**, **non-significant** effect.

The bedrock, a **medium** receptor, will be drilled through during the cliffside HDD drilling and is likely to be encountered along some of the cable route excavation. The only likely potential polluting substances to be in contact with the bedrock during these works would be hydraulic fluid or fuel leaks from plant and equipment. Such releases are likely to be low in volume but could locally contaminate the bedrock. Therefore, the impact magnitude would be **negligible** which results in a **negligible**, **non-significant** effect.

8.4.1.4 Hydrogeological Effects

Due to the presence of groundwater within weathered rock at the base of glacial deposits and possible more extensive aquifer through fractures in deeper bedrock as well as the artesian conditions locally in Fourfields, there is the potential that excavations will interact with groundwater. The cable trenches for the majority of the route are relatively shallow but, groundwater may seep into them. Where small volumes seep into the trenches they will be managed with surface water arisings in excavations as discussed in Chapter 10 - Water Quality (Onshore) and, as such, groundwater seepage into cable trenches will not be considered further within this Chapter.

The deeper excavation required to install the cable ducting into the Fourfields site has the potential to pass into the water table and, as such, groundwater will be a much more significant element requiring management at this location. It is likely that groundwater will need to be actively managed (dewatering pumps) to facilitate construction works. With regard to the duct installation in isolation, the requirement to actively manage groundwater will be temporary and hence any effects on hydrogeology will be temporary and localised giving rise to a **low** magnitude of impact on a **high** value receptor, leading to a **minor, non-significant** effect.

The abstraction of groundwater falls under the Water Environment (Controlled Activities) (Scotland) Regulations (as amended) (CAR), compliance with the regulations for the cable installation is discussed in Chapter 10.

8.4.2 Operations

8.4.2.1 Change of Land Use

Part of the bedrock will be permanently affected once the HDD's have been completed. The drilled holes are expected to be in the region of 800mm in diameter. There will be three Landfall HDD boreholes and three Road Crossing HDD boreholes. The bedrock, a **medium** receptor, will be affected during the landfall HDD drilling and along some lengths of the cable route, although excavation in rock is anticipated to be limited. As such there will be a minor loss of bedrock. This leads to a **low** magnitude of impact which results in a **minor, non-significant effect.**

The soil receptor, valued as a **high** receptor, will be permanently affected by the installed infrastructure including cables, ducts and joint pits. The total area taken up by the infrastructure installed in relation to the overall area of the surrounding land will be small the magnitude of impact is **low**. The effects on the soil receptor is therefore defined as being a **minor, non-significant effect**.

8.4.2.2 Hydrogeological Effects

The presence of the HVDC cable infrastructure in the ground is highly unlikely to change the levels or flows of groundwater, due to the small volume that the infrastructure will take up, the reuse of existing soils during reinstatement and the fact ducts will be sealed once cables are in place to prevent groundwater ingress. Impacts on hydrogeology **high** value receptor, are deemed to have a **negligible** magnitude of impact, leading to a **negligible**, **non -significant** effect.

8.5 Mitigation Measures

Significant effects, specifically on groundwater, could occur in event of a release of hazardous substances without appropriate mitigation. Mitigation identified in Chapter 24: Resource Usage and Waste and in Chapter 10: Water Quality (Onshore), with regard to the appropriate storage and handling of materials including refuelling activities, will aid in the reduction of the chance of a release of a hazardous substance and limit the volumes released. Furthermore, the spill response plans, spill kits and operator trained in their use identified in Chapter 10, will minimise the spread of contamination and facilitate prompt recovery. This will reduce the risk of hazardous substances reaching groundwater.

8.6 Residual Effects

Taking account of the proposed spill prevention and response mitigation the magnitude of impact on groundwater is reduced to **low** giving rise to a **minor, non-significant effect.**

8.7 Cumulative Effects

There is the potential to have cumulative effects with the NorthConnect Converter Station and HVAC cabling. The previous ES relating to the Interconnector Converter Station and HVAC Cable Route (NorthConnect 2015), was based on initial ground investigations. The surveys completed in 2017 and 2018 have augmented the understanding of geology and hydrogeology at the Fourfields site. The additional information discussed in this chapter, supplemented by further pumping tests to ascertain the location, levels and flow rates of groundwater at the site, will be utilised to inform detailed design for the Converter Station site earthworks and any associated groundwater management.

The 2017 CAR amendments mean that a construction site licence will be required for the Converter Station site and, as such, a Pollution Prevention Plan will be developed.

The installation of the HVDC cable ducts and cables on the Fourfields site is a small element in comparison to the earthworks associated with the Converter Station, and will not significantly change the scale of any effects on geology or hydrogeology, or any associated management requirements. The HVDC cables will, however, be considered within the CAR Construction Licence for the Fourfields site. The cumulative effect of the HVDC cables on the Converter Station is deemed to be **minor, non-significant**.

8.8 Summary of effects

The effects on land quality were considered and no significant effects are expected due to the cable installation taking account of mitigation. The mitigation identified has been incorporated into the Schedule of Mitigation. Table 8.9 provides a summary of the possible effects on land use.

Table 8.9: Summary of Geology and Hydrogeology Effects

Receptor	Nature of Impact	Receptor Sensitivity	Impact Magnitude	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Construction							
The Buchan Ness to Collieston SSSI	Change of Land Use	Very High	Negligible	Minor: Non-significant		Negligible	Minor: non-significant
Skelmuir Hill, Stirling Hill, Dudwick LNCS	Change of Land Use	Medium	Temporary Low	Minor: Non-significant	Reinstatement of land with existing soil, after cable installation has been completed.	Low	Minor: non-significant
Soil	Change of Land Use	High	Temporary Low	Minor: non-significant	Reinstatement of land with existing soil, after cable installation has been completed.	Low	Minor: non-significant
The Buchan Ness to Collieston SSSI	Release of Hazardous Substances	Very High	Negligible	Negligible: Non-significant	Appropriate storage and handling of materials and wastes as defined in Chapter 24. Spill response plans, spill kits and trained operators as per Chapter 10.	Negligible	Negligible: Non-significant
Skelmuir Hill, Stirling Hill, Dudwick LNCS	Release of Hazardous Substances	Medium	Negligible	Negligible: Non-significant		Negligible	Negligible: Non-significant
Ground Water	Release of Hazardous Substances	High	Medium	**Moderate: Significant**		Low	Minor: Non-significant
Soil	Release of Hazardous Substances	High	Low	Minor: Non-significant		Negligible	Negligible: Non-significant
Bedrock	Release of Hazardous Substance	Medium	Negligible	Negligible: Non-significant		Negligible	Negligible: Non-significant

Receptor	Nature of Impact	Receptor Sensitivity	Impact Magnitude	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Hydrogeology	Hydrogeological Effects	High	Low	Minor: Non-significant			
Operations							
Bedrock	Change of Land Use	Medium	Permenant Low	Minor: Non-significant		Low	Minor: Non-significant
Soil	Change of Land Use	Permanen High	Low	Minor: Non-significant		Low	Minor: Non-significant
Hydrogeology	Hydrogeological Effects	High	Negligible	Negligible: Non-significant		Negligible	Negligible: Non-significant

Key

	Significant Effect

8.9 References

Aberdeenshire Council (2017). Aberdeenshire Local Development Plan. *https://www.aberdeenshire.gov.uk/planning/plans-and-policies/aberdeenshire-local-development-plan-2017/*.

British Standards Institution (2006). BS EN ISO 22475-1:2006. Geotechnical investigation and testing. Sampling methods and groundwater measurements. Technical principles for execution. BSI.

British Standards Institution (2007). BS EN 1997-2:2007 Eurocode 7. Geotechnical design. Ground investigation and testing. BSI.

British Standards Institution (2013). BS EN 1997-1:2004+A1:2013: Eurocode 7: Geotechnical Design. General rules. BSI.

British Standards Institution (2013). BS EN ISO 14688-1:2002+A1:2013. Geotechnical investigation and testing – Identification and classification of soil: Part 1: Identification and description. BSI.

British Standards Institution (2013). BS EN ISO 14688-2:2004 +A1:2013. Geotechnical investigation and testing – Identification and classification of soil: Part 2: Principles for a classification. BSI.

British Standards Institution (2015). BS 5930: 2015: Code of practice for ground investigations. BSI.

British Standards Institution (2015). BS EN ISO 14689-1:2003. Geotechnical investigation and testing – Identification and classification of rock: Part 1: Identification and description. BSI.

British Standards Institution (2016). BS 1377-1:2016: Methods of test for soils for civil engineering purposes. General requirements and sample preparation. BSI.

British Standards Institution (2017). BS 10175 :2011+A2:2017 Investigation of potentially contaminated sites. Code of practice. BSI

Envirocentre (2015). Fourfields, Boddam: Bareside Pond Hydrological Assessment.

Environment Agency (2007). UK soil and herbage pollutant survey. Available at https://www.gov.uk/government/publications/uk-soil-and-herbage-pollutant-survey (Accessed 27/6/18)

Environmental Reclamation Services Ltd (2013) North Collielaw & Denend, Peterhead, Desk Study REP01-REV02, November 2013.

Nathanail, C.P., McCaffrey, C., Gillett, A.G., Ogden, R.C., and Nathanail, J.F. (2015). The LQM/CIEH S4ULs for human health risk assessment 2015. Land Quality Press, Nottingham (S4UL3283).

NorthConnect (2015). NorthConnect Interconnector Convertor Station and High Voltage Alternative Current Cable Route Environmental Statement.

Scotland's environment web (n.d). Aquifer classification. Available at https://map.environment.gov.scot/sewebmap/ (Accessed 3/7/18).

Scottish Geodiversity Forum. (2018). Scottish Geodiversity Forum. Retrieved from https://scottishgeodiversityforum.org/news/

Scottish Government (2000). Planning Advice Note PAN 33 Development of Contaminated Land.

Scottish Ministers (2014a). Scotland's Third National Planning Framework (NPF3) SG/2014/100.

Scottish Ministers (2014b). Scottish Planning Policy (SPP).

SEPA (n.d.). Water Classification hub. Available at https://www.sepa.org.uk/data-visualisation/water-classification-hub/ (accessed 3/7/18).

SNH (2017). SiteLink. Retrieved from http://gateway.snh.gov.uk/sitelink/index.jspStructural Soils Ltd. Peterhead, Scotland - Factual Report on Ground Investigation (Project No: 541286), May 2018

Structural Soils Ltd (2018). Peterhead Factual Report on Ground Investigation (accessed 16/8/18)

The James Hutton Institute (n.d.). The National Soil Inventory of Scotland (NSIS 1978-88). Available at http://map.environment.gov.scot/Soil_maps/?layer=11 (accessed 27/6/18)

The water intended for human consumption (private supplies) (Scotland) Regulations 2017. HMSO.

World Health Organization (2008). Petroleum Products in Drinking-water Background document for development of WHO Guidelines for Drinking-water Quality WHO/SDE/WSH/05.08/123 English only. Available at http://www.who.int/water_sanitation_health/dwq/chemicals/petroleumproducts_2add_june2008.pdf (Accessed 4/7/2018)

Chapter 9: Air Quality

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Contents

9 Air Quality

9.1 Introduction

In this chapter, the potential effects on air quality are discussed and assessed. Mitigation measures required to minimise impacts are identified and residual effects assessed. The focus is on dust associated with construction onshore, and the overall Carbon Dioxide (CO_2) savings of the project during operations. Decommissioning has been scoped out of the assessment.

9.2 Sources of Information

9.2.1 Regulatory Framework

9.2.1.1 International

The Directive 2008/50/EC on ambient air quality and cleaner air (European Parliament, 2008), aims to reduce harmful effects on health and the environment by defining and establishing ambient air quality objectives. It lays down measures for assessment, information collation and sharing, maintaining and improving air quality, and promotes member state cooperation to assist with its aim.

Directive 2008/50/EC sets out specific monitoring requirements and targets for Sulphur Dioxide, Nitrogen Dioxide (NO_2) and oxides of Nitrogen (NO_x), particulate matter (PM10 and PM2.5), Lead, Benzene and Carbon Monoxide (CO) as well as Ozone (O_3).

Similarly, Directive 2004/107/EC relating to Arsenic, Cadmium, Mercury, Nickel and Polycyclic Aromatic Hydrocarbons in ambient air (European Parliament, 2004), aims to minimise effects on human health associated with these substances in air. It lays out target values for each of the substances.

9.2.1.2 National

Air Quality Standards (Scotland) Regulations 2010 enacts the two European directives into Scottish Law. It identifies the circumstances under which Air Quality Plans must be drawn up for zones, in order to achieve the appropriate limits and target values.

As discussed in Chapter 2: Project Description, Section 2.3: Needs Case, there are both International and National policy drivers to reduce Carbon emissions, this is reflected down through the planning policy framework as discussed in Chapter 5: Planning Policy.

The Climate Change (Scotland) Act 2009 (Scottish Parliament, 2009) sets a target of reducing greenhouse gas emissions by at least 80% by 2050, with an interim target of reducing emissions by at least 42% by 2020.

The Scottish Government has also developed policies relating to air quality in the document, 'Cleaner Air for Scotland – The Road to a Healthier Future' (Scottish Government, 2015). This document provides a national strategy in order to *"achieve the best possible air quality for Scotland"*.

9.2.1.3 Local

Since the Local Air Quality Management (LAQM) review and assessment process was introduced by the Environment Act 1995 (UK Government, 1995) and associated regulations, local authorities across Scotland have been required to review and assess the air quality within their geographical areas. The process is designed to identify any exceedances of the Scotland Air Quality Strategy Objectives, and to enable any local authority that identifies such an exceedance to develop and implement a plan to improve air quality within the area.

Under section 83(1) of the Environment Act 1995, Local Authorities have a duty to designate any relevant areas where the air quality objectives are not being (or are unlikely to be) met as Air Quality Management Areas (AQMAs) and follow the declaration with an Air Quality Action Plan to improve air quality in that area.

Aberdeenshire Council carry out a yearly review of monitoring data and emission sources within the Council area, in which the information is compared with National Air Quality Objectives (NAQS), and their last published report was in 2017 (Aberdeenshire Council, 2017). Additionally, a triennial Air Quality Updating and Screening Assessment is undertaken, the last having been published in 2015 (Aberdeenshire Council, 2015).

In the last yearly report published in 2017, NO_2 concentrations were monitored at 15 sites, 6 of which were located in Peterhead. It must be noted that Aberdeenshire Council does not carry out any monitoring in respect of any of the other pollutants included in the Air Quality Standards (Scotland) Regulations 2010, since the concentration of those pollutants has traditionally been negligible and there is no reason to believe otherwise at present.

9.2.2 Air Quality Guidance

The following documents published by the Institute of Air Quality Management (IAQM) have been utilised in the production of this chapter:

- Assessment of Dust from Demolition and Construction (IAQM, 2014); and
- Guidance on Air Quality Monitoring in the Vicinity of Demolition and Construction Sites(IAQM, 2012).

9.2.3 Energy Forecasts

The following sources of information were used to help inform the analysis of CO_2 savings of the NorthConnect project:

- ENTSO-E 10 Year Network Development Plan; and
- National Grid Future Energy Scenarios.

9.3 Assessment Methodology

9.3.1 Baseline

A desk study was undertaken to inform the characterisation of the existing baseline conditions. The Air Quality in Scotland website provides a centralised source of air quality information for Scotland. Data and maps on Local Air Quality Management parameters, and Air Quality Management Areas, are provided (Ricardo-AEA, 2015).

9.3.2 Impact Assessment Methodology

The air quality impact associated with the project, which could have a negative effect, is particulate and dust emissions during construction works. PM_{10} is particulate matter of particles with a diameter of 10 micrometres (µm) or less. Dust is the particulate matter whose diameter is larger than 10 µm. Suspended particulate matter is known to affect breathing and respiratory systems, damage lung tissue, as well as being linked to cancer. The elderly, children, and people with chronic lung disease, asthma, or influenza, are especially sensitive to the effects of particulate matter.

In practical terms, the sources of dust and PM_{10}s as well as the mitigation measures utilised to control them are the same. As such, the term dust will be utilised within this chapter to cover both dust and PM_{10} effects.

The impact assessment methodology utilised is based on the IAQM Guidance on the Assessment of Dust from Demolition and Construction (IAQM, 2014). It should be noted that the methodology, unlike that described in Chapter 3: Methodology, does not take into account tertiary mitigation such as standard construction practices outlined in Pollution Prevention Guidance notes, in the initial assessment.

The NorthConnect project has the potential to contribute towards a reduction in CO_2 emissions. CO_2 is the primary greenhouse gas emitted through human activities. Global climate change is the most obvious consequence of the increasing levels of CO_2, and some of the effects associated with this phenomenon are rising sea levels and structural changes to ecosystems, amongst others. The use of the standard methodology detailed in Chapter 3 for assessing the significance of effects is not appropriate in this case. As an alternative, CO_2 calculations and estimates have been carried out to estimate the carbon cost of construction. This is offset against the potential CO_2 savings predicted by energy modelling, to provide an understanding of the overall effect of the project.

9.3.2.1 Evaluation of Receptors

The sensitivity of various receptors to air pollution is determined by a number of factors including:

- Duration spent within the area, i.e. transient or constant presence;
- Sensitivity of receptor i.e. the very old or young or certain plant species; and
- Distance from the source.

For any human receptor within 350m or ecological receptor within 50m of the site boundary, or any human or ecological receptor 50m of the route used by construction up to 500m from the site entrance, an assessment is required (IAQM, 2014).

Table 9.1 considers a range of factors based on the IAQM Guidance (2014) to define sensitivity of air quality receptors.

Table 9.1 Air Quality Sensitivity

Sensitivity	Criteria
High	Hospitals, Care homes, Schools within 50m of the source. >10 residences within 20m of the source. >100 residences within 50m of source. Areas where people expect a high level of enjoyment of an amenity or where people are continually present or will spend long periods of time e.g. museum. Amenities of high cultural or sensitive nature within 50m. Long-term carparks within 50m. Internationally or Nationally designated sites and the designated feature may be affected by dust soiling is within 20m. Community of dust sensitive species included in the Red Data list species within 20m.
Medium	1-10 residences within 20m of source. >10 residences between 20 to 50m of source. >100 residences between 50 and 100m of source Non-residential properties where people are present for long periods of time e.g. offices within 50m. Areas of amenity users would expect to enjoy at a reasonable level continuously or regularly for extended periods e.g. parks within 100m. Medium-term carparks within 100m. Internationally or Nationally designated sites where the qualifying feature dust sensitivity is uncertain or unknown or may be sensitive within 50m (SSSI).
Low	1-10 residence between 20m and 350m of source. >10 residences between 50m and 350m of source. >100 residence between 100 and 350m of source Transient exposure groups, people moving through an area i.e. footpaths. Short term carparks. Where users would not reasonably expect the enjoyment of the amenity and reasonably be expected to be present only for limited time. Non-residential properties where people are present for long periods of time e.g. offices within 100m. Locally designated sites where the qualifying feature may be sensitive to dust. Internationally or Nationally designated sites and the designated feature may be affected by dust soiling is within 100m.

9.3.2.2 Magnitude of Impact

The definitions of impact magnitude for various dust emitting operations that may occur on a construction site provided in the IAQM Guidance (IAQM, 2014). The ones relevant to the HVDC cable laying are outlined in Table 9.2.

Table 9.2 Magnitude of Potential Impact

Dust Emissions Classes for Earthworks Activities	
Large	Total site area >10,000m^2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry to due small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >8m in height, total material moved >100,000 tonne.
Medium	Total site area 2,500m^2 – 10,000m^2, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 4m – 8m in height, total material moved 20,000tonne – 100,000tonne.
Small	Total site area <2,500m^2, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4m in height, total material moved <10,000tonne, earthworks during wetter months.
Dust Emissions Classes for Trackout	
Large	>50 HGV (>3.5t) trips in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100m.
Medium	10-50 HGV (>3.5t) trips in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50m – 100m.
Small	<10 HGV (>3.5t) trips in any one day, surface material with low potential for dust release, unpaved road length <50m.

9.3.2.3 Significance Evaluation

The significance of effects will be determined as per Table 9.3, taking account of receptor sensitivity accounting for distance from the source, and impact magnitude.

Table 9.3 Categorising significance of effects.

	Receptor Sensitivity		
Magnitude of Impact	**High**	**Medium**	**Low**
Large	Major	Moderate	Minor
Medium	Moderate	Moderate	Minor
Small	Minor	Minor	Negligible

Key

(orange)	**Significant Effect**
(blue)	**Non-Significant Effect**

9.3.3 Mitigation Identification

Appropriate mitigation is identified for the management of dust, taking into account IAQM Guidance (IAQM, 2014) and Pollution Prevention Guidance (PPG) 6: Working at Construction and Demolition Sites (SEPA, 2014). Monitoring is also proposed in line with IAQM's Air Quality Monitoring in the Vicinity of Demolition and Construction Sites (IAQM, 2012).

9.3.4 Residual Effects

Residual effects are assessed by reassessing the impact magnitude taking account of the mitigation and then re-categorising the significance of the effect.

9.4 Baseline Information

This section describes the baseline local air quality conditions within the area of influence of the HVDC cabling. The majority of the HV cable corridor is currently farmland and, as such, is assumed to have a relatively high air quality. The cable corridor crosses the A90, a busy road, which will produce some vehicle fuel emissions.

According to the Air Quality in Scotland database and website, there are no Air Quality Management Areas in Aberdeenshire Council Area (AQIS, 2017). The closest AQMAs are located in Aberdeen, 30 miles to the south of the proposed development.

The locations of the six NO_2 concentration monitoring locations in the Peterhead area are provided in Table 9.4 (Aberdeenshire Council, 2017). The closest monitoring location to the NorthConnect site is Peterhead SR which is approximately 2.8km north north east of Fourfields.

Table 9.4 Details of NO_2 Monitoring Sites in Peterhead in 2017.

Site Name	Site Type	OS Grid Ref	Pollutants Monitored	Distance to kerb of nearest road
Peterhead 2	Kerbside	E 413209 N 846356	NO_2	< 5m
Peterhead 4	Kerbside	E 415758 N 846144	NO_2	< 5m
Peterhead BH	Roadside	E 413379 N 845906	NO_2	< 5m
Peterhead MS1	Kerbside	E 413420 N 845918	NO_2	< 5m
Peterhead MC	Kerbside	E 412553 N 844839	NO_2	<3m
Peterhead SR	Kerbside	E 412495 N 844286	NO_2	<3m

The last results published by Aberdeenshire Council in 2017, includes data to 2016 (Aberdeenshire Council, 2017). The emissions data covering the period from 2012 to 2016 is included in Table 9.5.

Table 9.5 Results of NO_2 Diffusion Tubes (2012-2016) at Peterhead

Site Name	Valid data capture in 2016 (%)	NO_2 annual mean concentrations (µg/m^3)				
		2012	**2013**	**2014**	**2015**	**2016**
Peterhead 2	75	29.3	27.5	30.0	28.3	23.0
Peterhead 4	75	22.4	28.5	25.3	22.5	21.4
Peterhead BH	75	N/A	N/A	32.2	31.4	26.6
Peterhead MS1	75	N/A	N/A	28.1	28.1	25.4
Peterhead MC	75	N/A	N/A	N/A	N/A	9.8
Peterhead SR	75	N/A	N/A	N/A	N/A	9.7

None of the annual mean concentrations at any of the stations exceeded the National Air Quality Objective for NO_2, set at 40 µg/m^3. The highest annual mean concentration was recorded at the Peterhead BH station, being 32.2µg/m^3 in 2014. It is noted that the lowest concentrations of NO_2 are those closest to the site, and on the outskirts of the Peterhead. Around the HVDC onshore cable route levels would be expected to be lower still, with highest concentration of NO_2 being in the vicinity of the A90.

Other air pollutants are below concentration levels that would give local concern, hence the lack of routine monitoring data available. This is expected to be true of the HVDC onshore corridor also due to the lack of significant air pollution sources. Traffic on the A90 will contribute to PM_{10} and NO_x concentrations, but not at significant levels.

The presence of the Breedon Aggregates quarry to the east of the Fourfields site at the northern end of the HVDC cable corridor may give rise to dust emissions, particularly during peak times of activity or under unfavourable weather conditions. This is appropriately managed and controlled by Breedon Aggregates under their permits and licenses to operate the site.

It should be noted that the east coast of Scotland has a drier climate than the west or north of Scotland, with the annual precipitation rates at the nearest SEPA weather station amounting to less than 800mm per year (Scotland Info, 2018; SEPA, 2018). Under drier conditions, there is more of a chance for dust to be blown from the site. However, the ground along the HVDC cable corridor is known to be highly permeable with wet soil present (see Chapter 8: Geology and Hydrogeology), which means it is less likely to be lose and blown.

There are limited sources of information on air quality in the North Sea and there is no air quality management in place in the UK related to shipping specifically. A report produced in 2017 for the Department for Environment, Food and Rural Affairs (DEFRA), Scottish Government, Welsh Government and the Department of the Environment in Northern Ireland, assessed the impact of shipping on UK air quality (AQEG, 2017). Shipping does contribute to onshore emissions of NO_x and $PM_{2.5}$ concentrations near busy ports such as Aberdeen where the annual mean NO_x contribution from local shipping has been modelled in be in excess of 25µm/m^3 Aberdeen. In the immediate vicinity of Peterhead Harbour levels local shipping is modelled to contribute between 1 and 5µg/m^3, reducing to less than 1µg/m^3 before it reaches the cable corridor. Regional contributions to NO_x from shipping is between 0.5 and 1µg/m^3 from shipping for the whole of Aberdeenshire. Contribution to the UK's PM2.5 levels contributed to shipping are very low with mean annual level predictions below 1µg/m^3.

9.5 Identification and Evaluation of Receptors

Figure 9.1 demonstrates where the human receptors are in relation to the HVDC cable works. Station House, to the south of the A90 is approximately 50m from where the Access Road will be constructed. The closest occupied property to the HVDC cable corridor is Longhaven Mains farm whose farm house and outbuilding are between 50 and 100m from the cable construction corridor. Highfields is between 50 and 100m from the northernmost end of the HVDC consenting corridor. All other residencies are beyond 100m of HVDC cable construction works. In total there are less than 10 residential properties within 100m and less than 100 residencies within 350m as such residential receptors are classed as low sensitivity in accordance with Table 9.1.

The quarry boundary is within 20m of the Fourfield site and hence the redline boundary, however the cables will be installed such that they enter the west side of the converter station site, as such it is over 100m away. The quarry does include office accommodation, however it is not utilised for long periods of time, as such the quarry is not deemed to be a sensitive receptor.

The paths around the Fourfields site and along the cliff top, facilitate access to transient leisure receptors which are defined as having low sensitivity.

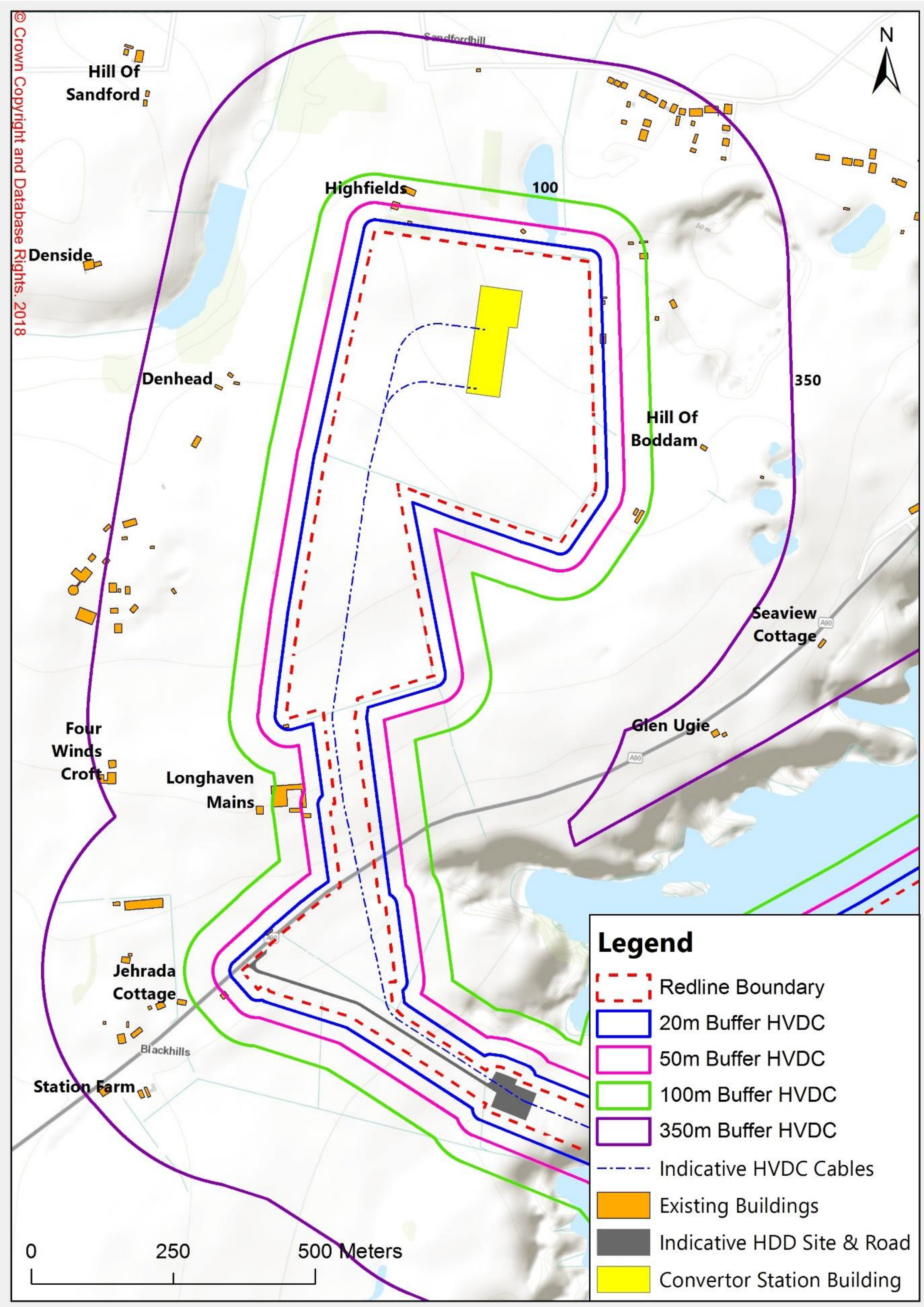

Figure 9.1 Human receptors within 350m of the HVDC cable corridor.

Further receptors which require evaluation are the Buchan Ness to Collieston Coast SAC, the Bullers of Buchan Coast SSSI designated sites; and Longhaven cliffs SWT nature reserve. These receptors are located close to the Landfall Horizontal Directional Drill (HDD) site. The Landfall HDD site and the HVDC cable corridor are all beyond 20m of the nature conservation sites apart from a very small section of land near the Landfall HDD site. This same section of the cliff falls within 50m of the HVDC cable corridor. From the vegetation survey carried out as part of the assessment on terrestrial ecology (see Chapter 13: Terrestrial Ecology), it is noted that this relates to a small section of MC9 (subdominant habitat), which is a designated maritime grassland; coastal heathland; and tall herbs and ferns. Due to lack of data, it is unknown whether these species are particularly sensitive to dust pollution but in accordance with Table 9.1, these habitats are assessed as being of medium sensitivity as a precautionary approach.

Figure 9.2 demonstrates where the nature conservation receptors are in relation to the HVDC cable works.

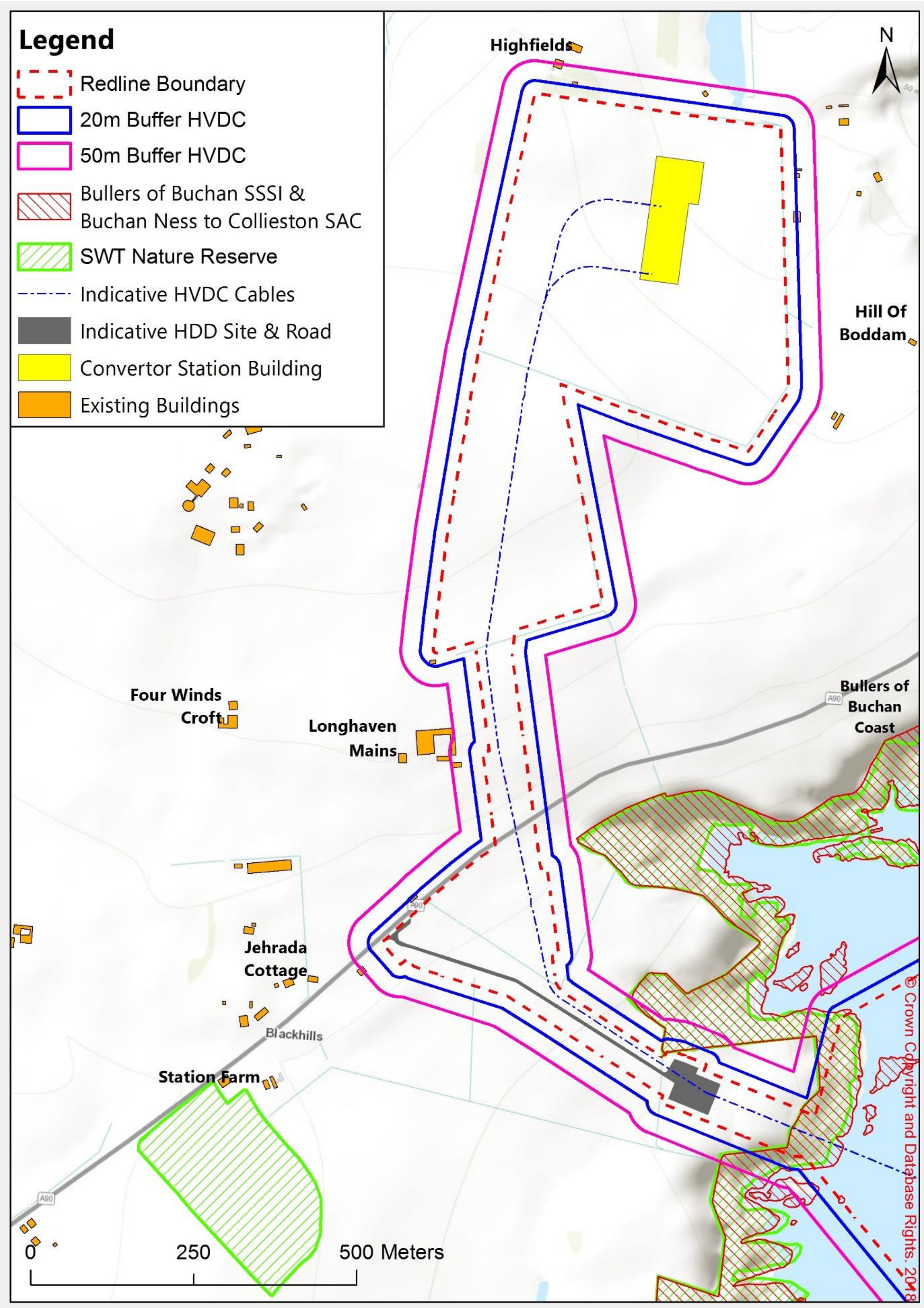

Figure 9.2 Nature Conservation Interests in relation to the HVDC cable corridor.

9.6 Impact Assessment

9.6.1 Construction

9.6.1.1 Dust

There are several sources which could give rise to local dust issues during the onshore construction works including: ground works, track out and material storage. As discussed in Chapter 24: Resource Usage and Waste, bentonite will be delivered dry in one tonne bags for use in the drilling fluid. Volumes stored on site at any one time will be minimised and as such will not give rise to a dust source of a scale requiring consideration here. Similarly aggregates utilised in the cable trench and the road construction will be delivered just in time and not stored hence do not provide a source of dust requiring consideration.

9.6.1.1.1 Earthworks

Earthworks required for the onshore installation of the cables, their approximate areas and associated potential dust sources are listed in Table 9.6.

Table 9.6: Dust Sources associated with Earthworks.

Earthworks Requirement	Approximate Area	Dust Sources
Access Road to Landfall HDD Site Installation	3,500m^2	Soil stripping. Aggregates utilised in road construction. Reinstatement removal of aggregate and replacement of soils.
Landfall HDD Compound Preparation	6,000m^2	Soil stripping. Bund creation. Aggregates utilised in compound construction. Reinstatement removal of aggregate and replacement of soils.
Road Crossing HDD Compound Preparation	2,000m^2	Soil stripping. Aggregates utilised in compound construction. Reinstatement removal of aggregate and replacement of soils.
Joint Pits Cable Trenching • Landfall HDD to Joint Pit 1 • Road HDD to Joint Pit 2 • Joint Pit 2 to Converter Station	300m^2 3,400m^2 7,000m^2 4,000m^2	Soil stripping. Soil removal and storage. Reinstatement of soil.
Cable Route Access Road	7000m^2	Soil stripping. Aggregates utilised in road construction. Reinstatement removal of aggregate and replacement of soils.

Not all activities will be carried out at one time, and there may be weeks or months between activities, however the total earthworks will cover an area well in excess of 10,000m^2 and as such are deemed to have a **large** magnitude of impact without mitigation in accordance with Table 9.2.

All human receptors (residential and leisure) are deemed to be of low sensitivity giving rise to a **minor**, **non-significant** effect on this residential and leisure receptor.

The Buchan Ness to Collieston Coast SAC, the Bullers of Buchan Coast SSSI designated sites; and Longhaven cliffs SWT nature reserve was deemed to be of **medium** sensitivity, the enabling works associated with the HDD site set up and sections of the access road and cable trenching could impact this receptor, giving rise to a **moderate, significant** effect without mitigation.

9.6.1.1.2 Trackout

The HDD access road will provide the track out for construction traffic getting to the HDD site and the HVDC cable corridor south of the A90.

The estimated average numbers of vehicle movements to the construction area to the south-east of the A90 are as follows:

- Personnel movements - 24 light vehicle movements per day for the duration of construction;
- Road construction - 20 heavy vehicle movements per day for a period of approximately 6 weeks (delivery of construction materials and equipment);
- HDD site establishment - 10 heavy vehicle and 4 light vehicle movements per day for a period of approximately 4 weeks (delivery of site accommodation and drilling equipment);
- HDD operations - 6 heavy vehicle and 6 light vehicle movements per day for a period of approximately 26 weeks (removal of material/waste and equipment deliveries).

Therefore, the worst case is during road construction with a total of 44 vehicle movements per day, including 20 heavy vehicle movements, for an estimated duration of six weeks.

Vehicle numbers accessing the area to the north of the A90 will be much lower, and most access will be from the Fourfields site. Track out associated with the access to the Fourfield site has been assessed as part of the Converter Station and HVAC Cable Route Environmental Statement (NorthConnect, 2015) and as such will not be re assessed here.

In accordance with the Table 9.2, track-out associated with the enabling works and reinstatement is deemed to be of **medium** magnitude. The nearest receptor to the track-out will be station house, which has been identified as a low sensitive receptor and as such will give rise to a **minor, non-significant** effect without any mitigation.

The Buchan Ness to Collieston Coast SAC, the Bullers of Buchan Coast SSSI designated sites are well over 100m from the potential trackout location onto the A90 and as such will not be affected.

Once the enabling works are complete the road will be in place, hence the surface material will be much less of a dust source and the heavy vehicle numbers will be reduced. The magnitude of impact will reduce to **small** giving rise to a **negligible, non-significant** effect on residential receptors.

9.6.1.2 Carbon Dioxide

There is a carbon cost associated with the installation of the HVDC cables. The carbon cost is associated with the use of fossil fuels to power vessels, vehicles plant and equipment associated with the cables installation and associated enabling works. This is estimated to be in the order of 200 to 300 tonnes CO_{2e}

In addition, the materials utilised will have an inherent carbon cost or CO_2 equivalence (CO_{2e}). The main material for the project is the HVDC Cables, as described in Chapter 2: Project Description, the cables are made up of a variety of components, however the metal conductors are likely to have the highest CO_{2e} values. The conductor can be either copper or aluminium, the CO_{2e} conversion factors for these are 2.77 kgCO_{2e}/kg and 2.01 kgCO_{2e}/kg respectively. As a worst-case assumption, it could be assumed that the full 11,752 tonnes of UK cable has a CO_{2e} of 2.77 kgCO_{2e}/kg then the cable carbon cost would be 32,553 tonnes.

Other construction materials required such as cement, aggregates and bentonite for the HDD have much lower volume and/or carbon conversion factors and as such a conservative estimate of 1,000 tonnes is utilised. There is a high quantity of rock utilised for cable protection, however it has a low associated CO_{2e} from 'production' the associated carbon is associated with transport, which will be determined by the distance from source an estimate of 150 tonnes of CO_{2e} has been utilised.

Overall around 35,000 tonnes of CO_{2e} is expected for this element of the project primarily due to the cable.

The estimated carbon cost of the HVAC cables and converter station site was previous calculated as 11,925 tonnes of CO_{2e} (NorthConnect, 2015). Assuming similar values for the Norwegian elements of the project a total CO_{2e} for construction of the full NorthConnect project is in the region of 100,000 tonnes.

9.6.2 Operation

9.6.2.1 Dust

During operation the HVDC cables will be buried and therefore there should be no dust sources on the site. No effects are predicted and therefore no further assessment is required.

9.6.2.2 Carbon Dioxide

Although NorthConnect does not produce electricity, it does facilitate the increase of renewables into the energy mix, by coupling the variable renewable energy sources such as wind, wave and tidal in the UK, to the hydropower resource of Norway. A larger proportion of renewable energy sources in the energy supply mix will reduce demand on conventional power such as oil, gas, nuclear and coal and hence contribute to reducing CO_2 emissions.

Modelling can be utilised to predict energy trading, the potential for additional Renewable Energy Systems (RES), associated CO_2 savings, and the associated financial performance of changes to the grid such as introducing new interconnectors.

The European Network of Transmission System Operators for Electricity (ENTSO-E) have developed models for Interconnectors which has been utilised for projects across Europe. The ENTSO-E model is utilised for multiple projects it is appropriately generic. It should be noted that it as does not accurately take account of the hydro-electric dominated Norwegian energy market, nor the constraints within the UK grid system.

The ENTSO-E's 10 Year Network Development Plan (ENTSO-E, 2014) considers four scenario visions for future energy generation mixes:

- Vision 1: Slowest Progress;
- Vision 2: Constrained Progress;
- Vision 3: National Green Transition; and
- Vision 4: European Green Revolution

Table 9.8 shows the ENTSO-E model outcomes in terms of additional RES that could be brought on line due to NorthConnect and the associated CO_2 savings/emissions per year (measured in 1000's of Tonnes - kT). The CO_2 lifetime savings has assumed a project lifespan of 40 years.

Table 9.1 ENTSO-E's NorthConnect Predictions from 2014 and 2016 (ENTSO-E, 2014, 2016).

Vision	Renewable Energy Systems (RES) TWh/Year		CO_2 Annual Savings (Green)/Emissions (Yellow) kT/Year		CO_2 Lifetime Savings (Green)/Emissions (Yellow) MT	
	2014	2016	2014	2016	2014	2016
1	1-1.2	0.15 ± 0.15	360-440	1500 ± 400	14.4-17.6	60 ± 16
2	0.9-1.1	0.85 ± 0.06	190-240	700 ± 300	7.6-9.6	28 ± 12
3	2.7-3.3	0.84 ± 0.17	1700-2000	900 ± 300	68-80	36 ± 12
4	2.1-2.6	0.87 ± 0.39	1500-1800	900 ± 600	60-72	36 ± 24

ENTSO-E visions in 2014 showed a CO_2 lifetime savings for all visions, I the 2016 model only visions 3 and 4 predict substantial CO_2 savings throughout the project.

The UK National Grid has also completed modelling which takes account of the specific challenges associated with UK's grid constraints. The National Gird have utilised BID3 Pöyry's power market model which incorporates sophisticated hydro modelling, which allows it to appropriately account for the Norwegian energy market. Analysis was carried out for four scenario's to identify carbon savings as detailed in Figure 9.1, the scenarios take account of different financial availability and environmental ambition (National Grid Systems Operator, 2018).

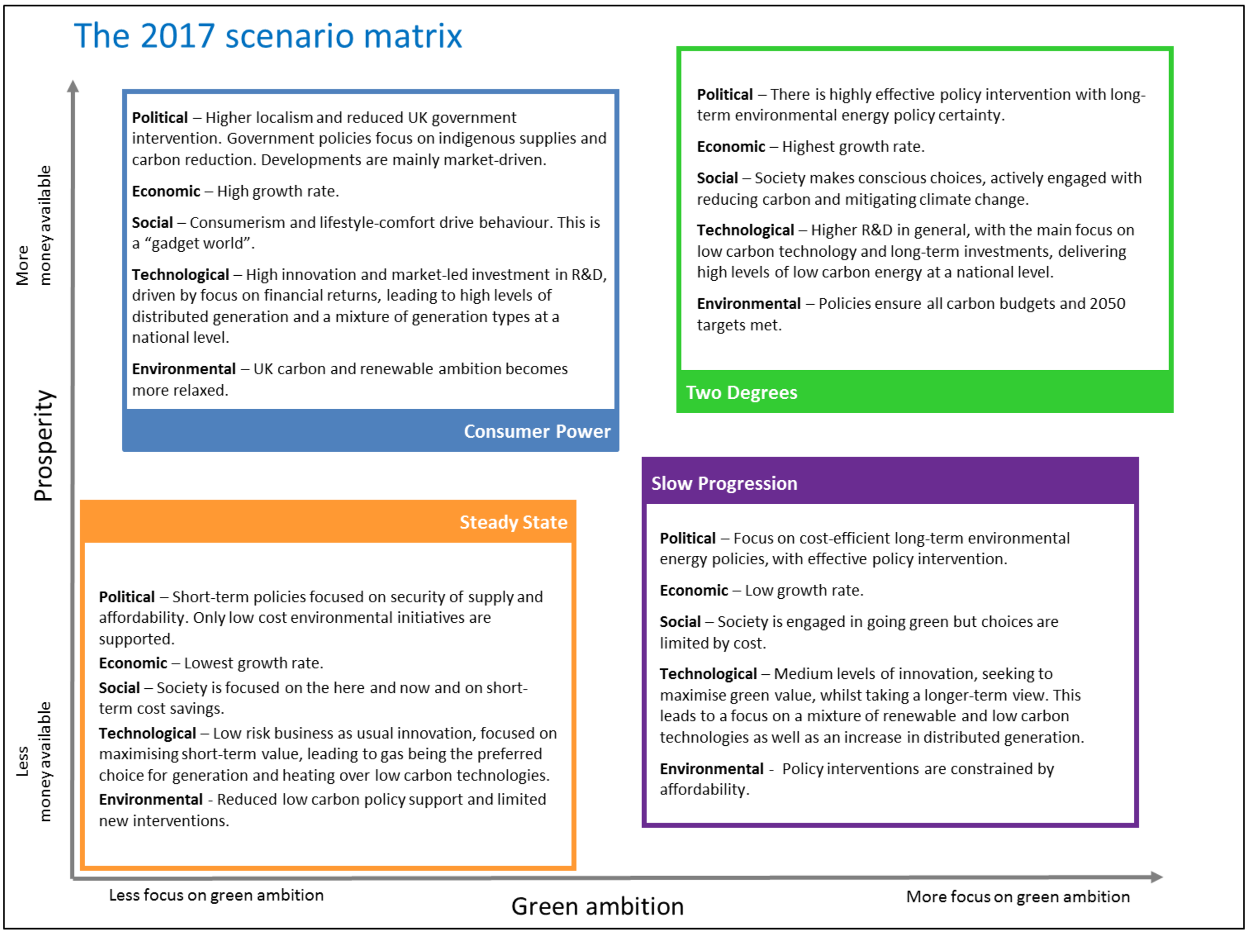

Figure 9.1: Future Energy Scenario's for National Grid Modelling (National Grid Systems Operator, 2018).

The four scenarios: Two Degrees (TD); Slow Progression (SP); Steady State (SS); and Consumer Power (CP) were then further divided for modelling, relating to predictions of a central assumption case, a wet weather case, or a dry weather case. The results of the modelling are shown in Figure 9.2 (National Grid, 2018).

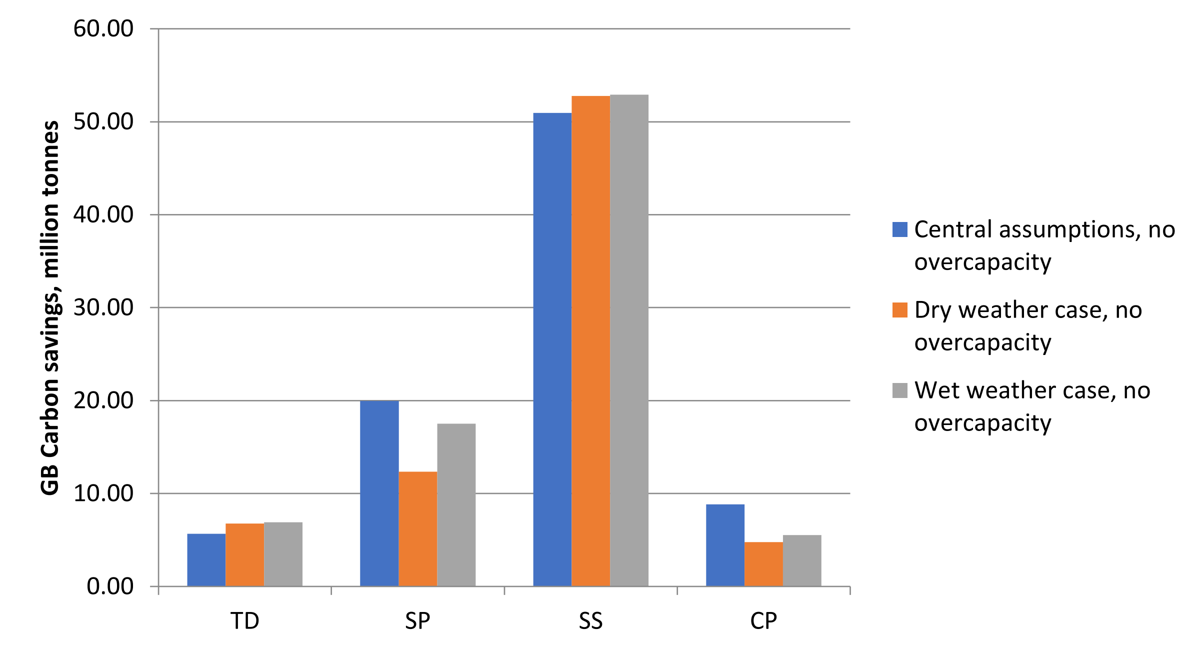

Figure 9.2: Lifetime Carbon Savings by NorthConnect Project as Predicted by National Grid Models (National Grid Systems Operator, 2018).

In all four scenarios under the National Grid modelling, the NorthConnect project has overall carbon savings, ranging from approximately 4.76 million tonnes of carbon saving, up to over 52.92 million tonnes of carbon saving.

As previously mentioned, the combined project carbon cost of construction is around 100,000 tonnes of CO_{2e}. The worst-case scenario from the National Grid modelling (4.76 million tonnes), this would result in an overall saving of 4.66 million tonnes, best case would be 52.82 million tonnes of CO_{2e} saved.

Hence overall the NorthConnect project has a **moderate to major benefit**, significant effect.

9.6.3 Decommissioning

9.6.3.1 Dust

If the onshore cable is removed at the point of decommissioning, dust effects will be similar to construction, but likely to be on a smaller scale, mitigation measures required will be equivalent to those required for construction but will be specified as required at the time.

9.6.3.2 Carbon Dioxide

The marine cable is likely to be removed from the seabed for the majority of the route, this is partly due to the value or the cable conductor. The cable would be stripped to allow the conductor (copper or aluminium) and potentially other components to be recycled. The recycling of metals utilises much less energy than virgin material as such this helps to reduce overall carbon emissions. Hence the recycling of the redundant cable at decommissioning could be seen as a carbon saving. This has conservatively not been taken account of in the overall carbon calculations for the project.

9.7 Mitigation Measures

9.7.1 Dust

A Dust Management Plan (DMP) will be developed and included within the Construction Environmental Management Document. This will detail both the monitoring and mitigation strategies. The detail of the DMP will take account of best practise included within IAQM Guidance (2014) and PPG 6: Working at Construction and Demolition Sites (SEPA, 2014).

Mitigation measures proposed for earthworks include:

- Appropriate planning to minimise the number of times material is moved and the time material is stored and ground left bare; and
- Due to the volume of materials being removed from the cable trench, it is not possible to cover stored material. The topsoil and subsoils will be separated to ensure they are reused again appropriately. The stored materials will be compacting to help reduce the amount of loose material, reducing the potential for dust.
- The material removed for the Landfall HDD work area will be utilised to create bunds around the site, vegetation will be allowed to establish on these as they will be in place for potentially over a year.
- If required, mobile water bowsers or equivalent will be utilised in dry weather conditions to damp down potential dust sources and, where possible, they will utilise runoff water (grey water) gathered on the site.

Mitigation measures to avoid trackout will include:

- Vehicles entering and leaving sites will be covered to prevent escape of materials during transport;
- The access road will be appropriately surfaced such that vehicles returning to the A90 will travel over clean stone and bituminous surfaces for at least 50m;
- Rumble strips shall be installed on the access roads at least 45m before exit onto the A90 to assist in the removal of mud from wheels; and
- Signs of track out will be monitored and if an issue arises, water-assisted dust sweeper(s) will be utilised on the A90 and bitumous section of the access roads to remove track out as necessary.

Mitigation measures for general construction activities will include but not be limited to:

- Appropriate material management as detailed in Chapter 24: Resource Usage and Waste; and
- Good housekeeping across the site.

A full monitoring plan will be developed taking account of the IAQM Guidance (IAQM, 2014) as part of the DMP, and it will include:

- Directional dust deposit gauges will be installed at least 2 weeks prior to construction works starting to gain an understanding of background dust levels;
- Directional dust deposit gauges will be utilised throughout the construction period, the frequency of change will be proportionate to the risk associated with onsite activities;
- Monitoring results will be reviewed to ensure that mitigation employed is effective and, if not, improvements made; and
- Dust Audits will be undertaken. A checklist will be utilised to ensure all issues are covered and recorded. The audit will include: material storage status; use of dust covers by delivery vehicles; inspection of the access roads and the A90; and looking for signs of surface soiling

on surfaces around site. Dust audits will be carried out more frequently in periods of dry weather and when cable trenches are open.

9.7.2 Carbon Dioxide

The lifecycle CO_{2e} for the full project is predicted to be a carbon saving, efforts will be made to maximise the benefits. The mitigation techniques identified in Chapter 24: Resource Usage and Waste to minimise material usage and maximise recycling will aid in the minimisation of the Carbon costs of construction.

The recycling of the cable at the point of decommissioning will also help to reduce the lifecycle CO_{2e} of the project.

Once NorthConnect is operational, the renewables sector will have access to additional market opportunities. This should encourage additional RES entry to the market in Scotland, potentially the wider UK and Norway. NorthConnect will continue to keep the energy sector informed of progress, such that the grid operators renewable energy developers know when the project will be coming on line so that they can maximise the benefits of the interconnector at the earliest point.

9.8 Residual Effects

9.8.1 Construction Dust

With appropriate mitigations, dust impact magnitude will be reduced to small from all sources, giving rise to **negligible, non-significant** effects on human receptors (residential properties and leisure), and **minor, non-significant** effects on the Buchan Ness to Collieston Coast SAC, the Bullers of Buchan Coast SSSI designated sites.

9.8.2 Lifecycle CO_2

The CO_{2e} cost of construction will be in the region of 100,00 tonnes. However, this is off-set by the role the project plays in allowing more renewable energy to come online replacing CO_2 emitting electricity sources, estimated to be between 4.76 and 52.92 Million tonnes. This is a **significant beneficial** effect.

9.9 Cumulative effects

The NorthConnect Convertor Station and HVDC works will have a cumulative effect on dust with the HVDC cabling element of the project. With mitigation the Convertor Station and HVDC works were identified to have negligible to minor effects due to dust. There is one residential property that could be affected by both elements of the NorthConnect project namely Highfields and leisure users of the paths around the Fourfields site could be affected by both elements, however in both instances the effects are negligible or minor with mitigation hence cumulatively it is highly unlikely they will be significant.

In addition, the whole NorthConnect project will operate under the Overarching Construction Environmental Management Plan which will outline the dust management strategy for the whole project. The specific construction element DMP's will be based on these and incorporate the requirements detailed within this chapter and the schedule of mitigation.

For NorthConnect to operate and for the potential CO_2 savings to be realised, it will require all parts of the project to be consented, constructed and operated.

9.10 Summary

The construction earthworks and track out have the potential to lead to dust effects if not mitigated. However, standard construction best practice can be utilised to mitigate dust impacts so no significant effects result.

NorthConnect has the potential to greatly reduce CO_2 emissions which is an overall positive effect of the full NorthConnect project.

Table 9.2 summarises the results of the assessment.

Table 9.2 Summary of Air Quality Effects

Receptor	Nature of Impact	Receptor Sensitivity	Impact Magnitude	Significance (Absence of Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Construction							
Residential and Leisure Users	Dust: Earthworks	Low	Large	Minor, Non-Significant	DMP Implemented	Small	Negligible, Non-Significant
Buchan Ness to Collieston Coast SAC, the Bullers of Buchan Coast SSSI designated sites; and Longhaven cliffs SWT nature reserve	Dust: Earthworks	Medium	Large	Moderate: significant	DMP Implemented	Small	Minor: non-significant
Residential - Station Farm	Dust: Trackout during enabling works and reinstatement	Low	Medium	Minor: non-significant	DMP Implemented	Small	Negligible: non-significant
Residential - Station Farm	Dust: Trackout	Low	Small	Minor: non-significant	DMP Implemented	Small	Negligible: non-significant
Lifecycle							
Climate Change	CO2 Savings		Large Positive	Moderate to Major: significant benefit	Material Optimisation Recycling of Wastes Engagement with Energy Sector	Large Positive	Moderate to Major: significant benefit

Key

	Significant Effect

9.11 References

Aberdeenshire Council. (2015). *Air Quality Updating and Screening Assessment* Retrieved from www.scottishairquality.co.uk/assets/documents//2015_USA-Final.pdf

Aberdeenshire Council. (2017). *Air Quality in Scotland Aberdeenshire Progress Report 2017*. Retrieved from http://www.scottishairquality.co.uk/news/reports?view=laqm

AQEG. (2017). *Impacts of Shipping on UK Air Quality*. Retrieved from https://uk-air.defra.gov.uk/assets/documents/reports/cat11/1708081025_170807_Shipping_Report.pdf

ENTSO-E. (2014). 10-Year Networkd Development Plan 2014.

ENTSO-E. (2016). Ten Year Network Development Plan - Project 190 Sheet 2016.

European Parliament. (2004). Directive 2004/107/EC of the European Parliament and of the Council of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air. *Official Journal of the European Union*.

European Parliament. (2008). Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe. *Official Journal of the European Union*.

IAQM. (2012). Guidance on Air Quality Monitoring in the Vicinity of Demolition and Construction Sites.

IAQM. (2014). *Guidance on the Assessment of Dust from Demolition and Construction* Retrieved from iaqm.co.uk/wp-content/uploads/guidance/iaqm_guidance_report_draft1.4.pdf

National Grid Systems Operator. (2018). NorthConnect Constraints Impact Report.

NorthConnect. (2015). NorthConnect Interconnecter Convertor Station and High Voltage Alternative Current Cable Route Environmental Statement. *2*.

Scotland Info. (2018). Scotland Weather and Climate. *Scotland Info Guide.* Retrieved from https://www.scotlandinfo.eu/scotland-weather-and-climate/

Scottish Government. (2015). *Cleaner Air for Scotland - The Road to a Healthier Future*. Retrieved from http://www.gov.scot/Topics/Environment/waste-and-pollution/Pollution-1/16215: http://www.gov.scot/Topics/Environment/waste-and-pollution/Pollution-1/16215

Scottish Parliament. (2009). Climate Change (Scotland) Act 2009.

SEPA. (2014). Pollution Prevention Guidance (PPG) 6: Work at Construction and Demolition Sites.

SEPA. (2018). Rainfall data for Scotland. Retrieved from http://apps.sepa.org.uk/rainfall/

UK Government. (1995). Environment Act.

Chapter 10: Water Quality (Onshore)

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Contents

10 Water Quality (Onshore)

10.1 Introduction

This chapter covers the assessment of potential environmental impacts on onshore water quality, of the proposed NorthConnect HVDC cable. The chapter outlines the background description of the existing hydrological conditions of the area and the potential environmental effects of the construction and operations of the development are assessed. Based on the impact assessment, appropriate mitigation measures to minimise effects are identified. The scoping phase of the EIA scoped out the requirement to assess the impacts resulting from decommissioning of the onshore HVDC cable, due to no likely significant impacts upon terrestrial water quality.

10.2 Planning and Legislative Framework

10.2.1 National Policy

The basic premises for Managing Flood Risk and Drainage in the Scottish Planning Policy (SPP)(Scottish Ministers, 2014) are that:

'…the planning system should prevent development which would have a significant probability of being affected by flooding or would increase the probability of flooding elsewhere.'

'Infrastructure and buildings should generally be designed to be free from surface water flooding in rainfall events where the annual probability of occurrence is greater than 0.5% (1:200 years).' (Medium to High Risk – annual probability of coastal or watercourse flooding is greater than 0.5% (1:200 years)).'

'Surface water drainage measures should have a neutral or better effect on the risk of flooding both on and off the site, taking account of rain falling on the site and run-off from adjacent areas.'

In addition, the SPP regarding Valuing the Natural Environment states that:

'The planning system should promote protection and improvement of the water environment, including rivers, lochs, estuaries, wetlands, coastal waters and groundwater, in a sustainable and co-ordinated way'.

10.2.2 Local Policy

It is stated in Supplementary Guidance No. 8: Flooding and Erosion, as part of Policy 8 (Layout, Siting and Design of new development) of Aberdeenshire Local Development Plan (Aberdeenshire Council, 2011) that:

'The current policy approach involves a presumption against development on any land that is at risk from flooding (such as a functional floodplain), is required for long-term managed retreat from areas at risk of flood or is at risk from erosion. Exceptions may be permitted where it can be demonstrated through an appropriate technical assessment that there is neither a medium or high risk of flooding, or it is in a location where adequate existing flood prevention measures are in place.'

Also the local planning policy Safeguarding 1: Protection and conservation of the water environment, contained within the Aberdeenshire Local Development Plan, is deemed as relevant to the current development. The aims of the policy include:

'to support the implementation of the European Commission's Water Framework Directive (European Parliament & Council, 2000); to contribute to the Scotland District River Basin Plan (Scottish

Government, 2015); to promote the enhancement of the water environment and the creation of good quality riparian habitat; and to provide protection to Aberdeenshire's aquatic environment from new development that could result in unacceptable ecological impacts'.

10.2.3 Regulatory Framework

10.2.3.1 The Water Framework Directive / Water Environment and Water Service (Scotland Act 2003)

The EU Water Framework Directive (WFD) (European Parliament & Council, 2000) established a comprehensive legal framework for the protection, improvement and sustainable use of all water bodies across Europe. The remit of the WFD extends to all rivers, canals, lochs, estuaries, wetlands, coastal waters and groundwater. It requires the development of River Basin Management Plans to prevent deterioration of the status of water bodies and to achieve a 'good' status for surface waters and groundwaters within 15 years of the directive being implemented.

The WFD was transposed into Scottish Law through the Water Environment and Water Services (WEWS) (Scotland) Act 2003 (as amended). The core objective of the WEWS Act is to protect and improve Scotland's water environment. This includes preventing deterioration in the status of water bodies and, where possible, restoring surface waters and groundwater damaged by pollution, water abstraction, dams and engineering activities.

10.2.3.2 The EU Floods Directive / Flood Risk Management Act (Scotland 2009)

The Flood Risk Management (Scotland) Act 2009 (Scottish Government, 2009) transposes the EU Floods Directive (European Parliament & European Council, 2007) into Scottish law, and creates a new and more sustainable approach to assessing and managing flood risk management across Scotland.

Under this act flooding risk to a development must be assessed and mitigated if necessary. Furthermore, the downstream effects must also be considered, including increased flooding risks due to increased discharges arising from a development.

10.2.3.3 The Water Environment (Controlled Activities (Scotland)) Regulations 2011 (as amended)

The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) (CAR) is intended to control activities which have the potential to cause pollution to the water environment. Such activities are controlled at three different levels depending on the potential risks and these are:

- General Binding Rules (GBRs) – cover low-risk activities for which there is no need to contact the Scottish Environment Protection Agency (SEPA). However, a person undertaking an activity controlled by the GBRs must abide by any rule in the regulations which is applicable to the activity;
- Registration – also covers low-risk activities, but those which may cause a cumulative risk to the water environment. Such activities must be registered with SEPA, who may impose conditions but only so far as to describe the activity; and
- Licensing – for higher risk activities which require site-specific rules, or where constraints on an activity are required. Such activities will be regulated through a CAR license which must be sought through SEPA.

10.2.3.4 The Control of Pollution Act 1974

Part 2 of the Control of Pollution Act (UK Government, 1974) defines a number of offences relating to water pollution. Specifically, section 30F states that:

'A person contravenes this section if he causes or knowingly permits any poisonous, noxious or polluting matter or any solid waste matter to enter any controlled waters.'

As such, any deliberate or reckless release of a pollutant into the water environment is an offence under the act and is liable to prosecution.

10.2.4 Guidance

Multiple Pollution Prevention Guidelines (PPGs) and Guidance for Pollution Prevention (GPPs) have been produced by SEPA in collaboration with other UK environmental protection agencies. These guidance's provide comprehensive environmental management across a range of areas. These include:

- PPG 1: Understanding your environmental responsibilities – good environmental practices (NIEA, SEPA, & Environment Agency, 2013);
- GPP 2: Above ground oil storage tanks (NIEA, SEPA, & Natural Resources Wales, 2017b);
- GPP 5: Works and maintenance in or near water (NIEA, SEPA, & Natural Resources Wales, 2017c);
- PPG 6: Working at construction and demolition sites (NIEA, SEPA, & Environment Agency);
- PPG 7: Safe storage – The safe operation of refuelling facilities (NIEA, SEPA, & Environment Agency, 2011a);
- GPP 8: Safe storage of and disposal of used oils (NIEA, SEPA, & Natural Resources Wales, 2017a);
- PPG 18: Managing fire water and major spillages (SEPA, Environment Agency, & Environment and Heritage Service);
- GPP 21: Pollution incident response planning (NIEA, SEPA, & Natural Resources Wales, 2017d);
- PPG 22: Incident response – dealing with spills (NIEA, SEPA, & Environment Agency, 2011b); and
- Engineering in the Water Environment: Good Practice Guide Temporary Construction Methods (SEPA, 2009).

10.3 Assessment Methodology

This assessment has been undertaken primarily using a qualitative approach based on analysis of data and statutory or general guidance, combined with professional judgment. The assessment follows the methodology provided within Chapter 3: Methodology.

10.3.1 Baseline Data Collection

An Otter *(Lutra lutra),* Water Vole *(Arvicola amphibius)* and Eurasian Badger *(Meles meles)* survey was conducted for the Environmental Impact Assessment of the NorthConnect Interconnector Converter Station and High Voltage Alternating Current Cable Route on the 29th of September 2014 by Tracks Ecology (Bunyan, 2014). The walkover survey identified and assessed indirectly aquatic habitats quality as Water Vole and Otter have specific aquatic habitat requirements (Moss, 1998). In 2017 a further Otter, Water Vole and Eurasian Badger survey were conducted for this EIAR by Tracks Ecology, which indirectly assessed the quality of identified aquatic habitats of the HVDC cable route (Bunyan, 2017). In addition, a desk-based literature review was undertaken to further establish the baseline conditions, and this included use of the SEPA's interactive map to identify the status of water bodies.

10.3.2 Impact Assessment Methodology

10.3.2.1 Magnitude of Impact

The magnitude of impact takes into account change to the baseline conditions resultant from a given effect. It considers the level of change of the baseline conditions, value of the hydrological feature and duration of the effect upon the receptor prior to recovery. Definitions for a range of hydrological elements are set out in Table 10.1.

Table 10.1: Definitions of Magnitude of Impact

Magnitude of Impacted of Impact	Examples of Impact Magnitude
High	Material reduction in water quality. Characteristics may include: • Significant diffuse pollution. • Ecological impact e.g. fish deaths. • Medium to long-term impacts.
Medium	Reduction in water quality. Characteristics may include: • Minor diffuse pollution. • Measurable changes in water quality. • Minor harm to the ecosystem. • Reversible with no long-term impacts.
Low	Small changes to the water quality. Characteristics may include: • Localised pollution incident with reversible effects. • Potential visible signs of pollution. • No medium-term impacts. • No impacts on the ecosystem.

10.3.2.2 Likelihood of Impact Occurring

The likelihood of an impact occurring is also assessed. A qualitative approach is taken to predict the likelihood of an impact based on the probability of an impact occurring and professional judgment rather than data frequency. In this chapter, the likelihood categories are displayed in Table 10.2 with their definition. The likelihood of any effect occurring is described in the impact characterisation text.

Table 10.2: Likelihood Categories and their Definitions.

Likelihood	Definition
Certain/near-Certain	> 1 in 1 year
Probable	< 1 in 1 year but > 1 in 10 years
Unlikely	< 1 in 10 years but > 1 in 100 years
Extremely Unlikely	< 1 in 100 years

10.3.2.3 Significance of Effect

The significant of effect is derived by considering the magnitude of impact and probability of the impact occurring. Determination of whether the identified effect was categorised as significant or non-significant utilised the matrix set out in Table 10.3.

Table 10.3 Significance of Effects Matrix.

Magnitude of Impact	Probability			
	Certain	**Probable**	**Unlikely**	**Extremely Unlikely**
High	Major	Moderate	Moderate	Minor
Medium	Moderate	Moderate	Minor	Negligible
Low	Minor	Minor	Negligible	Negligible

Key

(orange)	**Significant Effect**
(blue)	**Non-Significant Effect**

10.3.2.4 Identification and Assessment of Mitigation

Mitigation measures have been identified in line with best practice to prevent, minimise and mitigate impacts are discussed in Section 10.6.

10.3.2.5 Assessment of Residual Effects

Where mitigation has been identified, the magnitude of the impact will be reassessed as per Table 10.1 to 10.3, to understand the resultant residual effect.

10.4 Baseline Information

10.4.1.1 Surface Water Hydrology - Waterbodies

Figure 10.1 details identified waterbodies within the vicinity of the proposed HVDC project. There is a small pool (Waterbody 1), to the north of Fourfields. Waterbody 1 was manmade for fishing and is approximately 175m long and 75m wide with a small vegetated island. To the east of Waterbody 1 lie five smaller water bodies (Waterbody 2). Waterbody 2 consists of multiple settlement lagoons utilised for water treatment from the operational quarry. The lagoons are steep-sided and lined with coarse rock armour which has been colonised by vegetation (Bunyan, 2017).

Waterbody 3 to the east of Fourfields is a 20m long and 8m wide agricultural pond with agricultural drains entering the south eastern corner. Waterbody 4 lies approximately 90m north-north-west of the Landfall Horizontal Directional Drilling (HDD) area and approximately 60m east of the proposed onshore cable corridor. Waterbody 4 was likely to have been formed through natural infilling of a disused quarry. Surrounded by steep cliff edges, only limited vegetation surrounds the waterbody, dominated by tall herbs and some scrubs and the water depth is unknown (Bunyan, 2017). Approximately 300m south-south-west from the proposed landfall HDD area lies Waterbody 5. Waterbody 5 also appears to be an old quarry that has overtime filled with water and it also has steep rocky sides (Bunyan, 2014).

10.4.1.2 Surface Water Hydrology – Watercourses

Along the onshore HVDC cable route lie multiple watercourses (Figure 10.1). The watercourses were identified and assessed by the Otter, Water Vole and Badger surveys conducted in 2014 and 2017. Surveys concluded that the watercourses are agricultural drains dominated generally by low levels of water (Bunyan, 2017).

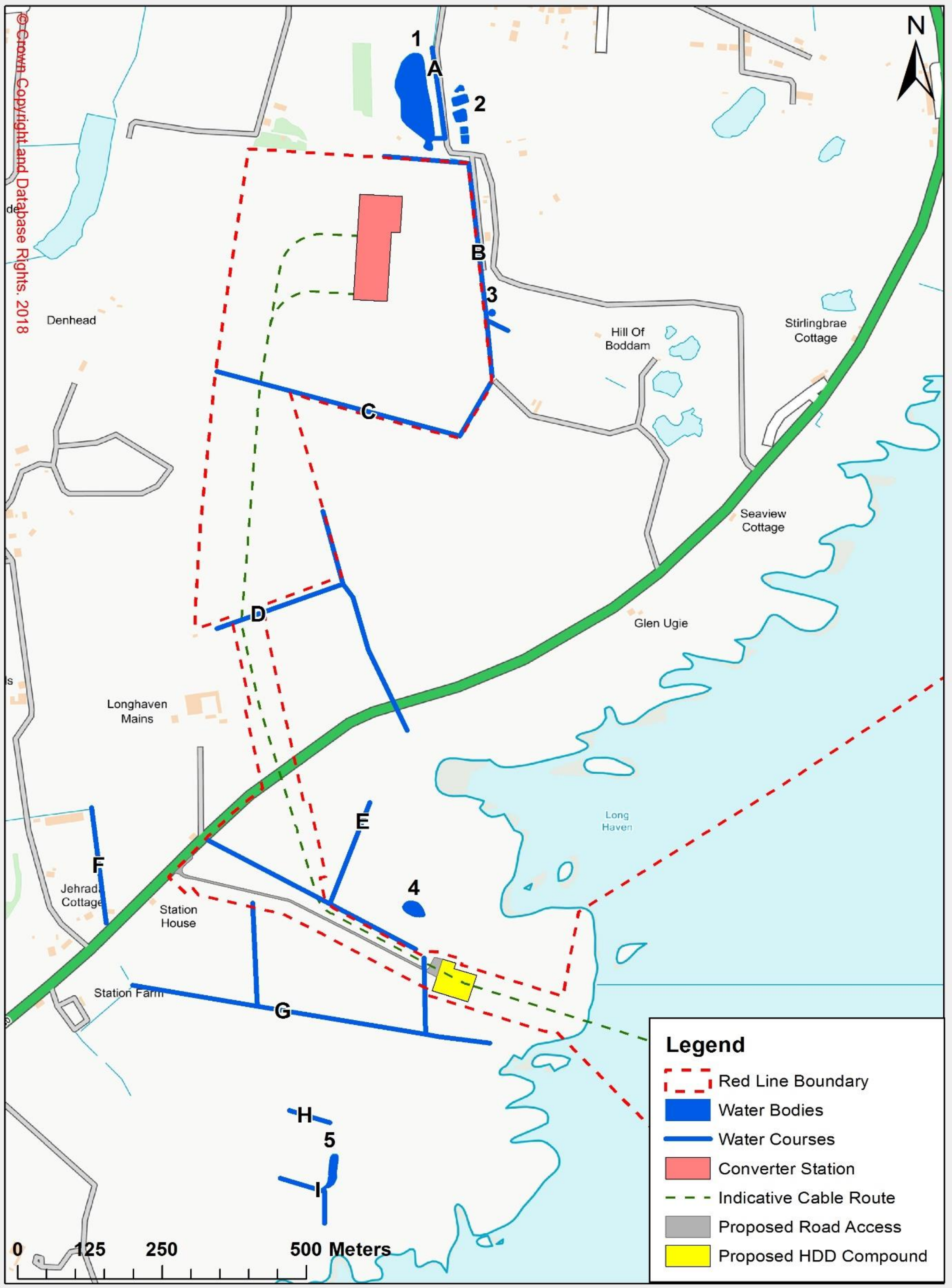

Figure 10.1: Locations of waterbodies, watercourses opposed HDD site, converter station and HVDC cable route.

Watercourse B and Waterbody 1 both flow into Watercourse A (see Figure 10.1), which flows north towards Lendrum Terrace where it passes under a public road via a culvert and appears to join the

Millbank Burn approximately 200m north of Lendrum Terrace. Watercourse B includes 2 branches, one running north along the eastern edge of the Fourfields site, and the other running east along the northern edge of Fourfields, both discharging into Watercourse A. Watercourse B was of low water depth, < 10cm when surveyed. The watercourse consists of steep sides with banks extending a maximum of 2.5m. Watercourse B has connectivity with Waterbody 3.

Watercourse C contained gravel substrate and, during the survey, no water was identified in this agricultural drain. Watercourse D is an agricultural drain with an approximate depth and width of 1m. Watercourses E and G are heavily covered by vegetation (Bunyan, 2017). The HVDC Cable will cross Watercourses C, D, E and G.

10.4.1.3 Surface Water Quality

The small nature of all identified waterbodies and watercourses mean that none are classified by SEPA. No obvious signs of pollution have been observed on site visits in any of the watercourses. There are no industrial discharges into any of the watercourses. Surface water runoff into the watercourses could wash in agricultural pollutants such as pesticides and herbicides, and, when fields are ploughed there could be silts and soils reaching watercourses.

Waterbody 2 is utilised for water treatment by the quarry and, as such, will have increased suspended solids loading. The other waterbodies showed no sign of pollution.

10.4.2 Flooding

As part of an initial Flood Risk Screening exercise, a visual inspection of the site has been undertaken. There has been no evidence of flooding of the drainage ditches along the onshore HVDC cable route and HDD site, however, the SEPA Floodmap (SEPA, 2017) shows Watercourse B as having a medium likelihood of flooding, which is defined as having a 0.5% probability of occurring in any given year (often expressed as a 1-in-200-year event), but not spreading into the Fourfields construction area. No other watercourses discussed in Section 10.4.1.2 were identified as having a likelihood of flooding (SEPA, 2017).

The entire cable route and Landfall HDD site fall within the Potentially Vulnerable Area PVA 06/08 Buchan Coastal, as shown on SEPA's Local Plan Districts and Potentially Vulnerable Areas - North East (SEPA, 2016). River flooding has been associated with the Millbank Burn and, in addition, there is a surface water flood risk in the Stirling village and Boddam area. Lendrum Terrace has flooded in recent years (SEPA, 2016).

10.4.3 Identification of Receptors

The potential hydrological receptors have been identified as watercourses and waterbodies which can be considered to receive any surface water, or which might be physically affected by the HDVC cable route (e.g. surface water runoff). All watercourses and waterbodies discussed above can be considered as potential receptors, except for the waterbodies and watercourse that were either a large distance away, or uphill, from the proposed cable route, namely Waterbodies 2 and 5 and Watercourses H and I.

10.5 Impact Assessment

Impacts on water quality will occur through either a direct physical disturbance of a watercourse, or through pollution events. These could take place during the construction phase, or during operation of the cable where maintenance works are required. Impacts on water quality arising during decommissioning were not assessed.

10.5.1 Construction

10.5.1.1 Release of Hazardous Substances

As identified in Chapter 24: Resources Usage and Waste, there will be fuel, oils and chemicals stored on site which, if released, could be harmful to the environment. It is assumed that they will be appropriately stored and utilised as detailed in Chapter 24, however, there is still a risk of loss of containment. The harm caused will be determined by the material involved and the volume reaching the aquatic environment.

The Landfall HDD site location as shown in Drawing NCGEN-NCT-Z-XD-0001-01 is 10m from Watercourse G. The indicative layout of the site (see Figure 2.10 in Chapter 2: Project Description) includes soil bunding to the south of the site, which will provide a physical barrier between the Landfall HDD works area and Watercourse G. The bund in effect breaks the pathway between the Landfall HDD works area and the stream. In addition, the fuel and storage areas are a distance away from Watercourse G.

Onshore trenching operations will require hydrocarbon-based fuels and hydraulic fluids to power required machinery. The mobile diesel storage tank(s) are the largest potential contaminating source, holding approximately 5m^3 of diesel.

As discussed in Chapter 24: Resource Usage and Waste, the fuel bowser will be under strict management controls to prevent pollution incidents. Where practicable, bio-degradable hydraulic fluids will be utilised in machinery and oils and chemicals will be subject to Control of Substances Hazardous to Health (COSHH) assessments, including environmental considerations and be appropriately stored. Spill kits and procedures will be in place.

The Landfall and Road Crossing HDD will utilise drilling fluid. It is assumed the drilling fluid bentonite will be used. Bentonite consists of a mixture of water and naturally occurring non-toxic clay. Additives like natural occurring xanthum gum and gypsum on occasions may be added to bentonite to improve the efficiency of the fluid (Sigma-Aldrich, 2012) and, in addition, Caustic Soda may be utilised as a pH modifier ((Riggall, 2017) provided as Appendix B.1).

Alternatives available to bentonite include Ecodrill and PureBore. Ecodrill is a silicate-based fluid that may also be utilised. Ecodrill does pose some environmental implications for aquatic environments where large volumes are released in an undiluted or unnaturalised state. The high pH of the fluid may affect the localised water quality by increasing the pH of the water (Silicates, 2012). Ecodrill, if utilised, would be diluted prior to use.

PureBore is similar to Ecodrill, in that it is a silicate-based fluid. It differs from bentonite and Ecodrill by having a lower pH, ranging from 6.5 to 8.5. Adaptation of PureBore pH sees Soda ash (sodium carbonate Na_2CO_3) being added to freshwater prior to mixing with concentrated PureBore, resulting in a neutral pH of the drilling fluid (Clear Solutions, 2018).

The drilling fluid will be appropriately stored, with the volume of drilling fluid minimised by recycling, as detailed in Chapter 2: Project Description. Spill kits and procedures will be in place with operatives' suitability trained. Spent drilling fluid will be tankered offsite for disposal. Even if drilling fluids are non-toxic they have a high solids loading which can increase suspended solid loadings and solids 'dropping out' of suspension can cover the stream beds, discolouring the water and reducing the ecological value of the watercourse or waterbody.

There may be a requirement for some in-situ concrete pouring for the Joint Pits. If required, it is likely that there will be cement washings arising. Cement washings can negatively affect water quality, if they reach the aquatic environment due to their high pH and solids content.

So, a discussed in Chapter 24: Resource Usage and Waste any equipment utilised for cement pouring will be washed out only at a designated area, designed to contain wet concrete/wash water, and the waste water arising will be appropriately treated prior to disposal.

The assessment utilises the source, pathway and receptor model, with the receptors being the watercourse and waterbodies discussed in Section 10.4.3. The assessment assumes compliance with the CAR GBR and the planned mitigation measures discussed above being in place (other than spill kits and procedures, which are an emergency mitigation measure only). Assuming that spills will not be contained and prevented from entering the watercourses by site personnel, is a pessimistic assumption for the purpose of assessment.

Table 10.4 provides an assessment of potential likely pollution risks upon the identified receptors.

Table 10.4: Loss of Hazardous Substances Impact Assessment

Source	Scenario	Pathway	Receptor	Probability	Impact Magnitude	Effect Significance
Fuel Storage bowser ($5m^3$ of diesel)	Catastrophic Failure - Loss of entire contents (upto $5m^3$).	Spillage to ground with the potential to reach water.	Waterbody 3	Extremely Unlikely Due to the distance from cable installation operations (approximately 2km)	Medium	Negligible: Non-Significant
			Waterbody 4	Unlikely Due to the distance from cable installation (approximately 90m)		Minor: Non-Significant
			Watercourse B	Extremely Unlikely Due to distance to from cable installation (approximately 200m)		Negligible: Non-Significant
			Watercourse C	Unlikely Fuel bowser will be kept a minimum of 10m from the watercourse.		Minor: Non-Significant
			Watercourse D	Unlikely Fuel bowser will be kept a minimum of 10m from the watercourse.		Minor: Non-Significant
			Watercourse E	Unlikely Fuel bowser will be kept a minimum of 10m from the watercourse.		Minor: Non-Significant
			Watercourse G	Unlikely Fuel bowser will be kept a minimum of 10m from the watercourse.		Minor: Non-Significant
Refuelling Activities	Loss of fuel during refuelling (up to 360l of diesel).	Spillage to the ground with the potential to reach water.	Waterbody 4	Unlikely	Medium	Minor: Non-Significant
			Watercourse B	Extremely Unlikely Due to the distance from cable installation operations (approximately 200m)		Negligible: Non-Significant
			Watercourse C	Unlikely Fuel bowser will be kept a minimum of 10m from the watercourse.		Minor: Non-Significant
			Watercourse D	Unlikely Fuel bowser will be kept a minimum of 10m from the watercourse.		Minor: Non-Significant

Source	Scenario	Pathway	Receptor	Probability	Impact Magnitude	Effect Significance
Refuelling Activities	Loss of fuel during refuelling (up to 360l of diesel).	Spillage to the ground with the potential to reach water.	Watercourse E Watercourse G	Unlikely Fuel bowser will be kept a minimum of 10m from the watercourse.	Medium	Minor: Non-Significant
				Unlikely Fuel bowser will be kept a minimum of 10m from the watercourse.		Minor: Non-Significant
Machinery Hydraulic Fluids	Loss of hydraulic fluids due to pipe rapture (< 22l).	Spillage to the ground with the potential to reach water.	Watercourse B	Unlikely Due to the distance from cable installation operations (approximately 200m).	Low	Minor: Non-Significant
			Watercourse C	Probable Hydraulic pipes fail from time to time and work is in the immediate vicinity.		Minor: Non-Significant
			Watercourse D	Probable Hydraulic pipes fail from time to time and work is in the immediate vicinity.		Minor: Non-Significant
			Watercourse E	Probable Hydraulic pipes fail from time to time and work in the immediate vicinity.		Minor: Non-Significant
			Watercourse G	Probable Hydraulic pipes fail from time to time and work in the immediate vicinity.		Minor: Non-Significant
COSHH Store and general activities: hydraulic fluids, maintenance oils, chemicals.	Loss of containment during storage, handling, equipment maintenance and HDD operations.	Spillage to the ground with the potential to reach water.	Waterbody 4	Unlikely Due to the distance to storage on HDD site (approximately 90m). Contents will be appropriately stored and handled.	Medium	Minor: Non-Significant
			Watercourse E	Unlikely Due to the distance to storage on HDD site (>10m). Contents will be appropriately stored and handled.		Minor: Non-Significant
			Watercourse G	Unlikely Due to the distance to storage on HDD site (>10m). Contents will be appropriately stored and handled.		Minor: Non-Significant

Source	Scenario	Pathway	Receptor	Probability	Impact Magnitude	Effect Significance
HDD Drilling Fluids Landfall HDD and Road Crossing HDD entrances.	Loss of drilling fluid during HDD operations.	Spillage to the ground with the potential to reach water.	Waterbody 4	Unlikely Due to the distance to from HDD (>10m).	Medium	Minor: Non-Significant
			Watercourse E	Unlikely Due to the distance to from HDD (>10m).		Minor: Non-Significant
			Watercourse G	Unlikely Due to the distance to from HDD (>10m).		Minor: Non-Significant
Cement Wash	Cement washings	Spillage to the ground with the potential to reach water.	Watercourse C	Unlikely Due to the distance from Joint Pit 2 (approximately 30m) and no cement washing occurring within 10m of an aquatic environment.	Medium	Minor: Non-Significant
			Watercourse E	Extremely Unlikely Due to the distance to from Joint Pit 1 at A90 (approximately 70m) and no cement washing occurring within 10m of an aquatic environment.		Negligible: Non-Significant

10.5.1.2 Surface Water Runoff

Surface water run-off from construction sites greater than 4 ha require a complex CAR licence and, as part of the application process, there is a need to submit a Pollution Prevention Plan. It can therefore be assumed that a CAR licence and Pollution Prevention Plan will be in place.

The removal of top and subsoil giving rise to exposed soils, and also the storage soils, can both act as a source of silt-laden water in wet weather and dust in dry weather. Impacts associated with dust are discussed in Chapter 9: Air Quality. In wet weather, water running over exposed soil or soil stockpiles will collect silt and become silt-laden. If silt-laden water were to reach either a water course or a waterbody, it would reduce the water quality. Silt can increase suspended solid loadings and solids 'dropping out' of suspension can cover the stream beds, discolouring the water and reducing the ecological value of the watercourse or waterbody.

Each of the phases of work that could give rise to silt laden waters are discussed in turn below, as each element could pose a risk to different watercourses and waterbodies, due to the location of the works.

Enabling Works

During enabling works, the HDD access road will be formed and will require top soil to be stripped, and then sub-base and sections of tarmac to be placed. The sub-base will be compacted or rolled into place to allow it to take heavy loads and this will minimise its potential to act as a dust/silt source. The topsoil removed will be retained to allow the road to be reinstated once the construction works have been completed. It is proposed that where viable the topsoil is removed as 'turf' with the soil underneath requiring removal then be moved on to a prepared area. The prepared area will be adjacent to the access road, and preparation may include the laying of a geotextile layer. Once the excavated topsoil has been bunded any turf removed will be laid on top. This will allow the turf to be retained and used for reinstatement where practicable and assist in covering the soil to minimise the risk of silt laden waters.

The access road crosses Watercourse G (the crossing is discussed in Section 10.5.1.3) and, as such, during the stripping process, there is a **probable** likelihood that when it rains, surface water runoff could enter Watercourse G. This would give rise to a **medium** magnitude of impact giving rise to a **moderate, significant impact.**

Earthworks for the HDD site working platform are also required. This will require soil to be stripped and stored in the form of bunds that are approximately 3.5m wide, and the bunds will be turfed in a similar way as described for the access road. Where there is not enough turf to cover the stored soils, the bunds will be bladed off or other suitable means to reduce the potential for dust and silt run-off. The HDD site working platform will be surfaced with stone to provide an appropriate working base, this will be compacted or rolled, minimising the source of dust and silts. The long distance (approximately 90m) between the HDD site and Waterbody 4 reduces the likelihood of silt-laden surface water runoff entering the waterbody. Therefore, the impact from surface water runoff from the HDD setup on Waterbody 4 is assessed as **extremely unlikely, low** magnitude impact, resulting in a **negligible, non-significant effect.**

Watercourse E and G are closer to the HDD site and, although the likelihood of silt laden water reaching them is higher, however in most instances it is **unlikely** and would give rise to **medium** magnitude impacts, resulting in a **minor: Non-significant effects**. However, during the creation of the southern bund before the turf is placed, or other surface stabilising takes place, there is a **probable** likelihood of a **medium** magnitude of effect on Watercourse G due to the large source of sediments associated with the uncovered soils. This would give rise to a **moderate, significant effect.**

Cable Installation

The installation of the cable will require trenches and joint pits to be dug, with the excavated material stored for use as backfill once the cables have been installed. The material will be handled as described for enabling works, with the earth being placed onto a prepared areas (most likely in linear bunds along the length of the cable) and bladed off to minimise the potential source of silt associated with the stored material. The open trenches, including joint pits, will however remain a source of silt. Surface water, where practicable, will be routed away from the stored material and the trenches. This may require field drainage channels or pipes to be installed, the design of which would be captured in the Pollution Prevention Plan.

Depending on the soil types, the water table levels along the cable route and the weather conditions, rainwater may soak away into the ground and, as such, not give rise to silt laden water, or it may pool within or run along the trench. As shown in Drawing NCGEN-NCT-Z-XE-0003-01, there will be concrete waterstops at least every 100m along the trenches, with more in steep areas. This will prevent water flowing over long stretches of the trench picking up solids. There is a potential in some areas of the cable route that groundwater levels will be higher than the base of the trench and, as such, groundwater may also be present in the trenches. If water is collecting in the trenches and needs to be removed to facilitate cable installation, an area next to a waterstop trench will be dug slightly deeper to allow water to collect and settle, prior to the water being pumped out and discharged appropriately. Depending on the quantities of surface water, the presence of groundwater and the exact location in relation to the groundwater dependant ecosystems (Chapter 13: Terrestrial Ecology), dewatering of the trenching works may fall under the GBR15 of CAR and, hence, these will be complied with. Alternatively, it will be incorporated within the construction CAR licence and associated Pollution Prevention Plan.

The cable route crosses Watercourses C, D, E and G, the crossings of which are discussed in Section 10.5.1.3, however, due to their close proximity to the trench earthworks it is **probable** that they could be contaminated with silt laden water, and the resultant magnitude of impact could be **medium** giving rise to a **moderate, significant** effect.

10.5.1.3 Temporarily Modification of Aquatic Environments

Enabling Works

The temporary access road crosses Watercourse G twice, as shown in NCGEN-NCT-Z-YX-0002-01. Temporary culverted bridges will be installed to facilitate the crossings. These will be less than 5 metres wide and 10m long and, as such, CAR *GBR6: Construction and Maintenance (or removal) of a temporary bridge over a river, burn or ditch that has a channel width of less than 5 metres (SEPA, 2018)* is applicable. If there is flow in the drainage channel when works are planned, then dams will be installed up and downstream of the crossing point to allow it to dry out. The water will be pumped from upstream of the crossing point to downstream of the crossing point, such that flows up and downstream of the crossing point are maintained as far as practicable. Vegetation clearance will be minimised. The culvert will be installed and road laid. Prior to the removal of the dams, the culvert will be cleared of loose material. The probability of the works occurring is **certain,** the associated impacts are expected to be **low** giving rise to a **minor, non-significant** effect.

Cable installation

There will be 4 watercourse crossings along the route (Watercourses C, D, E and G). The watercourses are all relatively minor. The watercourse will be dammed to allow the crossing point to dry out. The water will be pumped from upstream of the crossing point to downstream of the crossing point, such that flows up and downstream of the crossing point are maintained as far as practicable. Vegetation clearance will be minimised. The cable trench shall be dug, ducts inserted, or cables laid directly in the ground, then the stream will be reinstated, and the dams removed to allow the stream to return to previous condition. Prior to removal of the dams, loose material will be removed as far as practicable and temporary silt fences installed at the end of the working area to prevent silt spreading downstream. Therefore, the impact is assessed **certain**, **low** giving rise to a **minor, non-significant** effect.

To provide access for cable installation, a temporary haul road adjacent to the cable trench will be installed. This will utilise culverted crossings (across Watercourses C,D,E and G) equivalent to those installed through the enabling works. The probability of the works occurring is **certain** the associated impacts are expected to be **low** giving rise to a **minor, non-significant** effect.

These engineering works to temporarily alter the watercourses during cable installation are likely to require a simple licence under the CAR regulations, and this is likely to be incorporated within the Construction CAR licence and associated Pollution Prevention Plan.

10.5.1.4 Flood Risk

As detailed in Section 10.3.2, Watercourse B was identified to have a medium risk on the SEPA Flood Map. The cable route and HDD site also fall within the Potentially Vulnerable Area PVA 06/08 Buchan Coastal (SEPA, 2016).

To the southeast of the A90, the new access roads and HDD works site will give rise to temporary additional areas of hardstanding. An area has been allowed for within the HDD works site to manage surface water and, if required, this would be detailed in the Pollution Prevention Plan supporting the Construction CAR licence.

The fields to the southeast are known to get saturated in winter and there is a potential for local pooling of water. To the northwest of the A90, the haul road will be the only additional hardstanding area. The main fields are generally on a slope, but water does collect where it drains off. No increase to flooding is expected from the cable installation on the fields to the northwest.

There are field drains both sides of the A90, however it would appear that these have not been maintained in recent years. During the works where, local field drains are encountered they will be maintained and where necessary replaced. This will be addressed through the Construction CAR licence and associated pollution prevention plan.

Within Fourfields, which the closest point to Watercourse B, there is a potential that groundwater will be incurred during the installation of the cable ducts (see Chapter 8: Geology and Hydrogeology). This will need to be appropriately managed as part of the wider converter station enabling works activities as discussed in Chapter 8. The cable duct installation will not give rise to an increase in flood risk in its own right.

10.5.2 Operation and Maintenance

Since the HVDC cable will be buried along its length from the landfall to the proposed converter station, no ongoing effects on water quality are expected during normal operation. Maintenance and repair work to the cable may be required during its lifetime. This will result in similar risks to water quality as those described for construction, however, these will only persist for the duration of the maintenance works and be of a much smaller scale. Operations will not give rise to any increase to flooding risk.

10.6 Mitigation Measures

Significant effects were identified for surface water run-off, hence, specific mitigation measures for this are discussed in Section 10.6.2. In addition to this, mitigation measures will be employed in line with best practice to minimise risks.

10.6.1 Release of Hazardous Substance

Although not taken account of within the assessment process, an appropriate spill response plan will be put in place, and this will align with the pollution prevention hierarchy, with prioritised as follows:

- Stop the source of the pollution;
- Interrupt any pathways to the environment;
- Report the incident in as much detail as possible to site management and the ECoW;
- Clean the contaminated area and recover pollutants; and
- Analyse the event to prevent further incidents.

The spill response plan will take account of the specific site inventory and risks. Appropriately specified and sized spill kits will be made available and operators will be trained in their use.

Spill kits will be available for use during refuelling activities and appropriate drip trays utilised for in-situ refuelling activities. Refuelling will only be carried out by trained operatives in accordance with site procedures.

It will be ensured that site personnel are trained in the spill response plans and activities through regular toolbox talks, drills and safety briefs.

10.6.2 Surface Water Runoff

In addition to the creation of a Pollution Prevention Plan to support the Construction site CAR licence application, the Risk Assessments and Method Statements for the construction of the temporary road, HDD works site, cable trenches and joint pits will detail how surface water is to be managed.

The RAMS will be developed to ensure appropriate steps are taken to prevent pollution and silt issues arising during the works. Particular regard will be made to Guidance for Pollution Prevention 5: Works and maintenance in or near water (GPP 5) (NIEA et al., 2017c) and applicable CAR GBR’s. In accordance with Engineering in the Water Environment: Good Practice Guide Temporary Construction Methods (SEPA, 2009), the three following principles will be followed:

- Divert clean water away from exposed soils and working areas;
- Minimise erosion of exposed soils; and
- Prevent contaminated water from entering watercourses untreated.

Silt fences or equivalent (straw bales) will be utilised in the vicinity of watercourses to prevent silt laden water reaching the watercourses. There will be regular checks to ensure that silt fences are appropriately sited and working effectively.

10.7 Residual Effects

Effective implantation of the proposed mitigation measures will reduce the magnitude of all potential impacts to **Non-Significant**, as detailed in Table 10.5.

10.8 Cumulative Effects

There is the potential to have cumulative effects with the NorthConnect Converter Station and HVAC cabling, specifically for the cable installation works within the Fourfields site. The HVDC cable ducts will be installed as part of the converter station enabling works. The Environmental Statement (ES) from the NorthConnect Converter Station identified similar potential impacts arising from the development as were identified in this chapter, but with similar mitigation as that identified here, the resultant effects were negligible to minor, not significant. Hence no cumulative significant effects are expected.

10.9 Summary of Effects

The chapter assessed the potential impacts posed by construction and operation of the NorthConnect onshore HVDC cable infrastructure on onshore water quality. Table 10.5 details the summary of effects identified. The assessment identified no significant effects on onshore water quality during the construction or operation phase of the development with mitigation in place. Effects on water quality due to decommissioning of the project were not assessed.

Table 10.8 Summary of Onshore Water Quality Effects

Aspect	Phase	Predicted Impact	Probability	Receptor	Impact Magnitude	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Fuel Storage bowser (up to 5m³ of diesel)	Construction	Loss of pollutant from fuel storage bowser (approx. 5m³ of diesel) with the potential to reach water. Diesel in water increases total organic carbon and form an impregnable layer on top of the water column, reducing oxygen availability by preventing oxygen diffusion.	Extremely Unlikely	Waterbody 3	Medium	Negligible: Non-Significant	Compliance with GBR for oil storage. Spill responce procedures and kits in place, with personel trained in their use.	Low	**Negligible: Non-Significant**
			Unlikely	Waterbody 4		Minor: Non-Significant		Low	**Negligible: Non-Significant**
			Extremely Unlikely	Watercourse B		Negligible: Non-Significant		Low	**Negligible: Non-Significant**
			Unlikely	Watercourse D		Minor: Non-Significant		Low	**Negligible: Non-Significant**
			Unlikely	Watercourse E		Minor: Non-Significant		Low	**Negligible: Non-Significant**
			Unlikely	Watercourse G		Minor: Non-Significant		Low	**Negligible: Non-Significant**

Aspect	Phase	Predicted Impact	Probability	Receptor	Impact Magnitude	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Refuelling activity	Construction	Loss of pollutant during refuelling (upto 360l) with the potential to reach water. Diesel in water increases total organic carbon and form an impregnable layer on top of the water column, reducing oxygen availability by preventing oxygen diffusion.	Unlikely	Waterbody 4	Medium	Minor: Non-Significant	Compliance with GBR for oil storage. Spill responce procedures and kits in place, with personel trained in their use. Refuelling procedures in place and pperators trained in them. Refuelling actives to occur >10m from a watercourse or waterbody.	Low	**Negligible: Non-Significant**
			Extremely Unlikely	Watercourse B		Negligible: Non-Significant			**Negligible: Non-Significant**
			Unlikely	Watercourse D		Minor: Non-Significant			**Negligible: Non-Significant**
			Unlikely	Watercourse E		Minor: Non-Significant			**Negligible: Non-Significant**
			Unlikely	Watercourse G		Minor: Non-Significant			**Negligible: Non-Significant**

Aspect	Phase	Predicted Impact	Probability	Receptor	Impact Magnitude	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Machinery Hydraulic Fluids	Construction	Loss of hydraulic fluid (< 1L) with the potential to reach water. Potential to affect oxygen availability in water by preventing oxygen diffusion.	Unlikely	Watercourse B	Low	Negligible: Non-Significant	Machinery to be well maintained. Spill responce procedures and kits in place, with personel trained in their use.	Low	**Negligible: Non-Significant**
	Construction		Probable	Watercourse C		Minor: Non-Significant			**Minor: Non-Significant**
	Construction		Probable	Watercourse D		Minor: Non-Significant			**Minor: Non-Significant**
	Construction		Probable	Watercourse E		Minor: Non-Significant			**Minor: Non-Significant**
	Construction		Probable	Watercourse G		Minor: Non-Significant			**Minor: Non-Significant**
Loss of containment during storage, handling, equipment maintenance and HDD operations.	Construction	Loss of pollutant during handling, maintenance and HDD operations. Potential to cause: harmfull release to the aquatic environments, changing water pH and reducing oxygen availability.	Unlikely	Waterbody 4	Medium	Minor: Non-Significant	Compliance with GBR for oil storage. Appropriate chemical storage as discussed in Chapter 24. Spill responce procedures and kits in place, with personel trained in their use.	Low	**Negligible: Non-Significant**
			Unlikely	Watercourse E		Minor: Non-Significant			**Negligible: Non-Significant**
			Unlikely	Watercourse G		Minor: Non-Significant			**Negligible: Non-Significant**

Aspect	Phase	Predicted Impact	Probability	Receptor	Impact Magnitude	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Loss of drilling fluid during HDD operations	Construction	Potential to cause: harmfull release to the aquatic environments, increasing suspended solids, pH and reducing oxygen availability.	Unlikely	Waterbody 4	Medium	Minor: Non-Significant	Spill responce procedures and kits in place, with personel trained in their use.	Low	**Negligible: Non-Significant**
				Watercourse E		Minor: Non-Significant			**Negligible: Non-Significant**
				Watercourse G		Minor: Non-Significant			**Negligible: Non-Significant**
Cement Wash	Construction	Cement wash runoff with the potential to reach water. Leading to the potential altering of water pH.	Unlikely	Watercourse C	Medium	Minor: Non-Significant	Designated washing area, with capture and treatment of cement washings for appropriate disposal.	Low	**Negligible: Non-Significant**
			Extremely Unlikely	Watercourse E		Minor: Non-Significant			**Negligible: Non-Significant**

Aspect	Phase	Predicted Impact	Probability	Receptor	Impact Magnitude	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Surface Water Enabling Works	Construction	Silt ladden water from temporary road construction.	Probable	Watercourse G	Medium	Moderate: Significant	Utilisation of silt fences to screen and filter sediment.	Low	**Minor: Non-Significant**
		Silt ladden water from HDD site works.	Extremely unlikely	Waterbody 4	Low	Negligible: Non-Significant		Low	**Negligible: Non-Significant**
			Unlikely	Watercourse E	Low/ Medium	Minor: Non-Significant		Low	**Minor: Non-Significant**
			Unlikely	Watercourse G	Low/ Medium	Minor: Non-Significant		Low	**Minor: Non-Significant**
		Silt ladden water during HDD bund creation.	Probable	Watercourse G	Medium	Moderate: Significant		Low	**Minor: Non-Significant**
Surface Water Runoff from Cable Installation	Construction	Surface water runoff from cable installation activities	Probable	Watercourse C	Medium	Moderate: Significant	Utilisation of silt fences to screen and filter sediment.	Low	**Minor: Non-Significant**
				Watercourse D					
				Watercourse E					
				Watercourse G					

Aspect	Phase	Predicted Impact	Probability	Receptor	Impact Magnitude	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Temporary Modification of Watercourses **Enabling works**	Construction	Disturbance & modification of watercourses during culverts installation.	Certain	Watercourse G	Low	Minor: Non-Significant	GBR6 Rules and GPP5 followed. Silt curtains utilised.	Low	**Minor: Non-Significant**
Modification of Watercourses **Cable Installation**	Construction	Physical disturbance of watercourse through diversion during cable installation with the potential to increase water column sediment loading.	Certain	Watercourse C Watercourse D Watercourse E **Watercourse G**	Low	Minor: Non-Significant	GPP5 followed. Silt curtains utilised.	Low	**Minor: Non-Significant**

Key

	Significant Effect

10.10 References

Aberdeenshire Council. (2011). Supplementary Guidance No. 8: Flooding and Erosion 166.

Bunyan, J. (2014). North Connect Ecological Surveys: Otter, Water Vole & Badger Survey. 26.

Bunyan, J. (2017). North Connect Ecological Surveys: Otter, Water Vole & Badger Survey.

Clear Solutions. (2018). Pure-Bore. 1.

European Parliament, & Council, E. (2000). The Water Framework Directive.

European Parliament, & European Council. (2007). The European Union Floods Directive.

Moss, B. (1998). *Ecology of Fresh Waters* (Third ed.). Oxford: Blackwell Science.

NIEA, SEPA, & Environment Agency. PPG 6: Working at construction and demolition sites.

NIEA, SEPA, & Environment Agency. (2011a). PPG 7: The safe operation of refueling facilities.

NIEA, SEPA, & Environment Agency. (2011b). PPG 22: Dealing with spills.

NIEA, SEPA, & Environment Agency. (2013). Pollution Prevention Guidelines: PPG 1 - Understanding Your Environmental Responsibilities - Good Environmental Practice

NIEA, SEPA, & Natural Resources Wales. (2017a). GPP8: Safe storage and disposal of used oils.

NIEA, SEPA, & Natural Resources Wales. (2017b). GPP 2: Above ground oil storage tanks.

NIEA, SEPA, & Natural Resources Wales. (2017c). GPP 5: Works and maintenance in or near water.

NIEA, SEPA, & Natural Resources Wales. (2017d). GPP 21: Pollution incident response planning 25.

Riggall, T. (2017). Horizontal Directional Drilling (HDD) Feasibility Report. *NorthConnect Cable Landfalls, Longhaven, Peterhead, U.K.*(20160401RA-C-FR01_Rev00).

Scottish Government. (2009). Flood Risk Management (Scotland) Act 73.

Scottish Government. (2015). The river basin managment plan for the Scotland river basin district: 2015-2027.

Scottish Ministers. (2014). Scottish Planning Policy (SPP).

SEPA. (2009). Engineering in the Water Environment Good Practice Guide: Temporary Construction Methods. 61.

SEPA. (2016). Peterhead (Potentially Vulnerable Area 06/08). 12.

SEPA. (2017). SEPA Flood Map.

SEPA. (2018). The Water Environmetn (Controlled Activities) (Scotland) Regulations 2011 (as amended) - A Practical Guide. (8.2).

SEPA, Environment Agency, & Environment and Heritage Service. (2000). PPG 18: Managing fire water and major spillage's.

Sigma-Aldrich. (2012, 2018). Safety Data Sheet - Bentonite. Retrieved from https://www.sigmaaldrich.com/MSDS/MSDS/DisplayMSDSPage.do?country=GB&language=en&productNumber=B3378&brand=SIGMA&PageToGoToURL=https%3A%2F%2Fwww.sigmaaldrich.com%2Fcatalog%2Fproduct%2Fsigma%2Fb3378%3Flang%3Den

Silicates, N. (2012). Material Safetey Data Sheet - EcoDrill. Retrieved from https://www.pqcorp.com/docs/default-source/msds/pq-corporation/potassium-silicates/ecodrill/ecodrill_317_potassium_silicate_msds2012.pdf?sfvrsn=96034cc7_4

UK Government. (1974). Control of Pollution Act 1974.

Chapter 11: Water Quality (Marine Environment)

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Contents

11 Water Quality (Marine Environment)

11.1 Introduction

This chapter provides an assessment of marine water quality and potential water quality effects associated with the installation and operation of the NorthConnect HVDC cable infrastructure. Mitigation measures to minimise effects are identified and potential cumulative impacts are discussed.

It is noted that the operation and decommissioning phases were scoped out of the assessment in agreement with Marine Scotland, as detailed in Chapter 3: Methodology.

11.1.1 Marine Planning Framework

In the National Marine Plan (Scottish Government, 2015a), the Scottish government released general policies in favour of the sustainable development and use of marine resources, these include:

- **GEN 10 Invasive Non-Native Species**: Opportunities to reduce the introduction of invasive non-native species to a minimum or proactively improve the practice of existing activity should be taken when decisions are being made (Scottish Government, 2015a); and
- **Gen 12 Water Quality and Resource:** Developments and activities should not result in a deterioration of the quality of waters to which the Water Framework Directive, Marine Strategy Framework Directive or other related Directives apply (Scottish Government, 2015a).

The National Marine Plan also provides a series of good environmental status descriptors, which reflect the ecosystem services approach in the adoption of strategic objectives (Scottish Government, 2015a). The descriptors identify vital parts of the ecosystem structure and functions, and set targets to maintain their status. These include:

- **GES 2:** Non-indigenous species introduced by human activity are at levels that do not adversely alter the ecosystem;
- **GES 5:** Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algal blooms and oxygen deficiency in bottom waters; and
- **GES 8:** Concentrations of contaminants are at a levels not giving rise to pollution effects (Scottish Government, 2015a).

11.1.2 Legislative Framework

11.1.2.1 Water Framework Directive

The Water Framework Directive's (2000/60/EC) (WFD) primary purpose is to create a framework to protect groundwater, coastal waters, transitional and inland surface waters (European Parliament *et al.*, 2000). The framework details multiple aims which include:

- Prevention and protection of aquatic environments and enhancement of their ecosystem status in regard to the water needs of wetland and terrestrial ecosystems which rely upon aquatic environments;
- Enhancement of aquatic environments through the introduction of measures to reduce discharges, emissions and losses of hazardous substances; and
- Continues progressive reduction of groundwater pollution and further prevention of its pollution.

Under the Water Framework directive, member states are to achieve "*good ecological status*" of their coastal, transitional and inland waters. Protection and restoration of member states ground waters to maintain the dependent surface water and terrestrial ecosystems are also required. In Scotland, the Water Environment and Water Services (Scotland) Act 2003 transposed the Directive into Scottish Law (Scottish Parliament, 2003).

The directive also requires that classified waterbodies are given legal protection. In Scotland this was incorporated into law under the Environmental Liability (Scotland) Regulations 2009, making it an offence to adversely affect a classified waterbody so that its status or potential under the WFD are deteriorated (Scottish Parliament, 2009).

11.1.2.2 Bathing Water Directive (2006/7/EC)

The Bathing Water Directive 76/160/EC came into force in 1975 and is a further piece of European legislation that should be considered. The main objective of the directive is to protect public health and that of the aquatic environment including coastal and inland areas, which include rivers and lakes, from pollution. It placed a mandatory duty upon member states to conduct regular monitoring of designated bathing sites which must comply with specific standards set out within the directive. In 2006 the directive was revised (2006/7/EC), introducing higher standards but simplifying classifications of designated bathing sites by only considering two measurements (19 laboratory tests previously), intestinal enterococci and *Escherichia coli* (Mansilha *et al.*, 2009). New compliance categories which included excellent, good, sufficient and poor were also introduced while placing a duty upon the member state to ensure all bathing waters meet the criteria to be categorised as sufficient, in addition to taking action to increase numbers of designated sites to categories of excellent and good. In Scotland the revised directive was transposed into law through the Bathing Waters (Sampling & Analysis) (Natrual Scotland) Direction 2008 and the Bathing Waters (Natrual Scotland) Regulations 2008 (The Scottish Goverment, 2010).

11.1.2.3 The Water Environment (Shellfish Water Protected Areas: Environmental Objectives etc.) (Scotland) Regulations 2013

The Water Environment (Shellfish Water Protected Areas: Designation) (Scotland) Order 2013 (Scottish Parliament, 2013a) identifies waters as 'shellfish water protected areas'. In 2016, 84 waters were identified under the order (Marine Scotland, 2016). Under the Shellfish Regulations, specific environmental objectives are placed upon the identified designated sites (Scottish Parliament, 2013b) with regular monitoring of the water quality conducted by SEPA (Marine Scotland, 2016).

11.2 Guidance

The following sources of information were utilised:

- GPP 5: Works and maintenance in or near water (NIEA SEPA *et al.*, 2017);
- River Basin Management Plan 2015 (Natrual Scotland, 2015);
- Horizontal Directional Drilling (HDD) Feasibility Report (Riggal, 2017);
- Protocol for the Derivation of Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (CCME, 2001);
- Guidance on Marine Non-Native Species (GreenBlue, 2013);
- Marine Biosecurity Planning: Guidance for Producing Site and Operation-Based Plans for Preventing the Introduction of Non-native Species (Natural Resources Wales *et al.*, 2015);
- The Alien Invasive Species and the Oil and Gas Industry Guidance (IPIECA *et al.*, 2010);
- Marine Biosecurity Planning – Identification of Best Practice (Cook *et al.*, 2014); and

- Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions (European Commission, 1999).

11.3 Assessment Methodology

11.3.1 Baseline Data Collection

Baseline conditions were established by undertaking a marine survey of the proposed consenting corridor within Scottish Territorial Waters (STW) (mean high-water mark to 12NM) and the UK exclusive economic zone (UKEEZ) (12-200NM). The survey continued into the Norwegian EEZ, however, these results are not discussed in this environmental impact assessment report (EIAR). Surveying involved sediment sampling (5 in STW and 12 in UKEEZ), however, water quality sampling was not undertaken within the consenting corridor. Additionally, a literature review of reports, research articles and other subsea cable projects was undertaken to establish the baseline conditions, which will be used to inform the assessment of the potential effects on marine water quality.

The North Sea has been extensively researched by projects such as the Land-Ocean Interaction Study (LOIS) to gain data on a large scale. Covering river catchments, estuaries, coastal seas and their long-term evolution, air-sea interaction, and self-edge interaction with the open ocean. However, the number of abiotic, biotic, and anthropogenic influences upon the North Sea water quality results in data gaps and uncertainties (Cardenas *et al.*, 2016; Thurstan *et al.*, 2015). Where uncertainties in baseline conditions exist, these are acknowledged in the EIAR with an indication of the magnitude of the uncertainty.

11.3.2 Impact Assessment Methodology

Potential impacts upon the water quality resulting from the installation, operation and decommissioning of the NorthConnect subsea cable have been assessed utilising the methodology outlined below.

11.3.2.1 Magnitude of Impact

The magnitude of impact takes into account change to the baseline conditions resulting from a given effect. It considers the level of change of the baseline conditions, value of the hydrological feature and duration of the effect upon the receptor prior to recovery. Definitions for a range of hydrological elements are set out in Table 11.1.

Table 11.1 Definitions of magnitude of impact.

Magnitude of Impacted of Impact	Examples of Impact/Effect Magnitude
High	Material reduction in water quality. Characteristics may include: • Significant diffuse pollution. • Ecological impact e.g. fish deaths. • Medium to long-term impacts.
Medium	Reduction in water quality. Characteristics may include: • Minor diffuse pollution. • Measurable changes in water quality. • Minor harm to the ecosystem. • Reversible with no long-term impacts.
Low	Small changes to the water quality. Characteristics may include: • Localised pollution incident with reversible effects. • Potential visible signs of pollution. • No medium-term impacts. • No impacts on the ecosystem.

11.3.2.2 Likelihood of Impact Occurring

The likelihood of an impact occurring is also assessed. A qualitative approach is taken to predict the likelihood of an impact based on the probability of an impact occurring and professional judgement rather than data frequency. In this chapter, the likelihood categories are displayed in Table 11.2 with their definition. The likelihood of any effect occurring is described in the impact characterisation text.

Table 11.2 Likelihood Categories and their Definitions.

Likelihood	Definition
Certain/near-Certain	> 1 in 1 year
Probable	< 1 in 1 year but > 1 in 10 years
Unlikely	< 1 in 10 years but > 1 in 100 years
Extremely Unlikely	< 1 in 100 years

11.3.2.3 Significance of Effect

The significant of effect is derived by considering the magnitude of impact and probability of the impact occurring. Determination of whether the identified effect was categorised as significant or non-significant utilised the matrix set out in Table 11.3.

Table 11.3 Significance of Effects Matrix.

Magnitude of Impact	Probability			
	Certain	**Probable**	**Unlikely**	**Extremely Unlikely**
High	Major	Moderate	Moderate	Minor
Medium	Moderate	Moderate	Minor	Negligible
Low	Minor	Minor	Negligible	Negligible

Key

	Significant Effect
	Non-Significant Effect

11.3.3 Identification and Assessment of Mitigation

Mitigation measures have been identified in line with best practice to prevent, minimise and mitigate impacts.

11.3.4 Assessment of Residual Effects

Where mitigation has been identified, the magnitude and likelihood of the impact will be reassessed as per Table 11.1 and11.2 and the overall significance of effect reassessed in line with Table 11.3 to understand the resultant residual effect.

11.4 Baseline Information

11.4.1 Sediment Loading

Occurrence of sediment loading within the water column of aquatic bodies is a natural phenomenon due to the natural abundance of particle matter within water bodies, like sands and minerals, with the levels of remobilised sediment fluctuating. Multiple combining factors result in naturally occurring increases of sediment loading, such as storms, which increase in frequency in winter months in the North Sea, resulting in remobilised sediment from the seabed entering the water column (Gohin *et al.*, 2015; Schulz *et al.*, 2015). The fluctuations of sediment loading levels are important to the marine ecosystem, as remobilised sediments influence primary production, heat transfer, sedimentation rates, and act as a natural cleansing cycle of the water column by attaching to some contaminates and dragging these down to the seabed, where they are buried overtime (UKMMAS, 2010b). High levels of remobilised sediments can alter light penetration in the marine water column, impacting ecological process like photosynthesis and, over prolonged periods, can alter energy fluxes throughout the marine food web (Remy *et al.*, 2017).

Data on North Sea sediment loading levels are relatively low and fragmented to localised studies, mostly within the Dutch and German North Sea. The Southern North Sea Sediment Transport Study (Phase 2) covered the eastern coastline of England between Flamborough Head and North Foreland, and ran from 2000 to 2002. It was concluded that the southern North Sea possesses stronger tidal currents and shallower waters which result in greater resuspension of sediment, hence, the northern North Sea generally has a lower rate of sediment loading (Wallingford *et al.*, 2002). The study also identified that concentrations of suspended particles or suspended particular matter (SPM) in the southern North Sea in offshore areas lies around 4 mg/l, with estuaries generally having much higher concentrations, over 300 mg/l (UKMMAS, 2010b). However, research by Capuzzo *et al* (2015) identified that an increase in sediment loading levels in the southern and central North Sea since the 20th century has occurred, with multiple combining factors contributing to the increase (Cappuzzo *et al.*, 2015). Values for the northern North Sea were not identified in this literature review. The type of sediment disturbed also influences the degree of increase in sediment loading, its geographical spread and the period of suspension within the water column. Lighter sediment types like silt are more readily remobilised if disturbed and stay suspended over longer periods, allowing greater geographical dispersal. Heavier sediment types like sand require greater kinetic energy to be resuspended and, due to their greater mass, quickly fall back to the seabed, hence, geographic spread is more limited (Jones *et al.*, 2016). The results from the benthic survey Particle Size Distribution (PSD) analysis from the mean high-water mark to the UK EEZ limit will be discussed here, with additional description of sediment types provided in Chapter 7: Seabed Quality. The locations of the PSD samples within the consenting corridor are shown in Figure 11.1 below.

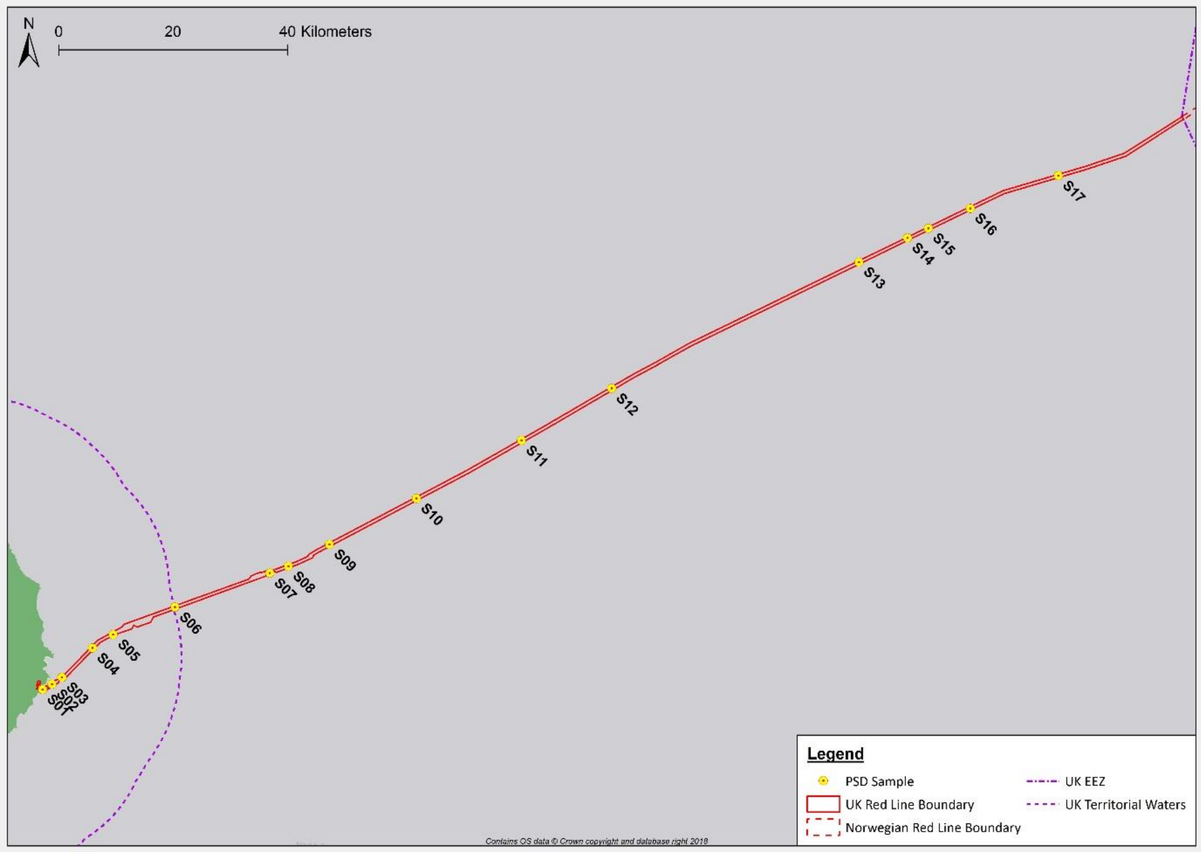

Figure 11.1. Locations of PSD samples within UK Consenting Corridor.

The particle size distribution (PSD) analysis of five samples taken within STW (S1 – S5) (Figure 11.2) along the consenting corridor showed that the PSD was dominated by sand and moderate fractions of gravel and small volumes of silt and cobbles/boulder (MMT, 2018).

Between the Scottish 12NM limit and the limit of the UK EEZ, sites S6 to S10 also contained high proportions of sands and gravels. Towards the east of the UK consenting corridor, the proportion of silts and clays increase, as sands and gravels decrease. Sites S11-S17 contain high proportions of silt, with clays also becoming more prominent, and silt is the dominant particle size in sites S12 to S17 (MMT, 2018).

The PSD samples are only representative of a very small area of the consenting corridor, however, the results of the geophysical and geotechnical surveys were used to classify sediment types throughout the whole consenting corridor, with further detail available in Chapter 7: Seabed Quality. The results from the PSD analysis agree with the interpretation of the geophysical and geotechnical data, which found that sands and gravels were dominant in the western end of the UK consenting corridor, with increasing silt and clay fractions towards the east.

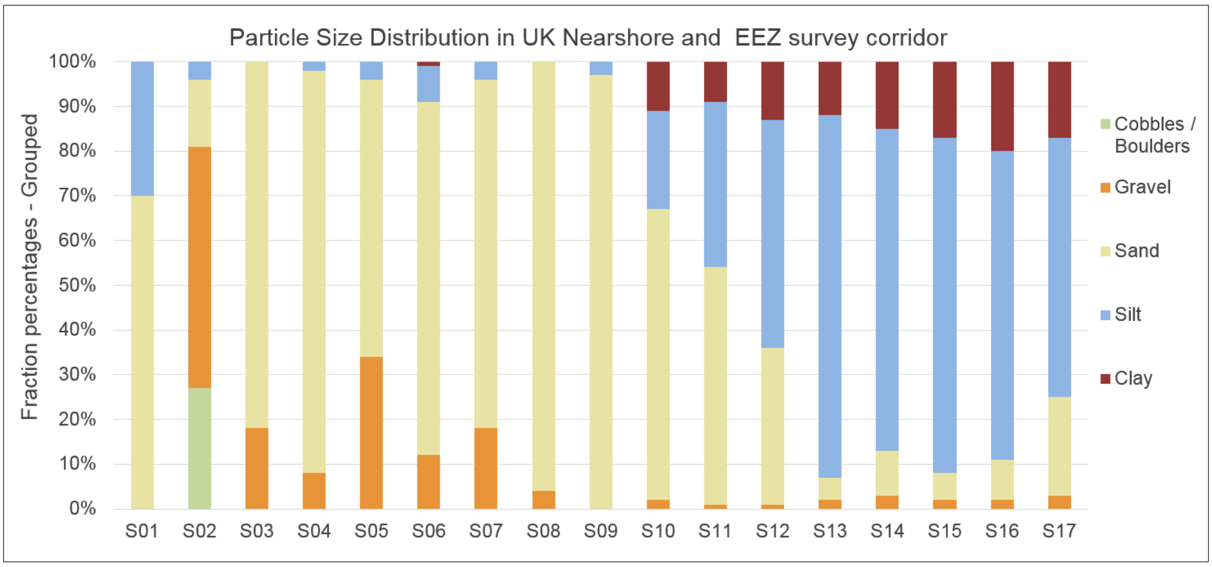

Figure 11.2 Particle Size Distribution from the UK Coast to the UK EEZ limit (MMT, 2018).

11.4.2 Sediment Contaminants

11.4.2.1 Organic

Organic contaminants are carbon-based chemicals such as oils, pesticides, and solvents. In the North Sea, organic contaminants enter through three main sources: terrestrial run off; atmospheric deposition; and offshore oil and gas exploitation facilities. Extensive levels of organic contaminants within the marine water column poses a direct risk to marine species like acute and chronic damage to organic tissue upon exposure. Indirect effects also occur throughout the food web due to bioaccumulation, potentially impacting upon marine ecological processes (Henry *et al.*, 2017). A recent study by Robinson *et al* (2017) identified that concentrations of pollutants across all sampled sites in the North Sea are elevated above normal background levels, with an increasing gradient of contamination conditions across the northern and southern North Sea, coinciding with OSPAR Commissions' findings (OSPAR Commission, 2010).

Chemical analysis of the grab samples examined 18 Polycyclic aromatic hydrocarbons (PAHs) compounds across the survey corridor with results within STW and UKEEZ. Chapter 7: Seabed Quality provides a detailed discussion of the PAH results, with a summary of the findings provided in this chapter.

In order to evaluate the potential environmental effects of the PAH concentrations identified within the consenting corridor, the assessment criteria developed by the United States Environmental Protection Agency (USEPA) and Canadian Council of Ministers of the Environment (CCME), were used as guidelines. Assessment of total petroleum hydrocarbons (TPH) levels used the Dutch National Institute for Public Health and the Environment (RIVM) criteria for aquatic sediments, as no USEPA or CCME contamination threshold values for TPH exist (MMT, 2018).

The USEPA criteria utilised for PAHs, referred to as effect range low (ERL), is defined as a concentration below which adverse effects on organisms are rarely observed. Identified concentrations of PAHs in the samples were also compared against CCME probable effect level (PEL), which is defined as the concentration above which adverse environmental effects frequently occur. Criteria for TPH is the Dutch target value, a level below which there is sustainable sediment quality.

Concentrations of PAHs in the UK consenting corridor are detailed in Chapter 7: Seabed Quality, Table 7.7. Concentrations of PAHs of all extracted sediment samples within the STW and UKEEZ were low, regularly falling below detection levels. No samples exceeded the PAHs ERL criteria and, as such, levels of PAHs are below concentrations where adverse effects on marine organisms are even rarely observed (MMT, 2018).

This concurs with PAH levels identified during the literature review, which indicate that PAH levels in the North Sea are below the environmental effects range (Remy, Hillebrand, & Flöder) and thus unlikely to harm marine species, as assessed by OSPAR Commission. However, mean PAH concentrations within sediment remain elevated above normal background concentrations (OSPAR Commission, 2010; UKMMAS, 2010a).

Total Petroleum Hydrocarbons (TPH) concentrations were also assessed as detailed in Chapter 7: Seabed Quality. The analysis identified that no sample exceeded the Dutch Target Value, hence, levels of TPHs of sediments at the sample sites within the consenting corridor are sustainable and are unlikely to result in adverse environmental effects. Samples S12 and S14 to S17 contained markedly higher TPH concentrations and, at these sample locations, elevated levels of PAHs and metal concentrations were also found (MMT, 2018).

11.4.2.2 Inorganic

Anthropogenic discharges rich in inorganic contaminants to rivers that flowed into the North Sea, and direct discharges to the marine environment, increased within a few decades almost exponentially during the industrial revolution (Ansari *et al.*, 2004). As a result, coastal industrialized areas regularly contain elevated levels of heavy metals within aquatic sediments. Natural and agricultural processes also contribute to inorganic compounds entering the marine environment (Alsenoy *et al.*, 1993). Inorganic contamination can also be found in the open North Sea from offshore industrial processes including gas and oil extraction (Ansari, Marr, & Tariq, 2004).

While discharges in of inorganic contaminants have been decreasing through advances in technology and enforcement of legislative frameworks, the lack of carbon within inorganic compounds prevents breakdown overtime and the contaminants simply become trapped in deeper levels of sediment until they are physically disturbed. When such sediments are disturbed, the inorganic contaminants trapped within them can be re-released, potentially resulting in adverse environmental effects. The ability of some inorganic substances (such as mercury) to bioaccumulate, also allows migration through the food-chain, with potential to affect ecological processes.

Chemical analysis results of grab samples from the survey corridor were compared against the Threshold Effect Level (TEL) and PEL criteria developed by the CCME. TEL is defined as a concentration above which adverse effects may occasionally occur. Concentrations of metals from samples throughout the consenting corridor were generally low, as detailed in Chapter 7: Seabed Quality. In the STW, three sample locations contained arsenic and/or nickel exceeding TEL levels (S03-S05). Between the 12NM limit and the limit of the UKEEZ, seven sample locations (S06, S08, and S13-17) contained concentrations of Arsenic, copper, nickel, or zinc which exceeded the TEL criteria. Exceedances of the nickel TEL criteria were the most prevalent. No sample contained metal contamination exceeding the PEL criteria, hence, heavy metal contamination in some areas of the consenting corridor are at concentrations where adverse environmental effects may occur, but are considered unlikely.

The results from the grab samples coincide with results from the Charting Progress 2 Feeder Report (2010) and OSPAR Environmental Assessment (2017) which highlighted inorganic contamination in the North Sea is above natural background, but considered generally of low risk.

Therefore, heavy metal contamination of sediments within the consenting corridor is expected to be generally low, with little or no potential to result in water quality deterioration if re-suspended.

11.4.3 SEPA Coastal Water Monitoring

The HVDC landfall at Long Haven lies within the SEPA water quality monitoring zone of Buchan Ness to Cruden Bay. SEPA categorised the water quality as having an overall high status and chemical pass in 2016 (SEPA, 2017).

To the North of the Buchan Ness to Cruden Bay area, lies the monitoring zone Ugie Estuary to Buchan Ness. The coastal area was categorised as having overall good ecological potential with a chemical pass in 2016 (SEPA, 2017). The Cruden Bay area is situated to the South of the Buchan Ness to Cruden Bay zone, where SEPA categorised the area to have an overall high status and chemical pass in 2016 (SEPA, 2017).

11.4.4 Bathing Waters

Three designated bathing water sites are located in the vicinity of the UK landfall end of the consenting corridor, Peterhead (Lido) (UK7616042) being the closest (approximately 5km from the consenting corridor). Peterhead (Lido) was designated in 1999 and assessed as having good overall bathing water quality (SEPA, 2016). Southwards of the proposed landfall site lie Cruden Bay and Collieston. Cruden Bay, approximately 6km from the landfall site, was designated in 1999 and assessed in 2016 as having poor bathing water quality (SEPA, 2016). Collieston beach, approximately 14km from the proposed landfall site, was designated in 2014 and surveyed in 2017, resulting in a designation of excellent (SEPA, 2016). Balmadie and Aberdeen also possess designated bathing waters, however, these are not considered in this Chapter due their considerable distance from the HVDC cable landfall area, approximately 26km and 36km respectively (SEPA, 2016).

Peterhead (Lido) is located within the breakwaters of Peterhead harbour and so is effectively isolated from any potential reduction in water quality resulting from the NorthConnect marine HVDC cable installation. All other bathing water sites are too far from the consenting corridor for water quality effects at these receptors to be expected and, as such, bathing waters will not be considered further in this assessment.

11.4.5 Shellfish Waters

The closest designated shellfish waters to the UK consenting corridor are located approximately 140km to the north west within the Cromarty Firth (Marine Scotland, 2018). As such, the installation of the marine HVDC cables does not have any potential to affect water quality within any designated shellfish waters, hence, these sites will not be considered further.

11.5 Impact Assessment

11.5.1 Horizontal Directional Drilling (HDD) Fluid Discharges to the Marine Environment

As detailed in Chapter 2: Project Description, horizontal directional drilling (HDD) is required to link the onshore and marine HVDC cable routes. HDD operations require the use of drilling fluids in order to lubricate the drill head. Prior to breaking through the seabed, the HDD holes will be pumped out as so far as is possible, to remove all excess drilling fluid, and further information on this is provided in the Construction Method Statement (CMS). However, some drilling fluid that cannot be removed will remain in the holes and will escape to the marine environment when the HDD breaks out through the seabed. It is estimated that a total of 3,000m^3 of drilling fluid will be lost to sea during the drilling of the 3 HDD holes. The fluids will contain approximately 18m^3 of drilling solids, which is most likely to be bentonite drilling compound and pulverised granite drill cuttings. However, the HDD holes are drilled individually, therefore only 1,000m^3 of fluid and 6m^3 of solids are released at any one time. Assessment of potential ecological effects are discussed in Chapter 14: Benthic Ecology, Chapter 15: Fish and Shellfish and Chapter 16: Marine Mammals and Chapter 17: Ornithology.

Bentonite consists of a mixture of water and naturally occurring non-toxic clay. Additives like natural occurring xanthum gum and gypsum on occasions may be added to bentonite to improve the efficiency of the fluid (Sigma-Aldrich, 2012). Alternatives available to bentonite include Ecodrill and PureBore. Ecodrill is a silicate-based fluid that may be utilised for the last section of the drilling prior to pushing through to the seabed. Ecodrill could pose some environmental implications for the marine environment if large volumes were released in an undiluted or un-neutralised state. The high pH of the fluid may affect the localised water quality by increasing the pH of the water (Silicates, 2012). However, utilisation of Ecodrill in an undiluted form is not proposed. Any potential use of Ecodrill will see appropriate reduction of its pH using caustic Soda as a pH modifier (MI Swaco, 2015). PureBore, is similar to Ecodrill in that it is a silicate-based fluid. It differs from bentonite and Ecodrill by having a lower pH, ranging from 6.5 to 8.5. If PureBore is used, soda ash (sodium carbonate Na_2CO_3) will be used as a pH modifier to neutralise the drilling fluid prior to use (Clear Solutions, 2018).

The release of bentonite, PureBore or Ecodrill into the North Sea during the drilling process will see a **certain** localised increase in water column sediment loading. The drilling fluids are non-toxic and will be dispersed rapidly due to localised wave action and tidal currents (Kim *et al.*, 2018), thereby reducing the duration of the effect. Therefore, the potential effect is considered to be short term and reversible. As such the magnitude of effect is assessed as **low**, and the resulting impact is **minor: non-significant** effect.

11.5.2 Increased Sediment Loading from Offshore Cable Installation

As detailed in Chapter 2: Project Description and the CMS, cable installation will utilise a range of techniques, potentially including jet trenching, ploughing and mechanical trenching. Rock placement will also be required in areas where burial is not possible or does not provide sufficient protection. The trenching, ploughing and, where required, rock placement, will see a **near certain** resuspension of sediment into the water column, increasing localised sediment loading in the water column. Geographic spread and duration of suspension of the remobilised sediments from cable installation activities depend on the sediment's particle size (Wenger *et al.*, 2017).

The STW sediment samples (S01-S05) are dominated by sand with fractions of gravel and minor volumes of silt, except for S01, which consisted of 30% silt, as identified by the marine survey. However, the samples are only representative of very limited areas of the consenting corridor. But the results concur with the identified seabed types discussed in 7: Seabed Quality. The larger sized and heavier sand and gravel particles will quickly resettle once disturbed, decreasing the size of any resulting sediment plume.

Considering the sediment from the UK shore to the limits of the STW are dominated by sand and gravel which quickly resettles, any remobilisation of sediment will be short term and reversible. Therefore, the magnitude is assessed as **low**, giving rise to a **minor: non-significant** effect.

As detailed in Section 11.4.1 Figure 11.4.1, particle size distribution analysis of sediment samples identified much larger fractions of silt in the consenting corridor near the limits of the UK EEZ. Although high fractions of sand were also identified (S05 to S10), with small fractions of clay and gravel found throughout the UK EEZ samples, clay concentrations being significantly larger in the UK EEZ samples. Disturbance to the areas containing higher fractions of silt may result in increased sediment loading of the water column over extended periods, compared to those containing substrates with large particle size. The silts smaller particle mass will also mean greater geographic spread once disturbed and a prolonged resuspension state (Jones *et al.*, 2016). However, a study of resuspension of sediment during subsea cable installation through ploughing identified 90% of suspended sediment re-deposited within 20m of the source, with a further 5% re-deposited between 20m and 500m from the source (BERR, 2008). Thus, geographic spread of re-suspended sediment is not expected to extend outwith the consenting corridor.

While disturbance of finer sediments like silt will see increased sediment loading of the water column lasting for longer periods than when larger sediment types are remobilised, the effects will still be localised and temporary. Therefore, the magnitude is assessed as **low**, giving rise to a **minor: non-significant** effect. Impacts on marine flora and fauna exposed to the remobilised sediments are discussed in Chapter 14: Benthic Ecology, Chapter 15: Fish and Shellfish, Chapter 16: Marine Mammals and Chapter 17: Ornithology.

11.5.3 Remobilisation of Sediment Bound Contaminants

The remobilisation of sediments can result in sediment bound contaminants entering the water column which, in turn, can degrade water quality and become bioavailable to increased assemblages of marine species (Roberts, 2012).

As detailed in Section 11.4.2, with further information provided in Chapter 7: Seabed Quality, the chemical analysis of grab samples conducted during the survey operations found that generally contamination levels were very low. PEL levels were not exceeded at any site for organic or inorganic contaminants, and TPH levels were below the Dutch Target Value at all sites. All PAHs were also below the ERL criteria at all sites. Some heavy metals, notably arsenic and nickel, were present at levels exceeding the TEL criteria at 10 of the 17 sample locations, however, PEL levels were not exceeded. As such, it can be said that the sediments within the UK consenting corridor are relatively uncontaminated, with levels of contaminants below the levels where environmental effects can be expected. It is however noted, that the chemical analysis results are only representative of the areas sampled and the distances between the sample locations mean that unidentified areas of more significant contamination may be present within the consenting corridor, though this is not considered likely according to the literature review detailed in Section 11.4.2.

The low levels of observed sediment contamination mean that the disturbance of sediments during the installation of the marine HVDC cables are **unlikely** to result in the mobilisation of sediment bound contaminants levels with a potential to result in a significant deterioration of water quality within the consenting corridor. Also, as detailed in Section 11.5.2, the duration and extent of sediment plumes resulting from the installation activities will be limited, and likely to be confined within the consenting corridor. Therefore, any reduction in water quality which does result from the mobilisation of sediment bound contaminants will be short term and localised and, hence, the magnitude of effect is assessed as **low.** The resulting impact is therefore assessed as **minor: non-significant** effect. Impacts on marine flora and fauna exposed to the remobilised sediments are discussed in Chapter 14: Benthic Ecology, Chapter 15: Fish and Shellfish, Chapter 16: Marine Mammals and Chapter 17: Ornithology.

11.5.4 Release of Hazardous Substances

11.5.4.1 Loss of Chemicals and Fuels from Installation Vessels

Loss of chemicals and fuels from vessels required for HVDC cables installation has the potential to degrade water quality. The magnitude of any reduction in water quality is dependent on the type of pollutant and volumes entering the aquatic body (Chang *et al.*, 2014; Nelson *et al.*, 2018).

Installation vessels are expected to carry potential pollutants, with hydrocarbon-based fuels, lubricants and hydraulic fluids being the biggest potential pollution sources. The assessment assumes that all vessels and equipment are well maintained and operated by suitably trained personnel. In addition, all installation and support vessels are required to comply with the International Convention for the Prevention of Pollution from Ships (MARPOL) regulations. The regulations cover the prevention of chemical spills and hydrocarbons during both routine operations and incidents. The operating vessels will also have shipboard oil pollution emergency plans (SOPEP), which will minimise the potential impacts of any loss of containment that may occur.

Table 11.4 provides an assessment of the pollution risks likely to be present on the installation spread. It utilises the source, pathway, receptor model, with the marine environment being the receptor. Effects on other receptors are considered within Chapter 7: Seabed Quality, and the marine ecology Chapters: 14-17.

Table 11.4. Loss of Containment Impact Assessment

Source	Scenario	Pathway	Probability	Impact Magnitude	Impact Significance
Deck Equipment – Hydraulic Fluids	Loss of hydraulic fluid, due to pipe burst (5l to 100l)	Spillage to deck - potential to reach water.	**Probable** Despite being well maintained, hydraulic pipes may rupture unexpectedly.	**Low**	**Minor: Non-Significant**
ROVs – Hydraulic Fluids	Loss of containment from ROV due to mechanical failure of the ROV (5l to 100l).	Spillage directly to water.	**Probable** Despite being well maintained, ROVs are known to suffer mechanical failures which can result in losses of hydraulic fluid.	**Low**	**Minor: Non-Significant**
Support and Guard Vessels	Accidental damage to fuel tank loss of contents (<100m^3), through collision or impact with submerged object.	Spillage directly to water.	**Unlikely** Masters of the vessels will be appropriately trained. Operating in open water. Further detail provided in Chapter 19: Navigation and Shipping.	**Medium**	**Minor: Non-Significant**
Installation Vessels	Accidental damage to fuel tank loss of contents (<500m^3), through collision or impact with submerged object.	Spillage directly to water.	**Extremely Unlikely** Masters of the vessels will be appropriately trained. Guard vessels and safety zones maintained, Further detail provided in Chapter 19: Navigation and Shipping. Vessels are DP2 so have full backup power systems in the event of loss of propulsion.	**High**	**Minor: Non-Significant**

11.5.4.2 Discharge of Wastewaters and Sewage from Installation Vessels

Under normal operating conditions, installation and support ships are **certain** to discharge wastewaters and potentially sewage, which may contain chemical and biological contaminants that can influence the marine environment. However, all vessels employed to facilitate the installation of NorthConnect marine HVDC cables will be MARPOL compliant and, as such, all discharges will be appropriately treated to reduce potential contaminants to acceptable levels, and conducted in an appropriate manner to minimise water quality impacts. When considered in the context of existing shipping levels and associated discharges in the North Sea, the magnitude of the impact is **low.** Therefore, the effect is assessed as **minor: non-significant**.

11.5.4.3 Accidental Damage to Subsea Oil and Gas Infrastructure

The North Sea in the vicinity of the consenting corridor is widely exploited by the oil and gas sector and, as such, numerous existing submarine pipelines are present in the area. As discussed in Chapter 2: Project Description, the consenting corridor crosses pipelines between the UK landfall and the limit of the UK EEZ. Cable installation (laying and burial), together with the placement of rock to protect the existing asset and the proposed NorthConnect cables, have the potential to damage submarine pipelines within the consenting corridor. Damage to an oil pipeline has the potential to result in a significant release of oil into the marine environment, which could lead to a major reduction of marine water quality over an extended area. The magnitude of the effect which could result from damaging an existing submarine pipeline is therefore **high.**

However, NorthConnect will follow the International Cable Protection Committee (ICPC) recommendations for existing infrastructure crossings. Individual crossing agreements will be made with the respective asset owners prior to cable installation commencing, so that the crossing design, installation techniques and associated safety exclusion zones for different installation tools, can be agreed. Emergency response procedures will also be agreed to ensure that, in the event of damage to a pipeline occurring, all parties can work quickly to minimise the magnitude of the spill.

Detailed crossing engineering will be performed by the cable installation contractor, in close cooperation with NorthConnect and the asset owners. The engineering will allow mitigation to be designed and implemented for each crossing, further reducing the likelihood of a submarine pipeline being damaged. As such, it is **extremely unlikely** that the installation activities will result in damage to a submarine pipeline which would lead to a significant reduction in water quality. The resulting effect is therefore assessed as **minor: non-significant**.

11.5.5 Invasive Non-Native Species (INNS)

The introduction of INNS has the potential to result in severe ecological impacts which, in turn, can result in major economic costs due to the difficulty in trying to eradicate a species once it has been introduced. The vector with the greatest risk of introducing INNS associated with the installation of the marine HVDC cables is the vessels that will make up the installation spread. Vessels travelling from already contaminated ports and harbours, or different ecoregions, can transport INNS via their ballast water and, to a more limited extent, through biofouling (marine growth) on hulls (Yang et al., 2018). Further detail on the vessel movements expected during the installation of the marine HVDC cables is provided in Chapter 19: Navigation and Shipping. There is also the potential that other equipment, such as trenching tools, ROVs, and ploughs, could introduce INNSs via soils and sediment trapped in the equipment from previous deployments.

As detailed in Chapter 14: Benthic Ecology, no INNS were identified within the consenting corridor during the benthic survey operations. There are also ecologically sensitive habitats in the vicinity of the consenting corridor which could be affected through the introduction of INNS. The duration of such an impact would be long-term to permanent, due to the difficulties in eradicating an INNS once it is established. As such, the magnitude of impact resulting from the introduction of an INNS is assessed as **high.** Ecological impacts of INNS introduction are specifically considered in Chapter 14: Benthic Ecology.

With regard to the potential for introduction of INNS via vessel ballast water, the International Maritime Organization (IMO) ratified the International Convention for the Control and Management of Ships' Ballast Water and Sediments Management (Ballast Water Management (BWM) Convention) in September 2017. This requires all commercial vessels to adopt an approved ballast water management plan, involving either the exchange of ballast water outwith coastal waters, or the treatment of ballast water to denature potential INNSs. NorthConnect will require that all vessels employed to facilitate the installation of the marine HVDC cables are fully IMO compliant, including the BWM Convention. As such, the ballast water vector for INNS is effectively removed. The probability of INNS being introduced is therefore assessed as **very unlikely**, resulting in a **minor: non-significant** effect.

Implementation of the BWM Convention does not mitigate the risk of an INNS being introduced via biofouling on a vessel. However, this vector is considered to carry a lower risk of INNS introduction than ballast water. Furthermore, the North Sea in the region of the consenting corridor is frequently visited by vessels from around the UK, Europe, and wider world, as detailed in Chapter 19. As such, the installation vessel movements are unlikely to constitute a change from baseline conditions with respect to the potential for introducing INNS. Therefore, the probability of INNS introduction occurring through biofouling of vessels is assessed as **unlikely**, and the resulting effect is **minor: non-significant**.

The probability of INNS being introduced via sediments and soils trapped on equipment mobilised to facilitate the marine cable installation is considered to be **unlikely**. This is due to the fact that the soils and sediment which could act as a vector are likely to dry during transit to site, greatly reducing the probability of an INNS surviving the transit to the consenting corridor. The resultant effect is therefore assessed as **minor: non-significant**.

11.6 Mitigation measures

The assessment identified no potential significant effects from the proposed development on marine water quality, therefore, no further mitigation is required.

11.7 Residual effects

No potential significant effects from the proposed development on marine water quality were identified, therefore, no reassessment of the residual effects taking into account mitigation measures is required.

11.8 Cumulative Effects

The potential impacts on marine water quality associated with the seabed preparation and installation of the NorthConnect marine HVDC cables are extremely localised in nature. This will also be true of the water quality impacts resulting from the other marine developments detailed in Chapter 6: Cumulative Effects. With the exception of the Norwegian section of the NorthConnect project, the closest marine development to the UK consenting corridor is the Peterhead Port Authority Harbour Masterplan, which is 3km to the north of the consenting corridor at its closest point. All other projects are located 20km or more from the consenting corridor. As such, there is no potential for any interaction between the NorthConnect marine water quality impacts and those resulting from the other marine developments. The cumulative effects are therefore assessed as **no-change**.

With regard the Norwegian section of the NorthConnect project, the Norwegian operations may be conducted concurrently, and adjacent to the UK installation works. The installation techniques that will be used in Norwegian waters will be analogous to those described here and in the supporting chapters. As such, the water quality impacts associated with the seabed preparation and cable installation works in the Norwegian EEZ will be the same as those expected in the UK EEZ and, hence, the resulting cumulative effects are assessed as **non-significant**.

11.9 Summary of Effects

This chapter has assessed the potential environmental impacts on marine water quality resulting from the seabed preparations and installation of the proposed NorthConnect marine HVDC cables. No impacts were assessed as being significant under the terms of the EIA Regulations. A summary of the assessment is provided in Table 11.5 below.

Table 5 Summary of Impacts on Marine Water Quality and Mitigation.

Aspect	Phase	Predicted Impact	Probability	Impact Magnitude	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Probability	Significance of Residual Effect
HDD Drilling	Installation	Drilling fluid Discharges to Marine Environment Increased sediment loading of the water column.	Certain	Low	Minor: Non-Significant	Pumping out of excess drilling fluid from drilled ducts reducing the total lost volumes.	Certain	Minor: Non-Significant
Offshore Cable Installation and Protection	Installation	Increased water column sediment loading	Near-certain	Low	Minor: Non-Significant	No specific mitigation required/	Near-certain	Minor: Non-Significant
		Remobilisation of sediment bound contaminates.	Near-certain	Low	Minor: Non-Significant	No specific mitigation required/	Near-certain	Minor: Non-Significant
Release of Hazardous Substances from Installation Vessels	Installation	Loss of hydraulic fluid (5L to 100L) from deck equipment.	Probable	Low	Minor: Non-Significant	• Equipment to be well maintained. • MARPOL compliance. • SOPEPs.	Probable	Minor: Non-Significant
		Loss of hydraulic fluid (5L to 100L) from ROVs .	Probable	Low	Minor: Non-Significant	• Equipment to be well maintained • SOPEPs.	Probable	Minor: Non-Significant
		Damage to fuel tank and loss of contents (<100m^3) of support and guard vessels.	Unlikely	Medium	Minor: Non-Significant	International Regulations for the Prevention of Collision at Sea.	Unlikely	Minor: Non-Significant
		Accidental damage to fuel tank and loss of contents (<500m^3).	Extremely Unlikely	High	Minor: Non-Significant	• International Regulations for the Prevention of Collision at Sea. • Guard Vessels. • Vessels DP2.	Extremely Unlikely	Minor: Non-Significant

Aspect	Phase	Predicted Impact	Probability	Impact Magnitude	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Probability	Significance of Residual Effect
Release of Hazardous Substances from Installation Vessels	Installation	Planned discharges of waste water and sewage from installation spread vessels.	Certain	Low	Minor: Non-Significant	Following of MARPOL convention.	Certain	Minor: Non-Significant
Exisitng Pipeline Crossings	Installation	Accidental damage to subsea oil and gas infrastructure resulting in widespread pollution.	Extremely Unlikely	High	Minor: Non-Significant	• Following of International Cable Protection Committee recommendations. • Crossing Agreements. • Mitigation identified through detailed crossing engineering and cooperation between stakeholders. • Procedures in place to deal with damage to infrastructure.	Extremely Unlikely	Minor: Non-Significant
Use of Vessels from Outwith the North Sea Ecoregion.	Installation	Introduction of invasive non-native species through ballast water.	Extremely Unlikely	High	Minor: Non-Significant	Compliance with International Convention for the Control and Management of Ships' Ballast Water and Sediments Convention.	Extremely Unlikely	Minor: Non-Significant

Aspect	Phase	Predicted Impact	Probability	Impact Magnitude	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Probability	Significance of Residual Effect
Use of Vessels from Outwith the North Sea Ecoregion.	Installation	Introduction of invasive non-native species through biofouling of vessels.	Unlikely	High	Minor: Non-Significant	No specific mitigation required.	Unlikely	Minor: Non-Significant
		Introduction of invasive non-native species through contamination of tools and equipment with organic material from previous sites.	Unlikely	High	Minor: Non-Significant	Equipment will be cleaned and inspected prior to mobilisation.	Unlikely	Minor: Non-Significant

11.10 References

Alsenoy, V., Bernard, P., & Grieken, R. (1993). Elemental concentrations and heavy metal pollution in sediments and suspended matter from the Belgian North Sea and the Scheldt estuary. *Science of the total environment, 133*(2), 153-181.

Ansari, T., Marr, I., & Tariq, N. (2004). Heavy Metals in Marine Pollution Perspective - A Mini Review. *Journal of Applied Sciences, 4*(1), 20.

Baker, T., Tyler, C., & Galloway, T. (2013). Impacts of metal and metal oxide nanoparticles on marine organisms. *Environmental Pollution, 186*(2), 1-15.

BERR. (2008). Review of Cabling Techniques and Environmental Effects Applicable to the Offshore Wind Farm Industry. In (pp. 164): Department for Business Enterprise & Regulatory Reform.

Cappuzzo, E., Stephens, D., & Silva, T. (2015). Decrease in water clarity of the southern and central North Sea during the 20th century. *Global Change Biology, 21*(6), 2206 - 2214.

Cardenas, I. C., & Halman, J. I. M. (2016). Coping with uncertainty in environmental impact assessments: Open techniques. *Environmental Impact Assessment Review, 60*, 24-39. doi:https://doi.org/10.1016/j.eiar.2016.02.006

CCME. (2001). Canadian Sediment Quality Guidelines for the Protection of Aquatic Life. In: Canadian Council of Ministers of the Environment.

Chang, S. E., Stone, J., Demes, K., & Piscitelli, M. (2014). Consequences of oil spills: a review and framework for informing planning. *Ecology and Society, 19*(2). doi:10.5751/ES-06406-190226

Clear Solutions. (2018). Pure-Bore. In (pp. 1): Clear Solutions.

Cook, E., Payne, R., & Macleod, A. (2014). Marine Biosecurity Planning - Identification of Best Practice In (pp. 46). Edinburgh: SNH.

European Commission. (1999). Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions. In (pp. 172). Luxembourg: European Communities

European Parliament, & Council, E. (2000). The Water Framework Directive. In: European Parliament and European Council

Gohin, F., Bryère, P., & Griffiths, J. W. (2015). The exceptional surface turbidity of the North-West European shelf seas during the stormy 2013–2014 winter: Consequences for the initiation of the phytoplankton blooms? *Journal of Marine Systems, 148*, 70-85. doi:https://doi.org/10.1016/j.jmarsys.2015.02.001

Govind, P., & Madhuri, S. (2014). HEavy Metals Causing Toxicity in Animals and Fishes *Research Journal of Animal, Veterinary and Fishery Sciences, 2*(2), 17-23.

GreenBlue. (2013). Guidance on marine Non-Native Species. In.

Henry, Harris, Kingston, & Roberts. (2017). Historic scale and persistence of drill cuttings impacts on North Sea benthos. *Marine Environmental Research, 129*(1), 219-228.

IPIECA, & OGP. (2010). The Alien Invasive Species and the Oil and Gas Industry Guidance. In: IPIECA and OG.

Jones, R., Bessell-Browne, P., Fisher, R., Klonowski, W., & Slivkoff, M. (2016). Assessing the impacts of sediments from dredging on corals. *Marine Pollution Bulletin, 102*(1), 9-29. doi:https://doi.org/10.1016/j.marpolbul.2015.10.049

Kim, N.-H., Pham, V. S., Hwang, J. H., Won, N. I., Ha, H. K., Im, J., & Kim, Y. (2018). Effects of seasonal variations on sediment-plume streaks from dredging operations. *Marine Pollution Bulletin, 129*(1), 26-34. doi:https://doi.org/10.1016/j.marpolbul.2018.02.014

Mansilha, C. R., Coelho, C. A., Heitor, A. M., Amado, J., Martins, J. P., & Gameiro, P. (2009). Bathing waters: New directive, new standards, new quality approach. *Marine Pollution Bulletin, 58*(10), 1562-1565. doi:https://doi.org/10.1016/j.marpolbul.2009.03.018

Marine Scotland. (2016). Shellfish water protected areas. Retrieved from http://marine.gov.scot/information/shellfish-water-protected-areas

Marine Scotland. (2018). National Marine Plan Interactive. In: Marine Scotland.

MI Swaco. (2015). Safety Data Sheet Sodium Hydroxide. In (pp. 12): MI Swaco.

MMT. (2018). Benthic Survey Report: NorthConnect - UK Nearshore, North Sea, and Norwegian Ford Survey In (Vol. Rev A): MMT.

Natrual Scotland. (2015). *The river basin managment plan for the Scotland river basin district: 2015-2027*. Retrieved from Edinburgh: https://www.sepa.org.uk/media/163445/the-river-basin-management-plan-for-the-scotland-river-basin-district-2015-2027.pdf

Natural Resources Wales, Department for Environment Food & Rural Affairs, & SNH. (2015). Marine Biosecurity Planning: Guidance for producing site and operation-based plans for preventing the introduction and spread of invasive non-native species in England and Wales. In (pp. 35): Natrual England and Natural Resources Wales.

Nelson, J. R., & Grubesic, T. H. (2018). Oil spill modeling:Risk, spatial vulnerability, and impact assessment. *Progress in Physical Geography: Earth and Environment, 42*(1), 112-127. doi:10.1177/0309133317744737

NIEA SEPA, & Natrual Resources Wales. (2017). *GPP 5: Works and maintenance in or near water*. Retrieved from http://www.netregs.org.uk/media/1418/gpp-5-works-and-maintenance-in-or-near-water.pdf?utm_source=website&utm_medium=social&utm_campaign=GPP5%2027112017

OSPAR Commission. (2010). *Quality Status Report*. Retrieved from London: http://qsr2010.ospar.org/en/media/chapter_pdf/QSR_complete_EN.pdf

Remy, M., Hillebrand, H., & Flöder, S. (2017). Stability of marine phytoplankton communities facing stress related to global change: Interactive effects of heat waves and turbidity. *Journal of Experimental Marine Biology and Ecology, 497*, 219-229. doi:https://doi.org/10.1016/j.jembe.2017.10.002

Riggal, P. (2017). Horizontal Directional Drilling (HDD) Feasibility Report. In (pp. 76): Riggal & Assocaites Ltd.

Roberts, D. (2012). *Causes and ecological effects of resuspended contaminated sediments (RCS) in marine environments* (Vol. 40).

Schulz, A. C., Badewien, T. H., & Zielinski, O. (2015, 2-6 March 2015). *Impact of currents and turbulence on turbidity dynamics at the time series station Spiekeroog (Wadden sea, Southern North sea).* Paper presented at the 2015 IEEE/OES Eleveth Current, Waves and Turbulence Measurement (CWTM).

Scottish Government. (2015a). *Scotland's National Marine Plan: A single framework for managing our seas*. Retrieved from http://www.gov.scot/Publications/2015/03/6517/downloads#res-1.

Scottish Government. (2015b). Scotland's National Marine Plan: A Single Framework for Managing our Seas. In (pp. 144). Edinburgh Scottish Government.

Scottish Parliament. (2003). Water Environment and Water Services (Scotland) Act 2003. In: Scottish Government.

Scottish Parliament. (2009). The Environmental Liability (Scotland) Regulations 2009. In (pp. 24): Scottish Parliament.

Scottish Parliament. (2013a). The Water Environment (Shellfish Water Protected Areas: Designation) (Scotland) Order 2013. In. Edinburgh Scottish Parliament

Scottish Parliament. (2013b). The Water Environment (Shellfish Water Protected Areas: Environmental Objectives etc.) (Scotland) Regulations 2013. In. Edinburgh Scottish Parliament.

SEPA. (2016). *Scottish Bathing Waters*. Retrieved from Edinburgh: https://www.sepa.org.uk/media/219168/1282_sepa_bathing_waters_2016_web.pdf

SEPA. (2017). River Basin Managment Plan Interactive Map. Retrieved from http://map.sepa.org.uk/rbmp/

Sigma-Aldrich. (2012, 2018). Safety Data Sheet - Bentonite. Retrieved from https://www.sigmaaldrich.com/MSDS/MSDS/DisplayMSDSPage.do?country=GB&language=

en&productNumber=B3378&brand=SIGMA&PageToGoToURL=https%3A%2F%2Fwww.sigmaaldrich.com%2Fcatalog%2Fproduct%2Fsigma%2Fb3378%3Flang%3Den

Silicates, N. (2012). Material Safetey Data Sheet - EcoDrill. Retrieved from https://www.pqcorp.com/docs/default-source/msds/pq-corporation/potassium-silicates/ecodrill/ecodrill_317_potassium_silicate_msds2012.pdf?sfvrsn=96034cc7_4

The Scottish Goverment. (2010, 2 November 2010). Revised Bathing Water Directive (2006/7/EC). Retrieved from http://www.gov.scot/Topics/Environment/Water/15561/bathingwaters/BWD2

Thurstan, R. H., McClenachan, L., Crowder, L. B., Drew, J. A., Kittinger, J. N., Levin, P. S., . . . Pandolfi, J. M. (2015). Filling historical data gaps to foster solutions in marine conservation. *Ocean & Coastal Management, 115*, 31-40. doi:https://doi.org/10.1016/j.ocecoaman.2015.04.019

UKMMAS. (2010a). *Charting Progress 2 Feeder report: Clean*

and Safe Seas. Retrieved from London: http://www.gov.scot/Resource/Doc/295194/0114537.pdf

UKMMAS. (2010b). *Charting Progress 2 Feeder Report: Ocean Processes*. Retrieved from London: http://www.gov.scot/Resource/Doc/295194/0108001.pdf

Wallingford, Haskoning, & D'Olier. (2002). *Southern North Sea Sediment Transport Study, Phase 2*. Retrieved from Wallingford: https://www.north-norfolk.gov.uk/media/3112/southern-north-sea-sediment-transport-study-phase-2-main-report.pdf

Wenger, A., Harvey, E., Wilson, S., Rawson, C., Newman, S., Clarke, D., . . . Evans, R. (2017). A critical analysis of the direct effects of dredging on fish. *Fish and Fisheries, 18*(1), 967-985.

Chapter 12: Archaeology & Cultural Heritage

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12.1 Introduction

This report details the assessment undertaken to consider the Historic Environment in respect of the NorthConnect High Voltage Direct Current (HVDC) Cable Corridor from Fourfields Converter station, 2 miles west of Boddam, out to the UK median line (UK EEZ at 200 nautical miles) off the coast from Long Haven Bay.

In support of the baseline, an archaeological walkover survey was carried out onshore, and an archaeological report was prepared as part of the Marine Survey carried out along a 500m wide marine survey corridor (see NorthConnect – UK, Nearshore and North Sea Survey, Archaeological Report (MMT, 2017)). In addition, the unexploded ordnance (UXO) report was considered for its contribution to the baseline (6 Alpha, 2017). These works were designed to inform on the character of historic environment assets, terrestrial and marine, which may be affected, assess the significance of the anticipated impact, and thereby inform the design of the proposed HVDC Cable Corridor and any necessary mitigation strategy.

Along the HVDC Cable Corridor the appraisal established a baseline of Cultural Heritage and Archaeological assets that fall within the consented boundary and referred to as the 'Study Area' throughout the assessment (Figure 12.1 and 12.5). The preparation of this report has been undertaken by Rathmell Archaeology Limited (Rathmell) and informed by consultation with Aberdeenshire Council, Marine Scotland, and Historic Environment Scotland.

Within the terrestrial HVDC Cable Corridor Study Area, ten historic environment assets were identified, and none were designated for their significance. There are no nationally significant historic environment assets that will be subject to significant indirect or setting impacts from the proposed development.

Within the marine section of the HVDC Cable Corridor Study Area, six historic environment assets were identified. While none of these assets have a confirmed significance, **S16** the possible aircraft loss, in the absence of records, will be treated on a precautionary basis as a Protected Place under the Protection of Military Remains Act 1986 (i.e. there is a potential that this is a military aircraft).

There are no nationally significant historic environment assets that will be subject to significant indirect or setting impacts from the proposed development.

The Development will be compliant with the Development Plan and Planning Guidance by not generating any new significant effects.

12.2 Planning and Legislative Context

Scotland has been altered by a series of historic decisions about the use of our land and sea. The resultant modern land and seascape is a palimpsest of relict elements from these past uses that contribute to form our historic environment. Our work examines the local historic environment to identify the significant contributing elements (assets) to enable design developments to enhance the historic environment and avoid adverse impacts.

The UK and Scottish Governments have passed legislation for the conservation and protection of the historic environment; this legislation has generated a range of relevant designations, as summarised in Table 12.1.

Table 12.1 Relevant historic environment designations

Designation	Explanation	Environment	Importance	Responsibility
Ancient Woodland	Areas identified within the Inventory of Ancient Woodland based on the longevity of woodland cover.	Terrestrial	National Regional and Local	Scottish Natural Heritage
Conservation Areas	Areas of special architectural or historic interest can be designated as Conservation Areas, under the *Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997*.	Terrestrial	Local	Planning Authority
Historic Battlefields*	Battlefields included on the Inventory of Historic Battlefields giving them protection through the planning system.	Terrestrial	National	Historic Environment Scotland
Historic Gardens and Designed Landscapes*	Gardens and designed landscapes included on the Inventory of Gardens and Designed Landscapes giving them protection through the planning system.	Terrestrial	National	Historic Environment Scotland
Listed Buildings	Buildings of special architectural or historic interest protected under the *Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997* as modified by the *Historic Environment (Amendment)(Scotland) Act 2011.* Classified into (non-statutory) categories A, B and C in decreasing order of importance.	Terrestrial	National, Regional and Local	Historic Environment Scotland and Planning Authority
World Heritage Sites	Inscribed by UNESCO as exceptional places of '*outstanding universal value'* under the *UNESCO World Heritage Convention* ratified by the UK in 1984.	Terrestrial	International	Historic Environment Scotland and Planning Authority
National Scenic Area	Landscapes of outstanding scenic interest, incorporating historic environment dimension, designated under *Planning (Scotland) Act 2006*. Receiving protection through the planning system	Terrestrial and Marine	National	Scottish Natural Heritage
Protected Places	Under *Protection of Military Remains Act 1986.*	Terrestrial and Marine	National	Ministry of Defence
Scheduled Monuments	Ancient monuments protected for archaeological interest under *Ancient Monuments and Archaeological Areas Act 1979* as modified by the *Historic Environment (Amendment)(Scotland) Act 2011.*	Terrestrial and Marine	National	Historic Environment Scotland
Controlled Sites	Under *Protection of Military Remains Act 1986.*	Marine	National	Ministry of Defence
Designated Wrecks	Wrecks protected for their historical, artistic, or archaeological importance under the *Protection of Wrecks Act 1973.*	Marine	National	Historic Environment Scotland
Historic Maritime Protected Area	The identification of Historic Marine Protected Areas was established under *Marine (Scotland) Act 2010*. These protect historic assets of national importance within the Scottish Territorial Waters (STW).	Marine	National	Historic Environment Scotland

* these Inventories are required to be compiled and maintained under the Historic Environment (Amendment)(Scotland) Act 2011 but there is no statutory protection afforded to the so designated heritage asset.

12.2.1 Scottish Planning Policy

Assets without statutory protection are curated within the relevant planning system by the appropriate planning authority. Given that the current development proposal covers changes of use in both the terrestrial and marine environment, it is important to note that planning control under the Town and Country Planning (Scotland) Act 1997 and associated legislation extends to Mean Low Water Springs (MLWS).

Scottish Planning Policy 2010 deals with all aspects of the historic environment with a view to its protection, conservation, and enhancement.

> *"In most cases, the historic environment (excluding archaeology) can accommodate change which is informed and sensitively managed, and can be adapted to accommodate new uses whilst retaining its special character. However, in some cases the importance of the heritage asset is such that change may be difficult or may not be possible. Decisions should be based on a clear understanding of the importance of the heritage assets."* (Scottish Government, 2010)

Historic Environment Scotland has also issued guidance that is a material consideration through their *Managing Change in the Historic Environment* series. For archaeological assets *PAN 2/2011 Planning & Archaeology* indicates that the principle of preservation *in situ* where possible, and by record if loss cannot be avoided.

The Scottish Government in 2014 expressed their strategy towards the management of the historic environment through *Our Place In Time*. Of note in this context:

> *"Any decision made in relation to the care and management of the historic environment should be informed by the best available evidence, supported by robust data. This is at the heart of all good decision making and delivery, and is core to the international community's approach to managing the historic environment."* (Scottish Government, 2014)

The local terrestrial planning authority, Aberdeenshire Council, delivers the Development Plan through a Local Development Plan; *Aberdeenshire Council: Aberdeenshire Local Development Plan 2012* (Aberdeenshire Council, 2012) a series of specific policies identifies the approach that should be taken to the historic environment. All the policies lie nested below Policy 13 Protecting, Improving and conserving the historic environment that identifies that:

> *"Aberdeenshire Council supports the protection, improvement and conservation of the historic environment. There will be a presumption against development that would have a negative effect on the quality of these historic assets. Different parts of the historic environment require to be subject to specific guidance and controls to make sure that we maintain and improve their value"*

There are four separately published supplementary guidance:

SG Historic Environment 1: Listed Buildings

(a) We will protect all "listed buildings" contained in the statutory list of Buildings of Special Architectural or Historic Interest for Aberdeenshire, and we will encourage their protection, maintenance, enhancement, active use and conservation.

(b) We will refuse planning permission and/or listed building consent for any works, including demolition, which would have a detrimental effect on their character, integrity or setting.

(c) We will only approve alterations or extensions to listed buildings or new development within their curtilage, subject to other policies, if:

- *They are of the highest quality, and respect the original structure in terms of setting, scale, design and materials.*
- *The proposed development is essential to securing the best viable use of the listed building without undermining its architectural or historic character, or its setting.*

SG Historic Environment 2: Conservation Areas

(a) We will refuse planning permission and/or conservation area consent for any development, including change of use or demolition, which would have a detrimental effect on the special character or setting of a conservation area.

(b) We will only approve new development wholly or partly within a conservation area, subject to other policies, if:

- *all details are provided under cover of an application for full planning permission;*
- *the design is of the highest quality, and respects and enhances the architectural, historic and visual qualities that give rise to the designation;*
- *Any trees that contribute to the conservation areas setting and character are retained.*

SG Historic Environment 3: Historic gardens and designed landscapes

(a) We will only approve development that would have an adverse effect on the character, structure or setting of a designated historic garden or designed landscape, subject to other policies, if:

- *the objectives of designation and the overall integrity and character of the designated area will not be compromised; OR*
- *any significant adverse effects on the qualities for which the area has been designated are clearly outweighed by long term strategic social or economic benefits of over-riding public importance, for which no other alternative site is available.*

(b) In either case, mitigation and appropriate measures must be taken to conserve and enhance the essential characteristics, aesthetics, archaeological, historical value and setting of the garden or the designed landscape.

SG Historic Environment 4: Archaeological sites and monuments

(a) We will only approve development that would have an adverse effect on a scheduled ancient monument or on any other archaeological site, including battlefields, of either national or local importance, or on their setting, subject to other policies, if:

- *there are imperative reasons of overriding public interest, including those of a social or economic nature;*
- *there is no alternative site for the development;*
- *Where there is doubt, the applicant has provided further information, at their expense, on the nature and location of the archaeological feature(s) involved, prior to determination of the planning application.*

(b)In any such case, the applicant must at their own expense:

- *take satisfactory steps to mitigate adverse development impacts;*

- *when the preservation of the site in its original location is not possible, arrange for the full excavation and recording of the site in advance of development.*

12.2.2 Marine Planning

The 2015 National Marine Plan (Scottish Government, 2015), with regard to Cultural Heritage and Archaeology, establishes the relevant policy and will apply to both inshore and offshore waters:

Gen 6 Historic environment

Development and use of the marine environment should protect and, where appropriate, enhance heritage assets in a manner proportionate to their significance.

The guidance with this policy sustains a common stance the terrestrial planning system – the provision of competent information, preference for protection of assets with the need to seek to minimise and mitigate any impacts that cannot be avoided.

Further, the 2010 Act, within Section 73 on Historic Marine Protected Areas (MPAs), defines a marine historic asset as any of:

- a vessel, vehicle or aircraft (or part of a vessel, vehicle or aircraft);
- the remains of a vessel, vehicle or aircraft (or a part of such remains);
- an object contained in, or formerly contained in, a vessel, vehicle or aircraft;
- a building or other structure (or a part of a building or structure);
- a cave or excavation; or
- a deposit or artefact (whether or not formerly part of a cargo of a ship) or any other thing which evidences, or groups of things which evidence, previous human activity.

In turn, the 2009 Act, in Section 54 on Marine Plans (Part 3 Marine Planning, Chapter 2) states that *'the cultural characteristics of the authority's region includes a reference to characteristics of that region which are of a historic or archaeological nature*'. Further, within Section 151 on Marine Conservation Zones (Part 5 Nature Conservation, Chapter 1), recognises that ' *"marine environmental matters" means – (a) the conservation or enhancement of … any features of archaeological or historic interest in such areas …*'.

12.3 Approach to Assessment

The works comprised a desk-based assessment supported by an inspection survey for both terrestrial and marine aspects of the assessment. The assessment focused on the proposed cable corridor for the NorthConnect Development (Figure 12.1 and Figure 12.5). For some resources where, insufficient information was available within that area, an adjacent buffer has been included within the study area to examine any sites that are in close proximity and which present the potential to inform on the resource; in particular past archaeological interventions have been considered from a larger area.

All works were conducted in keeping with the Chartered Institute for Archaeologists' Standards and Policy Statements and Code of Conduct and Historic Environment Scotland Policy Statements.

12.3.1 Objectives

The objective of the assessment was to assess the known historic environment sites and the potential for currently un-located archaeological sites within the study area for the NorthConnect Development.

The assessment was then to determine the potential impact of the development on the historic environment resource, and hence recommend a mitigation strategy to reduce any adverse impacts.

12.3.2 Baseline Characterisation

12.3.2.1 Onshore Historical Assets

A programme of works was agreed with NorthConnect to compile an onshore baseline through a desk-based assessment and walkover survey.

Given the history of survey in the area, the gathering of baseline information was limited to a desk-based assessment which incorporated available data and a walkover inspection of the ground that will be impacted by the project. The desk-based assessment consulted resources within:

- National Collection of the Historic Environment (NCHE) (including Canmore, Maritime Canmore, the National Collection of Aerial Photography (NCAP) Scheduled Monuments and other designations);
- Aberdeenshire Council Sites and Monuments Record (known archaeological sites);
- National Library of Scotland (bibliographic records, historic Ordnance Survey and pre-Ordnance Survey mapping);
- Local museums, libraries and other archives (Old & New Statistical Accounts, local history books);
- Online resources; such as Historic Environment Scotland's PastMap; and
- Previous work associated with the NorthConnect Interconnector Station and HVAC cable route.

As part of the development of the HVDC Cable Corridor, there will not be any new permanent above ground structures or plant. Therefore, it was not necessary to consider the visual impact on any significant Archaeology & Cultural Heritage sites within or outwith the Study Area. Where the marine and onshore cables are to be joined, the 'Joint Pit' is to be constructed below ground surface and thus no permanent visual effect.

Information contained within available published and web-based sources was also consulted with the baseline compiled using a Geographic Information System package (QGIS).

The walkover survey comprised:

- classification of the archaeological sites and monuments;
- written site description;
- photographic record (digital) of all sites; and
- locating all archaeological site limits and elements by DGPS equipment (Leica GS50) allowing real-time correction to Ordnance Survey National Grid and Datum.

All works complied with the Chartered Institute for Archaeologists' Standards and Policy Statements and Code of Conduct and Historic Environment Scotland Policy Statements.

12.3.2.2 Marine Historical Assets

Maritime data was incorporated in the baseline for the cable corridor that covered both inshore waters (out to 12 nautical miles being STW) and offshore waters (to the edge of the UK Exclusive Economic Waters, 200 nautical miles). The Marine Archaeological Report was carried out separately by MMT Sweden AB (see (MMT, 2017) for detailed methodology).

The MMT Sweden AB Archaeological Report (MMT, 2017) details the findings of possible archaeological interest from a combination of geophysical surveys and visual inspections along the UK Nearshore and North Sea Sections of the subsea cable corridor. The results in this report are based upon interpretations of geophysical data as well as video inspections. The combination of Side Sonar Scan (SSS), and Multi Beam Echosounder (MBES) data collected is considered an effective method of detecting the presence of wrecks on the seabed throughout the route corridor. The Sub Bottom Profiler (SBP) and Magnetometer (MAG) data acquired may detect buried wrecks directly under the survey lines but not throughout the survey corridor. The probability of detection with these systems depends on the size of the object and their ferrous mass (magnetometer).

The UK Nearshore Survey corridor is located south of Peterhead. The survey corridor is approximately 500 m wide, and reaches approximately 4 km from the coast at Long Haven Bay. The geophysical survey was conducted in two phases. Firstly, a hull MBES survey was conducted, as close to shore as possible. Then a geophysical survey with Work Class Remotely Operated Vehicle (WROV) mounted MBES, SSS, SBP and MAG, following nine survey lines with a separation of 65 m was completed. Additional crosslines were run close to shore in order to fill gaps in the coverage resulting from the complex coastline.

The North Sea survey work included hull mounted MBES and remotely operated towed vehicle (ROTV) mounted SSS and SBP. A magnetometer was towed 10.7 m behind the ROTV. The survey included three survey lines with 125 m line spacing covering a 500 m wide corridor. Additional survey lines were run in challenging areas to widen the corridor, in order to locate the optimal conditions for cable installation. SSS range was set to 100 m for the high frequency (HF) data and 150 m range for the low frequency (LF) data. The LF data was only processed where HF data was not available (nadir and wing lines (WL) outer range).

Consequent to the Marine Survey, a desk based unexploded ordnance (UXO) threat and risk assessment study for the project in order to support the proposed cable installation operations was undertaken (6 Alpha, 2017).

12.3.3 The Significance of Potential Impacts

The criteria published in *Scottish Planning Policy* and the *Local Development Plan* have been used to determine the importance / sensitivity of historic environment assets. This remains compliant with the National Marine Plan. The main thresholds of importance / sensitivity are recognised as International, National, Regional, Local and Other. The importance of designated assets is detailed in Table 12.2; undesignated assets are assessed against the published criteria. Typically, these assets will fall within Regional or Local importance, but where there is no substantive significance then they may be assessed as being of Other importance / sensitivity.

Table 12.2 Definitions of sensitivity of historic environment assets

Sensitivity	Site Types
International/ National	World Heritage Sites National Scenic Areas Designated Wrecks, Protected Places & Controlled Sites Historic Maritime Protected Areas Scheduled Monuments Category A Listed Buildings Inventory Gardens and Designed Landscapes Inventory Battlefields Assets that are of national or international importance, either architectural or historic, or fine, little-altered examples of some particular period, style or building type (inc. Ancient Woodland).

Sensitivity	Site Types
Regional	Archaeological sites and areas of distinctive regional importance Category B Listed Buildings Non-Inventory Gardens and Designed Landscapes identified in Development Plan Assets that are major examples of some period, style or building type, which may have been somewhat altered (inc. Ancient Woodland).
Local	Conservation Areas Archaeological sites and areas of local importance Category C Listed Buildings Assets that are lesser examples of any period, style or building type, whether as originally constructed or as a result of subsequent alteration (inc. Ancient Woodland).
Other	Assets without statutory protection and with less than local importance such as findspots with no known remains Unlisted Buildings and townscapes of some historic or architectural interest

The type of effects and impacts from the development on historic environment resources are divided into the following categories:

Direct: where there will be a physical, typically irreversible, effect on an asset. Direct effects may be caused by a range of activities associated with the construction and operation of proposed development. Construction activities may include ground-disturbing excavations for foundations, cable trenches, access roads, extraction, installation of anchorages and foreshore reclamation. In addition, other disturbance from processes, such as vehicle movement and soil or overburden bunding, may produce irreversible effects upon historic environment assets; and

Indirect: where the asset may be affected as a consequence of the development occurring in a manner that may be either irreversible or temporary. Indirect effects may relate to the new development reducing views to or from historic environment assets with important landscape settings, or may result from increased noise or vibration, or the initiation of processes such as erosive scour from the operation of marine structures or may cause increased fragmentation of the historic landscape and the loss of connection between its component parts. Such effects are likely to occur during the construction phase of the development and persist through the operational phase.

Potential effects, direct and indirect, have been considered in terms of their longevity, reversibility, and nature, which allowed the magnitude of effect to be determined. Magnitudes of impact are assessed in the categories major, moderate, minor and negligible, and are described in Table 12.3.

Table 12.3 Criteria for classifying Magnitude of Impact

Magnitude of Impact	Criteria
Major	Fundamental change to the specific environmental conditions assessed resulting in temporary or permanent change to the character or setting.
Moderate	Detectable change to the specific environmental conditions assessed resulting in non-fundamental temporary or permanent change and partial alteration of character or setting.
Minor	Detectable but minor change to the specific environmental conditions assessed and does not affect the condition of the receptor materially.
Negligible	No perceptible change to the specific environmental conditions assessed.

The assessment of significance of predicted effects and impacts was undertaken using two key criteria: importance / sensitivity of the asset and the magnitude of the anticipated impact. Table 12.4 combines these criteria to provide an assessment of the level of significance of effect. All adverse direct and indirect impacts resulting in Moderate or Major Effects are considered to be significant in terms of the EIA Regulations.

Table 12.4 Matrix for Assessing Significance of Effect

Magnitude of Impact	Sensitivity			
	International and National	Regional	Local	Other
Major	Major	Moderate	Minor	Insignificant
Moderate	Moderate	Moderate	Minor	Insignificant
Minor	Minor	Minor	Insignificant	Insignificant
Negligible	Insignificant	Insignificant	Insignificant	Insignificant

12.3.4 Identification and Assessment of Mitigation

Where direct effects are identified that have not been designed out, mitigation will be proposed where there is both a magnitude of change greater than negligible and a reasonable potential for the enhancement of our comprehension of the historic environment. Mitigation will be framed to be in keeping with planning guidance, the Development Plan, the policies of the Chartered Institute for Archaeologists and relevant best practice.

For indirect effects that are identified that have not been designed out there is no credible potential to further mitigate the impact.

12.3.5 Assessment of Residual Impacts

The resource being considered, the Cultural Heritage and Archaeology, by its nature is a static and non-renewable resource. Hence the original assessment of the Project for direct and indirect permanent impacts will remain sound post-mitigation and hence this assessment will be sustained as the residual impact.

Where mitigation has been detailed, typically for construction related direct effects, this mitigation usually orientates to the recovery, interpretation and dissemination of knowledge about the compromised historic environment assets. Some of this knowledge may be embodied in physical object (artefacts) that are retained. While the mitigation has ensured that the potential knowledge inherent within those compromised sites has been realised and retained, compliant with the principles of the Local Development Plan and National Marine Plan, this does not fundamentally alter the loss of a non-renewable resource.

12.3.6 Limitations of the Assessment

The absence of large scale and systematic archaeological fieldwork within the Study Area has a consequence on the comprehensiveness and comparability of the archaeological record for any individual piece of ground. The archaeological record is effectively a composite of antiquarian and archaeological interest through time (whether stimulated by academic or commercial drivers) and as such is piecemeal, fragmentary and partial (both spatially and temporally). This process of compilation will inevitably perpetuate information gaps and erroneous information that cannot be confidently identified.

The studies to compile the baseline information will have resolved many of the information gaps. However, there is always the potential for additional, unidentified sites to be present.

12.4 Baseline information on the Historic Environment

Presented within this section is a narrative description of the known Cultural Heritage and Archaeological conditions within the Study Area. Historic environment assets are identified with a site number (e.g. S4) with a detailed listing of data relating to them is presented in Table 12.6 (onshore) and Table 12.7 (marine), with their locations shown in Figure 12.1 and Figure 12.5 respectively.

12.4.1 Designated Assets

The assessment identified no specific assets within the onshore or marine portion of the study area that were protected for their cultural heritage or archaeological merit under any historic environment designation (see Table 12.1). The possible aircraft loss **S16**, in the absence of records, will be treated on a precautionary basis as a Protected Place under the Protection of Military Remains Act 1986.

12.4.2 Previous Archaeological Studies

A broad range of studies have been undertaken across the study area to develop the established Historic Environment Record. Some are studies that have significantly enhanced the record on a national or regional scale, often driven by a thematic issue. In terms of specific studies within the onshore section, as part of the wider project connected with the location of the Converter Station and HVAC Cable Corridor, a desk-based assessment and linked walkover survey have been carried out (Klemen, 2015).

Of particular relevance to the marine section was the RCAHMS's *Project Adair*; this has sought to reconcile the continually updated database of wrecks and other obstructions held by the UK Hydrographic Office (UKHO) with their Canmore database. A number of the marine assets identified within NorthConnect's study area derive from this UKHO data and also the Whittaker database (2011) of all known marine losses.

The introduction of large volumes of marine data from multiple sources that cover the same historical events has potentially generated duplication of data that has yet to be consolidated within the record. Also note that the UKHO legacy effect weights away from smaller vessels, particularly wooden ones, as these are harder to detect with marine geophysics and are less likely to present a significant navigational hazard (WA Coastal & Marine, 2012).

12.4.3 Prehistoric Landscapes

There is no evidence for specific known heritage sites from the prehistoric period, though there would have been substantive occupation and land use within the study area that covers the HVDC Cable Corridor.

Given the marine nature of much of the cable corridor, it should be recognised that humans have occupied the UK Continental Shelf at various points in our past for over 700,000 years. A range of Palaeolithic stone artefacts as well as Pleistocene faunal remains have neem recovered in the North Sea. A significant body of cumulative evidence shows that there are submerged prehistoric landscapes across wide areas of the UK continental shelf (WA Coastal & Marine, 2012). Many of the discoveries of this evidence have derived from seabed development.

The potential for the survival of cultural heritage within the study area (both terrestrial and marine) will be determined by various physical factors, processes and topography.

12.4.4 The Early Historic, Medieval and Later Periods

The earliest name given to Peterhead is Keith Inch which it retained until 1593 when it obtained a charter as a burgh. The Study Area lies within the parish of Peterhead with Peter-Ugie, Petri Promontorium and Petri Polis also other derivatives that are found on associated charters (Donald, 1834-45: 344 Moss, 1791-99: 385). The estate of the Earls of Marischall included the parish of Peterhead and had one of their residences at Boddam Castle.

Both the Old (1791-99) and New (1834-45) Statistical Accounts provide a detailed insight into the economic and social state of the parish. With particular reference to the topographic feature of Stirling Hill that forms the southern extent of Peterhead Parish and has an abundance of fine granite. Moss (1791-99: 558) refers to this abundance and quality of the granite having been used for numerous buildings in Peterhead while Donald (1834-45: 331) highlights it being taken down to the Isle of Sheppey in Kent to be used in the construction of the naval dockyards at Sheerness.

The earliest mappings depicting the area of Boddam are Robert Gordon's *Aberdeen, Banff, Murrey to Inverness: [and] Fra the North Water to Ross* (1640) and Joan Blaeu's *Description of the two shyres Aberdene and Banf, with such contreys and provinces as are Comprehended un* (1654), itself a re-depiction of Gordon's survey. Both surveys label Boddam (spelt 'Boddom') and the larger settlement of Peterhead to the north with the inland area in which the Study Area is located as hills (not shown).

It is not until Roy's *Military Survey of Scotland* (1747-52) (Figure 12.2a) depicts an open landscape with Stirling Hill (labelled as Sterling Brae) the only significant topographic feature labelled. Roy also depicts the coastal topographic feature of Longhaven and the area of the later quarry (**S2**), and also provides the current spelling. However, he also depicts a settlement of at least nine structures and it is most likely the labelling refers to this settlement. This area falls outwith the boundary of the HVDC Cable Corridor.

There are four clachans depicted by Roy and located to the northwest of the Longhaven settlement and what is the area of Longhaven Quarry (**S2**). Due to inaccuracies in the survey it is difficult to be conclusive if they are located within the study area for the HDVC Cable Corridor. It is possible that parts may have been subsumed into existing farmsteads or that if they have totally disappeared and nothing survives.

Both John Thomson's (1832) *Northern part of Aberdeen and Banff Shires* (not shown) and Alexander Gibb's (1858) *Map of the north eastern districts of Aberdeenshire* (not shown) do not depict either the settlement that Roy labels as Longhaven or the four clachans.

With the *25-inch 1st edition Ordnance Survey* (1868) the landscape has become enclosed and resembles the current layout of the landscape with the Fourfields site clearly distinguishable as are the fields forming the lower southern portion of the proposed cable corridor (Figures 12.2b & 12.3a).

Gibb's (1858) survey (not shown) is the first to depict and label the current farmstead called Longhaven and located to the north of the A90 with the *25-inch 1st edition Ordnance Survey* (1872) (Figure 12.3a) also depicting its presence. This is the first survey to depict the farmstead at Sandfordhill (**S10**) (HER ID: NK14SW0069) (Figure 12.2b) and formed by two rectangular buildings and a small enclosure to the south. The north-south aligned turf and stone boundary wall (**S9**) of Sandfordhill South is also depicted (Figure 12.2b). This is currently sited to the east of Stirling Hill Radar Station and forms the upper northwest edge of the study area and the consented boundary for the HVDC Cable Corridor. The 1st edition survey is also the first time that the salmon house at Heathery Haven (**S1**) (Figure 12.3a) is depicted.

With the *25-inch 2nd edition Ordnance Survey* (1901) (Figures 12.2b & 12.3a) a number of the heritage assets are depicted for the first time. A second structure and aligned roughly east-west and to the south of the previous structure is depicted at Heathery Haven (**S1**) and maybe related to activity associated with the Salmon House (Figure 12.4a). Due to its close proximity to the Salmon House, this structure has been incorporated into the area of **S1**.

An unroofed structure (**S4**) to the east of Heathery Haven is also depicted. Longhaven Quarry (**S2**) is depicted and a working quarry at this point. It is possible that the structure of (**S4**) is associated with quarrying activity at **S2** as similar structures are noted at Stirling Hill Quarry.

The structure called Longhaven for the purposes of the assessment (**S6**) and the two wells called Long Haven (**S7**) and Longhaven Mains (**S8**) for the purposes of the assessment are also both first depicted. A major feature is the presence of the southwest-northeast running Boddam Branch of the Great North of Scotland Railway (**S5**) that cuts through the study area for a short section from NK 1168 4023 to NK 1198 4046.

The disused railway (**S5**) was part of a 24 km single track branch line running from the Formatine & Buchan Railway at Ellon to Boddam. Opening in August 1897 the branch carried freight (predominantly from local quarries) and passenger traffic. To the immediate southwest of the Study Area was the site of Longhaven Station (NK 1153 4010) which had an associated small goods siding immediately to the southeast. The branch line remained in use until 1932 when it was closed to passengers due to lack of traffic. Subsequently it was closed to freight in 1945 and then dismantled in 1950.

Table 12.6: Onshore Historic Environment Assets within the Study Area

Site	Name	NGR Ref:	UID, Designation & Description	Period	Image from Site Inspection
S1	Heathery Haven	NK 1204 4007	**Canmore ID 75962**; The remains of a Salmon House (top image) are situated at the head of the cliffs overlooking Heathery Haven. It is depicted as roofed (and noted as a 'Salmon House') on the 1st edition of the OS 6-inch map (1872), which also shows a path dropping down to the beach below. On the 2nd edition 6-inch map (1901) a second structure aligned E-W (bottom image), is depicted to the south and close to the Salmon House previously depicted. The second structure is first depicted on the 2nd edition ordnance Survey (1901).	Post-medieval	
S2	Longhaven Quarry	NK 1200 4014	**AHER ID NK14SW0015**; Disused quarry. Distinctive Peterhead pink granite was quarried from here for monumental and building purposes. The quarry was closed but subsequently re-opened c.1986 on a small scale, using a non-explosive carbon dioxide blasting method to extract the granite. Now disused and water filled.	Modern	
S3	Longhaven (bay)	NK 1208 4042	**AHER ID NK14SW0044**; During WWII a boat carrying iron ore was run aground here deliberately after a bomb attack in order to save the cargo.	Modern	

Site	Name	NGR Ref:	UID, Designation & Description	Period	Image from Site Inspection
S4	Heathery Haven	NK 1209 4008	**No designation**; Roofed structure: depicted on the 2nd edition OS survey. Sited to the east of the Salmon House. The structure is depicted as unroofed in the OS mapping. The current roofing is a later edition.	Modern	
S5	Boddam Branch, Great North of Scotland Railway	NK 1169 4023 to NK 1198 4046	**No designation**; The disused railway running from NK 1168 4023 to NK 1198 4046 is a section of the former Boddam Branch of the Great North of Scotland Railway; a 24 km single track branch line running from the Formatine & Buchan Railway at Ellon to Boddam. Opened in August 1897 the branch carried freight (predominantly from local quarries) and passenger traffic. Longhaven Station NK1153 4010 formed part of the disued branch line as did the goods siding to the southeast of the station.	Post-medieval	
S6	Long Haven	NK 1187 4037	**No designation**; Unroofed structure: depicted and labelled on the 2nd edition OS survey.	Post-medieval	

Site	Name	NGR Ref:	UID, Designation & Description	Period	Image from Site Inspection
S7	Long Haven	NK 1184 4038	**No designation**; Well: depicted and labelled on the 2nd edition OS survey.	Post-medieval	
S8	Longhaven Mains	NK 1195 4051	**No designation**; Well: depicted and labelled on the 2nd edition OS survey.	Post-medieval	
S9	Sandfordhill South	NK 1165 4111 to NK 1161 40652	**No Designation**; A stone and turf boundary wall running north-south and depicted on the first edition of the OS 6-inch map (Aberdeenshire, 1872)	Post-medieval	
S10	Sandford Hill	NK 1170 4117	AHER ID NK14SW0069; Site of a farmstead depicted on OS 1st and 2nd edition OS maps, which show 2 rectangular buildings with a small enclosure to the south.	Post-medieval	

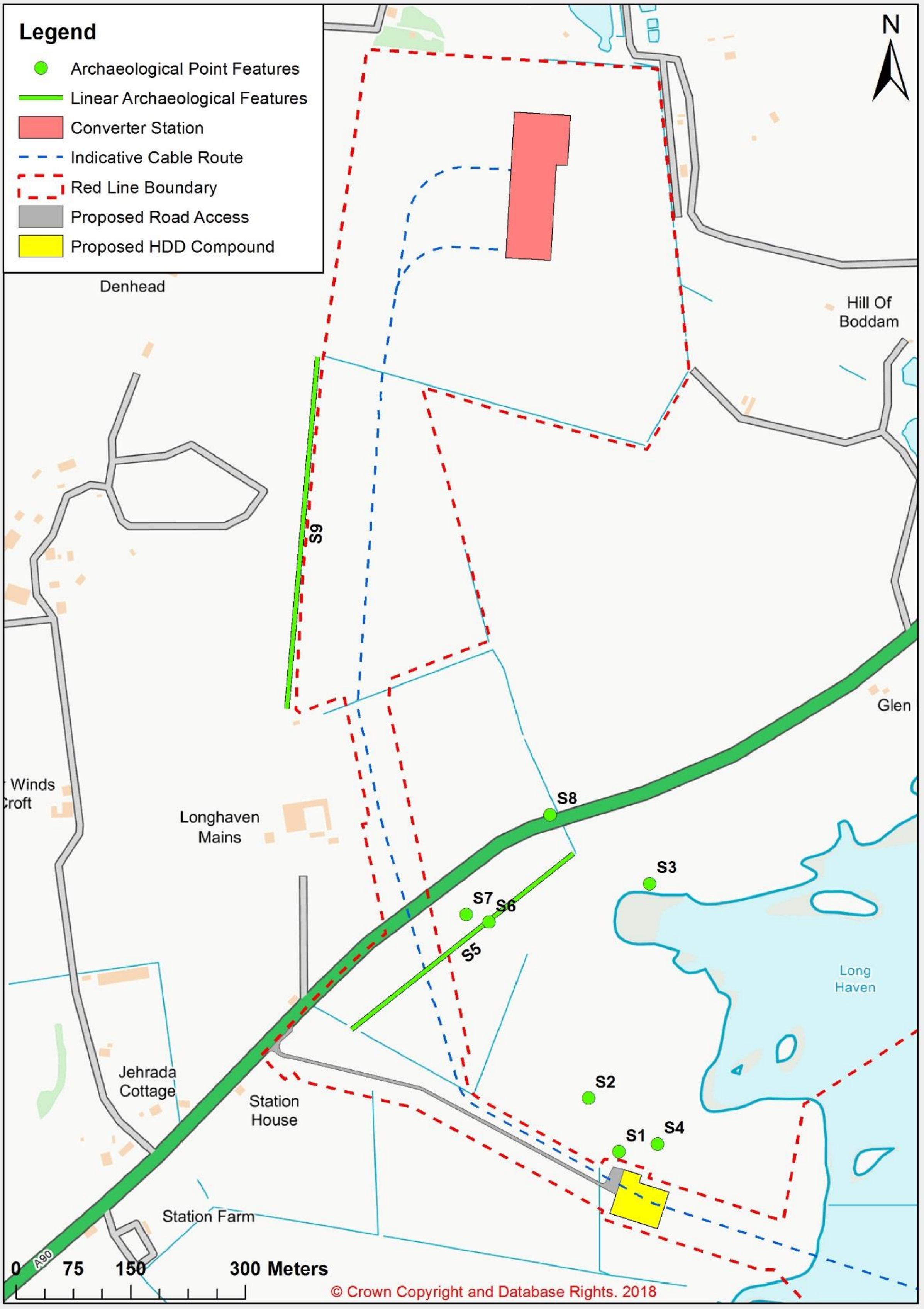


Figure 12.1 Onshore Archaeological features of interest.

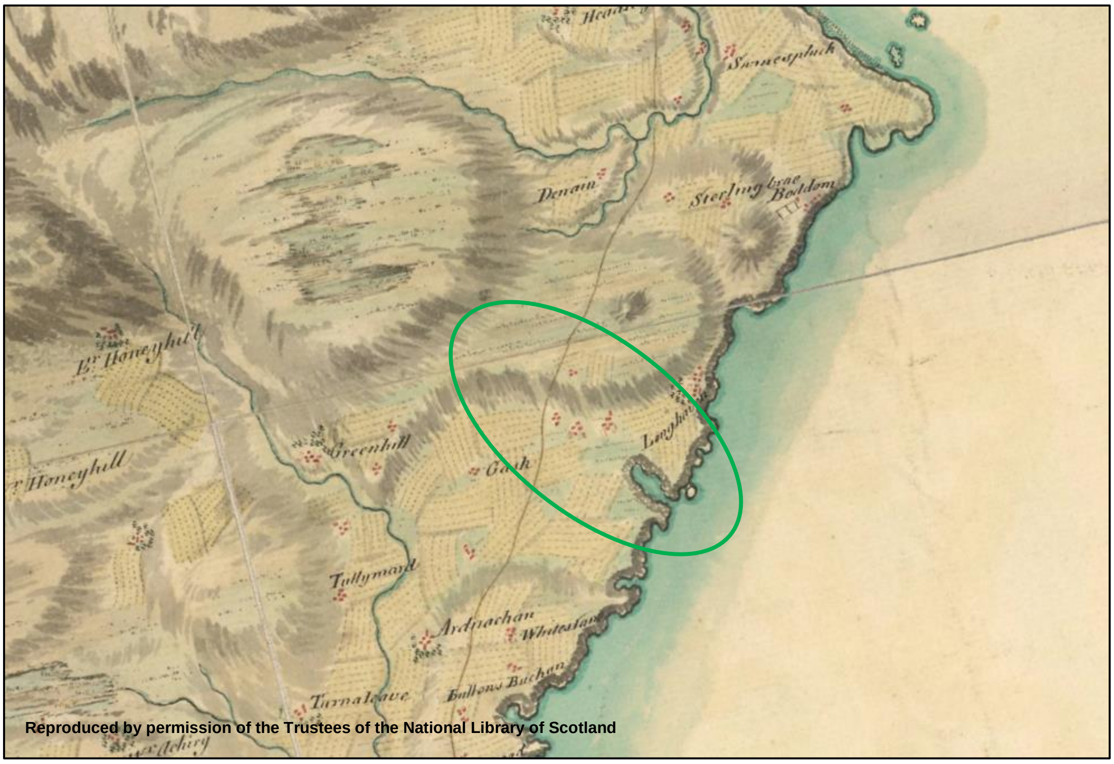


Figure 12.2a: Extract from Roy's *Military Survey of Scotland* (1747-52). Green circle study area.

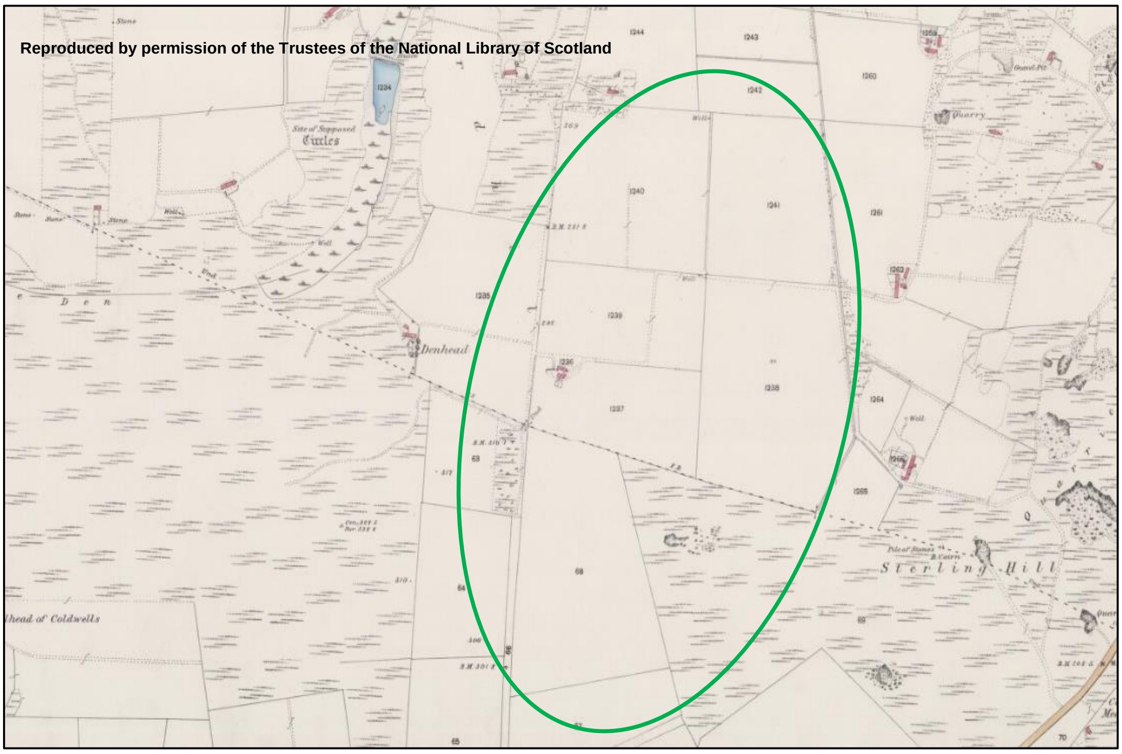


Figure 12.2b: Extract from 25-inch 1st edition Ordnance Survey (1868), north area of the HVDC Cable Corridor. Green circle denotes the study area.

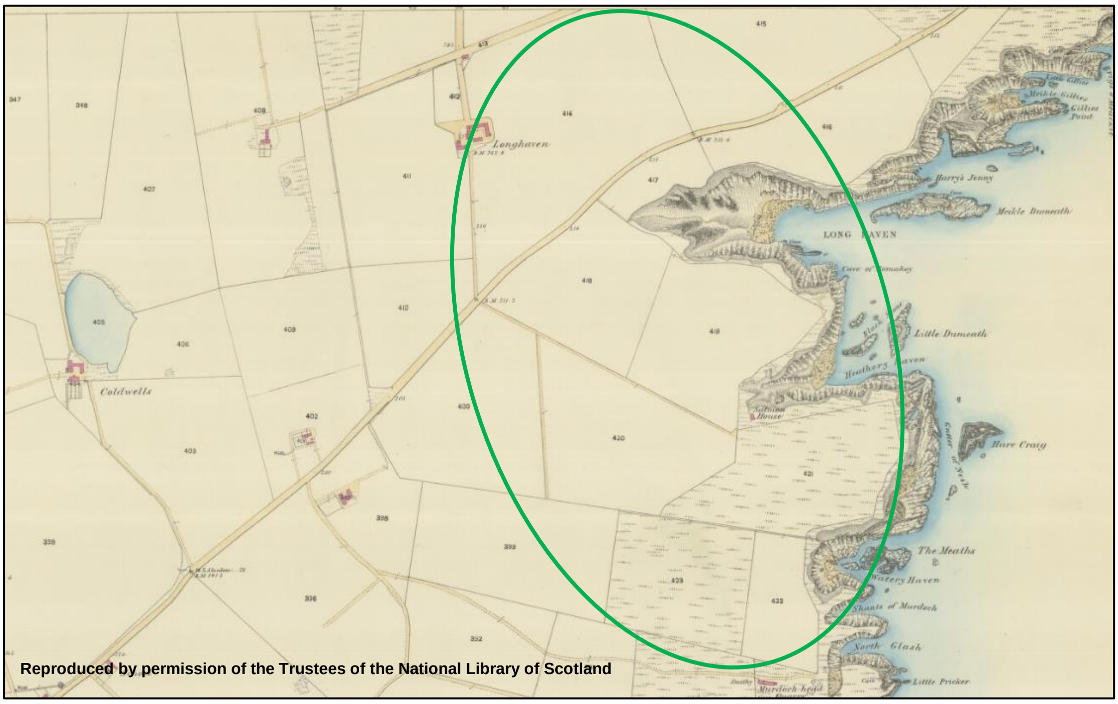


Figure 12.3a: Extract from 25-inch 1st edition Ordnance Survey (1868), south area of the HVDC Cable Corridor. Green circle denotes the study area.

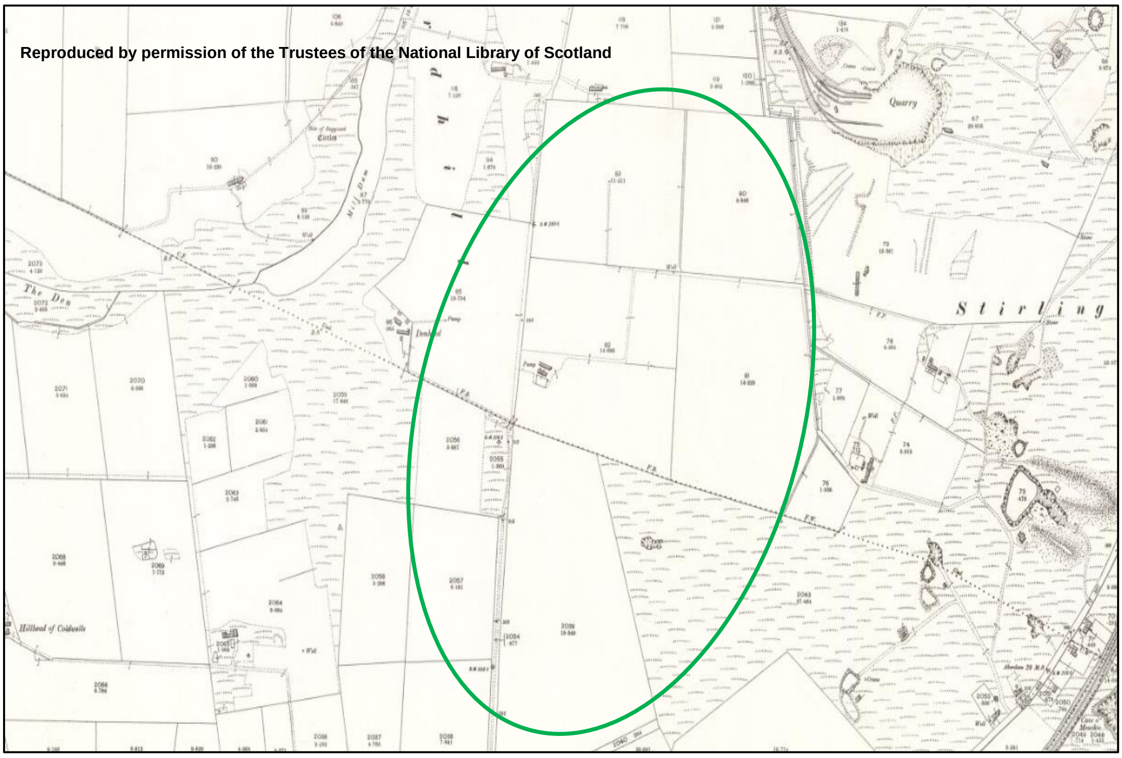


Figure 12.3b: Extract from 25-inch 2nd edition Ordnance Survey (1901), north area of the HVDC

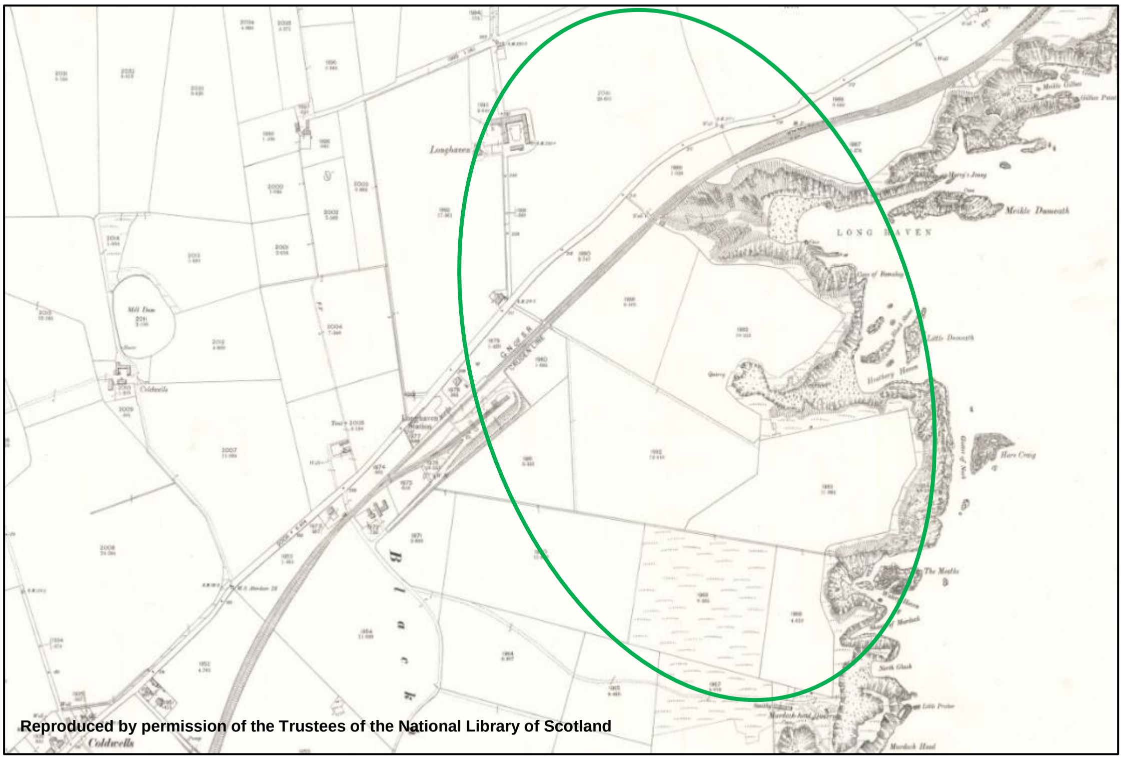


Figure 12.4a: Extract from 25-inch 2nd edition Ordnance Survey (1901), south area of the HVDC

The *2nd edition Ordnance Survey* (1901) (Figure 12.4a) depicts the form of this section of the branch line while in use. In sequence from southwest-northeast the branch is a single track line initially in a cutting for the first 220m, at NK 1185 4037 it transitions from cutting to a slight embankment which continues for the next 140m to NK 1197 4045 where the next stretch of cutting commences as the branch leaves the study area. There is no indication of any additional railway infrastructure on this section. A trackway is depicted falling to the point of transition from cutting to embankment at NK 1185 4037 where there is an informal crossing point.

The site of Longhaven Bay (**S3**) is recorded as a ship wreck from World War II and therefore would not be depicted on any mapping.

12.4.5 Walkover Survey

A preliminary inspection survey was carried out on a section of disused railway (**S5**) that the NorthConnect HVDC cables need to cross for early assessment. Site inspection was undertaken on 14th September 2017. An inspection survey encompassing the full onshore study area was undertaken on the 20th November 2017 in cloudy, breezy conditions. This was to assist in the characterisation of surviving upstanding archaeological remains (Figure 12.1). No new unrecorded sites were recorded.

The assessment area was found to be generally undulating rough pasture on unimproved ground and field boundaries within the study area took the form of dry stone dykes and timber post and wire fences.

The two structures at Heathery Haven **S1** were covered in dense vegetation but their outlines were visible. The structure depicted on the *1st edition Ordnance survey* (1872) and labelled as 'Salmon House' (Figure 12.3a) is rectangular in form and orientated roughly northwest-southeast and measured approximately 4m by 7m. Located 5m to the south is another rectangular turf and stone structure orientated roughly east-west, measuring approximately 5m by 14m and adjoins onto a current stone field boundary wall and is first depicted on the *2nd edition Ordnance survey* (1901).

The area of Longhaven Quarry **S2** is clearly visible although there are no signs of any associated quarry equipment/furniture. However, the small rectangular structure of **S4** Heathery Haven, is possibly a powder hut associated with the quarry. Constructed of pink granite with a concrete roof the structure measures 2m by 3m and is aligned east-west.

It was not able to access the area of Longhaven Bay **S3** due to no clear access route and Health and Safety concerns. From a raised viewpoint it was not possible to observe any obvious remains associated with the cargo ship deliberately run aground in World War II. It is possible that they were either removed soon after the incident or if left *in situ* natural forces have removed any sign of the vessel.

Site inspection at the disused railway line **S5** confirmed that the mapped character reflects the modern landform. No *in situ* track was noted. The cutting, embankment and track bed were covered by turf with the track bed appearing a consistent 3m breadth and the cuttings were up to 8m broad and 3m deep. The trackway falling to the informal crossing was readily identifiable as a banked linear feature that rose to meet the level of the track bed. Longhaven Station was predominantly outwith the Study Area but inspection noted the survival of the terraced landform of the good sidings to the southeast of the main railway line, though covered by gorse. The modern field boundary to the northeast of this landform maintaining the boundary mapped on the *2nd edition Ordnance Survey* (1901).

Within the general Study Area isolated cast iron fence posts were noted that may relate to the fencing of the branch line in the late 19th century. Further, numerous *ex situ* timber sleepers were recognised, typically reused in post-and-wire fences as either gateposts or straining posts. No other railway furniture was noted.

Site inspection of Long Haven, **S6** demonstrated that its location is behind a timber post and wire fence as well as a turf and stone field boundary wall. Due to strong winds closer inspection was not possible and also there is signage that notes the unstable condition of the structure.

The mapped well of site **S7**; Long Haven is located just to the west of **S6**. However, the well has been infilled and vegetation cover makes the exact site difficult to be conclusively located, but a stone filled hollow is the possible location. A similar stone filled hollow was recorded at the well site of Longhaven Mains **S8**. The exact location was difficult to conclude and may fall just outwith the study area.

The stone and turf field boundary of **S9** Sandfordhill South is clearly visible running in a north-south alignment up to the southeast corner of 'Fourfields' and the overall location of the converter station.

The former farmstead of Sandfordhill **S10** on the *1st and 2nd editions Ordnance Survey* (1872 & 1901) depicts two rectangular buildings with a small enclosure on the southern side. The present condition is a large grass covered mound.

12.4.6 Maritime Losses

12.4.6.1 Scottish Territorial Waters Survey Corridor

There are a series of records relating to maritime losses identified by the Marine Survey (see Tables 25 and 27 within MMT, 2017) within STW Survey Corridor. The marine archaeology report (MMT, 2017) recognised that historic records of loss can embody considerable uncertainty in terms of location and duplicate entries can be generated in different archives. Two confirmed wrecks were located within this portion of the survey corridor, the Cairnavon **S11** and the Egenaes **S12**.

The wreck **S11** was located slightly north of the 500m survey corridor and was provisionally identified as the mixed cargo motor vessel Cairnavon, lost in 1925 (see Table 12.7 and Figure 12.5). The second wreck was concluded to be linked to two records related to a single loss, that of the fishing vessel the Egenaes **S12** in March 1917 (MB-1000 within MMT,2017) based on the commonality of information. The location of this wreck was confirmed by inspection with both metal and wooden debris observed (see Table 12.7 and Figure 12.5).

When commenting on the wrecks identified by the Marine Survey (**S11** and **S12** within inshore waters and the offshore wrecks noted below) MMT(2017) stressed that detected wrecks were surrounded by a debris field of varying size and complexity. The full extent of these debris fields may not be apparent from the SSS and MBES data due to sediment cover.

12.4.6.2 UK Exclusive Economic Zone Offshore Survey Corridor

Within the Offshore Survey Corridor (from the STW limit, to the limit of the UK Exclusive Economic Zone (UK EEZ)) a further four historic environment assets were confirmed. Two (**S13** and **S14**) were interpreted as debris of uncertain origin and date, but anthropic in character. The wreck of a second 20th century fishing vessel (**S15**) was located. This wreck was identified by the fishing representative as the M/V Margareta Nyborg, a Danish fishing vessel.

At a fourth location (**S16**) both debris (including an anchor) and wreckage (including thin riveted metal) were identified. The character of the wreckage is such that it may derive from an aircraft. Given that there is no record of a loss at this location, a precautionary approach should be adopted and the potential for this location to be the remains of a military aircraft loss considered. On this basis, unless further information is forthcoming, this site should be treated as if it were a Protected Place under the terms of the Protection of Military Remains Act 1986.

12.4.1 Methane Gas expulsion

A consideration during the installation and working period of the offshore cable corridor is the occurrence of methane expulsion from the sea bed. The cause and effect are not fully understood but North Sea surveys have produced a high coincidence of wrecks sitting at the centre of depressions formed by escaping gas. Sonar surveys in an area called 'Witch Ground' approximately 150km northeast from Aberdeen demonstrated a sea bed peppered with pockmarks from escaping gas.

The Marine Survey (Figures 13 & 18 within MMT,2017) demonstrates numerous features potentially associated with escaping methane gas from seabed sediments. It also noticeable that two historic environment assets **S15** and **S16** have a close correlation with a surrounding depression that correspond to the wrecks hitting the seabed with the impact disrupting the integrity of the sediments and releasing a pocket of methane gas.

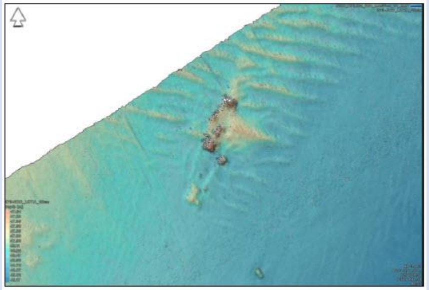
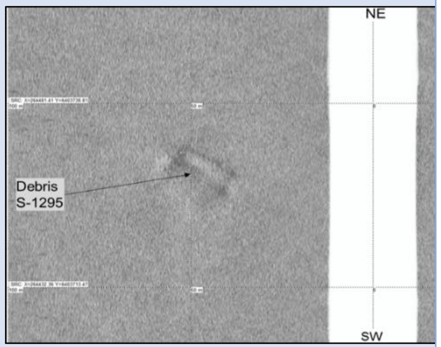
12.4.2 Unexploded Ordnance (UXO)

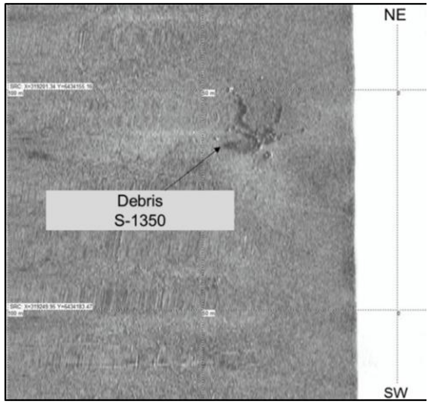
No anomalies or records were noted during the Marine Survey that were interpreted as potentially historic unexploded ordnance from historic conflict (MMT,2017). However, this report noted that due to the limitations of the single towed magnetometer system a further survey for UXO was appropriate.

A subsequent desk based Unexploded Ordnance threat and risk assessment study (6 Alpha, 2017) did not identify any known UXO assets within the study area. However, it was concluded that there is a low probability of encountering UXO in UK Nearshore Waters; with low to high probability of UXO being encountered off shore.

Given that the debris **S16** has, on a precautionary basis, been identified as the potential remains of a military aircraft it should further be considered that there is the potential for UXO associated with this site.

Table 12.7: Marine Historic Environment Assets within the Study Area

Site	MMT ID	Latitude	Longitude	UID, Designation & Description	Period	Image from Site Inspection
S11	S-0354	57° 28.109' N	001° 47.993' W	Canmore: 101835; No Designation: Wreck Wreck measuring 33.5 m by 7.4 m with 2 m elevation. Provisionally correlates to **Cairnavon** – a steel motor vessel carrying a mixed cargo of coke and general goods lost 1th November 1925.	20th Century	
S12	MB-1000	57° 33.643' N	001° 32.336' W	Canmore: 101866; No Designation: Wreck Wreck measuring 36.2 m by 11.5 m with 3 m elevation having an orientation 010/190°, seabed depth 84m. Correlates to the **Egenaes** - sunk on 22 March 1917, torpedoed by German U-boat SM UC-17. The vessel was lost approximately 10 miles East of Peterhead. Registration: Norwegian. Weight: 399 tons.	20th Century	
S13	S-1295	57° 42.811' N	000° 57.252' E	No HER UID; No Designation: Debris Regularly shaped rectangular object (considered debris), 15.0 m long by 5.6 m wide. The contact was not visually inspected. The regular shape suggests it is anthropic.	Unknown	

Site	MMT ID	Latitude	Longitude	UID, Designation & Description	Period	Image from Site Inspection
S14	S-1350	58° 0.744' N	000° 3.638' E	No HER UID; No Designation: Debris An irregularly shaped area of suspected debris 13.1 m long and 3.7 m wide located in a small depression. There are a number of small points around the contact, which may be part of a debris field.	Unknown	
S15	S-1499	58° 13.616' N	000° 40.388' E	No HER UID; No Designation: Wreck Wreck measuring 19.3 m by 14.6 m with elevation of 2.7 m. Surrounded by depressions that may correlate with associated items of debris. Correlates to the **M/V Margareta Nyborg**, a Danish fishing vessel.	20th Century	
S16	S-1515	58° 13.465' N	000° 40.892' E	No HER UID; Protected Place (precautionary); Wreck/Aeroplane (?) Possible wreck located in a depression. Contact measures 30.4 m by 28.8 m and has an elevation of 1.1 m above the surrounding seabed. Surrounded by depressions that may correlate with associated items of debris. Inspection showed presence of thin riveted metal giving potential some of contact may be airplane wreckage. Note that if a military airframe, potential for UXO.	20th Century	

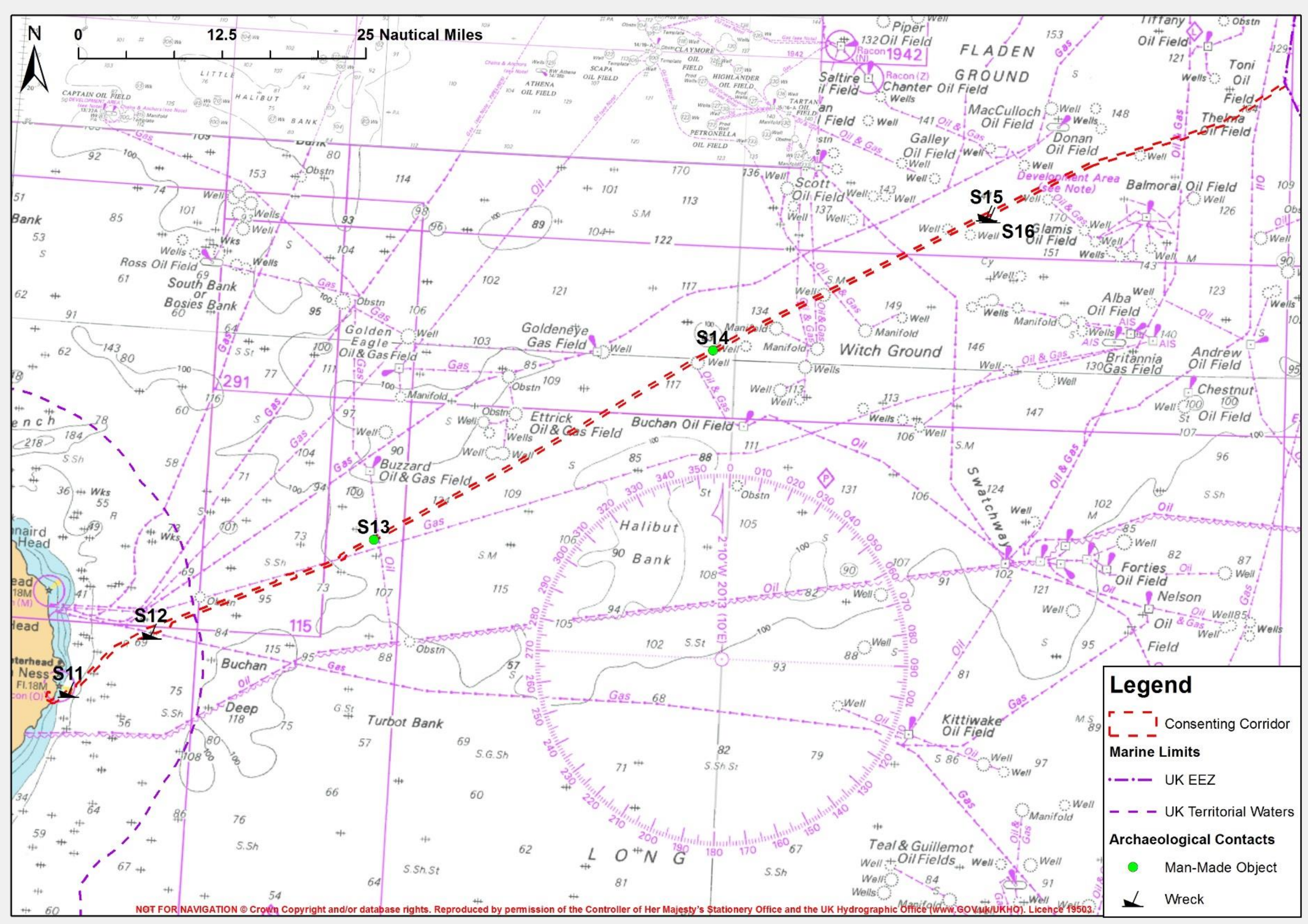


Figure 12.5 Archaeological features of interest in the marine environment

12.4.3 Sensitivity of Historic Environment Assets

Ascribing sensitivity to the sites identified within the Cable Corridor Study Area has followed the criteria detailed above and are presented in Table 12.2. In the absence of any formally designated sites within the Cable Corridor Study Area the ascription was based on the known origin and potential importance of these sites as identified by the baseline studies.

Minor features in the environment such as wells, quarries, debris, former sites of wrecks have been ascribed an 'Other sensitivity' (i.e.: below Local) as they have little potential to contribute to the historic environment in terms of either landscape presence or embodied information.

Upstanding historic structures (such as **S4** and **S6**) make a contribution to the landscape and have embodied information in terms of their architectural history, they are also commonly associated with subsurface remains. As such they are ascribed Local sensitivity. In a similar manner, the former site of a farmstead (**S10**) is considered to be with subsurface remains that warrant the same sensitivity.

The three 20th century wrecks of the fishing vessels (**S12** and **S15**) and the mixed cargo motor vessel (**S11**) are small, discrete assets that through the process of loss provide heritage links to both families and coastal communities as well as informing on both conflict (for **S12**) and the working of fisheries. On this basis they are ascribed a Regional sensitivity.

The Boddam Branch of the railway (**S5**) within the study area is substantially a cutting, while the goods sidings at Longhaven Station retain a more complex terraced landform. Overall this site is an element of a long, linear site that relates to 19th century expansion of the rail network. On this group value, this is ascribed a Regional sensitivity.

The wreck that incorporates possible aircraft fragments (**S16**) because of the unrecorded nature of this loss and the potential for this to be a military loss is ascribed a National sensitivity.

12.5 Impact Assessment

12.5.1 Potential Direct Impacts of the Proposed Development

12.5.1.1 Onshore Survey Corridor

Within the onshore portion of the HVDC Cable Corridor the baseline identified ten historic environment assets. None of the assets were designated or nationally important. The HVDC cable corridor and associated construction impacts are to be located so there are no potential direct impacts to nine of the assets within the historic environment.

Only one asset, the Railway **S5**, has the potential for direct impacts as this site cannot be avoided. The design has been altered to carry the cables under the asset by the use of horizontal directional drilling (removing this as an adverse impact). An adverse impact may result from any fencing associated with the wayleave and will result from forming the access track adjacent to Longhaven Station. The potential for the former will be minimal given that the track bed has not been lifted and this is an engineered surface. The latter will result in change to this section of the railway line during the construction of the road. Overall this remaining direct adverse effect is considered to have an impact magnitude of **minor**, producing a **minor** effect which is **non-significant**.

12.5.1.2 Scottish Territorial Waters Survey Corridor

Within STW the baseline identified two historic environment assets. The design of the cable corridor is on the basis of a construction exclusion zone of 50m from the physical boundary of the debris/wreck assets. The marine cable team will ensure all subsea operations remain outwith this exclusion zone so there are no potential direct impacts to the asset.

There remains an uncertainty about the presence of currently unknown historic environment assets within the construction corridor. The baseline has been informed by studies that have sought to suppress this uncertainty, however there remains a residual potential that additional unknown sites may be present.

12.5.1.3 UK Exclusive Economic Zone Survey Corridor

Within the offshore element of the study area the baseline identified four historic environment assets. None of the assets were formally designated, however the site of the possible aircraft loss **S16** should be treated on a precautionary basis as a Protected Place under the Protection of Military Remains Act 1986 due to the absence of records for this asset.

The design of the cable corridor is on the basis of a construction exclusion zone of 50m from the physical boundary of the four debris/wreck assets. The marine cable team will ensure all subsea operations remain outwith this exclusion zone so there are no potential direct impacts to the four assets.

There remains an uncertainty about the presence of currently unknown historic environment assets within the construction corridor. The baseline has been informed by studies that have sought to suppress this uncertainty, however there remains a residual potential that additional unknown sites may be present.

12.5.2 Potential Indirect Impacts of the Proposed Development

Visual or setting impacts can only impinge upon onshore assets. The character of the development is that the vast bulk of the new structures created, once the construction phase has been completed, are beneath the ground with the original topography restored. As such the minor landscape alterations have been assessed to only have the potential to generate significant visual impacts in relation to nationally sensitive historic environment assets within the Cable Corridor Study Area. There are no such assets present and hence we assess that there are no potential significant indirect impacts from the proposed development.

12.5.3 Summary of Potential Impacts Onshore and Marine Historic Assets.

Table 12.8 provides a summary of the assessment of potential impacts on both inshore and marine historical assets.

Table 12.8: Sensitivity of Historic Environment Assets and Direct Effects within the Study Area

Site	Name	Description	Cable Corridor	Sensitivity	Magnitude Effect	Significance
S1	Heathery Haven	Salmon House	Onshore	Regional	Nil	
S2	Longhaven Quarry	Quarry	Onshore	Other	Nil	
S3	Longhaven (bay)	Wreck (beached)	Onshore	Other	Nil	
S4	Heathery Haven	Structure	Onshore	Local	Nil	
S5	Boddam Branch, Great North of Scotland Railway	Railway	Onshore	Regional	Minor	Minor, non-significant
S6	Long Haven	Structure	Onshore	Local	Nil	
S7	Long Haven	Well	Onshore	Other	Nil	
S8	Longhaven Mains	Well	Onshore	Other	Nil	
S9	Sandfordhill South	Wall	Onshore	Other	Nil	
S10	Sandford Hill	Farmstead (site of)	Onshore	Local	Nil	
S11	S-0354	Motor Vessel Cairnavon	STW	Regional	Nil	
S12	MB-1000	Fishing Vessel Egenaes	STW	Regional	Nil	
S13	S-1295	Debris	UK Offshore Waters	Other	Nil	
S14	S-1350	Debris	UK Offshore Waters	Other	Nil	
S15	S-1499	Fishing Vessel M/V Margareta Nyborg,	UK Offshore Waters	Regional	Nil	
S16	S-1515	Possible Aircraft	UK Offshore Waters	National	Nil	

12.6 Mitigation Measures

A programme of works to be implemented will mitigate the potential adverse impacts from the proposed development.

The design of the works has already been flexed to ensure the retention and integrity of the Boddam Branch, Great North of Scotland Railway (**S5**) from the installation of the cable. To ensure the competent suppression of impact at this point, any vehicular movement to access the working area for Joint Pit 1 and the HDD site to the south of the railway will be from the southwest, off the temporary access track after it has crossed the railway.

The temporary watermain and access track will cross the railway at a point where it is in a shallow cutting. An archaeological watching brief will be undertaken to monitor ground breaking works associated with forming these temporary structures across the railway and wherever feasible the existing engineered surfaces will be retained and overlain by the new temporary structure. On the conclusion of the works, the original landform of the railway cutting will be restored to maintain the integrity of the linearity of the monument.

The onshore groundworks have the potential to disturb or expose significant archaeological material, should such material be present at locations currently unknown. An archaeological watching brief will be undertaken to monitor shallow ground breaking works as they are undertaken to ensure any archaeologically significant material is identified prior to loss. Appropriate and proportionate further stages of on-site mitigation (excavation and recording), technical reporting and subsequent analysis will be undertaken to ensure the appropriate treatment of this material.

The marine works (STW and UKEEZ) have the potential to disturb or expose significant archaeological material, should such material be present at locations currently unknown.

A Protocol for Archaeological Discovery will be put in place for such unexpected or incidental finds, compliant with *Protocol for Archaeological Discoveries* (The Crown Estate, 2014). A retained archaeologist will be appointed who will liaise between the Project Manager, Nominated Contact and the Implementation Service to ensure the smooth delivery of the protocol. These roles will be defined within the Protocol.

12.7 Residual Impacts

There are no identified significant direct or indirect impacts on the historic environment assets with mitigation designed to respond to unexpected discoveries. Hence there remain no residual impacts anticipated from the operational phase of the development on the terrestrial or maritime assets.

12.8 Cumulative Effects

Cumulative effects on the historic environment are when an increased severity of effect is anticipated as a consequence of considering the development in conjunction with other developments that are likely to occur in the foreseeable future.

For the Onshore section of the cable corridor the ability to generate cumulative effects will, because of the fundamental character of the project, be limited to those relating to direct impacts from consented or prospective development proposals. As such these developments need to be in close proximity to the cable corridor or impact the same historic environment sites. A review on this basis has identified only one relevant development:

- APP/2015/1121 Site At Four Fields Boddam - 1.4 GW Interconnector Convertor Station and High Voltage Alternating Current (HVAC) Cable Connection to Peterhead Power Station

This development is the NorthConnect Interconnector Converter Station and HVAC Cable Corridor that the HVDC cable arrives into at the northern end of its onshore route. The convertor station at the Four Fields site does not impact in common with the HVDC Cable Project on any historic environment sites. Hence, there would be no cumulative effect in conjunction with this development.

For the Marine section of the cable corridor (both STW and Offshore) the HVDC cable will not cause any direct effects on known historic environment sites. Hence there is no potential for cumulative effects.

12.9 Summary

This assessment undertaken has considered both the onshore and marine historic environment as an element of the Environmental Impact Assessment, in respect of the installation and operation of the NorthConnect HVDC Cabling.

Within the onshore element of the HVDC Cable Corridor only one historic environment asset; **S5** the Boddam Branch, Great North of Scotland Railway, has the potential for direct impacts from the forming of the temporary access track and watermain but these are not considered to be significant. Mitigation will be put in place for this asset to ensure disturbance of the site is minimised.

There is a potential for the presence of currently unknown historic environment assets within both the onshore and marine corridor. Mitigation measures have been embedded within the project to ensure any discoveries are dealt with appropriately (Tables 12.9 & 12.10).

This project meets the planning guidance on the treatment of the historic environment and will not result in a significant adverse impact on this resource. This project is compliant with the historic environment aspects of the Development Plan.

Table 12.9: Summary of Onshore Cultural Heritage and Archaeology Effects

Nature of Impact	Receptor Sensitivity	Impact Magnitude	Significance of Effect	Mitigation Summary	Residual Impact Magnitude	Residual Significance of Effect	Assessment of Residual Effects
Construction							
Visual effects of works on cultural and archaeological heritage sites.	Other-Regional	Temporary – Minor	Insignificant - Minor	Not Required	Temporary – Minor	Insignificant - Minor	Not Significant
Physical disturbance of historic railway S5	Regional	Minor	Minor	Archaeological monitoring of forming access track and watermain. Restoration of railway landform after works.	Insignificant	Insignificant	Not Significant
Disturbance of unknown buried archaeological artefacts.	Local	Moderate	Minor	Archaeological monitoring of shallow groundworks.	Moderate	Minor	Not Significant
Operational							
Change in Character of cultural and archaeological heritage sites	Other-Regional	Nil	Nil	Not Required	Nil	Nil	Not Significant

Table 12.10: Summary of Marine Cultural Heritage and Archaeology Effects

Nature of Impact	Receptor Sensitivity	Impact Magnitude	Significance of Effect	Mitigation Summary	Residual Impact Magnitude	Residual Significance of Effect	Assessment of Residual Effects
Construction							
Disturbance of unknown buried archaeological artefacts.	Local	Moderate	Minor	Archaeological protocol for discoveries.	Moderate	Minor	Not Significant
Operational							
Change in Character of cultural and archaeological heritage sites	Other-National	Nil	Nil	Not Required	Nil	Nil	Not Significant

12.10 References

12.10.1 Documentary

6 Alpha Associates. (2017). Unexploded Ordnance (UXO) Threat & Risk Assessment with Risk Mitigation Strategy for Cable Installation, Project: NorthConnect, Client: MMT, Report Number: P5530.

Aberdeenshire Council (2012). Aberdeenshire Local Development Plan.

Donald, Rev. W. (1834-4). Parish of Peterhead: Presbytery of Deer, Synod of Aberdeen. New Statistical Accounts of Scotland Vol12: p344-396.

Klemen, P. (2015). Northconnect: Converter Station and AC Line Environment Statement: Chapter 9 Cultural Heritage and Archaeology. Northconnect

MMT (2017). NorthConnect – UK, Nearshore and North Sea Survey, Archaeological Report, unpublished commercial report by MMT Sweden AB

Moss, Dr (Minister). (1791-99). Parish of Peterhead (County & Synod of Aberdeen, District of Buchan and Presbytery of Deer). Statistical Accounts of Scotland Vol18: p541-630.

Scottish Government (2010). Scottish Planning Policy.

Scottish Government (2014). Our Place In Time.

Scottish Parliament. (2010). Marine (Scotland) Act 2010

Scottish Natural Heritage 2010. The Special Qualities of the National Scenic Areas

The Crown Estate (2014). Protocol for Archaeological Discoveries.

UK Government. (2009). Marine and Coastal Access Act 2009

WA Coastal & Marine. 2012. Characterising Scotland’s Marine Archaeological Resource, Wessex Archaeology

Whittaker, I. G. (1998). Off Scotland: A Comprehensive Record of Maritime and Aviation Losses in Scottish Waters. Edinburgh

12.10.2 Cartographic

1640 Gordon, R. Aberdeen, Banf, Murray to Inverness: [and] Fra the North Water to Ross

1654 Blaeu, J. Description of the two shyres Aberdene & Banf, with such countreys and provinces as ar comprehended un.

1747-52 Roy, W. Military Survey of Scotland

1832 Thomson, J. Northern Part of Aberdeen and Banf Shires. Southern Part

1858 Gibb, A. Map of Northeastern districts of Aberdeenshire

1872 Ordnance Survey 25 inch 1st edition Aberdeenshire Sheet XXXII

1901 Ordnance Survey 25 inch 2nd edition Aberdeenshire Sheet XXXII.NW

Chapter 13: Terrestrial Ecology

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Contents

13 Terrestrial Ecology

13.1 Introduction

This chapter presents the results of an Ecological Impact Assessment (EcIA) of the NorthConnect HVDC project. The purpose of this EclA is to: describe the potential effects of the development on the non-avian, terrestrial nature conservation interests of the Site and its immediate environs; assess their significance; and identify appropriate mitigation and good practice methods to protect the nature conservation interests. Related ecological chapters are: Chapter 17, which presents the EcIA for avian features of the Site, and Chapters 14-16 presents the EcIA for the marine nature conservation interests of the Site. The assessment concentrates predominantly on the construction phase of the onshore cabling, as once installed there will be no, or minimal effects during operation. Decommissioning has been scoped out of the assessment, but the impacts would be expected to be similar to those during construction, the effects will be determined by the ecological status at the time of decommissioning.

For the purpose of this EcIA, the Site is detailed in Drawings NCFFS-NCT-X-XG-0001-01and includes the red line application boundary for the HVDC cable corridor from the Converter Station located at 'Fourfields' grid reference NK119 412), to the HDD landfall site at Long Haven (NK 121 399).

The survey areas for ecological components extend beyond the Site boundary to include an ecologically relevant buffer. The survey area for habitats is detailed in Drawing 3155 in Appendix D.4, and for protected mammals in Drawing 3199 in Appendix D.1. This chapter encompasses potential impacts on: terrestrial mammals (otter *Lutra lutra*, water vole *Arvicola amphibious*, and badger *Meles meles*), and the vegetation within the Site. Other terrestrial fauna, for example bats, amphibians and reptiles, were scoped out of this EIA as no significant effects were expected, following previous survey work (Atmos Consulting, 2014).

This chapter is supported by five appendices:

- D.1: Technical Report: Otter, Water vole and Badger survey (Tracks Ecology, 2017b);
- D.2: Extended Phase 1 Habitat Survey (Atmos Consulting, 2014);
- D.3: Time Lapse Camera Otter Survey Report (NorthConnect, 2017);
- D.4: Technical Report: HVDC Route NVC Survey (Tracks Ecology, 2017c); and
- D.5: Longhaven Cliffs SWT Nature Reserve NVC Survey (Tracks Ecology, 2017a)

This EcIA presents baseline information, anticipated impacts from both construction and operation, mitigation and residual impacts, as well as considering associated cumulative impacts.

13.1.1 Terminology Used Within Terrestrial Ecology Chapter

Table 13.1 lays out the terminology used within the chapter and the relevant drawings associated with it.

Table 13.1 Terminology Used and Associated Drawings

Term	Relating To	Relevant Drawing
HVDC NVC survey area	The boundary within which the NVC and Phase 1 habitat survey took place.	3155 in Appendix D.4
HVDC Protected Mammal survey area	The boundary within which the otter, water vole and badger surveys took place.	3199 in Appendix D.1
HVDC Consenting Corridor	The HVDC cable corridor area, within which the cable construction corridor will be.	NCFFS-NCT-X-XG-0001-01

13.2 Sources of Information

13.2.1 Planning Framework

13.2.1.1 National

Biodiversity features within the vision of National Planning Framework (NPF3) as '*natural and resilient place*' with a key action within the NPF3 to '*implement the Scottish Biodiversity Strategy, including completing the suite of protected places and improving their connectivity through a national ecological network centred on these sites'*(Scottish Ministers, 2014a).

The Scottish Planning Policy (SPP) sits alongside the NPF3 and sets out how the NPF3 visions should be delivered on the ground (Scottish Ministers, 2014b). As a statement of Ministers' priorities, it carries significant weight in the preparation of development plans and is a material consideration in planning decisions.

Biodiversity and the natural environment are central to the SPP. The principle polices of the SPP; Sustainability and Placemaking, both feature the natural environment as a consideration.

The primary Subject Policy regarding the natural environment is, 'A Natural, Resilient Place' with benefits for biodiversity sought from new development where possible, including the restoration of degraded habitats and the avoidance of further fragmentation or isolation of habitats. Recognition to the duty by all public bodies under the Nature Conservation (Scotland) Act 2004, to further the conservation of biodiversity, is reflected in the SPP.

It is acknowledged within the Policy – Valuing the Natural Environment that:

'Planning permission should be refused where the nature or scale of proposed development would have an unacceptable impact on the natural environment […] Planning authorities should apply the precautionary principle where the impacts of a proposed development on nationally or internationally significant landscape or natural heritage resources are uncertain but there is sound evidence indicating that significant irreversible damage could occur'.

It is also stated within the same Policy that:

'If there is any likelihood that significant irreversible damage could occur, modifications to the proposal to eliminate the risk of such damage should be considered'.

It is also acknowledged that protected species are an important consideration in assessing planning applications:

'If there is evidence to suggest that a protected species is present on site or may be affected by a proposed development, steps must be taken to establish their presence. The level of protection afforded by legislation must be factored into the planning and design of the development and any impacts must be fully considered prior to the determination of the application'.

The 2020 Challenge for Scotland's Biodiversity aims to promote and enhance Scotland's nature, and to better connect people with the natural world through developing a national ecological network over time. The 2020 Challenge is a supplement to the Scottish Biodiversity Strategy (2004) and together comprise the Scottish Biodiversity Strategy.

13.2.1.2 Local

Aberdeenshire Council specifically acknowledge the need to protect the natural environment within their Local Development Plan (LDP) (Aberdeenshire Council, 2017). Section 15 of the most recent LDP presents the Natural Heritage and Landscape policies which will be adhered to when considering planning applications.

Aberdeenshire Council states within Policy E1 Natural heritage, **Nature conservation sites**, that:

'We will not allow new development where it may have an adverse effect on a nature conservation site designated for its biodiversity or geodiversity importance, except where the following circumstances apply'.

'In the case of an internationally important site, we will not allow development which may have an adverse effect on its integrity, except where there are imperative reasons of overriding public important and there is no alternative solution. In all cases, suitable compensatory measures must be implemented.

For nationally designated sites a thorough assessment must demonstrate that the objective of designation and the overall integrity of the site will not be compromised, or that any significant adverse effects on the qualities for which the site has been designated are clearly outweighed by social, environmental or economic benefits or national importance. In all cases, any impact must be suitably mitigated.

For other recognised nature conservation sites…the proposal's public benefits must clearly outweigh the nature conservation value of the site. In all cases, impacts must be suitably mitigated for.'

Aberdeenshire Council states within Policy E1 Natural Heritage, **Protected Species**, that:

'Development should seek to avoid any detrimental impact on protected species through the carrying out of surveys and submission of protection plans describing appropriate mitigation where necessary.

Development likely to have a detrimental impact on protected species will not be approved unless: for European Protected Species, a thorough assessment of the site has demonstrated that the development is required for imperative reasons of overriding public interest and that the population will be maintained at a favourable conservation status in its natural range; or, for non-bird species protected under the Wildlife and Countryside Act 1981 (as amended) or the Protection of Badgers Act 1992, there will be significant social, economic or environmental benefits. IN either case there must be no other satisfactory solution.'

Aberdeenshire Council states within Policy E1 Natural Heritage, **Wider Biodiversity and Geodiversity**, that:

'If a development may affect undesignated habitats listed in Annex 1 of the EC Habitats Directive, species listed in Annex II of the EC habitats Directive, species listed in the Annexes I and II of the EC Birds Directive, habitats or species on the Scottish Biodiversity List, Local Biodiversity Action Plan priority habitats/species, other species of importance to biodiversity, areas of importance to geodiversity, or semi-natural habitats, we will only approve it when a baseline ecological survey has been carried out…Development will not be allowed if it fragments habitats or is not designed to minimised any adverse impact on the sites environmental quality, ecological status or viability.'

13.2.2 Legislative Framework

13.2.2.1 Habitats Directive

The European Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, also referred to as the 'Habitats Directive' (European Commission, 1992). The primary aim of the Habitats Directive is to maintain biodiversity within the Member States and is transposed into Scottish law by a combination of the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland), commonly known and the 'Habitat Regulations' together with the Habitats Regulations 2010 (in relation to reserved matters).

The Habitats Regulations identify several habitats or species whose conservation interest requires the designation of Special Areas of Conservation (SAC) and, in combination with the designation of Special Protection Areas (SPAs) under the Birds Directive, form the Natura 2000 network of protected sites.

In addition, the Regulations make it an offence (subject to exceptions) to deliberately capture, kill, disturb, or trade in the animals listed in Schedule 2, or pick, collect, cut, uproot, destroy, or trade in the plants listed in Schedule 4. However, these actions can be made lawful through the granting of licenses by the appropriate authorities. These species are commonly termed European Protected Species (EPS).

Otters are an EPS and as such it is an offence to:

- Deliberately or recklessly capture, injure or kill, harass, damage or destroy a breeding site or resting place;
- Disturb an otter while it is at a place it uses for shelter or protection;
- Obstruct access by an otter to a breeding or resting place; or
- Disturb an otter in a manner which is likely to impair its ability to survive, breed or reproduce, or rear or otherwise care for its young.

13.2.2.2 Wildlife and Countryside Act 1981 and Nature Conservation (Scotland) Act 2004

The Wildlife & Countryside Act 1981 (WCA) (as amended in Scotland) was originally conceived to implement the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) and the Birds Directive in Great Britain (UK Parliament, 1981). It has been extensively amended since it came first into force.

Schedule 5 of the WCA provides special protection to selected animal species other than birds, through section 9(4) of the Act, against damage to "*any structure or place which [any wild animal included in the schedule] uses for shelter and protection*", and against disturbance whilst in such places.

The WCA contains measures for preventing the establishment of non-native species which may be detrimental to native wildlife, prohibiting the release of animals and planting of plants listed in

Schedule 9. It also provides a mechanism making the above offences legal through the granting of licenses by the appropriate authorities.

Important amendments to the WCA have been introduced in Scotland including the **Nature Conservation (Scotland) Act 2004** (in Scotland) (NCSA) (Scottish Parliament, 2004). Part 3 and Schedule 6 of this Act make amendments to the WCA, strengthening the legal protection for threatened species. The Nature Conservation (Scotland) Act 2004 (in Scotland) is also the instrument under which Sites of Special Scientific Interest (SSSI) are protected in Scotland.

The **Wildlife and Natural Environment (Scotland) Act 2011** provided a new licensing element to the WCA within Scotland, specifically for certain non-avian protected species 'for any other social, economic or environmental purpose'. This licensing purpose is qualified by two constraints; "*that undertaking the conduct authorised by the licence will give rise to, or contribute towards the achievement of, a significant social, economic or environmental benefit; and that there is no other satisfactory solution*".

All wild plant species receive protection under the WCA, with some species given added protected being listed on Schedule 8. Water voles are afforded protection under Schedule 5 of the WCA, and badgers are afforded protection under Schedule 6.

13.2.2.3 Protection of Badgers Act 1992

Badgers and their setts are protected by the Protection of Badgers Act 1992 (as amended by the Nature Conservation (Scotland) Act 2004) (UK Government, 1992), making it an offence, amongst other actions, to wilfully kill, injure, take or attempt to kill a badger, or, by intentionally or recklessly causing or allowing disturbance or obstruction of a badger sett. In common with other legislation, it is possible to carry out actions that would otherwise be illegal if the activities are conducted under a licence.

13.2.2.4 Water Environment and Water Services (Scotland) Act 2003.

Where a habitat is identified as a potential Ground Water Dependent Terrestrial Ecosystem (GWDTE), they are protected under the Water Framework Directive (Directive 2000/60/EC) (European Commission, 2000) and transposed into Scottish law through the Water Environment and Water Services (Scotland) Act 2003 (Scottish Parliament, 2003). This means any disturbance to the groundwater resource on which a particular GWDTE relies, would be a breach of legislation.

13.2.3 Ecology Guidance

All baseline survey methodologies were undertaken in accordance with current survey guidelines and were agreed to be sufficient by Aberdeenshire Council and Scottish Natural Heritage (SNH). Baseline surveys follow nationally-recognised best practice guidelines (Institute of Environmental Assessment, 1995).

Further relevant guidance included:

- Scottish Biodiversity List, which comes under Section 2 (4) of the NCSA (Scottish Government, 2013);
- PAN 60: Planning for Natural Heritage (Scottish Government, 2008);
- Guidelines for Ecological Impact Assessment in the United Kingdom, (IEEM, 2012);
- The Handbook for Phase 1 Habitat Survey – a technique for Environmental Audit (JNCC, 2010);
- National Vegetation Survey (NVC): Users' handbook (Rodwell, 2006);
- Land Use Planning System (LUPS) Guidance Note 31 (SEPA, 2014);

Further species-specific guidance was also followed and is referenced in the relevant sections.

13.3 Assessment Methodology

The EIA methodology adopted within this assessment is based on standard best practice as detailed in Chapter 3: Methodology and has been agreed with Aberdeenshire Council through the EIA Scoping process.

13.3.1 Desk Study

A desk study and literature search was undertaken to inform the characterisation of the existing baseline conditions. Baseline data on the nature conservation interest of the Site and its surroundings, including information on designated nature conservation sites and protected species records, were sought from the following sources:

- SNH interactive map facility at Sitelink (SNH, 2017);
- National Biodiversity Network (NBN) Gateway's information service (NBN, 2017);
- The Scottish Biodiversity List (SBL) is a list of animals, plants and habitats considered to be of principal importance for biodiversity conservation in Scotland; the List was first published in 2005 in compliance with Section 2(4) of The Nature Conservation (Scotland) Act 2004 and has been updated several times (Scottish Government, 2013);
- The UK Biodiversity Action Plan (UK BAP) and North-East Scotland Local Biodiversity Action Plan (LBAP) have been published in response to the Convention on Biological Diversity (CBD) (United Nations, 1992). The LBAP is currently under review and is altering the structure of the plan to an ecosystem approach (Aberdeenshire Council, 2014; JNCC, 2016).
- North East Scotland Biological Records Centre (NESBReC) provided information regarding statutory designations and notable and protected species; ecological records were requested for a buffer of 2km for all protected or notable species (NESBReC, 2016,);
- Large-scale 1:10,000 Ordnance Survey (OS) maps in conjunction with colour 1:25,000 OS map (to determine the presence of ponds and other features of nature conservation interest); and
- Aerial photography for the Site was examined using imagery in the public domain at www.maps.google.co.uk.

13.3.2 Field Surveys

To provide detailed contemporary information on the Site and to determine baselines accurately to inform the EIA, the following field surveys were carried out:

- Extended Phase 1 habitat survey (Atmos Consulting, 2014)
- National Vegetation Classification Survey (includes a Non-native species survey) for NorthConnect HVDC Site (included Phase 1 Habitat Classification) (Tracks Ecology, 2017c)
- Protected mammal (Otter, Water vole & Badger) surveys (Tracks Ecology, 2014, 2017b)
- Otter camera study (NorthConnect, 2017)

In addition, an NVC survey took place encompassing the Longhaven Cliffs Scottish Wildlife Trust (SWT) nature reserve (Tracks Ecology, 2017c). This was carried out to provide SWT with updated ecological information about their reserve. The section of the SWT reserve which the NorthConnect Site was within was also covered by the NVC survey carried out for the HVDC Site. Therefore, this additional report was not utilised for this EcIA.

13.3.2.1 Extended Phase 1 Habitat Survey

Phase 1 Habitat Survey is a standardised method of recording habitat types and characteristic vegetation, as set out in the Handbook for Phase 1 Habitat Survey – a technique for Environmental Audit (JNCC, 2010a).

The area surveyed during the Extended Phase 1 by Atmos Consulting in September 2013 and April 2014 encompassed all aspects of the NorthConnect project, from the HVAC route, to the converter station, to the HVDC route. For the purposes of this ecological assessment, only the land encompassed within the HVDC Site is considered for assessment. The results from this are taken in conjunction with the Tracks Ecology September 2017 NVC survey, which then classified habitat polygons according to Phase 1 Habitat Classifications. As the Tracks Ecology survey is the most recent only the values from this survey is presented for the baseline data. Only the target notes from the Atmos Consulting Report are presented within this EIAR.

This survey method was extended by evaluating the habitats in accordance with the habitats listed in the SNIFFER document Water Framework Directive (WFD) 95 - A Functional Wetland Typology for Scotland (Scotland and Northern Ireland Forum for Environmental Research, 2009), and through the recording of specific features indicating the presence, or likely presence, of protected species or other species of nature conservation significance.

The ecologists were suitably qualified, and surveys were conducted under suitable weather conditions during the optimal time of year.

13.3.2.2 National Vegetation Survey and Non-Native Species Survey

The National Vegetation Survey (hereafter the NVC survey) is described as, *“a detailed phytosociological classification, which assesses the full suite of vascular plant, bryophyte and macro-lichen species within a certain vegetation type” (JNCC, 2011)*. Following the scoping process, Scottish Natural Heritage stated that an NVC survey should be carried out in areas where habitats and/or species of *“natural heritage interest”* are identified. It was undertaken to add to the broader classifications that the Phase 1 Survey Area identified, and aimed to detail any rare or nationally scarce plants. In conjunction with this, a NSS was to take place to identify the presence of any invasive, non-native species.

The Scottish Wildlife Trust carried out an NVC survey in 2015 and shared this data with NorthConnect. The 2015 NVC survey data was used for comparative purposes with the more recent NVC survey commissioned by NorthConnect. The areas surveyed were:

- The HVDC cabling corridor, plus a buffer: see Appendix D.3, Figure 1 for surveyed area.
- Longhaven Cliffs Scottish Wildlife Trust (SWT) Reserve – the area shown in the Phase 1 habitat survey maps provided in Appendix D.5.

The ecologists who carried out the updated NVC and NSS surveys were suitably qualified, and one had worked on the extended Phase 1 habitat survey in 2013/2014, and therefore were very familiar with the survey area. Surveys were conducted under suitable weather conditions during the optimal time of year.

13.3.2.2.1 Limitation of the Data

An area of just over 1 ha where the temporary access road to the HDD site joins the A90 was not surveyed during the NVC survey as the survey was completed prior to the junction design being developed. However, from site visits, it is known that this is a section of land is similar to that of the land classified adjacent to it, as being a mixture of arable, neutral grassland (semi-improved) and a small section of marshy grassland. For these habitats there will be a slight underestimation of percentage of the land within the consenting corridor redline boundary, however as the largest habitat types present it will not have any bearing on the overall assessment.

13.3.2.2.2 Species of Conservation Interest

Conservation interests within the site were defined as:

- A habitat or species listed on the EU Directive on the Conservation of Natural Habitats and Wild Fauna and Flora (92/32/EEC), the EU Habitats Directive;
- A habitat forming a qualifying feature of a site designated for habitat and/or fauna and flora interests under the EU Habitats Directive;
- A habitat and/or species forming a qualifying feature of national or local designations (e.g. Sites of Special Scientific Interest);
- A habitat and/or species listed on the UK Biodiversity Action Plan and Scottish Biodiversity List; and
- A species listed on its relevant UK Red Data list as being vulnerable to or under threat.

13.3.2.3 Longhaven Cliffs Reserve: Inland Section

In addition to the NVC Survey for the HVDC consenting corridor, the survey work covered an area of the Longhaven Cliffs Reserve. The cliff section of this reserve which is adjacent to the HVDC consenting corridor is already encompassed within the above vegetation assessment. However, the inland section of the reserve was assessed separately.

13.3.2.4 Protected Mammal Surveys

The Phase 1 Habitat Survey recommended that further field surveys targeting otter *Lutra lutra*, water vole *Arvicola terrestris* and badger *Meles meles* should be undertaken to facilitate a comprehensive assessment of the potential impact of the proposal upon those species. As part of the Convertor station and HVAC environmental assessment, surveys targeting a number of protected mammal species were undertaken during September 2014. These surveys covered approximately half of the area proposed for the HVDC development, therefore further surveys were required to encompass the full onshore HVDC consenting corridor. The additional surveys took place on 6th and 7th July 2016, and were conducted by a suitably qualified and experienced ecologist, who is a Member of the Chartered Institute of Ecology and Environmental Management (MCIEEM).

The protected mammal survey areas were dependent on the species and are displayed on Drawing 3199 in Appendix D.1. For otters and water voles, the survey area included all watercourses and waterbodies within a buffer of at least 200m to the proposed infrastructure. For badgers, all land within a buffer of at least 200m to the proposed consenting corridor were surveyed.

13.3.2.4.1 Otter

The otter survey was undertaken on 6th and 7th July 2016 broadly in accordance with the approach detailed in "Otters and Development" guidance document (SNH, 2007) and Ecology of the European Otter (Chanin, 2003). The survey concentrated on all watercourses and waterbodies within at least 200m of proposed infrastructure and included a thorough check for otter resting places (holts and couches). Full details of the methodology are presented in Appendix D.1.

The following field signs were sought:

- Otter spraint (faeces);
- Otter holt (den);
- Footprint;
- Couch (resting place above ground); and
- Pathways and slides into water.

In addition to the survey work, a camera-trap study was set up to investigate the use of an otter holt found during the otter survey. The capture was set to take one video per activation, which would continue until the movement had ceased. Once complete a three-minute delay was in place before activating again. This was to prevent multiple successive captures of an animal remaining in the vicinity of the camera, and hence preserve battery life. The cameras were in 24-hour mode to allow for day and night recordings, and set to detect movement and temperature differences.

13.3.2.4.2 Water Vole

The methodology employed during the survey followed that of an adapted version of the Water Vole Conservation Handbook (Strachan, 2011) with additional reference to field sign guidance provided by Using Field Signs to Identify Water Voles (Ryland & Kemp, 2009) and The Handbook of British Mammals (Corbet & Southern, 1977).

The water vole survey was undertaken concurrently with the otter survey on 6th and 7th July 2016. The survey again focussed on watercourses and waterbodies within at least 200m of proposed infrastructure. Full details of the methodology are presented in Appendix D.1.

Active searches were conducted for water vole signs which included:

- Droppings;
- Burrows;
- Latrines;
- Feeding stations;
- Lawns; and
- Footprints and pathways.

13.3.2.4.3 Badger

The survey for badger was undertaken concurrently with the otter and water vole surveys on 6th and 7th July 2016. The badger survey covered all accessible areas within at least 200m of proposed consenting corridor. The badger survey comprised a search for setts and other signs of badger activity, e.g. latrines, dung pits, pathways, snagged hair and signs of foraging.

Badger surveys are generally best undertaken when vegetation is at a minimum during winter months to maximise chances of identifying sett structures. However, due to the dominance of agricultural habitats and European gorse *Ulex europaeus,* an evergreen species, means undertaking the survey during July was not considered a significant limitation. Full details of the methodology are presented in Appendix D.1.

13.3.3 Impact Assessment Methodology

The assessment of the significance of predicted impacts on ecological receptors is based on both the ‘value’ of a receptor and the nature and magnitude of the impact that the development will have on it. Effects on biodiversity may be direct (e.g. the loss of species or habitats), or indirect (e.g. effects due to noise, dust or disturbance), on receptors located within or out with the respective survey area. This EcIA has, in principle, followed the assessment methodology outlined in Chapter 3 with the specific ecological assessment methods and criteria detailed below.

13.3.3.1 Evaluation of Ecological Receptors

The evaluation methodology has been adapted from the Guidelines for Ecological Impact Assessment in the United Kingdom (CIEEM, 2016). A key consideration in assessing the effects of any development on flora and fauna is to define the areas of habitat and the species that need to be considered. This required the identification of a potential zone of influence, which is defined as those areas and resources that may be affected by biophysical changes caused by project activities, however remote from the respective survey area.

The approach that has been undertaken throughout this EcIA is to identify 'valued ecological receptors' i.e. species and habitats that are both valued in some way and could be affected by the proposed development and separately, to consider legally protected species. Both species populations and habitats have been valued using a broad geographical basis with full details in Table 13.2.

Table 13.2Table 13.2 Nature Conservation Receptor Value

Value	Criteria
International	• An internationally important site (SAC) or a site proposed for, or considered worthy of designation; • A regularly occurring substantial population of internationally important species (listed on Annex IV of the Habitats Directive).
National	• A nationally designated site, SSSI, or a site proposed for, or considered worthy of such designation; • A viable area of habitat type listed in Annex I of the Habitats Directive or of smaller areas of such habitat which are essential to maintain the viability of a larger whole; or • A regularly occurring substantial population of a nationally important species, e.g. listed on Schedule 5 & 8 of the 1981 Wildlife and Countryside Act.
Regional	• Areas of internationally or nationally important habitats which are degraded but are considered readily restored; • Viable areas of priority habitat or viable populations identified in the UKBAP or smaller areas/populations which are essential to maintain the viability of a larger area/population as a whole; • Regionally important population/assemblage of an EPS, Schedule 1 and/or 5 species. • Regionally important assemblages of other species or habitats.
High Local	• Ancient semi-natural woodland, Local Nature Reserves (LNRs) and Local Nature Conservation Sites (LNCS); • Locally important population/assemblage of an EPS, Schedule 1 and/or 5 species; or • Sites containing viable breeding populations of species known to be county rarities (e.g. included in the LBAP) or supplying critical elements of their habitat requirements.
Moderate Local	• Undesignated sites, features or species considered to appreciably enrich the habitat resource within the local context (within 2km radius from the site) and may benefit from mitigation as a good practice measure.
Low Local	• Undesignated sites, features or species considered to appreciably enrich the habitat resource within the immediate environs of the site and may benefit from mitigation as a good practice measure.
Negligible	• Common and widespread or modified habitats or species.
Negative	• Invasive, alien species often scheduled under Section 14, Schedule 9 of the Wildlife and Countryside Act 1981 (as amended).

The approach of this assessment is to consider the value of the Site for the species under consideration, rather than the nature conservation importance of the species itself, although this is a factor in the evaluation process with the level of use of the Site (number of individuals using the site and nature and level of use) taken into consideration. An assessment is then made of the value of the Site to that species, based upon a combination of data sources, professional judgment and knowledge of the Site and wider area.

13.3.3.2 Legal Protection of Species

There is a need to identify all legally protected species that could be affected by the proposed development to ensure that the development complies with all relevant nature conservation legislation. It is, therefore, appropriate to take into full consideration the legal protection of a species within the evaluation process. For example, full account of the Protection of Badgers Act is taken into consideration, notwithstanding the species protection on animal welfare grounds.

13.3.3.3 Nature and Magnitude of Impact

Impacts can be: permanent or temporary; direct or indirect; adverse or beneficial; reversible or irreversible; and may also have a cumulative function with other activities out with the assessed development. These factors are taken into consideration in the context of the sensitivity of the valued ecological receptor and the range of potential effects. To identify whether impacts are significant or not it is important to undertake the assessment in terms of the integrity (coherence of the ecological structure and function) and conservation status (ability of the receptor to maintain its distribution and/or extent/size) of the receptor.

Table 13.3 provides an overview of the range of impact magnitudes referred to within this assessment. In addition, impacts may also be positive in nature.

Table 13.3 Definition of Magnitude of Impact

Magnitude	Description
Negligible / None	Very slight change from the baseline conditions. Changes barely detectable, approximating to the 'no-change' situation. Any effects likely to be reversible within 12 months and not affect the conservation status or integrity of the receptor.
Low	Minor shift away from baseline conditions. Effects will be detectable but unlikely to be of a scale or duration to have a significant effect on the conservation status or integrity of the receptor in the short term (1-5 years). Overall baseline character of site will not alter substantially.
Medium	Clear effect on the conservation status or integrity of the receptor in the short to medium term (6-15 years), although this is likely to be reversible or replaceable in the long-term (15 years plus).
High	Total loss of, or major alteration to conservation status or integrity of a receptor with situation likely to be irreversible, even in the long term. Fundamental alteration to the character and composition of the Site.

13.3.3.4 Significance of Effects

The significance of an effect is a product of the value of the ecological receptor and the magnitude of the impact on it, moderated by professional judgment. Table 13.4 illustrates a matrix based on these two parameters which is used for guidance in the assessment of significance. In terms of the EIA Regulations, only effects which are 'moderate' or 'major' are considered significant, the others constituting a non-significant effect. The level of effect has been assessed as either major, moderate, minor or negligible, or beneficial in accordance with the definitions provided in Chapter 3: Methodology.

Table 13.4 Significance of Effects

Magnitude of Impact	Value				
	International	**National**	**Regional**	**Moderate Local/ High Local**	**Low Local /Negligible**
High	Major	Major	Moderate	Moderate	Minor
Medium	Major	Moderate	Moderate	Minor	Minor
Low	Moderate	Minor	Minor	Minor	Negligible
Negligible	Minor	Negligible	Negligible	Negligible	Negligible

Key

	Significant Effect
	Non-Significant Effect

13.4 Baseline Information

13.4.1 Statutory Designated Sites

Statutory Designated Sites which may be affected either directly or indirectly are detailed inTable 13.5 and the boundaries of these are mapped in Figure 13.1 One Site of Special Scientific Interest (SSSI) and two Special Areas of Conservation (SAC) were identified within 50km of the UK landfall site as having designated interests to consider for the EcIA.

Table 13.5 Designated Sites

Site	**Approximate distance from Cable Corridor**	**Relevant Terrestrial Designated Interests**
Buchan Ness to Collieston SAC	Crossed by HVDC corridor	Vegetated sea cliffs
Bullers of Buchan Coast SSSI	Crossed by HVDC corridor	Maritime cliff
Collieston to Whinnyfold Coast SSSI	8km south of UK landfall.	Vegetated sea cliffs: Sea wormwood *Seriphidium maritimum*
Rora Moss SSSI	12km NW of HVDC corridor	Raised bog
River Dee SAC	40km SW of UK landfall.	Otter

Figure 13.1 Designated Sites

13.4.1.1 Buchan Ness to Collieston SAC

Buchan Ness to Collieston SAC is located on the east coast and the HVDC corridor crosses through it. The qualifying interest of this SAC is the Annex 1 habitat vegetated sea cliffs of the Atlantic and Baltic Coast. The sea cliffs support a wide range of semi-natural plant communities including: maritime heath; acid peatland; and brackish flushes, which are now rare on the coast of north-east Scotland and this section of coastline has some of the best remaining examples. There is an abundance of local species such as Scot's lovage *Ligusticum scoticum* and roseroot *Sedum rosea* and other species which are more typical of southern Britain such as carline thistle *Carlina vulgaris* and cowslip *Primula veris,* which are associated with dry, calcareous grasslands (JNCC, 2017b).

13.4.1.2 Bullers of Buchan Coast SSSI

This SSSI is a constituent of the Buchan Ness to Collieston SAC and comprises of sea cliffs and inshore stacks which are of special geological and biological interest. Similar to the SAC, the sea cliffs support a wide range of maritime plant communities with good examples of coastal dwarf-shrub heath and brackish flushes (SNH, 2018). In addition, the SSSI supports important breeding seabird colonies, which are considered within Chapter 15: Ornithology.

13.4.1.3 Collieston to Whinnyfold Coast SSSI

This SSSI is a constituent of the Buchan Ness to Collieston SAC, approximately 8km south of the UK landfall site at Long haven, and is designated for its vegetated sea cliffs, specifically Sea Wormwood.

13.4.1.4 River Dee SAC

The River Dee SAC, approximately 40km to the southwest of the HVDC cable corridor, is selected for designated based on Annex II species of Freshwater pearl mussel *Margaritifera margaritifera*, Atlantic salmon *Salmo salar*, and Otter, the latter of which is relevant to this current development proposal. The River Dee has a total length of 570km included within the SAC. Otters are found throughout the Dee catchment as the river system has suitable habitat for otter feeding, resting and breeding (JNCC, 2018). The otter population in this part of north-east Scotland is a strong, high quality population (JNCC, 2018). The latest large-scale otter survey carried out in this area revealed 33 holts within 54 survey sites, and the SAC is defined as being in a favourable condition for the otters (Strachan, 2007).

13.4.2 Other sites

The Scottish Wildlife Trust (SWT) Longhaven Cliffs Reserve is within the boundaries of the designated sites Buchan Ness to Collieston SAC and Bullers of Buchan Coast SSSI. There is also an inland section of the reserve which is approximately 600m from the HVDC cable corridor. The coastal part of the reserve is considered to be important for breeding seabird colonies, along with special habitats such as maritime heath and salt marsh with plants such as devil's-bit scabious *Succisa pratensis* and grass-of-Parnassus *Parnassia palustris*. The HVDC cables will pass under the Longhaven Cliffs Reserve via HDD.

13.4.3 Habitats and Flora

The results from the NVC and NNS surveys were mapped and can be seen in Figure 13.2. The habitats present within detailed botanical surveys (NVC and NNS) are summarised below.

13.4.3.1 Phase 1 habitat survey classifications

The NVC survey carried out in 2017 updated the values of Phase 1 habitat areas from the previous Phase 1 habitat survey. The results of the classifications are summarised in Table 13.6.

Table 13.6 Phase 1 Habitat Community Areas.

Habitat	Area (ha)	Area % of Total
Arable	26.63	36.49
Neutral grassland - semi-improved	15.92	21.81
Marsh/marshy grassland	9.27	12.69
Coastal grassland	5.34	7.32
Maritime cliff	4.49	6.16
Neutral grassland - unimproved	3.97	5.44
Coastal heathland	2.21	3.03
Scrub - continuous	1.40	1.92
Other tall herb and fern - non-ruderal	1.35	1.85
Crevice/ledge vegetation	0.93	1.28
Bare ground	0.51	0.70
Access track	0.33	0.46
Acid grassland - unimproved	0.22	0.30
Shingle/gravel above high-tide mark	0.15	0.20
Other tall herb and fern - tall ruderal	0.10	0.14
Open water	0.09	0.12
Bracken - continuous	0.04	0.06
Quarry	0.03	0.04
Scree	0.02	0.02
Buildings and gardens	<0.01	<0.01
Grand Total	**72.98**	**100.00**

Figure 13.2 shows the habitat types summarised across the Survey Area. Target notes mapped relate to notes in Appendix H3. The dominant habitat types along the HVDC cable corridor are arable land and neutral grassland (semi-improved and improved), which combined relate to 63.7% of the total area surveyed. Marshy grassland is also present within the HVDC corridor (12.69% across the whole survey area) and thereafter all other habitat types were less than 10% within the Survey Area. The current Access Track which leads to the field where the HDD drilling activities will take place currently only takes up 0.46%, or 0.33Ha.

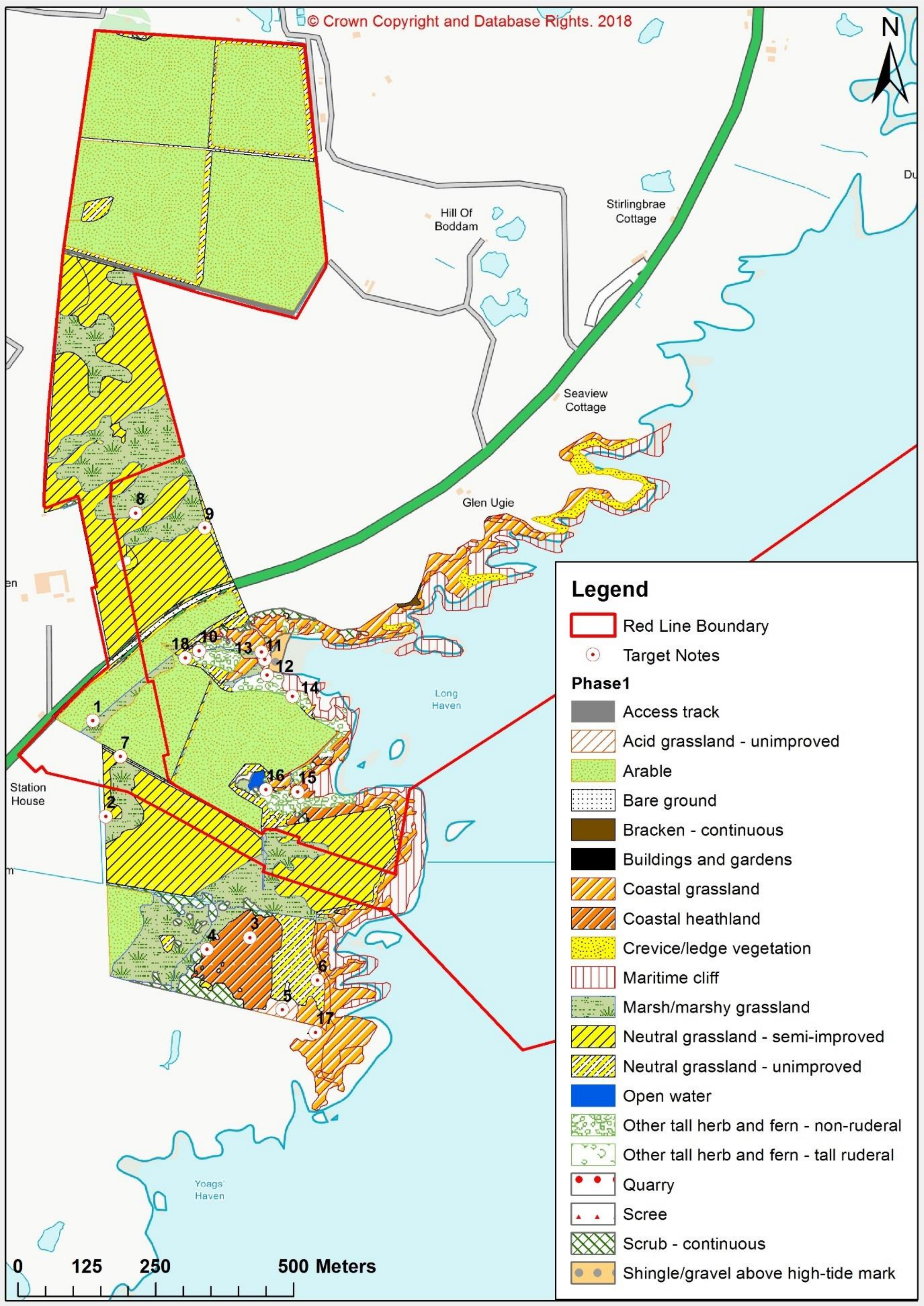

Figure 13.2 Phase 1 Habitat Results from the NVC Survey

13.4.3.2 NVC Survey

This survey encompassed a more in-depth survey of the specific plant communities within the broad habitat classifications. A summary of the NVC communities present within the survey site is shown in Table 13.7. The complete survey and associated figures are shown in Appendix D.4.

Table 13.7 NVC Communities

Code	Community/sub-community name
Woodlands and scrub	
W23a	*Ulex europaeus-Rubus fruticosus* scrub, *Anthoxanthum odoratum* sub-community
Mires and heaths	
H7c	*Calluna vulgaris-Scilla verna* heath, *Erica tetralix* sub-community
H7d	*Calluna vulgaris-Scilla verna* heath, *Empetrum nigrum* ssp. *nigrum* sub-community
M27a	*Filipendula ulmaria-Angelica sylvestris* mire, *Valeriana officinalis-Rumex acetosa* sub-community
M27c	*Filipendula ulmaria-Angelica sylvestris* mire, *Holcus lanatus-Juncus effusus* sub-community
M35x	*Ranunculus omiophyllus-Montia fontana* rill, variant community
Grassland and montane communities	
MG1a	*Arrhenatherum elatius* grassland, *Festuca rubra* sub-community
MG1b	*Arrhenatherum elatius* grassland, *Urtica dioica* sub-community
MG5a	*Cynosurus cristatus-Centaurea nigra* grassland, *Lathyrus pratensis* sub-community
MG6a	*Lolium perenne-Cynosurus cristatus* grassland, typical sub-community
MG7	*Lolium perenne* leys and related grasslands
MG10a	*Holcus lanatus-Juncus effusus* rush-pasture, typical sub-community
MG11	*Festuca rubra-Agrostis stolonifera-Potentilla anserina* grassland
U5d	*Nardus stricta-Galium saxatile* grassland, *Calluna vulgaris-Danthonia decumbens* sub-community
U17x	*Luzula sylvatica-Geum rivale* tall-herb community, variant sub-community
Maritime communities	
MC8a	*Festuca rubra-Armeria maritima* maritime grassland, typical sub-community
MC8c	*Festuca rubra-Armeria maritima* maritime grassland, *Ligusticum scoticum* sub-community
MC8d	*Festuca rubra-Armeria maritima* maritime grassland, *Holcus lanatus* sub-community
MC9e	*Festuca rubra-Holcus lanatus* maritime grassland, *Anthoxanthum odoratum* sub-community
Vegetation of open habitats	
OV25	*Urtica dioica-Cirsium arvense* community
OV25b	*Urtica dioica-Cirsium arvense* community, *Rumex obtusifolius-Artemisia vulgaris* sub-community

13.4.3.2.1 Woodlands and Scrub

Scrub communities dominated by European gorse, *Ulex europeaus,* are scattered throughout coastal areas along field margins. The majority of these scrub areas are homogenous stands of gorse, with a scattering of bramble *Rubus fruticosus* and grasses sweet-vernal grass *Anthoxanthum odoratum,* crested dog's-tail *Cynosurus cristatus*, Yorkshire fog *Holcus lanatus* and red fescue *Festuca rubra* at the fringes.

13.4.3.2.2 Mires and Heaths

The dominant heath community throughout the site was *Calluna vulgaris-Scilla verna* heath*.* The vegetation is typically short, being wind-clipped, and form rather open stands often transitional to other communities, particularly grasslands. The H7c *Erica tetralix* sub-community is found in wetter areas of heathland across the site, typically slightly inland on deeper soils and has higher coverage of the cross-leaved heath *Erica tetralix,* common bent *Agrostis capillaris* and mat-grass *Nardus stricta*.

The H7d *Empetrum nigrum* ssp. *nigrum* sub-community is the most common across the site, found on cliff tops and edges, often in exposed conditions or on dry soils.

The dominant mire community present within the survey area is *Filipendula ulmaria* forming the M27a *Filipendula ulmaria–Angelica sylvestris* mire, *Valeriana officinalis-Rumex acetosa* sub-community. This community is most frequent where natural drainage flows over cliffs from vegetation communities above. Typically, this vegetation is quite rich across the site. A second sub-community is present in Longhaven Bay and is grassier with higher cover of soft rush. This reflects the M27c *Holcus lanatus-Juncus effusus* sub-community.

13.4.3.2.3 Grassland and Montane Communities

There were a number of different grassland communities recorded during the survey. Certain grassland communities, for example MG6 *Lolium perenne-Cynosurus cristatus* grassland and MG7 *Lolio-Plantaginion* leys, are a result of agricultural improvement on the land. This has been recorded near Fourfields and in two large fields east of Longhaven Mains Farm. There are also rush-pasture communities recorded around areas of damp, ungrazed fields, and tall-herb communities present on cliffs along the coast.

13.4.3.2.4 Maritime Communities

A number of maritime communities are present along the edge of the cliffs. Generally, these communities are species poor.

13.4.3.2.5 Vegetation of Open Habitats

The *Urtica dioica-Cirsium arvense* community is the most common vegetation community within the survey area. The community is dominated by the two constants: common nettle and field thistle.

13.4.3.2.6 Species of Conservation Importance

Conservation interest within the site is defined as:

- A habitat or species listed on the EU Directive on the Conservation of Natural Habitats and Wild Fauna and Flora (92/32/EEC), the EU Habitats Directive;
- A habitat forming a qualifying feature of a site designated for habitat and/or fauna and flora interests under the EU Habitats Directive;
- A habitat and/or species forming a qualifying feature of national or local designations (e.g. Sites of Special Scientific Interest);
- A habitat and/or species listed on the UK Biodiversity Action Plan and Scottish Biodiversity List; and
- A species listed on its relevant UK red data list as being vulnerable to or under threat.

The following vegetation communities recorded within the site are identified as of conservation interest, as shown in Figure 13.3:

- MC8 *Festuca rubra-Armeria maritima* maritime grassland
- MC9 *Festuca rubra-Holcus lanatus* maritime grassland
- H7 *Calluna vulgaris-Scilla verna* heath

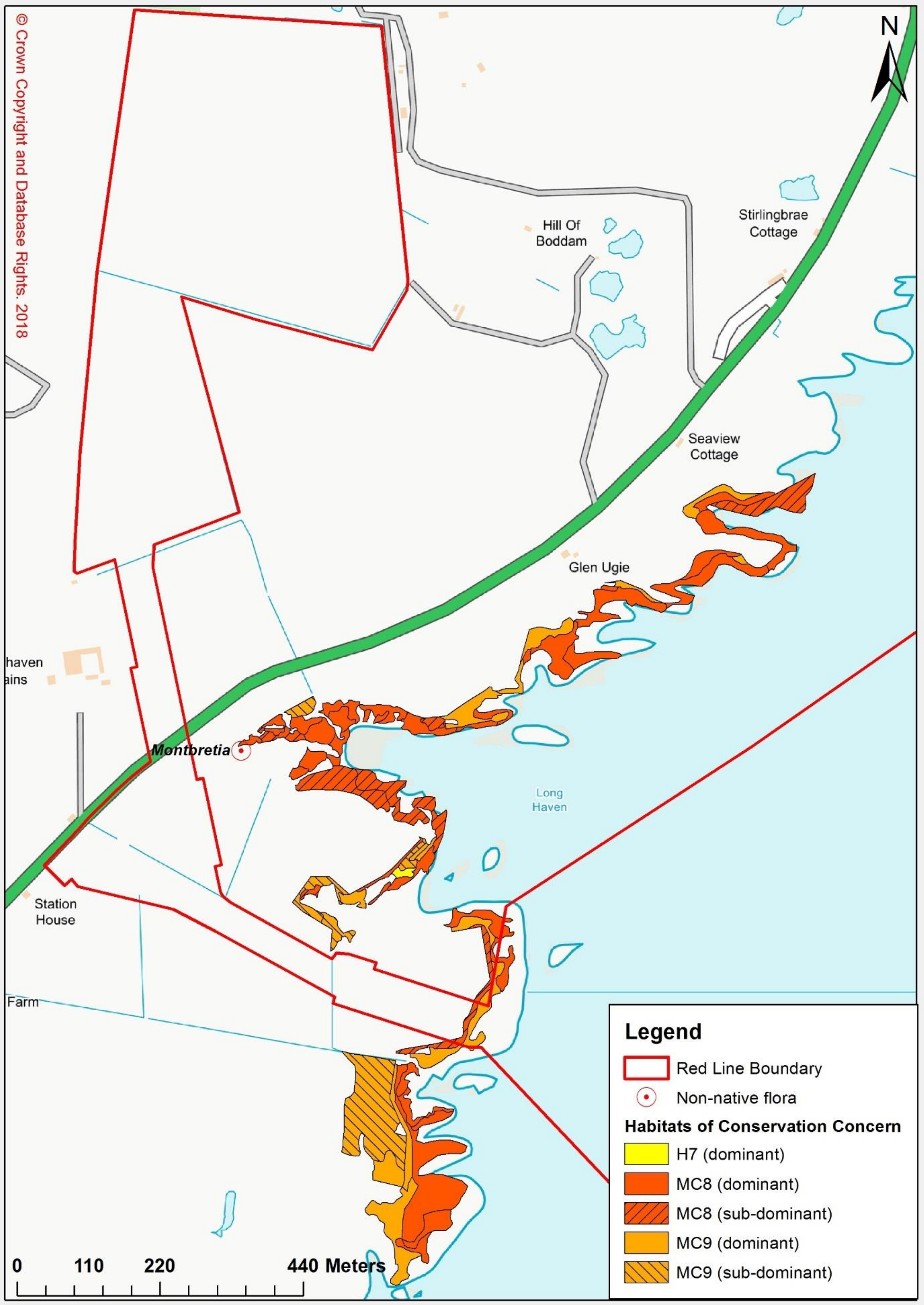

Figure 13.3 Habitats of Conservation Concern and Non-Native Flora

All three communities are listed under Annex 1 habitat type H1230: Vegetated sea cliffs of the Atlantic and Baltic coasts. All three communities also form component parts of maritime cliff and slope vegetation, listed under UK BAP and Scottish Biodiversity List priority habitats.

No individual flowering or lower plant species of conservation concern were recorded i.e. rare, threatened, or nationally scarce conservation status.

13.4.3.2.7 Groundwater Dependent Terrestrial Ecosystems

Habitat classifications related to groundwater dependent species, in line with current guidance (SEPA, 2014), are detailed in Figure 13.4. Only a single habitat which is recognised as being potentially highly dependent on groundwater (SEPA, 2014) was identified: U17 *Luzula sylvatica-Geum rivale* tall-herb community. This community is located along the cliffs and is not located further inland (Figure 13.4) The community tends to develop where there is protection from grazing and burning with more base-rich and mesotrophic soils and a degree of dampness which results in the community being identified as potentially dependent on groundwater. These communities are likely to have some influence from base-rich water present where soils become thin on the cliff tops but significant influence from groundwater at these locations is assessed as unlikely.

Two patches of MG10 *Holcus lanatus-Juncus effusus* rush-pasture marshy grassland are also present within the Site. The small area located near TN9 also supports an M35x *Ranunculus omiophyllus-Montia fontana* variant community and signifies a small localised upwelling of groundwater. A larger area of MG10a is unlikely to be significantly dependent on groundwater although some influence may be present.

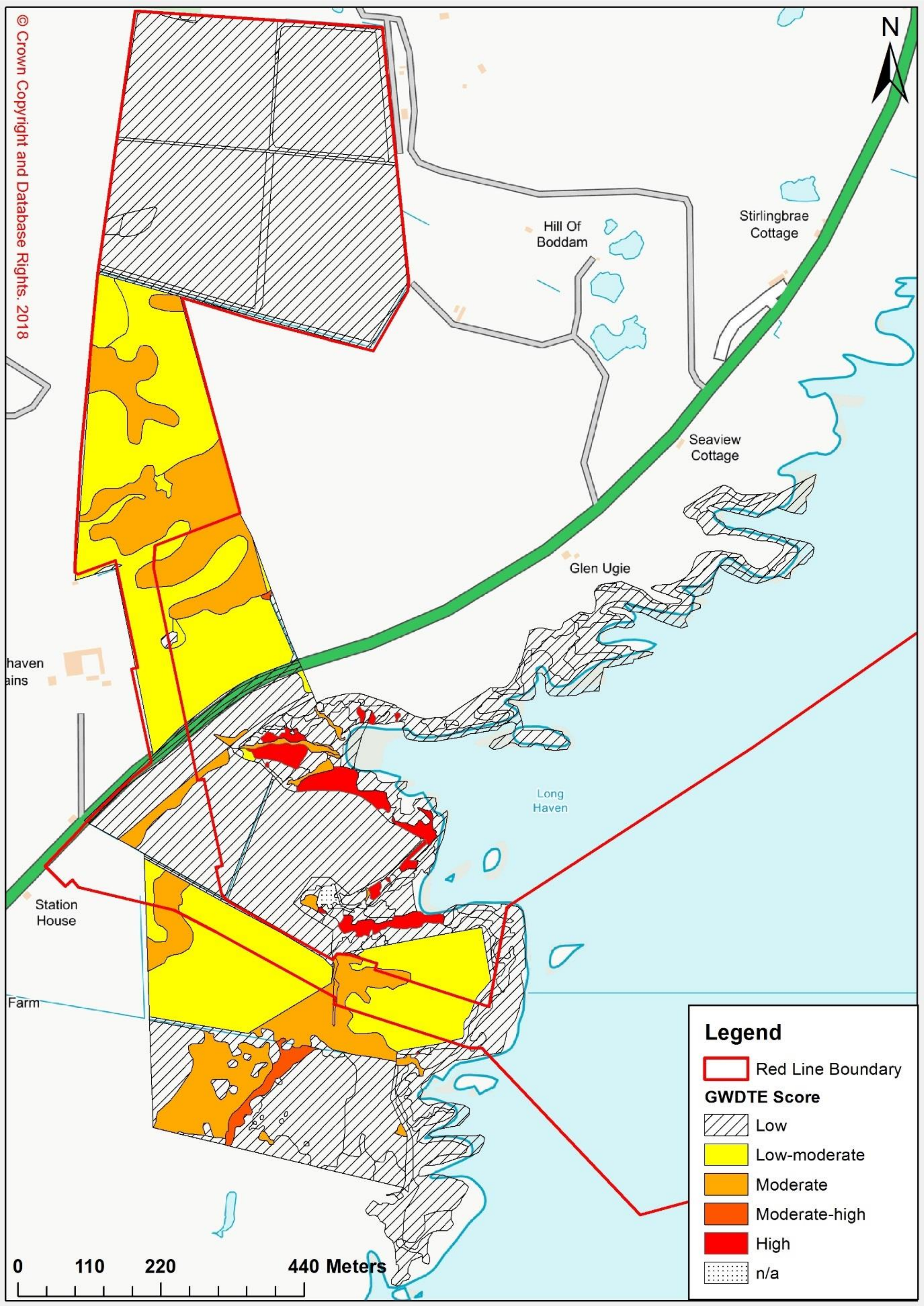

Figure 13.4 Groundwater Dependent Terrestrial Ecosystems

13.4.3.3 Non Native Species Survey

Non-native and invasive species survey was carried out in conjunction with the NVC survey.

Only a single non-native species was recorded within the Site as indicated on Figure 13.3:

- Monbretia, *Crocosmia* x crocosmiiflora

No species were recorded that are listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) (where relevant to Scotland), which makes it an offence to release or spread any plant or animal that is identified as a potential threat to native biodiversity. Species listed on Schedule 9 may not be released or introduced without a license, allowed to escape into the wild, or caused to be spread in the wild. No species were recorded within the survey area identified as invasive 'alien' species on the Water Framework Directive alien species list or on the Scottish Natural Heritage Species Action Framework as being target species for management to limit their spread. As a result, based on the survey findings no specific action in relation non-native species is likely to be required, although the spread of non-natives, not identified on Schedule 9 of the Wildlife and Countryside Act should also be avoided.

13.4.3.4 Longhaven Cliffs Reserve: Inland Section

The inland section of the Longhaven Cliffs Reserve, which is more than 600m from the HVDC onshore corridor, was found to have the following species of conservation interest within it (see Appendix D.5: Figure 4):

- H7 *Calluna vulgaris-Scilla verna* heath

No individual flowering or lower plant species of conservation concern were recorded i.e., rare, threatened, or nationally scarce conservation status.

The inland section of the Longhaven Cliffs Reserve was found to have the following non-native and invasive species present (Appendix D.5: Figure 5):

- Pampas grass, *Cortaderia selloana*
- Cotoneaster, *Cotoneaster* sp.

Neither of these species are listed on the Schedule 9 of the Wildlife and Countryside Act.

No habitats recognised as being potentially highly dependent on groundwater were located within the inland section of the Longhaven Cliffs Reserve.

13.4.4 Protected Species of Fauna

Existing information held by the NESBReC did not reveal any reports of otter, water vole or badgers within the HVDC red line boundary area, although the habitat was identified as being suitable for all three species. The results from the 2014 Extended Phase 1 Habitat Survey, the 2014 and 2016 Protected Mammal Surveys, revealed signs of all three-mammal species being assessed, the results of which are described below in detail, for each species. Further information is available in Appendix D.1.

13.4.4.1 Otter

General Information

Otters fall under the Annex II of the Conservation (Natural Habitats &c.) Regulations 1994 as amended in Scotland which transpose into Scottish law the European Community's Habitats Directive

(92/43/EEC). In addition, otters are listed in the Scottish Biodiversity List, the UK Biodiversity Action Plan (BAP), and fall within the ecosystem group for the North-East Scotland LBAP. The IUCN classifies otters as being Near Threatened, though in the UK the otter is currently recovering from its historical persecution. Whilst its distribution is known to be increasing, ongoing efforts to ensure it returns to a favourable conservation status are still required (JNCC, 2010b).

It is known that otters may have several resting places (including holts and couches) throughout their home range (Mason & Macdonald, 2009). A home range is the area which an animal utilises regularly for their individual requirements, including foraging, breeding, and sheltering. Depending on whether the otter is predominantly using freshwater habitats for their foraging needs or the coastal habitat, can affect how large their foraging range is, with coastal populations tending to have smaller ranges (JNCC, 2007). Sex differences in home ranges also exist with male otters normally recorded as having larger home ranges (Kruuk & Moorhouse, 1991). The distribution of these ranges can be up to 20km for a female otter and up to 32km for a male otter, or as little as 4-5km depending on the productivity of the habitat (SNH, 2007). Studies on the River Dee and River Don demonstrated ranges along the rivers of between 12km and 80km for male otters, and females using up to 20km of water (Chanin, 2013). Distances between otter shelters and resting places can be 2km, but may also be as little as being every 150m of shoreline (SNH, 2007).

Previous studies utilising otter signs as evidence for habitat usage have demonstrated that during the winter and spring months more otter spraints are recorded, as during the summer, 'smears' (secretions lacking solid food remains) are more common (Macdonald & Mason, 1987). It is likely that smears are more readily washed away in wet weather conditions.

Whilst the majority of otters in Scotland are located in the West and North, the Aberdeenshire coastline and the Dee catchment area have recorded otters throughout the area. This north-east coastline and riverine system has extensive areas of suitable habitat along the coastline for feeding, resting and breeding, including suitable watercourses. The Dee population of otters is described as *"a strong, high quality population, representative or north-east Scotland" (JNCC, 2017a)*.

Field survey results

No significant watercourses are present within the HVDC Protected Mammal survey area; which extends from the coast inland to a mix of mainly agricultural habitats. However, there are numerous small ditches with fast flowing water, small waterbodies, areas of scrub and the coastline, which may provide opportunities for places of shelter, commuting links and limited foraging (Tracks Ecology, 2017b). Table 13.8 present a summary of the waterbodies which were suitable for otters, and the evidence of otters recorded during the protected mammal surveys, the Phase 1 Habitat survey, and during subsequent visits to the HVDC Site. Those waterbodies which were unsuitable for otters are not summarised, although further information on these can be found in Appendix D.1. Figure 13.5 shows the location of the waterbodies within the otter survey area. Target Notes in Figure 13.5 relate to those described in Appendix D.2.

Table 13.8 Summary of Otter Survey Data

Location	Relation to HVDC Consenting Corridor	Description	Evidence of otters
Waterbody 1	North, by approx. 350m.	Man-made pond within Highfields property. Small vegetated island present.	Restricted access meant no detailed survey of pond could take place, but likely to offer foraging suitability and ground shelter opportunities
Waterbody 3	East, by approx. 10m.	Inland pond associated with agricultural drains, vegetated along the banks.	No evidence of otters, though the pond and surrounding habitat is suitable for an otter couch due to vegetation cover.
Waterbody 4	North East, by approx. 50m.	By former quarry by the cliff. Vegetation and some scrub present. Good sheltered links to the coastal areas. Holt camera set up at this location.	Holt found by the banks, sprainting and feeding evidence recorded on multiple visits from May 2014-February 2018.
NK 12022 40953	South, by approx. 45m.	Bog pool, 30m southeast of the Fourfields site. Target note 27 in Appendix D.2.	Otter spraint found on a grass hummock, and slide noted going into the bog pool.
NK 11927 40416	North east, by approx. 130m.	On the coastal path, adjacent to the dismantled railway line. Target note 31 in Appendix D.2.	Two otter spraints found on wooden steps.

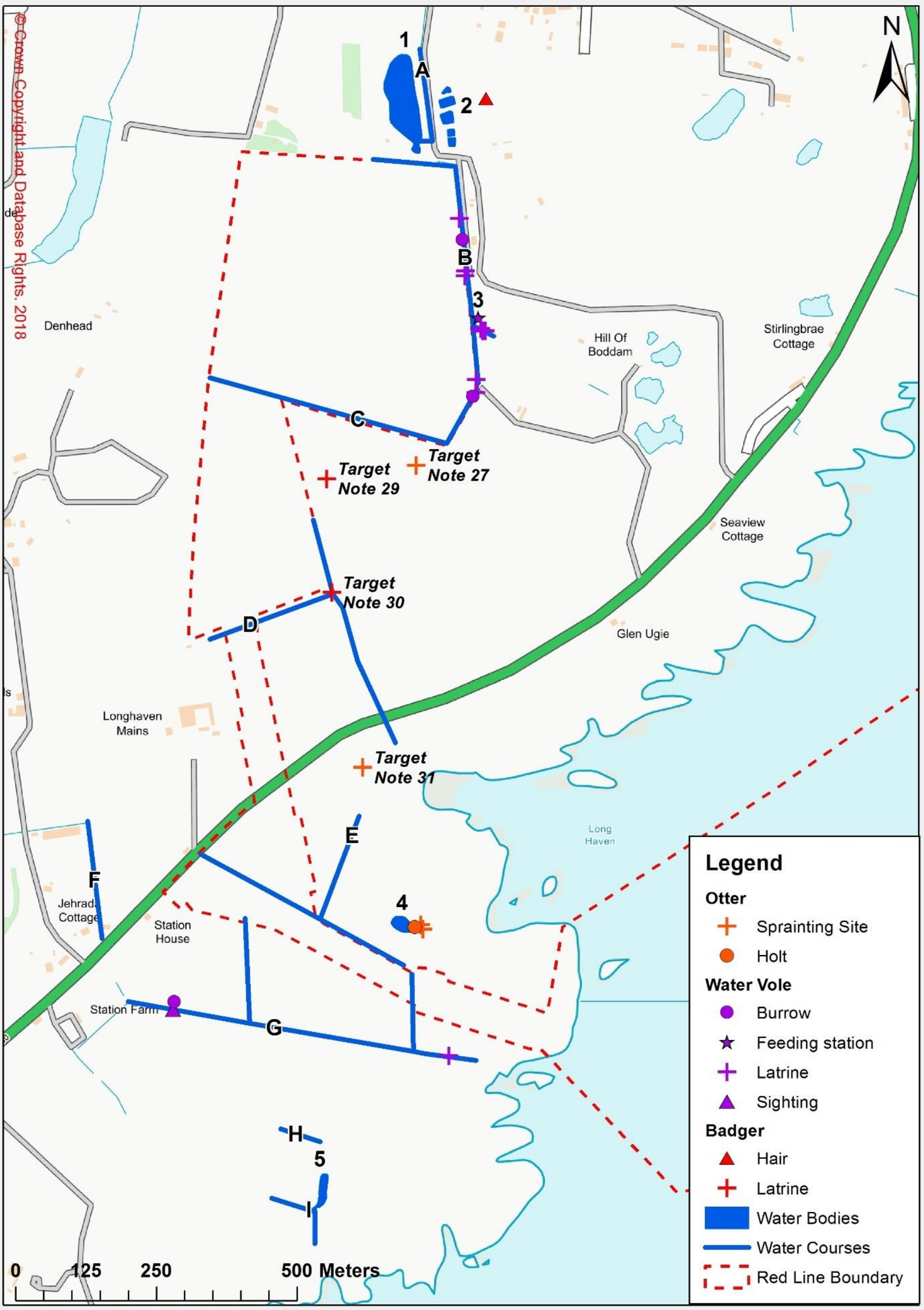

Figure 13.5 Protected Mammal Survey Results from within and surrounding the onshore HVDC consenting corridor. Target Notes relate to those described in Appendix D.2.

Waterbody 4, by a former quarry, was the only place recorded as possibly having an otter holt during the surveys within the HVDC otter survey area, and a holt was located within large boulders present by the water's edge. From the feeding and sprainting evidence found consistently over numerous site visits, it is thought that a coastal otter is using this location periodically. Whilst the otter camera study which took place from June-July 2017, and from October-November 2017, revealed no evidence on camera of regular otter usage of the holt, when visited in October 2017, the holt had been in use during the interim period as vegetation was cleared from the hole. It is possible that this is a holt which is used during another part of the annual cycle, or used less frequently than a natal holt would be. It is possible the otter has several sites along the coastline that it visits, and this site is one it transits through at particular times of the year. As otter home ranges can overlap (Kruuk & Moorhouse, 1991), it is possible that more than one otter will be using this coastline.

Further evidence of otter presence in the area came from the extended Phase 1 survey and the 2014 mammal survey, where both surveys identified otter spraints. The extended Phase 1 survey recorded them at two locations (Appendix D.2: TN27 and TN31), and the 2014 mammal survey recorded one by waterbody 4. In addition, ad hoc sightings of spraints along the coast were recorded during the ground investigation bird surveys on 31st January and 26th February 2018.

13.4.4.2 Water Vole

General Information

As well as being afforded protection under Schedule 5 in the WCA, water voles are listed in the Scottish Biodiversity List (SBL), the UK Biodiversity Action Plan (BAP), and are within the ecosystem group for the North-East Scotland LBAP. Water voles in the UK have had a long-term decline, with the most recent decline recorded as an 88% decrease in number of individuals.

Water voles require water bodies with grasses and herbs on the banks for feeding and digging their burrows (SNH, 2016). Maintaining this vegetation along water bodies is an important aspect of water vole conservation. Their preferred water habitat will largely be slow-flowing or static burns, ditches and drains, with a steep bank profile (SNH, 2016). Water voles tend to live in small colonies of up to 10 breeding individuals, and in the breeding period (March to September) will defend a territory of between 30-200m of watercourses (SNH, 2016).

In the field burrows are a distinctive sign of water voles, being recorded usually within 3m of a watercourse (SNH, 2016). Droppings are used to mark their territories and are deposited both outside burrows and at specific latrines along the watercourse.

The NBN Atlas revealed that whilst no water voles have been previously recorded in the HVDC water vole survey area, there are 34 records of water vole in a 10km grid south of Longhaven village, the outer edge of which is less than 2km away.

Field survey results

Most of the watercourses identified during the survey are essentially agricultural drains supporting often low levels of water. Nevertheless, there were a number of waterbodies which offered some suitability to water voles and evidence of water voles were recorded in a number of locations in both the 2014 and 2016 mammal surveys, these are shown in Figure 13.5. The extended Phase 1 habitat survey identified suitable habitat for water voles, but recorded no evidence of water voles during the survey. A summary of the waterbodies which had evidence of water vole usage recorded during the protected mammal surveys and the extended Phase 1 Habitat survey is presented in Table 13.9. Those waterbodies which were unsuitable for water vole are not summarised but further details of this can be seen in Appendix D.1.

Table 13.9 Summary of water vole evidence recorded during the surveys

Location	Relation to HVDC Consenting Corridor	Description	Evidence of water vole
Watercourse A	North, by approx. 35m.	A drain channel north of Fourfields, no open water present, extensive vegetation present	No water vole recorded but vegetation cover suitable for shelter and winter food available.
Watercourse B	On Eastern boundary of Consenting Corridor.	Ditch with low water depth, overgrown, vegetated banks.	Several water vole latrines identified, and a number of burrows.
Watercourse C	Consenting Corridor crosses this watercourse.	Ditch with limited vegetation cover and very little water.	Several water vole latrines identified, and a number of burrows.
Watercourse D	Consenting Corridor crosses this watercourse.	Section of agricultural drain, no open water present, extensive vegetation present	No water vole recorded but ditch offers suitable habitat with extensive foraging opportunities.
Watercourse G	Consenting Corridor crosses this watercourse.	Heavily vegetated field drain, south of A90	A number of burrows and latrines recorded, and a sighting of a water vole.
Waterbody 1	North, by approx. 20m.	Man-made pond within Highfields property. Small vegetated island present.	Restricted access meant no detailed survey of pond could take place, but likely to offer foraging suitability and ground shelter opportunities.
Waterbody 3	East, by approx. 10m.	Inland pond associated with agricultural drains, vegetated along the banks.	Water vole latrines recorded.

The water vole evidence noted in the watercourses and waterbodies within the water vole survey area confirm a small population present. At Watercourse G, evidence of water vole recorded is potentially a single dispersing individual looking to establish a territory.

No water voles were identified at these watercourses or waterbody locations during the 2014 survey, indicating a mobile metapopulation which is dispersing through the suitable agricultural drain network on an annual basis (Tracks Ecology, 2017b).

13.4.4.3 Badger

General Information

The Protection of Badgers Act 1992 affords protection to badgers and their setts, though the badger is not on either the UK BAP list or the SBL.

Badgers are highly territorial mammals which live in distinct social groupings, on average 4-6 adults will live per group (SNH, 2015). Latrines mark their territory boundaries, and in Scotland a territory is normally 70-120 hectares, though this can vary depending on the productivity of the area (SNH, 2015).

The NBN Atlas revealed two records of badgers within a 10km grid around Peterhead and Boddam. One record was north of Boddam in 2000, and the other was north of Peterhead in 2013 – neither of which is within the HVDC cable corridor.

Field survey results

During the extended Phase 1 survey evidence of badgers was identified at two locations. The first was a latrine at a disused quarry situated on the hill above Longhaven Mains, approximately 40 east of the Consenting Corridor, as shown in Figure 13.5 (Target note 29). The latrine had three pits and mammal pathways were present. No other signs of badgers were noted at this location. The second location was a latrine at the edge of the valley mire located adjacent to the Consenting Corridor, as shown in Figure 13.5 (Target note 30). This latrine had 10 pits and defined mammal pathways from the fence line to the quarry area. No confirmed setts were identified although a number of areas offered potential for sett construction including the disused quarry where the first latrine was found, in the boulders or in the gorse, and in the banks to the south of the Denend farmhouse. This latter location showed signs of a potential relict sett, now long abandoned, though is out with the HVDC cable corridor area.

During the surveys taken in 2014 and 2016, limited evidence to suggest that badgers were present within the HVDC badger survey area was identified. Only a single field sign in each survey was recorded, confirming the presence of badger in the area. A snagged hair on barbed wire fence to the south of Denend, and a snagged hair on fence adjacent to the quarry approximately 130m to the north east of the Consenting Corridor were found, as shown in Figure 13.5. No evidence of setts or latrines were identified from within the HVDC badger survey area.

The agricultural nature of the HVDC cable corridor area and surrounding landscape offers highly suitable habitat for badgers, and the presence in places of dense gorse cover could have obscured signs of setts being present. It is therefore likely that badgers use the HVDC cable corridor area on a frequent basis for foraging and commuting.

13.4.5 Valuation of Key Receptors

This section evaluates the nature conservation interests of the cable corridor survey area for its habitats and for the species it supports in terms of its relative importance in a geographical context. The value for each receptor is presented in Table 13.10.

Table 13.10 Evaluation of nature conservation interests.

Ecological Receptor	Conservation Importance	Evaluation Rationale	Ecological Receptor Value
Designated Sites for Nature Conservation			
Buchan Ness to Collieston SAC	International	The SAC is crossed at the cable landfall. The HVDC cables will pass underneath the vegetation in the SAC and therefore it is highly unlikely there will be any effects on the vegetated sea cliffs for which the site is designated. However, due to the proximity of the designated site to the consenting corridor it will be included in the assessment.	International.
Bullers of Buchan Coast SSSI	National	As with the SAC, the SSSI is crossed at the cable landfall. The HVDC cables will pass through the cliffs. The SSSI will be assessed in conjunction with the SAC.	National
Collieston to Whinnyfold Coast SSSI	National	This SSSI begins 8km south of the cable landfall. As the relevant desigated feature, vegetated seacliffs, has no ecological connectivity with any of the works being carried out for the HVDC cabling, this site can be excluded from further assessment.	Excluded from assessment.
River Dee SAC	International	The SAC is approximately 40km from the cable landfall site. Coastal otters have a much shorter range of between 2-10km and therefore it is unlikely any otters will be moving between the HVDC site and the SAC. River Dee otters are known to have larger ranges, but these otters use the river itself, rather than moving further up the coast. Therefore, there is unlikely to be connectivity between the River Dee otters and the coastal otters using land around the cable landfall site. This site is therefore excluded from further assessment.	Excluded from assessment.
Other Sites and Inventory Habitats			
Longhaven Cliffs Reserve	High Local	The coastal part of the reserve is located within the SAC and is therefore included as part of the SAC's assessment. The inland section of the reserve is approximately 600m from the closest point of the cable corridor and therefore no effects on the flora will be expected. Furthermore, no groundwater dependent species were found within the inland reserve section or individual flowering or lower plant species of conservation concern were found. Therefore, this is excluded from further assessment.	Excluded from assessment as included with Buchan Ness to Collieston SAC assessment.

Ecological Receptor	Conservation Importance	Evaluation Rationale	Ecological Receptor Value
Flora: Dominant Habitats			
Arable	High Local	Although Arable Field Margins is a UK BAP Priority Habitat, no significant field margins are present within the Phase 1 habitat survey area and the arable habitats present are highly managed through modern agricultural techniques. The wider landscape is dominated by this habitat. As the habitat is of limited ecological value, it is excluded from further assessment. It should be noted that the disturbance of the arable land is, however, taken into consideration further in Chapter 8: Land Quality.	Low local: excluded from further assessment
Semi-improved neutral grassland	High Local	Semi-improved neutral grassland can support a number of invertebrate and small mammal species which can enrich the local biodiversity. This feature is common and widespread at a local and regional level and supports an unremarkable array of floral species. The habitat is recognised within the LBAP. As the habitat is of limited ecological value, it is excluded from further assessment. It should be noted that the disturbance of the semi-improved land is, however, taken into consideration further in Chapter 8: Land Quality.	Low local: excluded from further assessment
Marshy grassland	Moderate Local	Although marshy grassland can be identified as habitat potentially dependent on groundwater, the habitat present in the HVDC survey is due to surface water movements and is related to farm management practices. In the NVC survey it was recorded that no groundwater dependent terrestrial ecosystems classified as moderate high or above will be crossed by the HVDC consenting corridor. The habitat within the Phase 1 HVDC survey area is occasionally grazed by cattle. All the land will be reinstated after installation. This habitat is excluded from further assessment.	Low Local: excluded from further assessment.
Coastal grassland	Regional	This grassland can support maritime species, and during the NVC survey a number of maritime communities were present. A small section of coastal grassland falls within the consenting corridor. However, as the cables will pass under this section of coastal grassland via HDD, no impacts are anticipated. Therefore, this habitat type is excluded from further assessment.	High Local: excluded from further assessment.

Ecological Receptor	Conservation Importance	Evaluation Rationale	Ecological Receptor Value
Maritime cliff	International	This habitat type is designated under the Bullers of Buchan Coast SSSI and under the SPA as vegetated sea cliffs, and as such is assessed under these designated sites. A number of habitat types of conservation interest were located within the maritime cliffs. Maritime cliff is within the consenting corridor, however the cables will pass beneath via HDD, so no impacts anticipated. It is however noted that one section of maritime cliff habitat is within 50m of the HDD entry point. This section was assessed in Chapter 9: Air Quality under potential dust effects. No significant effects on dust on this community, or any maritime community is predicted. Due to it being classed as having a regional value, it is included in the assessment as a precaution.	Regional
Flora: Other Notable Habitats			
Unimproved neutral grassland	Low Local	From north of the A90 up to Fourfields the consenting corridor will pass through sections of neutral grassland. This is an unremarkable habitat type with no species of conservation concern found within it. Its disturbance is already considered within Chapter 8: Land Quality. As it is ecologically not of high value, it is excluded from further assessment.	Negligible: excluded from further assessment.
Coastal heathland	Regional	The consenting corridor will not pass through the coastal heathland found as part of the NVC survey. One habitat of conservation concern was noted within the coastal heathland classification, approximately 110m north of the consenting corridor. Other coastal heathland habitat types were found within 50m of the consenting corridor near the HDD landfall. This was assessed in Chapter 9: Air Quality as having no significant effect due to dust. However, as there is a habitat of conservation concern within this habitat classification it is included for further assessment as a precaution.	High Local
Scrub - continuous	Negligible	Scrub dominated by European gorse is not notable in biodiversity terms, although it provides shelter and foraging habitat for a number of species (e.g. birds, invertebrates and mammals). Due to its widespread nature in the wider countryside, it is excluded from further assessment. However, it should be noted that shrub offers potential set building locations for badgers, which are considered separately.	Negligible: excluded from further assessment.
Bare ground and Access Track	Negligible	Of limited ecological value and therefore is excluded from further assessment.	Negligible: excluded from further assessment.

Ecological Receptor	Conservation Importance	Evaluation Rationale	Ecological Receptor Value
Acid grassland - unimproved	National	Lowland acid grassland on the UK BAP list. However, only 0.30% of the total survey area was found to have acid grassland on it, equating to 0.22 Ha. The consenting corridor does not pass through any area of acid grassland and therefore this habitat type is excluded from further assessment.	Moderate Local: excluded from further assessment.
Tall herb and fern	Regional	The species found within this habitat are highly dependent on groundwater. The consenting corridor will not pass directly though where these plants are found. However, they will be included as part of the assessment on a precautionary basis.	High Local
Open water	Moderate Local	The consenting corridor will not pass through the area of open water found during the NVC survey, however the open water is where a known otter holt is. Therefore, this will be included as part of the assessment.	Moderate Local
Quarry	Low Local	No quarries are present within the consenting corridor. The coastal disused quarry has the potential to provide shelter for a range of species, and is known to be where an otter holt is located. There is also an inland disused quarry surveyed during the extended Phase 1 habitat survey that had evidence of badger latrines. They should therefore be included in the assessment.	Low Local
Flora: Specific Botanical Interests			
Maritime grassland communities MC8: *Festuca rubra-Armeria maritima* and MC9 *Festuca rubra-Holcus lanatus*	National	Listed under Annex 1 habitat type H1230: vegetated sea cliffs of the Atlantic and Baltic coasts. These communities also form component parts of Maritime cliff and slope vegetation, listed under UK BAP and Scottish Biodiversity List priority habitats. These habitats are within the consenting corridor. However, the cables will pass under this section of the coast via HDD, so no impacts are anticipated. However, one section is within 50m of the HDD entrance and is therefore included as a precaution.	High Local
Heath community H7: *Calluna vulgaris-Scilla verna*	National	Listed under Annex 1 habitat type H1230: vegetated sea cliffs of the Atlantic and Baltic coasts. This community also form component parts of Maritime cliff and slope vegetation, listed under UK BAP and Scottish Biodiversity List priority habitats. There is one small patch identified approximately 110m from the HVDC consenting corridor. Due to its conservation status, this habitat is included as a precaution.	High Local:

Ecological Receptor	Conservation Importance	Evaluation Rationale	Ecological Receptor Value
GWDTE tall herb community U17 *Luzula sylvatica-Geum rivale*	National	Habitat is identified as being highly dependent on groundwater (SEPA, 2014). GWDTE are protected under the Water Framework Directive. This plant community was located along the cliffs to the north of the consenting corridor, but not within the consenting corridor itself. This habitat is included on a precautionary basis due to the potential effects on groundwater the cabling installation may have.	High Local.
Invasive species: Monbretia, Pampas grass and Cotoneaster	Negative	None of the invasive species identified are listed on the Schedule 9 of the WCA (where relevant to Scotland), or were identified as being an 'alien' species on the WFD list of SNH Species Action Framework. Pampas grass and Cotoneaster were recorded within the inland section of the Longhaven Reserve which is more than 600m from the nearest part of the HVDC cable corridor and therefore will remain untouched. Monbretia is found approximately 70m east of the consenting corridor. As good practice, mitigation will be implemented for Monbretia, however no further assessment of this species is required during the impact assessment.	Negative: excluded from further assessment.
Fauna: Protected Species			
Otter	International	Otters are a UK BAP priority species and receive full legal protection as an EPS. Otters are found throughout most of Scotland, the species is considered relatively widespread and common and the Scottish population represents 90% of the total British population (Scottish Natural Heritage, 2010). Evidence of otters being present during the protected mammal surveys demonstrates that they use this coastline. They are included as part of the assessment.	International
Water vole	National	Small population present on a short section of an unnamed burn, and evidence of habitat suitability in other areas near to the HVDC cable corridor. Water vole are distributed throughout much of north east Scotland and are one of the UKs most threatened native mammals. They are included as part of the assessment.	National
Badger	National	Badgers are identified as being present on at least an infrequent basis across the Survey Area, with a number of habitats likely to provide foraging resources. No evidence of active setts was identified although the dense scrub and areas of restricted access may support such.	National

13.5 Impact Assessment

The impacts of the development on the non-avian, terrestrial ecological receptors which have been assessed as having some ecological value are assessed in terms of their impact magnitude and significance. Where impacts are negligible, no further assessment is undertaken.

13.5.1 Nature of Potential Impacts

A number of potential impacts (in the absence of secondary mitigation) have been identified in connection with both the onshore construction phase of the development, and these may be direct or indirect impacts. Effects will be divided into those effects on flora receptors and those protected mammal receptors.

13.5.1.1 Effects on Habitats and Flora

Potential impacts may include:

- Loss of habitat within the construction corridor due to excavation of cabling trenches, installation of haul roads/drainage ditches, storage of soil heaps, construction laydown areas and temporary site compound facilities;
- Pollution of habitats or flora of conservation concern due to construction works; and
- Accidental effects on groundwater affecting groundwater dependent species.

13.5.1.1.1 Habitat Loss

None of the scoped-in habitats in Table 13.9 will be subject to any habitat loss as a result of the HVDC cable works. This is because the HDD will go under the maritime cliff and designated sites. The quarries and the open water habitats will also not be affected by the HVDC cabling. The NVC survey revealed the cable corridor mostly contains neutral grassland and disturbed agricultural land, which will be restored after the works have been completed.

Therefore, the impact on receptors, ranging from **international** to **low local** in value, is **negligible**, leading to either a **minor** or a **negligible**, **non-significant** effect.

13.5.1.1.2 Pollution of Habitats

If an accidental spill would occur during construction, it could impact upon the flora surrounding the spill. If it were to occur the most likely habitat type to be affected would be the agricultural land and grasslands, as these are the dominant habitat types the cable route is passing through. These habitats have been scoped out for assessment due to their widespread nature. Waterbody 4, where the otter holt was recorded, is located at the bottom of a cliff, not in direct proximity to any cabling activities, as discussed in Chapter 10: Water Quality (onshore) spillages to Waterbody 4 are unlikely, taking account of mitigation the resultant effects on water quality were deemed to be negligible, non-significant. The designated site habitats are being drilled under with HDD, so should not be subject to any pollution events.

There are several small sections of vegetation of conservation concern in close proximity to the consenting corridor, including; coastal grassland, coastal heathland, and non-ruderal tall herb and fern habitats. As identified in Chapter 9: Air Quality, there is the potential for these habitats to be affected by fugitive dust emissions from the cable installation works. However, as identified in the Air Quality assessment, no significant effects are expected providing the dust management plan is adhered to, as laid out within the Schedule of Mitigation.

Therefore, impacts on the designated sites and habitats, of **international** and **national** value, is **negligible** due to the techniques being used, leading to a **minor**, **non-significant** effect.

The impacts on the open water, quarry (Waterbody 4), of **moderate** and **low** local value, is **negligible**, leading to a **negligible**, non-significant effect.

Impacts of pollution on tall herb and fern habitats, which are associated as being potentially dependent on groundwater, are considered further in section 13.5.1.1.3, but if the land or groundwater were to be polluted there could be an effect on these receptors. As discussed in Chapter 8: Geology and Hydrogeology with mitigation including: pollution prevention measures, and a pollution response plan in place, the risk of a spill occurring and contaminating the ground water is low; hence the impact on these **high local** receptors is assessed as **low**, leading to a **minor**, **non-significant** effect.

13.5.1.1.3 Effects on Groundwater

As identified in Chapter 8: Geology and Hydrogeology there will be a potential need to extract groundwater entering excavation, particularly closer to the Fourfields Site. There are habitats within 50m of the consenting corridor which are defined as being highly dependent on groundwater, but from the habitat survey, none of these are within the Fourfields site.

In Chapter 9: Water Quality (Onshore), it is identified that the existing field drains are not currently well maintained and that maintenance shall be completed. Maintenance will be limited to the areas in the vicinity of the HDD work site, the access road and the cable installation works, which does not include moderate to high or high GWDE. Any effects on hydrology will be very localised. The surface water management during construction will be subject to a Construction Licence will be required under the Water Environment (Controlled Activities (Scotland) Regulations (as Amended) (CAR).

The highly groundwater dependent plants (tall herb and ferns) were found closer to the cliff, near the HDD site and just south of the A90. It is not expected that there will be long-lasting effects on the groundwater and hence on the species which are highly dependent upon it. Therefore, the effects on tall herb and ferns, a **high local** receptor, is expected to be **negligible**, leading to a **negligible**, **non-significant** effect.

13.5.1.2 Effects on Protected Mammal Species.

Potential impacts may include:

- Disturbance of habitat for species protected under European and National legislation during construction works;
- Direct physical damage inflicted to protected species as a consequence of construction works, resulting in injury or death;
- Pollution and degradations of watercourses/water quality due to construction disturbance, pollution, and run-off;
- Fragmentation of habitats and severance of ecological corridors during construction; and
- Indirect temporary impacts on adjacent habitats (and the species that use them) for example through noise and visual disturbance.

13.5.1.2.1 Habitat Disturbance

The project has specifically ensured that the identified otter holt is beyond 50m of the nearest point to the HVDC cable corridor. Furthermore, the coastal path around the cliffs, where otter spraints where located during the surveys, will not have any works near it. Therefore, the otter's coastal range will not be affected by the works. If the otter uses the farm fields to move across, then there is the chance that it will be disturbed during construction.

During the most recent badger surveys, limited signs of badger presence were recorded, however in the extended Phase 1 habitat survey carried out in 2014, evidence of badger latrines were present. Furthermore, from the NVC survey continuous scrub habitat is present, which can provide shelter and suitable habitat type for badgers to build their setts. From the habitat survey it is noticed that the majority of the scrub habitat is not within the HVDC corridor. There is a small patch of scrub at the south end of Fourfields which may need to be disturbed when the HVDC cables are being installed. Therefore, there is the potential for badgers to be disturbed during the works if they were to be using this scrub or moving across the fields.

For water voles, the surveys found that two water courses which will be crossed by the HVDC cabling had evidence of water vole usage. It is noted that water voles can disperse throughout different water bodies depending on the year or season, so they may well be using other waterbodies close to the consenting corridor by the time construction is due to commence.

For otters of **international** value in the absence of mitigation there could be a **low** impact magnitude, leading to a **moderate**, **significant** effect. For badgers of **national** value, this leads to a **minor**, **non-significant** effect. For water voles of **national** value, they could be subjected to a **medium** impact magnitude, leading to a **moderate**, significant effect.

13.5.1.2.2 Accidental Physical Damage

During the cable construction it is possible that one of the protected species of mammal is accidentally injured or killed through interactions with machinery or plant, or by becoming trapped in an excavation. In the absence of mitigation this effect is likely to negative and permanent for the individual animal, however it very unlikely to occur at a frequency that could result in population level effects at a species level. For otters of **international** value in the absence of mitigation there could be a **low** impact magnitude, leading to a **moderate**, **significant** effect. For water voles and badgers of **national** value, this leads to a **minor**, **non-significant** effect.

13.5.1.2.3 Pollution of Habitats

As laid out in Chapter 8: Land Quality and Chapter 10: Water Quality (on-shore) accidental spills could lead to effects on the land and water quality. However, with the comprehensive primary and tertiary mitigation in place, as set out in Chapters 8, 24 (Resource and Waste), and 25 (Schedule of Mitigation), the risk of a spill occurring, and the contaminant reaching the ground or water environment in a volume with the potential to cause environmental effects is extremely low.

The potential to for surface water runoff to carry silts into the watercourses and for silt issues to arise during culvert installation during road construction and cable installation across watercourses is considered with Chapter 10: Water Quality (Onshore). With appropriate mitigation the effects on water quality were deemed to be minor, non-significant. Watercourses potentially affected include Watercourses C and G which provided water vole habitat. Water voles are known to still use water courses which are turbid (Pond Conservation, 2010), provided this is not due to chemical pollutants.

As a result of the mitigation measures already in identified in other topic specific chapters, the effects of accidental spills the **international** valued otters and **nationally** valued water vole and badgers is expected to be of **negligible** magnitude, leading to a **minor**, **non-significant** effect for otters and **negligible, non-significant** effects for water voles and badgers.

For sedimentation of water bodies, with the mitigation identified in Chapter 10: Water Quality (Onshore), for water voles, there may be a **low** magnitude of effect, leading to a **minor, non-significant** effect.

13.5.1.2.4 Habitat Fragmentation

It is possible that the cable construction corridor could cause a small degree of habitat fragmentation as sections of the corridor where trenching is required will be fenced off during cable installation. However, as the construction corridor width is largely 50m, larger mammals such as the otters and badgers may be able to move cross the corridor to the south of the works, towards the coastal path and at the sections where HDD is being employed. Evidence from the otter survey revealed that it is likely a coastal otter that is utilising the area. As no parts of the coast will be disturbed during the works, no habitat fragmentation along the coast itself will take place. Badger evidence was low during the surveys, but the grassland is suitable habitat for them to cross through.

For water voles, there will be disturbance of some of the water courses during the cabling installation and temporary road works, which may mean they are not able to use sections of the water course temporarily whilst the construction is being completed. From the water vole surveys watercourses G and C had evidence of water voles' usage, and both these ditches will need to be crossed during enabling and installation works, however water flows will be maintained. Water voles often change their distribution year to year and it is possible that the existing population distribution as presented in the baseline information could expand or relocate to include additional areas. Their habitat may therefore be fragmented but this is only likely to occur for short periods of time, across one or two years (see Chapter 2: Project Description for predicted timings). As the project design is such that the land will be restored to its former usage after cable installation, this also relates to ensuring the water courses are not adversely affected in the medium or long term.

Otters, an **internationally** valued receptor is predicted to have a **negligible** magnitude of impact due to habitat fragmentation, leading to a **minor, non-significant** effect.

Badgers and water voles, **nationally** valued receptors, would also be subject to a **low** impact, leading to a **minor, non-significant** impact.

13.5.1.2.5 Noise and Visual Disturbance

Noise and visual disturbance may lead to avoidance of affected areas by the protected mammals which may alter their spatial use of the surrounding landscape, including disruption to commuting and foraging patterns. For otters, the identified holt, if it is in use during the construction works is more than 50m from the closest part of the cable corridor, and is at the bottom of a disused quarry, so is also afforded screening from the potential noise disturbance. Chapter 22: Noise (In-Air) demonstrated that noise in the quarry will not differ from background noise during HVDC cabling works.

Badgers are by nature nocturnal and as the working hours are predominantly during the day, it is unlikely there will be any visual or noise-based disturbance on these species. It should be noted that in the context of the site, the mammals may be used to relatively high background noise, due to the presence of the A90.

Water voles are notoriously shy animals and are easily disturbed by human presence. It is possible that if they are present during the works that they will be disturbed by the works and may move further along the water body.

Internationally valued otters and **nationally** valued water vole and badgers is expected to be of **negligible** magnitude, leading to a **minor**, **non-significant** effect for otters and **negligible, non-significant** effects for water voles and badgers.

13.5.2 Operation / Maintenance

It is not expected that the cables will require regular repairs or maintenance, but if they do require works sections of the cable route may need re-excavated. This would lead to temporary disturbance of a small area of land, but this would be reinstated again once the repairs had been carried out. As such, it is expected that once the HVDC cable is operational, there will be minimal disturbance and/or impact on the ecological receptors identified above, hence the potential effects on habitats, flora, and protected mammal species are assessed as **no change**.

13.6 Mitigation Measures

This section outlines the proposed mitigation strategy for the development. Mitigation measures are aimed to prevent or reduce any likely significant effects on the ecological receptors identified. In line with EcIA guidance, mitigation measures are required for impacts identified as being of minor significance or greater in EcIA terms. As detailed in Chapter 3: Methodology, standard construction practices, such as Pollution Prevention Guidance are assumed to be applied. However, where the overall EcIA significance is less than moderate, mitigation may not be required but some habitats and species are still subject to mitigation to ensure high environmental working standards and legal compliance, for example the European Protected Species.

13.6.1 Habitats and Flora

Potential impacts of the development on valued ecological receptors have been minimised through careful site design, resulting in no significant effects on habitats or flora being identified. However, the following considerations will be made in line with environmental best practice.

13.6.1.1 Invasive Species

As part of the Schedule of Mitigation the location supporting Montbretia, an invasive non-native species, will be identified on relevant constraints drawings. If works are located within 50m of the species, then the areas containing the invasive species will be clearly marked to prevent any disturbance. If these areas need to be disturbed, then a suitably experienced professional will be consulted with respect to the most appropriate method of managing the invasive species.

13.6.1.2 Aquatic Habitats and Groundwater Dependant Ecosystems.

Mitigation measures identified in Chapter 10: Water Quality (Onshore), and Chapter 8: Geology and Hydrogeology will be implemented to prevent pollution associated impacts and to minimise effects on hydrology in terms of flooding and impacts on GWDE.

13.6.2 Protected Species

Potential significant impacts were identified for otters and water voles, resulting from the effects of habitat disturbance and possible accidental physical damage resulting from the construction activities. The following mitigation measures will be implemented in order to reduce the magnitude of these effects.

13.6.2.1 Pre-construction Surveys

Pre-construction protected mammal surveys will be undertaken in order to ascertain whether any protected mammal species, or areas of importance to these species are present within or in the immediate vicinity of the construction areas, this will allow specifics of the mitigation to be tailored.

This will also safeguard against any breach in wildlife legislation with respect to protected terrestrial species within these areas.

This will focus on all watercourses within 200m of the proposed HVDC corridor for otters and water voles, and all areas within 200m of the HVDC cable corridor for badgers, and should be completed within 8 weeks of the start of construction. This will allow time for licences to be sought if required. Further checks closer to the time of the works should be completed as deemed appropriate by the initial survey to ensure no changes have occurred.

Dependent on the results of the pre-construction surveys, an assessment of the likelihood of disturbance to protected mammals will be undertaken and the need for an EPS or derogation licence under the Conservation (Natural Habitats &c.) Regulations 1994 as amended in Scotland will be assessed and discussed with SNH.

13.6.2.1 Prevention of Habitat Disturbance

Any protected mammal features in close proximity of the works will be clearly marked including an appropriate buffer zone. A minimum buffer of 40m will be implemented for any newly identified otter holt or badger sett, although this will be reviewed dependent on the level of activity identified during the surveys. Appropriate mitigation will be identified dependant on the nature of the protected mammal feature, and construction workers will be briefed on the significance of these locations.

In the unlikely event that a previously undiscovered protected mammal feature (holt, sett, or burrow etc.) is identified during the works, work will stop within 30m, of the feature or immediately if already within 30m, and the Contractor and Client will be informed. Appropriate mitigation measures will be identified through consultation with SNH, and appropriately qualified experts as necessary. Works will not recommence in the affected area until suitable mitigation is in place.

Trenching under the watercourses and associated use of dams and culverts shall be undertaken following best practice techniques as discussed in Chapter 10: Water Quality (Onshore), with duration and extent of disturbance minimised and habitat reinstatement undertaken at the earliest opportunity.

Artificial lighting within the site, and along watercourses should be minimised wherever possible and directed to only the areas where it is required.

13.6.2.2 Prevention of Physical Harm and Entrapment

All site personnel will be instructed to remain vigilant for protected mammals, and will stop operations in the event of risk of causing harm to a protected mammal. There will be an ongoing watching brief for protected mammals by the sites environmental staff, during all works with the potential to cause damage or injury to protected mammals in areas identified as being sensitive during the preconstruction surveys.

Any pipes or other such materials shall be stored upright, or have covers fitted to the ends, or be appropriately fenced off to prevent entrapment or occupation my protected mammal. Temporary ramps will be utilised within the cable trenches to allow mammals to escape by themselves, should they fall in.

13.7 Residual Effects

The potential significant effect is accidental injury caused to one of the protected mammals during works. Pre-construction surveys, as laid out in Mitigation, Section 13.6, will result in it being unlikely that any mammals will be injured as part of the work. Therefore, the resulting impact on the protected mammal species is of **negligible** magnitude, resulting in a **negligible**, **non-significant** effect.

For otters and water voles, which could be disturbed during the construction works, pre-construction surveys will also ensure that any mammals utilising the habitat are noted, which can then mean further mitigation can be put in place to minimise disturbance. Therefore, the resulting impact on the protected mammal species is of **negligible** magnitude, resulting in a **negligible**, **non-significant** effect.

13.8 Cumulative Effects

The only project which is to be considered as part of the cumulative assessment is the NorthConnect HVAC cabling and Converter Station construction. The permanent effect of arable land being disturbed as the Converter Station is being built on top of it, will not be added to by the HVDC works in the long-term as all the land will be restored to its former usage, with the exception for a 1m strip at the A90 of the temporary access road which will remain as a tarmacked. The same mitigation procedures will be put in place for the Protected Mammal species in both projects. Therefore, there are no cumulative effects expected for the terrestrial ecological receptors between the two aspects of the NorthConnect Project.

13.9 Summary

The key habitats and species within the respective survey area were identified during the completion of baseline surveys: Extended Phase 1 habitat survey; National Vegetation Survey, Non-native species Survey; and Otter, Water Vole and Badger Survey. No significant effects on ecological receptors have been identified resulting from the development. Several best practice measures have been identified along with a number of species specific mitigation approaches in order to reduce ecological effect as far as possible. Table 13.11 provides a summary of the potential impacts, their levels of significance before and after mitigation, along with a summary of mitigation.

Table 13.11 Summary of potential ecological effects.

Receptor	Nature of Impact	Receptor Sensitivity	Impact Magnitude	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
				Construction			
Buchan Ness to Collieston SAC	Habitat loss or pollution	International	Negligible	Minor: Non-Significant	No specific mitigation as cables pass under this site via-HDD.	Negligible	Minor: Non-significant
Buller of Buchan SSSI	Habitat loss or pollution	National	Negligible	Negligible: Non-significant	No specific mitigation as cables pass under this site via-HDD.	Negligible	Negligible: Non-significant
Maritime Cliff	Habitat loss or pollution	Regional	Negligible	Negligible: Non-significant	No specific mitigation.	Negligible	Negligible: Non-significant
Coastal Heathland	Habitat loss or pollution	High Local	Negligible	Negligible: Non-significant	Dust Management Plan.	Negligible	Negligible: Non-significant
Tall herb and fern	Habitat loss or pollution. Groundwater effects.	High Local	Low	Minor: Non-Significant	Dust Management Plan.	Negligible	Negligible: Non-significant
Open Water	Pollution	Moderate Local	Negligible	Negligible: Non-significant	No specific mitigation.	Negligible	Negligible: Non-significant
Quarry	Habitat loss or pollution	Low Local	Negligible	Negligible: Non-significant	No specific mitigation.	Negligible	Negligible: Non-significant
Habitats: MC8, MC9, H7.	Habitat loss or pollution	High Local	Negligible	Negligible: Non-significant	Dust Management Plan.	Negligible	Negligible: Non-significant
Habitat U17	Habitat loss or pollution. Groundwater effects.	High Local	Low	Negligible: Non-significant	As identified in Chapter 8: Geology and Hydrology, and 10: Water Quality	Negligible	Negligible: Non-significant

Receptor	Nature of Impact	Receptor Sensitivity	Impact Magnitude	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Otter	Habitat disturbance	International	Low	Moderate: Significant	Avoidance of construction near otter holt location Pre-construction surveys and exclusion zones.	Negligible	Minor: Non-significant
	Habitat fragmentation	International	Negligible	Minor: Non-significant		Negligible	Minor: Non-significant
	Noise or visual disturbance	International	Negligible	Minor: Non-significant	No specific mitigation	Negligible	Minor: Non-significant
	Accidental physical damage	International	Low	Moderate: Significant	Pre-construction surveys, exclusion zones, and construction watching briefs. Measures to prevent entrapment.	Negligible	Minor: Non-significant
	Water course pollution	International	Low	Moderate: Significant	As identified in Chapter 10: Water Quality	Negligible	Minor: Non-significant
Badger	Habitat disturbance or fragmentation	National	Low	Minor: Non-significant	No specific mitigation.	Low	Minor: Non-significant
	Noise or visual disturbance	National	Low	Minor: Non-significant	No specific mitigation.	Low	Minor: Non-significant

Receptor	Nature of Impact	Receptor Sensitivity	Impact Magnitude	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Badger	Accidental physical damage	National	Low	Minor: Non-significant	Pre-construction surveys, exclusion zones, and construction watching briefs. Measures to prevent entrapment.	Negligible	Minor: Non-significant
	Water course pollution	National	Low	Minor: Non-significant	No Specific mitigation.	Low	Minor: Non-significant
Water Vole	Habitat disturbance	National	Medium	Moderate Significant	Pre-construction surveys Culverts installed as discussed in Chapter 10: Water Quality (Onshore)	Low	Minor: Non-significant
	Habitat fragmentation	National	Low	Minor: Non-significant	No specific mitigation.	Low	Minor: Non-significant
	Noise or visual disturbance	National	Low	Minor: Non-significant	No specific mitigation.	Low	Minor: Non-significant
	Accidental physical damage	National	Low	Minor, Non-Significant	Pre-construction surveys, exclusion zones, and construction watching briefs. Measures to prevent entrapment.	Negligible	Negligible: Non-significant
	Water course pollution	National	Low	Minor, Non-Significant	As identified in Chapter 10: Water Quality	Low	Minor

13.10 References

Aberdeenshire Council. (2014). North East Local Biodiversity Action Plan

Aberdeenshire Council. (2017). Aberdeenshire Local Development Plan. *https://www.aberdeenshire.gov.uk/planning/plans-and-policies/aberdeenshire-local-development-plan-2017/*.

Atmos Consulting. (2014). NorthConnect Converter Building, Peterhead - Extended Phase 1 Survey. *19400-07/Rev1*.

Chanin, P. (2003). Ecology of the European Otter *Lutra lutra*. *Conserving Natura 2000 Rivers Ecology Series, 10*.

CIEEM. (2016). Guidelines for ecological impact assessment in the UK and Ireland: terrestrial, freshwater and coastal. In (2nd ed.): Chartered Institute of Ecology and Environmental Management.

Corbet, G. B., & Southern, H. N. (1977). *The Handbook of British Mammals*: Mammal Society.

European Commission. (1992). *Directive 92/43/EEC of 21 May 1992 on the Conservation of natural habitats and of wild fauna and flora*.

European Commission. (2000). Directive 2000/60/EC European Water Framework Directive

JNCC. (2007). *Second Report by the UK under Article 17 on the implementation of the Habitats Directive 2001 to December 2006*. Retrieved from Peterborough, JNCC:

JNCC. (2010a). Handbook for Phase 1 Habitat Survey – a Technique for Environmental Audit.

JNCC. (2010b). *UK priority species pages: Lutra lutra Otter* Joint Nature Conservation Committee.

JNCC. (2011). The National Vegetation Classification (NVC). *UK Habitat Classification.* Retrieved from http://jncc.defra.gov.uk/page-4259

JNCC. (2016). UK BAP priority species and habitats. Retrieved from http://jncc.defra.gov.uk/page-5705

JNCC. (2017a). *1355 Otter Lutra lutra*. Retrieved from http://jncc.defra.gov.uk/ProtectedSites/SACselection/species.asp?FeatureIntCode=S1355.

JNCC. (2017b). Buchan Ness to Collieston Site Details. Retrieved from http://jncc.defra.gov.uk/ProtectedSites/SACselection/sac.asp?EUCode=UK0030101

JNCC. (2018). River Dee SAC Site Information. Retrieved from http://jncc.defra.gov.uk/ProtectedSites/SACselection/sac.asp?EUCode=UK0030251

Kruuk, H., & Moorhouse, A. (1991). The spatial organization of otters (Lutra lutra) in Shetland. *Journal of Zoology, 224*(1), 41-57.

Macdonald, S. M., & Mason, C. F. (1987). Seasonal marking in an otter population. *Acta Theriologica, 32*(27), 449-461.

Mason, C. F., & Macdonald, S. (2009). *Otters: ecology and conservation*: Cambridge University Press.

NBN. (2017). NBN Atlas: Explore Your Area. Retrieved from https://records.nbnatlas.org/explore/your-area

NESBReC. (2016,). North East Scotland Biological Records Centre (NESBReC). In.

NorthConnect. (2017). Report on Long Haven otter camera study.

Ryland, K., & Kemp, B. (2009). Using field signs to identify water voles - are we getting it wrong? *Ecology and Environmental management - In practice, 63*, 23-25.

Scottish Government. (2008). *PAN 60: Planning for Natural Heritage*. Retrieved from http://www.gov.scot/Publications/2000/08/pan60-root/pan60.

Scottish Government. (2013). Scottish Biodiversity List.

Scottish Ministers. (2014a). Scotland’s Third National Planning Framework (NPF3) SG/2014/100.

Scottish Ministers. (2014b). Scottish Planning Policy (SPP).

Scottish Parliament. (2003). Water Environment and Water Services (Scotland) Act 2003.

Scottish Parliament. (2004). *Nature Conservation (Scotland) Act*

SEPA. (2014). *Land Use Planning System SEPA Guidance Note 17*. Retrieved from https://www.sepa.org.uk/media/143325/lups-gu17-marine-development-and-marine-aquaculture-planning-guidance.pdf.
SNH. (2007). Otters and Development. *Scottish Wildlife Series*.
SNH. (2015). About badgers. *Wildlife and you: Badgers.* Retrieved from http://www.snh.gov.uk/about-scotlands-nature/wildlife-and-you/badgers/about-badgers/
SNH. (2016). *More about water voles*. Scottish Natural Heritage.
SNH. (2017). SiteLink. Retrieved from http://gateway.snh.gov.uk/sitelink/index.jsp
SNH. (2018). Bullers of Buchan Coast SSSI. *SNH SiteLink Report*(A375679).
Strachan, R. (2011). Water vole Conservation Handbook.
Tracks Ecology. (2014). NorthConnect Ecological Surveys: Otter, Water Vole and Badger Survey. *Technical Report 14/021/AFF/R01*.
Tracks Ecology. (2017a). Longhaven Cliffs SWT Nature Reserve NVC Survey
Tracks Ecology. (2017b). Otter, water vole and badger survey. *Technical Report - 16/008/AFF/R01*.
Tracks Ecology. (2017c). Technical Report: National Vegetaion Survey
UK Government. (1992). Protection of Badgers Act.
UK Parliament. (1981). The Wildlife and Countryside Act 1981.

Chapter 14: Benthic Ecology

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Contents

14 Benthic Ecology

14.1 Introduction

This chapter presents the benthic ecology Ecological Impact Assessment for the proposed HVDC consenting corridor. Benthic habitats and species ecological receptors are considered in this chapter and are evaluated in the context of nature conservation legislation and relevant planning policy (see Chapter 5: Planning Policy). This EcIA presents baseline information, anticipated impacts upon benthic ecology receptors during installation and operation, as well as considering potential decommissioning impacts. Mitigation is proposed where appropriate, cumulative impacts are considered, and finally the residual impacts and their significance are assessed.

This chapter is supported by the following documents:

- NorthConnect – UK Nearshore and North Sea Survey Geophysical, Benthic and Geotechnical Route Survey (MMT, 2018).
- Habitat maps of the consenting corridor (MMT, 2018).
- Appendix E.1: Electromagnetic Field (EMF) and Sediment Heating literature review: Ecological Recommendations (NorthConnect, 2018).

14.2 Legislation, Policy and Guidance

This section outlines relevant legislation, policy and guidance applicable to the assessment of the potential effects on benthic ecology associated with installation, operation, and decommissioning phases of the project.

14.2.1 Legislative Framework

There are a number of different legislative instruments that are relevant to the assessment of potential impacts to benthic ecology receptors. These are detailed below:

14.2.1.1 International

- EC Directive 92/43/EEC on Conservation of Natural Habitats and of Wild Fauna and Flora known as the 'Habitats Directive', adopted in 1992. It was transposed into UK law via the Conservation (Natural Habitats, &c.) Regulations 1994 and Conservation of Habitats and Species Regulations 2010. In Scotland the Habitats Directive is transposed through a combination of the 1994 and 2010 Regulations. For offshore UK waters (12 nautical miles from the coast out to 200 nm or the limit of the UK Continental Shelf Designated Area) the Habitat Directive is transposed via The Conservation of Offshore Marine Habitats and Species Regulations 2017. Under the Habitats Regulations, benthic habitats listed in Annex I of the European Union (EU) Habitats Directive which are native to the UK should be conserved through the designation of Special Areas of Conservation (SACs). A number of Special Areas of Conservation (SACs) are designated for the conservation of benthic features off the North-east coast of Scotland.
- EC Directive 2000/60/EC known as the 'Water Framework Directive' (or WFD) which is the framework for an integrated approach to protection, improvement and sustainable use of water bodies in Europe, and necessitates member states to ensure that they meet 'good status' for ecological and chemical quality elements. This includes coastal waters up to 1 nautical mile offshore, and river and transitional water bodies have an invertebrates quality element that is assessed to determine their status.

14.2.1.2 National

- Wildlife and Countryside Act 1981 as amended. Schedule 5 of the Wildlife and Countryside Act provides a list of threatened species for which killing, injuring or taking by any method is prohibited. 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.
- Marine (Scotland) Act 2010 which provides a framework system for improved management and protection of marine and coastal environments in Scottish territorial waters. It included the establishment of Marine Scotland to act as the competent marine planning authority. It also included the designation of Scottish Marine Protected Areas (MPAs) to protect areas that are key in safeguarding the diversity of nationally rare or threatened and representative habitats and support functioning communities of species. The aim is to supplement existing marine protected areas such as SACs and SPAs. There are more than 180 MPAs in Scotland designated under the Marine (Scotland) Act 2010.
- Marine and Coastal Access Act (MCAA) 2009 which provides the legal mechanism to help ensure clean, healthy, safe, productive and biologically diverse oceans and seas by putting in place a new system for improved management and protection of the marine and coastal environment, for offshore waters around Scotland (from 12 nm to the UK territory limit).
- The Nature Conservation (Scotland) Act 2004, which was passed by Scottish Parliament to develop an integrated approach to long term protection and management enforcement measures surrounding Scotland's natural heritage. The Act placed obligations on public bodies to conserve biodiversity, increased protection for SSSIs, amended legislation on Nature Conservation Orders, provided for Land Management Orders for SSSIs and associated land, strengthens wildlife enforcement legislation, and requires the preparation of a Scottish Fossil Code.
- Scottish Biodiversity Strategy, which comprises the 2020 Challenge for Scotland's Biodiversity (response to the Aichi Targets set by the United Nations Convention on Biological Diversity, and the European Union's Biodiversity Strategy for 2020) and supplements Scotland's Biodiversity: It's in Your Hands (2004).

14.2.2 Policy Framework

Further to legislative drivers, there is a policy framework in place to guide the assessment of the project:

- UK Marine Policy Statement which aims to contribute to attaining sustainable development in marine UK waters and is the main policy in determining marine licence applications.
- United Kingdom Biodiversity Action Plan (UKBAP) which creates actions plans for UK BAP priority species and habitats in the UK. It is succeeded by the UK Post-2010 Biodiversity Framework (2012), which runs from 2010-2011.
- Scottish Biodiversity List which is a list of species and habitats that are considered to be of principal importance for biodiversity conservation in Scotland.
- OSPAR convention, which guides international collaboration on the protection of the marine environment of the North-East Atlantic.
- Scottish Natural Heritage (SNH) and the Joint Nature Conservation Committee (JNCC), in conjunction with Marine Scotland, have developed a priority list of marine habitats and species in Scotland's seas, known as Priority Marine Features (PMFs) (Howson *et al.*, 2012).

The list is intended to ensure that marine planning decisions are consistent, and in line with Marine Scotland's vision for marine nature conservation outlined in the Marine Nature Conservation Strategy. This list of PMFs included a number of benthic habitats and species which are present along the proposed consenting corridor.

14.2.3 Ecology Guidance

14.2.3.1 General Ecology Guidance

The following guidance will apply to this assessment:

- The Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment in the UK and Ireland (2016) is the primary source guidance for the assessment. The aim of the guidance is to promote good practice in EcIA relating to marine, coastal and estuarine environments of the UK. It updates CIEEM's Terrestrial EcIA 2006 Guidelines and CIEEM's Marine EcIA Guidelines 2010.
- The International Union for Conservation of Nature (IUCN) has compiled a Red list of threatened species that are facing a high risk of global extinction. The list (IUCN, 2016) includes benthic species that are or may be present in the vicinity of the project.
- The Convention for the Protection of the Marine Environment of the North-East Atlantic produced the OSPAR List of Threatened and/or Declining Species and Habitats, considered to be of conservation concern within the north-east Atlantic (OSPAR, 2008). A number of habitats and species on the list were recorded during the project-specific survey.
- Assessment of the environmental impacts of cables (OSPAR, 2009), which assesses the environmental impacts of sea cables in terms of their relevance for the area covered by the Convention.

14.2.3.2 Guidance on Defining Reef

The definition of what constitutes a reef has not yet been precisely determined particularly for *Sabellaria spinulosa* reef and Stony Reef as the presence of *S. spinulosa* tubes or a stony environment does not necessarily make the area a potential Annex I habitat. For the purposes of this assessment the identification of *S. spinulosa* reef has been assessed based on its physical, biological and spatial characteristic reef features and scored to assess the degree of 'reefiness' based on a classification proposed by Gubbay (2007). The reefiness is weighted according to the perceived importance of each feature. Furthermore, the reefiness is increased with a score indicating the confidence in the feature score (Table 14.1).

Table 14.1 Criteria for determining the 'reefiness' of *Sabellaria* reef (Gubbay, 2007).

Characteristic	**Not a reef**	**Reefiness**		
		Low	**Medium**	**High**
Elevation (cm) (average tube height)	<2	2-5	5-10	>10
Extent (m^2)	<25	25 - 10,000	10,000 – 1,000,000	>1,000,000
Patchiness (% cover)	<10	10-20	20-30	>30

Stony Reefs are defined by the EC Habitats Directive (European Commission, 2007) as areas where animal and plant communities develop on bedrock or stable boulders and cobbles. Because Irving's (2009) guideline for reefiness of stony areas is not applicable to bedrock, the parent category 'stony reef' as defined by the EC Habitats Directive has in this report been subdivided into Bedrock Reefs and

Stony Reefs, where Rtony Reefs refers to areas with cobbles or boulders with low, medium, or high reef characteristics (Table 14.2).

Table 14.2 Criteria to determine the 'reefiness' of Stony Reefs (Irving, 2009).

Characteristic	Not a reef	Reefiness		
		Low	Medium	High
Composition	<10 %	10-40 % Matrix supported	40-95 %	>95 % Clast supported
Elevation	Flat Seabed	<0.064 m	0.064 - 5 m	>5 m
Extent	<25 m^2	>25 m^2		
Biota	Dominated by infaunal species			>80 % of species present composed of epifaunal species.

This scoring system indicates that stony Reefs should be elevated by at least 0.064 m and with a composition of at least 10 % stones, covering an area of at least 25 m^2 and have an associated community of largely epifaunal species.

14.2.4 Consultation

Responses to comments made in the Marine Scotland Scoping Opinion (July, 2016) and Aberdeenshire Council Scoping Opinion (May, 2016) are presented in Chapter 4: Consultation, Table 4.1.

14.3 Assessment Methodology

14.3.1 Overview

The identification and assessment of the potential benthic ecological effects associated with the project was conducted in accordance with the CIEEM guidelines for EcIA (CIEEM, 2016). The method considers the importance (value / sensitivity) of the relevant ecological features and the magnitude of impacts, to determine an overall significance of effect upon these features. This method takes into account effect direction (beneficial or adverse), confidence, extent, duration, timing, frequency and reversibility.

The assessment approach was based on the conceptual 'source-pathway-receptor' model. This model was used to identify the likely impacts resulting from the installation, operation and decommissioning phases of the project. This model provided a transparent assessment route between impact sources and potentially sensitive receptors. The parameters of this model are defined as follows:

- **Source**: the origin of a potential impact (i.e. a project activity leading to an impact). Potential impact sources may have several pathways and receptors. For example, a potential impact source such as jetty foundation installation may result in several potential impacts such as resuspension of sediments, seabed abrasion and removal of substrata or underwater noise, which may each affect a number of receptors via different pathways.
- **Pathway**: the means by which the impact of the activity could influence a receptor. For the example above, resuspended sediment could settle across the seabed, or seabed disturbance could cause temporary or permanent habitat loss which could affect a receptor.
- **Receptor**: the element of the receiving environment which is affected by an impact. For the example above, benthic invertebrate species living on or in the seabed could be smothered by the deposited sediments which could affect their movement, feeding or respiration.

- The assessment was a combination of a quantitative approach where suitable data, evaluation and assessment methods were available and qualitative where required, based on a combination of empirical data, published literature and professional judgement.

Iterative steps involved in the assessment approach included:

- Determination of potential impact sources associated with the project (activities) and potential impacts.
- Definition of the benthic ecology receptors within the zone of influence of the project;
- Determination of potential interactions between impacts and benthic ecology receptors. At this point some impact / receptor combinations will be screened out, with consideration of interactions scoped out of assessment as reported in the Scoping Report (NorthConnect, 2016).
- Determination of the value and sensitivity of benthic ecology receptors;
- Assessment of the magnitude of impacts (considering embedded mitigation measures);
- Assessment of the significance of effects upon benthic ecology receptors (with embedded mitigation measures in place), including interacting or synergistic effects from the project;
- Proposal of additional mitigation measures to reduce, prevent or where possible offset any significant adverse effects of the project;
- Assessment of the residual effects (i.e. effects after any additional mitigation measures have been considered); and
- Assessment of cumulative effects upon benthic ecology receptors, considering other plans or projects in development. A full list of the other plans or projects considered is presented in Chapter 6: Cumulative Effects.

Further details for the assessment approach are provided in Section 14.3.4.

14.3.2 Desk Study

To determine benthic ecology receptors within the study area and inform an assessment of potential effects of the project on these receptors it was necessary to first establish the baseline (or existing) environment by conducting a desk-based review of grey and published literature.

Key data sources and information obtained from the desk-based review for benthic ecology are summarised in Section 14.4 below. It was concluded that insufficient up-to-date data were available for the benthic ecological habitats and species along the project's consenting corridor to conduct the assessment and consequently, project-specific benthic ecology field surveys were conducted along the consenting corridor as described in Section 14.3.3.

14.3.3 Field Surveys

14.3.3.1 Introduction

The following environmental surveys were conducted along a 500 m wide survey corridor covering the consenting corridor:

- Geophysical survey with multibeam echo sounder (MBES), side scan sonar (SSS), sub-bottom profiler (SBP), and magnetometer;
- Geotechnical survey (vibrocores (VC) and cone penetration tests (CPT)); and
- Benthic survey (faunal, chemical, and particle size samples and seabed imagery).

The survey was divided into three sections: 'UK nearshore waters' from the landfall area south of Peterhead to about 4 km along the survey corridor; the 'UK EEZ' (European Economic Zone); and the 'Norwegian waters' of the North Sea. This chapter considers the findings of the first two sections only (Figure 14.1).

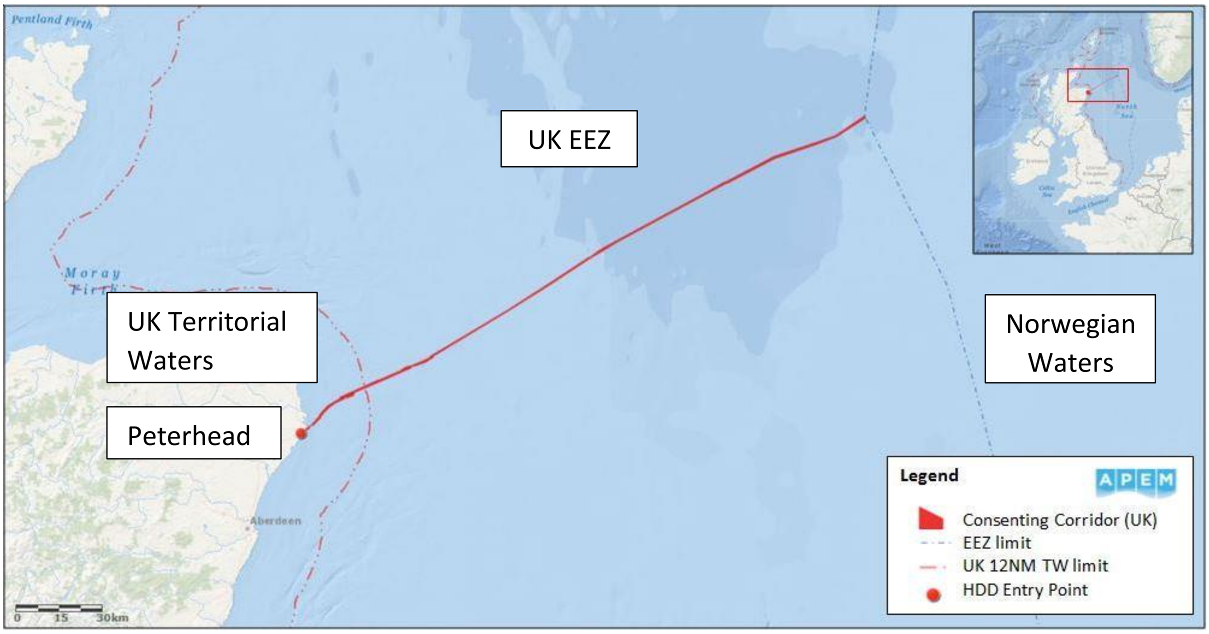

Figure 14.1 NorthConnect Consenting Corridor within UK waters

The UK nearshore section was surveyed between 8th and 12th December 2016. The North Sea section was surveyed between 6th and 29th July 2017 (UK and Norwegian waters). The benthic survey is described in detail below. Full details of the survey are provided in MMT (2018) with survey results summarised below in Section 14.4 Baseline Information.

The benthic survey was performed using a combination of grab samplers, as well as seabed photography and video systems. Sample locations were selected using the information provided from the geophysical survey data and in accordance with the requirements from NorthConnect and the Scottish Natural Heritage (SNH) report 'Guidance on survey and monitoring in relation to marine renewables deployments in Scotland' (Saunders et al., 2011).

A senior marine biologist on board during the geophysical survey determined the benthic ecology survey stations array based on the geophysical data and preliminary geological interpretations, ensuring that the different habitats interpreted from the SSS and MBES were ground-truthed.

Stations were sampled via a combination of video, still photography, and grab sampling (biota, Particle Size Analysis (PSA) and chemical analysis). However, where grab sampling was not possible due to the presence of hard seabed, coarse substrates, or sensitive habitat types, sampling was undertaken using video/still photo only.

The data from the benthic ecology survey, PSA and geophysical information were interpreted together to provide a GIS map of subtidal habitats with supporting quantitative sample data effectively characterising subtidal habitats/species within the survey area. Further details for each of the sampling methods are provided below.

14.3.3.2 Seabed Imagery

The UK Nearshore survey seabed imagery was obtained using a downward facing camera mounted on a Work Class Remotely Operated Vehicle (WROV). In contrast, the North Sea survey seabed imagery was obtained using the SeaSpyder Drop Down Video (DDV) system. Imagery was obtained at each grab sample station (see Section 14.3.3.3) and prior to grab sampling a minimum of four good quality, random still images were collected. In addition, approximately five minutes of video was recorded at each site, and used to provide further information for the habitats present and for the extent of any features identified.

In areas with hard bottom substrate or sensitive areas that could not be sampled with grab samplers, an extended video transect was performed in agreement with NorthConnect, to identify epifauna and habitat transitions and to aid the ground truthing of the predictive habitat model. The survey line was planned over the area of interest, with still images taken at appropriate predetermined intervals along the transect (usually every 25 or 50 m). The spacing between the still images was dependent on the length of the transect and characteristics of the features targeted.

The photos were analysed to identify species present and density of organisms. The video recordings were used to aid in the classification of habitats and to assess the extent of habitats. The different EUNIS habitat criteria were compared to the results of the still image analyses. Particular attention was paid to the elevation of habitats above seabed level, together with their spatial extent, percentage biogenic cover and patchiness, as these are key criteria for determining the presence of potential reef structures (Gubbay, 2007; Irving, 2009) and subsequently evaluating conservation importance of the habitats present.

A log was maintained of each still image and video collection at the grab sample locations, and during transects. As a minimum, this included the drop number, start and end location, duration, and a summary of the sediment type and the main species observed. A list of the still images, including the location of each, along with a clear indication of those taken at randomised pre-determined points for future analysis and those taken to show particular features of interest, was also maintained. Once the survey was complete, a detailed analysis of the stills data was conducted (see Section 14.3.3.6).

14.3.3.3 Grab Sampling and Analysis

In the UK nearshore waters a 0.1 m^2 Day grab and a 0.25 m^2 United States Naval Electronics Laboratory (USNEL) box corer were used. During the North Sea survey, only the USNEL box corer was used.

A total of 17 grab sampling locations were included in the survey in UK waters (both nearshore and EEZ). At each benthic grab sampling location, four grab samples were retrieved. Three of the replicate grabs were collected as samples for biotic analysis. One grab was used to obtain samples for particle size and chemical analysis.

A field log of sample positions was recorded including time of sampling, sediment type, and water depth. Photographs were taken of all samples *in situ*. Samples were carefully sieved using seawater and a sieving table consisting of a 5 mm mesh sieve over a 1 mm mesh sieve (using gentle hose pressure). The biological material retained in the 1 mm mesh was sorted from the remaining sediment and shell fragments using stereo microscopes. For identification of benthic biota both stereo-zoom microscope and compound microscope were used. Samples from each of the sampling sites were identified separately, and 10 % of the samples were later randomly quality controlled. The samples were preserved in 80% ethanol.

The macrobiota were counted and identified to the lowest practicable taxonomic level using standardised nomenclature and appropriate keys and references.

14.3.3.4 Particle Size Analysis

At each benthic grab sample location sediment was sampled for PSA. Up to one litre of sediment from each sample location was collected for analysis to determine the proportion of different particle size fractions. In line with the British standard Methods of test for soils for civil engineering purposes (British Standard 2010), wet sieving was applied in essentially cohesive sediments while dry sieving was only used for sediments that did not contain significant amounts of silt and clay, i.e. almost entirely granular sand and/or gravel.

To analyse the finer fractions such as silt and clay (<0.063 mm), the sedimentation by the hydrometer method was applied. This analysis is carried out when a certain percentage of material passing through the 0.0063 mm wet/dry sieve is reached. The percentage is usually 10 or 15% due to the fact that, at this level, the ratio of silt and/or clay can have a substantial effect on the physical properties of a soil.

14.3.3.5 Multivariate Statistical Analysis

Multivariate analysis was undertaken using the Plymouth Routines in Multivariate Ecological Research (PRIMER) v6.0 statistical package (Clarke & Gorley, 2006). Site related differences in community structure were examined using the Bray-Curtis similarity coefficient. Truncation of the macrobiota data was undertaken before calculation of multivariate statistics. Juvenile (JUV) individuals and colony forming species, e.g. the bryozoan *Flustra foliacea*, were excluded from the dataset.

Square root transformation was applied to the data before calculating the Bray-Curtis similarity measures. This transformation was applied to reduce the influence of dominant species in the assemblage characterisation (Clarke & Warwick, 2001).

CLUSTER analysis was utilised to provide a visual representation of sample similarity in the form of a dendrogram. CLUSTER analysis was conducted in conjunction with a SIMPROF (similarity profile) test to determine whether groups of samples were statistically indistinguishable at the 5% significance level, or whether any trends in groupings were apparent.

Non-numeric multi-dimensional scaling (MDS) was performed on the transformed dataset to further explore the data. The MDS plot visualises the relative similarities between samples.

14.3.3.6 Habitat Classification

Habitats/biotopes were classified based on the EUNIS classification system (European Environment Agency, 2017) to the lowest level possible. The classification involves consideration of semi-quantitative biological data (e.g. estimation of abundance of species) and environmental data (e.g. substrate type, wave exposure, tidal currents, salinity).

Quantitative methods were used for the identification of biota in grab samples, with all the data presented as individuals per square metre and percentage cover of colonial species. The semi quantitative SACFOR abundance scale was used for photo analyses.

14.3.4 Impact Assessment Methodology

The general approach to the Environmental Impact Assessment (EIA) is described in Chapter 3: Methodology including the approach to assessing the significance of effects based on the magnitude of impact and value/sensitivity of receptor. The following section should therefore be read in conjunction with Chapter 3: Methodology.

The value and sensitivity of each benthic ecological receptor was determined based on consideration of the factors outlined in Table 14.4 and Table 14.5. The assigned value and sensitivity for each receptor are not necessarily linked within a particular impact. For example, a receptor could be of very high value (e.g. a designated feature of a Special Area of Conservation (SAC)) but have a low or negligible physical/ecological sensitivity to an impact and vice versa. The sensitivity of a receptor (to the specific impact) has therefore been used where relevant as a modifier for the value assigned to the receptor, with the logic applied for the assessment clearly indicated in the assessment narrative.

Table 14.4 Receptor Value Criteria for Benthic Ecology

Value	Definition
Very High	• An internationally designated site or potential/candidate site for designation (SAC, cSAC, pSAC or Ramsar site) or an area which the Statutory Nature Conservation Body (SNCB) has determined meets the published selection criteria for such designation, irrespective of whether or not it has yet been notified. • Internationally significant and viable areas of a habitat type listed in Annex I of the Habitats Directive. • Globally threatened species (Critically endangered or endangered on IUCN Red list) or species listed on Annex I or II of the Bern Convention. • Regularly occurring populations of internationally important species that are rare or threatened in the UK or of uncertain conservation status. • A regularly occurring, nationally significant population/number of any internationally important species including species listed in Annex II of the Habitats Directive. • Habitats or species that are highly regarded for their important biodiversity, social, community and / or economic value.
High	• A nationally designated site (such as a Site of Special Scientific Interest (SSSI), National Nature Reserve (NNR), Marine Protected Area (MPA) and potential MPA (pMPA), Marine Nature Reserve (MNR) or Marine Conservation Zone (MCZ)) or a discrete area which the SNCB has determined meets the published selection criteria for national designation (such as SSSI selection guidelines) irrespective of whether or not it has yet been notified. • Regularly occurring, globally threatened species (Vulnerable or lower on IUCN Red list) or species listed on Annex 3 of the Bern Convention. • UKBAP habitats and species; Priority Marine Features; Scottish Biodiversity List • Habitats or species that possess important biodiversity, social, community and / or economic value.

Value	Definition
Medium	• Viable areas of key habitat identified in the Regional/County BAP or smaller areas of such habitat which are essential to maintain the viability of a larger whole. • Viable areas of key habitat identified as being of Regional value in the appropriate Natural Area profile. • Water Framework Directive biological quality element. • Any regularly occurring significant population that is listed in a Local Red Data Book. • Significant populations of a regionally/county important species. • Habitats or species that possess moderate biodiversity, social, community and / or economic value.
Low	• Areas of habitat identified in a sub-County (District/Borough) BAP or in the relevant Natural Area profile. • District sites that the designating authority has determined meet the published ecological selection criteria for designation, including Local Nature Reserves selected on District/Borough ecological criteria (District sites, where they exist, will often have been identified in local plans). • Sites/features that are scarce within the District/Borough or which appreciably enrich the District/Borough habitat resource. • Habitats or species that are abundant, common or widely distributed. • Habitats or species that possess low biodiversity, social, community and / or economic value.
Negligible	• No site designation for areas of habitat. • Species present are common and widespread. • Habitats or species that are not considered important for their biodiversity, social, community and / or economic value.

Table 14.5 Receptor Sensitivity Criteria for Benthic Ecology

Sensitivity	Definition
Very High	• Species are under significant pressure and/or are highly sensitive to changing environments. • Species are intolerant of the impact with little or only slow recovery.
High	• Species may be under significant pressure and/or highly sensitive to changing environments. • Species may have a very low capacity to tolerate the impact with little or only slow recovery.
Medium	• Species may be currently under pressure or are slow to adapt to changing environments. • Species may have a low capacity to tolerate or recover from the impact.
Low	• Species are generally adaptable to changing environments. • Species may show some tolerance of the impact or recover quickly from impacts.
Negligible	• Species are highly tolerant of the impact.

The magnitude of impacts were assessed based on consideration of the criteria in Table 14.6 and taking into account the application of any embedded mitigation design measures to be incorporated at the installation, operation or decommissioning phases. Where embedded mitigation design has been considered this has been clearly indicated in within the impact assessment.

Table 14.6 Impact Magnitude criteria for Benthic Ecology

Magnitude	Definition
Major	• **Habitat:** Impact causes changes to a large proportion of the receptor habitat extent or community composition, resulting in change of function of the wider habitat, that is not reversible through natural recruitment or recolonisation (permanent effect) or not reversible for several generations (temporary, long-term effect). • **Species:** Impact causes changes to a large proportion of the receptor species population, resulting in a decline in the abundance of the overall population, that is not reversible through natural recruitment or recolonisation (permanent effect) or not reversible for several generations (temporary, long-term effect).
Moderate	• **Habitat:** Impact causes a change to part of the receptor habitat extent or community composition, but does not result in change of function of the wider habitat, that is not reversible through natural recruitment or recolonisation (permanent effect) or not reversible for several generations (temporary, long-term effect) **or** impact causes changes to a large proportion of the receptor habitat extent or community composition, resulting in change of function of the wider habitat, that is reversible through natural recruitment or recolonisation in up to two generations (temporary, short-term effect). • **Species:** Impact causes a change to part of the receptor species population but does not result in a decline in the abundance of the overall population, that is not reversible through natural recruitment or recolonisation (permanent effect) or not reversible for several generations (temporary, long-term effect) **or** impact causes a change to a large proportion of the receptor species population resulting in a decline in the abundance of the overall population, that is reversible through natural recruitment or recolonisation in up to two generations (temporary, short-term effect).
Minor	• **Habitat:** Impact causes a change to part of the receptor habitat extent or community composition, but does not result in change of function of the wider habitat, that is reversible through natural recruitment or recolonisation in up to two generations (temporary, short-term effect). • **Species:** Impact causes a change to part of the receptor species population but does not result in a decline in the abundance of the overall population, that is reversible through natural recruitment or recolonisation in up to two generations (temporary, short-term effect).
Negligible	• **Habitat:** Impact causes an effect on the receptor habitat that is not likely to change the extent or community composition of the wider habitat. • **Species:** Impact causes an effect on the receptor species population that is undetectable or within the range of natural variation.
No Change	• Impact has no effect or has no interaction with the receptor.

Based on the value/sensitivity of the receptor and the magnitude of the potential impact, the significance of effect was then determined based on consideration of the matrix in Table 14.7.

Table 14.7 Categorising significance of effects for Benthic Ecology

Magnitude of Impact	Sensitivity/Value of Receptor				
	Very High	High	Medium	Low	Negligible
Major	Major	Major	Moderate	Minor	Minor
Moderate	Major	Moderate	Moderate	Minor	Negligible
Minor	Moderate	Moderate	Minor	Minor	Negligible
Negligible	Minor	Minor	Negligible	Negligible	Negligible
No Change	No Change	No Change	No Change	No Change	No Change

Key:

	Significant Effect
	Non-Significant Effect

For the purposes of this EIAR, an impact which has the potential to result in a significant effect on the environment has been defined as a moderate or major significance of effect (see Table 14.7), and mitigation is proposed where possible to prevent, reduce or offset the effect. Residual effects on benthic ecology receptors (i.e. effects following implementation of specific mitigation measures) were then identified and their significance determined.

Consequently, a significance of effect determined to be minor or lower is considered not to be significant in terms of the EIA Regulations. For these effects, mitigation measures have not been proposed to reduce the significance of the effect. For each significance of effect determined for each receptor/impact combination the assessment has indicated whether the effect is beneficial or adverse, and an assessment of the confidence in the assessment has been provided. The definitions for classifying the confidence in the assessment are provided in Table 14.8.

Table 14.8 Confidence in assessment of significance of effects

Confidence	Guideline	Evidence base to evaluate likelihood of effects
High	Probability estimated at 95% chance or greater	Scientific evidence and project information is detailed, consistent and extensive. Studies are based on consideration of same pressures arising from similar activities, acting on the same type of receptor in comparable areas (i.e. UK).
Medium	Probability estimated above 50% but below 95%	Scientific evidence and project information is available but variable in detail, consistency and volume. Studies are based on consideration of same pressures arising from similar activities, acting on the same type of receptor in comparable areas (i.e. UK) or similar pressures on receptor/similar receptor in other areas (i.e. outside UK).
Low	Probability estimated at below 50%	Scientific evidence and project information is limited in availability, and variable in detail, consistency and volume. Studies are not based on consideration of same pressures arising from similar activities, acting on the same type of receptor in comparable areas (i.e. UK) or similar pressures on receptor/similar receptor in other areas (i.e. outside UK), but are based on more distant habitats, species or populations being affected by other pressures.

14.3.5 Limitations of Assessment

Conditions at or near to the project will be subject to change over time with species movement and habitat change both into and out of the area. Therefore, this assessment reflects the conditions recorded at the time of the project-specific surveys and most recent desk study data available, as well as consideration of existing knowledge on the potential trends in the baseline in the future. As habitat mapping is based on the geophysical survey, and limited ground truthing was conducted, it is assumed that habitat mapping is a true reflection of the habitats within the consenting corridor. However, there is the potential for the actual boundaries of the predicted habitat types to vary from those predicted by the model.

14.4 Baseline Information

The understanding of the benthic ecology environment within the consenting corridor of the Project was largely informed by a Project specific benthic ecology survey conducted by MMT (2017). This understanding was further informed by a desk-based review of protected species and habitats within the vicinity.

The Project is located within the central North Sea. Biodiversity is generally lower in central and southern areas of the North Sea than in the northern areas (Künitzer *et al*., 1992; Kröncke, 2011). The benthic species present within the area are largely correlated with the substrate type and associated hydrodynamic conditions and the following section provides information on the benthic species and habitats within the vicinity of the Project.

14.4.1 Designated Sites (for benthic ecology species)

This section relates to sites designated in full, or in part, due to the presence of benthic habitats or species. No existing designated sites are currently located within the consenting corridor, however, the proposed Southern Trench MPA is located within the consenting corridor. The designated sites within the vicinity of the consenting corridor are shown in Figure 14.2.

Table 14.9 Designated Sites with Benthic Ecology Features

Designated Site Receptor	Distance to HVDC Corridor	Qualifying Features	Importance of Features
Southern Trench proposed MPA	0 km: Crossed by Consenting Corridor.	Burrowed mud habitat, shelf deeps minke whales, and oceanic fronts as well as geodiversity features	Burrowed mud is a Priority Marine Feature
Scanner Pockmark SAC	0.45 km South	Submarine structures made by leaking gases	Annex I habitat
Norwegian Boundary Sediment Plain MPA	27 km South East	Ocean quahog (*Arctica islandica*)	OSPAR Annex V species and Priority Marine Feature
Turbot Bank MPA	26 km South	Sandeels	Keystone species & prey item for many fish species

14.4.1.1 Southern Trench proposed MPA

The Southern Trench proposed MPA has also been proposed for burrowed mud habitat, minke whales, shelf deeps and oceanic fronts and its geodiversity features. The consenting corridor passes through the southern end of this MPA. The areas of burrowed mud have been recorded in the northern and north-western portions of this proposed MPA.

14.4.1.2 Scanner Pockmark SAC

Scanner Pockmark is a Special Area of Conservation (SAC) approximately 450 m south of the consenting corridor. The boundary of this site is currently under consideration for amendment. If this amendment is enforced, the boundary of the site may be less than 100 m south of the consenting corridor. Scanner pockmark is a large seabed depression in the northern North Sea which contains large blocks of the Annex I habitat ‘Submarine structures made by leaking gases’. The blocks lie in the base of the pockmark and support fauna more typically associated with rocky reef. These carbonate structures are notably colonised by large numbers of anemones (*Urticina felina* and *Metridium senile*) and squat lobsters (*Galathea squamifera)* (Dando, 2001).

14.4.1.3 Norwegian Boundary Sediment Plain MPA

The Norwegian Boundary Sediment Plain Marine Protected Area (MPA) is approximately 27 km south of the consenting corridor and is on the border of the UK EEZ. The Norwegian Boundary Sediment Plain MPA is home to a range of animals that live both in and on the sand and gravel habitats such as starfish, crabs, and the long-lived ocean quahog (*Arctica islandica*). This site has been designated for the ocean quahog which is an OSPAR Annex V species and Priority Marine Feature. Further information on this site is provided in Chapter 15: Fish and Shellfish.

14.4.1.4 Turbot Bank MPA

Turbot Bank MPA is approximately 26 km south of the consenting corridor and is an area of sandy sediment, including part of the shelf bank and mound feature known as 'Turbot Bank'. It is important for sandeels which are closely associated with sand habitats, living buried in the sand for months at a time. Further information on this site is provided in Chapter 15: Fish and Shellfish.

Figure 14.2 Protected sites designated for benthic ecology features within the vicinity of the consenting corridor

14.4.2 Intertidal Habitats, Species and Biotopes

The landfall site is at Longhaven Cliffs. Given the nature of the site, the benthic survey conducted along the consenting corridor was not able to survey close to the cliffs and the intertidal zone was not surveyed. However, observation of the site from the survey vessel and from the top of the cliff face indicates an exposed, barren habitat. Based on observations it is considered likely that limited populations of barnacles, limpets, chitons, and other encrusting species are present. There may also be some areas of fucoid algae particularly in sheltered crevices.

14.4.3 Subtidal Sediments

Sediment along the proposed consenting corridor varied between bedrock, sand, mud and mixed sediments with gravel and boulders. The sediment at the UK landfall end of the consenting corridor was bedrock that was overlaid with small areas of rippled gravel which also characterised the first 100 m of the survey corridor moving seaward away from the landfall. Beyond this point, the sediment became predominantly sand. PSA at Site S01 (Figure 14.3) confirmed the area was predominantly sandy (Table 14.10, Figure 14.4). Site S02 had a large proportion of gravel and some cobbles/boulders. From Site S03 to Site S09 sediment was predominantly sandy with a small gravel component, and the proportion of silt and clay gradually increased moving from Site S10 to Site S17 and was the dominant component from Site S12 to Site S17.

Table 14.10: PSA Results for Sediment Samples taken during the Benthic Survey

Sampling location	Sediment classification
S01	very silty fine SAND
S02	slightly silty sandy GRAVEL with COBBLES
S03	gravelly medium to coarse SAND
S04	slightly silty gravelly SAND
S05	slightly silty very gravelly SAND
S06	silty gravelly SAND
S07	slightly silty gravelly SAND
S08	slightly gravelly SAND
S09	slightly silty SAND.
S10	slightly gravelly very silty SAND
S11	slightly gravelly very silty SAND
S12	slightly gravelly sandy SILT
S13	slightly gravelly slightly sandy SILT
S14	slightly gravelly slightly sandy SILT
S15	slightly gravelly slightly sandy SILT
S16	slightly gravelly slightly sandy SILT
S17	slightly gravelly slightly sandy SILT

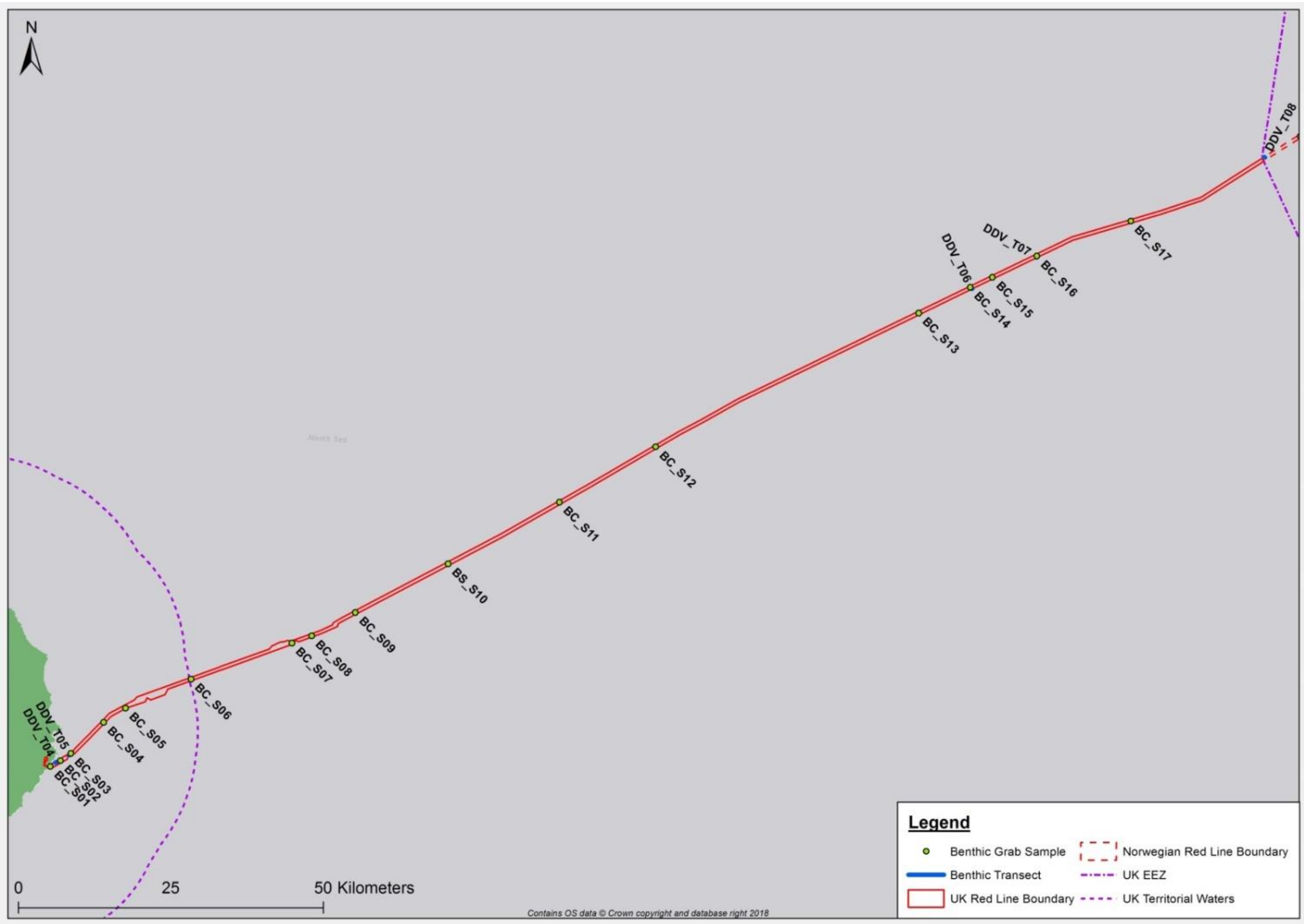

Figure 14.3 Grab Sample Locations within UK Waters

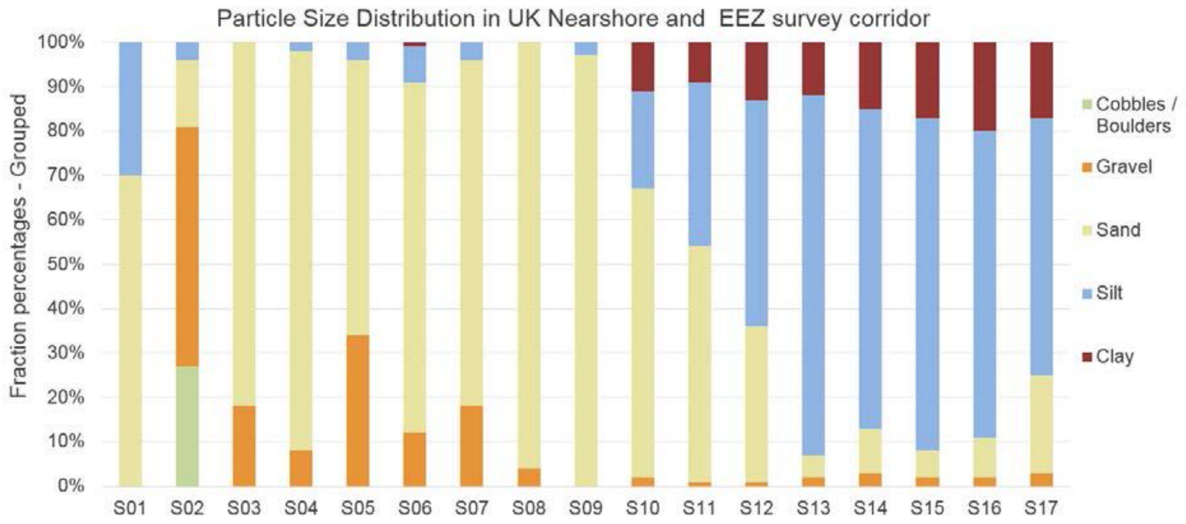

Figure 14.4 Particle size distribution chart for the sediment within the UK waters survey corridor (MMT, 2018).

14.4.4 Subtidal Species and Biotopes

During the environmental surveys conducted in 2017, within the survey corridor, a total of 17 habitats were recorded from the landfall area south of Peterhead to the limit of the UK EEZ, of which 12 habitats are within the proposed consenting corridor (Table 14.11). Habitat maps for the consenting corridor are provided in MMT (2018). The most abundant habitat identified within the survey corridor was 'Sea pens and burrowing megafauna in circalittoral fine mud (A5.361)' which was recorded along the last 95 km of the survey corridor up to the edge of the UK EEZ. This habitat is characterised by fine muds often heavily bioturbated by megafauna typically with the sea pens *Virgularia mirabilis* and *Pennatula phosphorea*.

A further 2.33 km^2 (233 ha) of the consenting corridor was designated as 'Pockmarks' and not assigned a EUNIS biotope code. The pockmark areas appear to belong to the same broad habitat classification as the surrounding areas (i.e. the biotopes A5.26, A5.35, and A5.361). They may later prove to represent a different or new biotope, following updates to the EUNIS classification (EEA, 2018).

The following habitats were recorded during the benthic survey, however, the boundary of the consenting corridor has been designed to exclude them due to their conservation value:

- A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock;
- A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock;
- A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock;
- A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand; and
- A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud.

For further detail on the findings of the survey see MMT (2018).

Table 14.11: Habitats recorded during the Environmental Survey in 2017 indicating EUNIS Habitat Classification and extent within consenting corridor.

Habitat Code	Habitat Classification	Site ID	Area within Consenting Corridor (km^2)	Area within Consenting Corridor (hectares)
A3.1	Atlantic and Mediterranean high energy infralittoral rock	none	0.02	2
A4.2	Atlantic and Mediterranean moderate energy circalittoral rock	none	0*	0*
A4.213	*Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	T05	0*	0*
A4.2211	*Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	T04, T05	0*	0*
A5.13	Infralittoral coarse sediment	none	0.02	2
A5.14	Circalittoral coarse sediment	T04, T05, S03	0.13	13
A5.15	Deep circalittoral coarse sediment	S05	4.87	487
A5.25	Circalittoral fine sand	T04, S01, S08	5.74	574
A5.251	*Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	S09	0*	0*
A5.26	Circalittoral muddy sand	S10	12.00	1,200
A5.27	Deep circalittoral sand		19.35	1,935
A5.35	Circalittoral sandy mud	S11	28.15	2,815
A5.36/ A5.361	Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	S13, S14, S15, S16, S17, S18, T06, T07, T08	52.47	5,247
A5.376	*Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	S12	0*	0*
A5.44	Circalittoral mixed sediment	T04, S02	1.25	125
A5.45	Deep circalittoral mixed sediments	S04	2.28	228
A5.611	*Sabellaria spinulosa* on stable circalittoral mixed sediment†	T04, S02, S06, S07	0.14	14

* These habitats were recorded within the survey corridor but are located outside of the consenting corridor.

† This habitat was not classed as a reef.

14.4.5 Habitats and Species of Conservation Importance

14.4.5.1 Habitats of Conservation Importance

14.4.5.1.1 Bedrock and Stony Reef

Bedrock Reef is listed in Annex I of the EC Habitat Directive under the ‘Reefs’ feature (Section 14.2.1). There are areas of potential bedrock and Stony Reef close to the consenting corridor, however, the consenting corridor has been designed to avoid these areas by at least 50m. Much of the first 4 km of the survey corridor was Bedrock Reef. At the start of the survey corridor, near the UK landfall, the bedrock is possible Bedrock Reef.

Transect T05 covered predominantly an area of outcropping bedrock between around KP 3.920 and KP 4.146. The epifauna was dominant and was characterised by *Sabellaria spinulosa* tubes. Hard surfaces where no tubes were present were covered by different species of bryozoans, hydrozoans and sea anemones. The extent of the bedrock area recorded along transect T05 was estimated to be approximately 22,000 m^2 based on SSS interpretation.

There are several smaller bedrock outcrops located between KP 3.768 and KP 4.566 but they were not sampled during the survey and these are all considered to be potential Bedrock Reefs.

14.4.5.1.2 Stony Reef

Stony Reef is listed in Annex I of the EC Habitat Directive under the 'Reefs' feature (Section 14.2.1). There are areas of potential bedrock and Stony Reef close to the consenting corridor, however the consenting corridor has been designed to avoid these areas by at least 50m. At transect T04 (KP 1.339 to KP 1.589) the habitat, classified as *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock (A4.2211), was assessed to meet the qualifying criteria of a potential Stony Reef (MMT, 2018) under the Annex I of the EC Habitats Directive. The clast-supported reef was graded as 'medium' based on:

- the composition having a coverage of 40 to 95 %;
- the elevation was assessed to vary between 0.05 m and 1 m, with a distinct separation from the seabed; and
- the extent was assessed to be approximately 70,000 m^2 based on the results of the geophysical survey.

The biota associated with the hard surfaces consisted mainly of *Sabellaria spinulosa*, the bryozoan *Flustra foliacea* and sea stars.

A similar area, composed of till, was interpreted in the northern part of the corridor at approximately KP 2.178. Due to its proximity to transect T04, the physical conditions can be assumed to be comparable and the assessment has been made that this area is a potential Stony Reef.

14.4.5.1.3 Pockmarks

Whilst pockmarks are not conservation features alone, they can support 'submarine structures made by leaking gases' which are list in Annex I of the EC Habitat Directive. Scanner Pockmark Marine Protected Area (MPA) is a Special Area of Conservation (SAC) approximately 450 m south of the consenting corridor. Pockmarks were present between KP 66.760 to KP 125.214. Interpretation of geophysical data suggested that the sediments within the majority of the pockmarks were composed of sediments different to the surrounding seabed, with occasional pockets of coarse sediments (A5.45). The frequency of pockmarks increased towards the east. Dense fields of pockmarks were identified between KP 125.214 and KP 199.042, with pockmarks becoming rarer to the east, but still present from KP 199.042 to KP 206.620. A 100 m transect, T06, was surveyed to the southeast of Site S14 over a pockmark. The transect started at KP 171.591 and ran eastwards until KP 171.693. None of these pockmarks appeared to have carbonate structures and so do not qualify as 'submarine structures made by leaking gases'.

14.4.5.1.4 Sabellaria spinulosa Reefs

Sabellaria spinulosa reefs are biogenic reefs that are listed in Annex I of the EC Habitats Directive. Aggregations of *S. spinulosa* tubes that have the potential to qualify as Annex I reef were located close to the consenting corridor, however, the consenting corridor has been designed to avoid these areas by at least 50m.

At the outcropping bedrock located around KP 4, surveyed at video transect T05, the *S. spinulosa* tube aggregations had a different structure and elevation. On the slopes and on bedrock elevated from the surrounding sand and gravel, large reef structures were elevated >10 cm from the underlying bedrock. No sampling was performed at the hard surfaces, but the structures were clearly visible in the video data, and example captures are seen in Figure 14.5. The area was very patchy, shifting between reef structures, bedrock lacking tubes, and strings of gravel. The location of the *S. spinulos*a reef made it difficult to take still images as it is mainly steep sloping bedrock and is the reason behind the lack of tube aggregations in the still images. Using the definition written described by Gubbay (2007) for grading the reefiness, it is considered to fulfil the criteria of a high graded *S. spinulosa* reef (MMT, 2018).

Figure 14.5 Elevated aggregations of *Sabellaria spinulosa* tubes along transect T05, in habitat A4.2211.

The assessment made from the video was in relatively poor visibility, and therefore should be considered an estimation. The extent of the area is hard to assess due to the mix of two different kinds of hard surfaces, one with and one without *S. spinulosa* present. These two habitats cannot be distinguished using available SSS and backscatter and is merged into a classification complex, A4.213/A4.2211, in the habitat charts.

During the UK North Sea survey camera calibration of the SeaSpyder DDV, a high density of *S. spinulosa* area was sampled. The stills from the camera calibration site, together with the video, show distinct tube formations densely aggregated accounting for a *S. spinulosa* coverage of 70-100 %. The epifauna on the reef was rich. The geophysical data indicates that the area covers approximately 12,200 m^2. This area is interpreted to potentially fulfil the criteria of a medium graded *Sabellaria* *spinulosa* reef ((MMT, 2018)) and to be classified as an Annex I – 1170 Biogenic Reef. The elevation was approximately ≥5 cm, with some of the aggregations abraded but still distinguishable as *S. spinulosa*. This area has been classified to a more detailed level, from 'Circalittoral mixed sediments (A5.44)', to '*Sabellaria spinulosa* on stable circalittoral mixed sediment (A5.611)'.

Grab sample location S07, located in the area of coarse sediment at KP 45.601, was characterised by sand and cobbles/boulders encrusted with *S. spinulosa* in a poorly sorted matrix. The grab sample was dominated by the echinoderm *Echinocyamus pusillus*, cnidarian Edwardsiidae and polychaetes. No *S. spinulosa* was identified in the grab sample replicates from this site. The *S. spinulosa* only appears to occur on the seabed in discrete larger aggregations, possibly encrusting boulders. The still images S07_03 and S07_04 have a 46 % and 23 % coverage of *S. spinulosa* respectively (MMT, 2018 #333). With consideration of the elevation and coverage together with the frequency of occurrence, a section from KP 45.338 to 45.723 south of SCL is considered to fulfil the criteria of a medium graded *Sabellaria spinulos*a reef and falls under the Annex I –1170 Biogenic Reef.

14.4.5.2 Species of Conservation Importance

14.4.5.2.1 Sea Pen and Burrowing Megafauna Communities

Sea pens and burrowing megafauna communities are on the OSPAR list of species considered under threat and/or decline in the Greater North Sea (region II) (OSPAR, 2008). This habitat consists of plains of mud at water depths ranging from 15–200 m or more, which are heavily bioturbated by burrowing megafauna. The burrowing activity of megafauna creates a complex habitat, providing deep oxygen penetration. It is found in sheltered basins of fjords, sea lochs, voes (small bays) and in deeper offshore waters including the North Sea.

An area of the consenting corridor of approximately 52.47 km^2 was assessed to be the OSPAR Sea pen and burrowing megafauna communities habitat. These communities are described within the biotope A5.361 – 'Sea pens and burrowing megafauna in circalittoral fine mud'.

14.4.5.2.1 Arctica islandica

The ocean quahog *Arctica islandica* is on the OSPAR list of species considered under threat and/or decline in the Greater North Sea (region II) (OSPAR, 2008) and it is a Priority Marine Feature under The Marine (Scotland) Act and the UK Marine and Coastal Access Act. It is a bivalve shell up to 13 cm in length found around all British and Irish coasts and offshore including the North Sea. Further information on ocean quahogs is provided in Chapter 15: Fish and Shellfish.

14.4.5.2.2 Sandeel

Turbot Bank NCMPA is approximately 26 km south of the consenting corridor and is an area of sandy sediment, including part of the shelf bank and mound feature known as 'Turbot Bank'. It is important for sandeels which are closely associated with sand habitats, living buried in the sand for months at a time. Further information on sandeels is provided in Chapter 15: Fish and Shellfish.

14.4.6 Sediment Quality and Contamination

Sediment quality and contamination are assessed in Chapter 7: Seabed Quality. Of the 17 sites samples for sediment contamination, no organic contaminants (including Polycyclic Aromatic Hydro Carbons, and Total Petroleum Hydrocarbons) were present at concentrations exceeding the Canadian Threshold Effect Levels (TEL). As such no site had organic contamination levels which have the potential to result in environmental effects.

With regard to inorganic contaminants, TELs were exceeded at 10 of 17 sites, however, there were no exceedances of the Probable Effect Levels (PEL). As such, at these sites, heavy metals were at levels where environmental effects are possible, but unlikely to occur.

It can therefore be said that sediment quality is generally good to very good and no levels of contamination were identified that are likely to result in adverse environmental effects.

14.4.7 Valuation of Key Receptors

A summary of the benthic ecology receptors relevant to the project, along with their assigned value/sensitivity is presented in Table 14.12.

Table 14.12: Valuation of Benthic Ecology Receptors

Receptor Group	Receptor	Receptor Value	Justification
Designated Sites	Scanner Pockmark SAC	Very High	Protected site under the EC Habitat Directive supporting the Annex I habitat - Submarine structures made by leaking gases.
Designated Sites	Southern Trench proposed MPA	High	Proposed site under the Marine (Scotland) Act 2010 which supports a burrowed mud habitat.
Designated Sites	Norwegian Boundary Sediment Plain NCMPA	High	Protected site under the Marine and Coastal Access Act (MCAA) 2009 which supports the ocean quahog (*Arctica islandica*).
Designated Sites	Turbot Bank NCMPA	High	Protected site under the Marine and Coastal Access Act (MCAA) 2009 which supports sandeels.
Very High Value Biotopes	A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	Potential to support EC Habitat Directive Annex I feature – Bedrock Reef or Stony Reef.
Very High Value Biotopes	A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	Potential to support EC Habitat Directive Annex I feature – Bedrock Reef or Stony Reef.
Very High Value Biotopes	A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	Potential to support EC Habitat Directive Annex I feature – Bedrock Reef or Stony Reef.
Very High Value Biotopes	Submarine structures made by leaking gases	Very High	Annex I feature of the Habitats Directive found at Scanner Pockmark MPA and may be associated with other pockmarks in the area. All pockmarks are included in this category as a precautionary approach.
Very High Value Biotopes	Pockmarks	Very High	Annex I feature of the Habitats Directive found at Scanner Pockmark MPA and may be associated with other pockmarks in the area. All pockmarks are included in this category as a precautionary approach.
Very High Value Biotopes	A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	Potential to support EC Habitat Directive Annex I feature – *Sabellaria spinulosa* reef.

Receptor Group	Receptor	Receptor Value	Justification
Very High Value Biotopes	A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	Potential to support EC Habitat Directive Annex I feature – *Sabellaria spinulosa* reef.
High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	Common habitat type supporting common species but has the potential to support Priority Marine Features.
High Value Biotopes	A5.14 - Circalittoral coarse sediment	High	Common habitat type but has the potential to support Priority Marine Features such as the sea cucumber *Neopentadactyla mixta*.
High Value Biotopes	A5.15 - Deep circalittoral coarse sediment	High	Common habitat type but has the potential to support Priority Marine Features such as the horse mussel *Modiolus modiolus*.
High Value Biotopes	A5.25 - Circalittoral fine sand	High	Common habitat type but has the potential to support Priority Marine Features.
High Value Biotopes	A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	High	This is a Priority Marine Feature.
High Value Biotopes	A5.27 - Deep circalittoral sand	High	Common habitat type supporting common species but has the potential to support Priority Marine Features.
High Value Biotopes	A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	This is a Priority Marine Feature and OSPAR threatened and/or declining habitats and species.
High Value Biotopes	A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	Common habitat type supporting common species.
High Value Biotopes	A5.45 - Deep circalittoral mixed sediments	High	Not very common habitat type with the potential to support Priority Marine Features such as the horse mussel *Modiolus modiolus*.
Intertidal species and biotopes	Intertidal species and habitats	Medium	Benthic invertebrates are a WFD biological element.
Medium Value biotopes	A5.44 - Circalittoral mixed sediment	Medium	Not very common habitat type supporting a rich community of species.

Receptor Group	Receptor	Receptor Value	Justification
Low Value Biotopes	A5.26 - Circalittoral muddy sand	Low	Common habitat type supporting common species. However, subtidal benthic species can provide a food resource for other species of conservation and commercial importance (other benthic species, fish and marine mammals).
Low Value Biotopes	A5.35 - Circalittoral sandy mud	Low	Common habitat type supporting common species. However, subtidal benthic species can provide a food resource for other species of conservation and commercial importance (other benthic species, fish and marine mammals).

14.4.8 Future Baseline

Given the anticipated lifetime of the project, there is the potential that species populations or ranges may alter due to climate change. Species with a natural range that does not currently extend as far north as the corridor may colonise this area in the future as mean water temperatures increase. For example, the decapods *Diogenes pugilator, Goneplax rhomboides*, and *Liocarcinus vernalis*, have extended their range farther into the North Sea during recent decades, with the Belgian coast previously believed to be the northernmost extent of their range (Birchenough *et al*., 2011). These species are now regularly occurring in Dutch and German waters.

Modelling has suggested that, whilst the majority of species that may move out of the North Sea as a result of increasing sea temperatures will do so in a north or north westerly direction, some species may move south or into deeper waters (Weinert *et al*., 2016). Studies of historical changes suggest there will be a lag between sea temperatures rising and species moving, resulting in lower diversity in the North Sea for a time (Hiddink *et al*., 2014). However, the *ICES status report on climate change in the North Atlantic* (Birchenough *et al*., 2011) suggests that more species will move into the North Sea from the south than will leave it to the north, suggesting that the long-term change may be an increase in biodiversity.

This is unlikely to occur by the time of cable installation, so no effects would be expected on these species during this phase. During operation and decommissioning, effects on these species are likely to be no greater than on other benthic species. These species are therefore not considered further within this assessment.

14.5 Impact Assessment

The potential impacts of the project during the installation, operation and decommissioning phases have been assessed to determine their magnitude of impact upon the benthic ecology receptors described in Section 14.4, and the subsequent significance of effect. The potential impacts of the project are summarised in Table 14.13, along with the potential pathways of effect for the relevant benthic ecology receptors. A summary table of the assessment is provided in Tables 14.15a-b, which fully details the valuation of each receptor, the magnitude of each impact upon each receptor and also the final significance of effect from the combination of value and magnitude, and whether that effect is considered to be significant in terms of the EIA Regulations.

The assessment is based on the information that has been provided to date in relation to methods of installation, operation and decommissioning. Some aspects of the installation and operation for the project are not yet finalised, as discussed in Chapter 2: Project Description and so, as a precautionary approach, a series of worst-case assumptions have been made for the purposes of the assessment. The various worst-case assumptions for the purposes of the assessment are discussed below:

- **Number of cables and bundling arrangements** – there will be two High Voltage Direct Current (HVDC) cables laid in up to two trenches (either bundled and laid in one trench, or laid separately in two trenches). The fibre-optic cable will be laid in the same trench as one of the HVDC cables (or both if bundled). The assessment will consider bundled cables in a single trench as a worst-case for operational sediment heating effects, and unbundled cables in two trenches as a worst-case for electromagnetic field (EMF) effects, cable trenching and installation and associated effects on habitats and species;
- **Micro-siting of the cables within the 500 m wide consenting corridor and cable separation distances** – the separation distance between the cables, if not laid bundled, is likely to vary

along the consenting corridor. Separation will be a minimum of 20 m and a maximum of 40 m within Scottish Waters (to 12 NM). Separation will then likely be a minimum of 20 m and maximum of the entire consenting corridor between 12 NM to the UK EEZ limit. A bundled cable will be used as a worst-case for operational sediment heating effects, and the maximum separation distances will be used as a worst-case for the EMF effects. Other effects are expected to be similar regardless of separation distance;

- **Cable depth of lowering along the consenting corridor** – the minimum depth of lowering will be 0.4 m in hard substrates and 0.5 m in soft substrates, with an aim to achieve a 0.8m depth of lowering if possible, and a likely maximum depth of lowering of 1.5 m. The minimum depth of lowering will be used for the assessment;
- **Cable burial methods** – a combination of jet-trenching, mechanical trenching or ploughing may be required to protect the cables. Burial will be assumed to be via natural infill rather than active infilling techniques as a worst-case for habitat recovery times. Within UK waters (to 200NM) rock placement will be in the region of 25m either side of the 4 cable crossings and 70m either side of the 14 surface laid pipeline crossings, and at a worst-case for extent of a 1:3 slope. Rock placement at the HDD exit point will be to a depth of 0.8m for a 70m distance at a 1:3 slope;
- **Cable trench** – methods of trenching will generate disturbance of the seabed around the trench, and depending upon the method used the trench and excavated material footprint will be a maximum of 5 m distance either side of the centre-line of the cable (a total of 10 m width) as a worst-case;
- **HDD** – a number of different drilling materials could be used, but it is assumed that the drilling fluid will solely comprise Bentonite;
- **Installation programme** – the detailed installation programme and start date is not yet finalised and so it is assumed that installation could be conducted at any time of year as a worst-case apart from the HDD, which will occur between September-March, and the cable laying, which will be between April-September;
- **Installation programme** – the cable installation programme may vary depending upon cable length used (which will be between 75 km and 170 km) and cable production ability. The worst-case programme duration of 5 years has been used as shown in Chapter 2: Project Description, which is based on use of a 170 km cable due to the time of production of a cable of this length. The cable installation programme in UK waters also assumes a worst-case programme of two separate HVDC cables being installed;
- **Operational repairs** – repairs could be once every 3 years as a likely worst-case and require disturbance of the seabed of up to twice the water depth at the repair location; and
- **Decommissioning phase arrangements** – the majority of the cable will be removed at decommissioning; however some sections may be left in-situ without transferring electricity. Removal will be assessed as a worst-case.

Table 14.13 Summary of impacts of the project and the presence of impact pathways to receptors (indicated with a tick). Those without a tick indicate that no pathway is considered to be present.

Receptor	**Subtidal habitats**	**Subtidal species**
Potential development impact		
Seabed Preparation and Cable Installation		
Habitat loss	✓	✓
Habitat creation - cable protection	✓	✓
Physical disturbance and displacement (disturbance of bottom sediments)	✓	✓
Changes to water quality (resuspension of sediments and increased sediment loading)		✓
Changes to water quality (release of hazardous substances)		✓
Changes to water quality (release of drilling fluids)	✓	✓
Introduction of invasive non-native species		✓
Operation		
Change in hydrodynamic regime (scour & accretion)	✓	✓
Sediment heating		✓
EMF from the cable		✓
Introduction of invasive non-native species		✓
Physical disturbance during inspection & repair	✓	✓
Decommissioning - if cable removed		
Habitat loss	✓	✓
Physical disturbance and displacement (disturbance of bottom sediments)	✓	✓
Changes to water quality (resuspension of sediments and increased sediment loading)		✓
Changes to water quality (release of hazardous substances)		✓
Introduction of invasive non-native species		✓

14.5.1 Receptors Scoped Out of the Assessment

As the cable will be routed under the cliff using HDD at the landfall, there will not be any impacts on the intertidal environment. As such, intertidal habitats and species have been scoped out of further assessment.

Norwegian Boundary Sediment Plain NCMPA and Turbot Bank NCMPA have been scoped out of further assessment as they are too far away (more than 25 km) for their benthic features to be affected by the Project.

Underwater noise and vibration was scoped out of the assessment during the scoping phase as it was considered there would not be any significant effects on benthic species.

14.5.2 Primary and Tertiary Mitigation

The primary and tertiary mitigation measures (see Chapter 2: Project Description) and that have been considered within the assessment are described below:

- The results of the benthic survey operations were used to inform the design of the consenting corridor, Annex 1 habitats have been excluded from the boundary of the consenting corridor by at least 50 m;
- For HDD activities, the drill will stop before it reaches the end point of the hole and all the excess material and drilling fluid will then be pumped out of the hole to minimise loss of HDD fluid. Therefore, only the final short drilling section will result in a of fluids and solids to the sea;
- For cable operation, a depth of lowering of at least 0.4 m in hard substrate and 0.5 m in soft substrate will be achieved, which will reduce EMF and sediment heating effects. Greater depths of lowering will be achieved where possible;
- For cable operation, electric fields will be contained within cable armouring due to shielding effects. The use of direct currents in the marine cables will prevent the formation of induced electric fields outside the cable armouring. Magnetic fields can, however, be detected beyond the cable armouring (Gill *et al.*, 2005);
- To minimise the introduction of invasive non-native species, all vessels used during construction, operation and decommissioning will follow the *International Convention for the Control and Management of Ships' Ballast Water and Sediments* (BWM) which entered into force in 2017;
- To minimise the introduction of invasive non-native species, all vessels used during construction, operation and decommissioning will be sourced from the North Atlantic Biogeographic region, or will be subject to appropriate decontamination procedures if sourced from elsewhere to remove the risk of INNS introduction – through the use of hull anti-fouling materials; and
- To minimise changes to water quality (release of hazardous substances), all vessels used during construction, operation and decommissioning will comply with the International Convention for the Prevention of Pollution from Ships (MARPOL) regulations.

14.5.3 Seabed Preparation and Cable Installation Phase Impacts

14.5.3.1 Habitat Loss

The cables will be approximately 230 km long within UK waters. A 'worst-case scenario' has been assumed for this assessment that an area of seabed up to 10 m wide along the length of each cable laid may be disturbed during trenching (5 m either side of each cable). An area of approximately 2.3 km^2 for each cable will therefore be temporarily lost of the existing habitat during the installation period.

Habitat within the consenting corridor may be lost as a result of seabed preparation, trenching and laying of the cable and from cable protection such as rock placement. Cable protection will be used in areas where the cable cannot be buried to the required depth (such as at crossing points with other cables). The breakdown for the amount of each habitat type that could be lost during cable installation is provided in Table 14.14. This has been calculated in two ways: a 20 m wide disturbance corridor has been applied along the centreline of the consenting corridor to estimate the area of each habitat that could be lost; and also the proportion of the consenting corridor made up of each habitat type is taken and applied to the total area of habitat loss (approximately 4.6 km^2) to provide another estimate of the area of each habitat that could be lost.

Table 14.14 Habitat Loss Estimates from Cable Installation

EUNIS Habitat	Total habitat areas within consenting corridor (km^2)	Habitat loss estimated from a 20m disturbance strip along the centre of the consenting corridor (km^2)	Habitat loss estimated from distributing the total area of disturbance proportionally across the areas of biotopes present within the consenting corridor (km^2)
A3.1	0.02	0	0.001
A5.13	0.025	0	0.001
A5.14	0.126	0.021	0.005
A5.15	4.868	0.179	0.173
A5.25	5.743	0.187	0.205
A5.26	12.001	0.461	0.427
A5.27	19.350	0.533	0.689
A5.35	28.152	1.025	1.003
A5.361	52.472	1.912	1.869
A5.44	1.253	0.057	0.045
A5.45	2.278	0.102	0.081
A5.611[†]	0.136	0.007	0.005
Pockmarks	2.329	0.102	0.083
Grand Total	**128.754**	**4.586**	**4.586**

[†] This is not reef and therefore does not qualify as Annex I habitat.

The trench may be subject to backfilled rock placement during the laying process (see Chapter 2: Project Description for details) or using natural infilling which allows the trench to be filled in over time by the collapse of the trench walls and settling of suspended material. Recovery of the seabed habitats disturbed by trenching will be longest if trenches are left to infill naturally. Recovery of habitats within the disturbed areas would take a number of years and will vary between biotopes.

The removal of the two out of service (OOS) cables will disturb around a 4 km length of seabed within the consenting corridor.

The rock placement at crossing points will be up to a 1 m burial depth for the four cable crossings, and 2 m burial depth for the 14 surface laid pipeline crossings. Existing habitat loss beneath the rock placement in UK waters will therefore be a maximum of 300 m^2 for each cable crossing, 1,680 m^2 for each surface laid pipeline crossing, and 336 m^2 at the HDD exit point. As detailed in the Construction Method Statement (NorthConnect, 2018) crossing designs are subject to agreement with the relevant asset owners, hence the figures utilised here, based on standard designs, are subject to change. Rock will also be placed as cable protection on areas of rocky ground or hard substrate along the consenting corridor, however, this placement is unlikely to change the nature of the seabed substrate and so will result in a temporary loss of habitat.

14.5.3.1.1 Designated Sites

The Southern Trench Proposed MPA is designated in part due to the presence of burrowed mud habitats and the consenting corridor overlaps with this area. The only areas of burrowed mud that have been recorded are in the northern and north-western portions of this proposed MPA and no areas of burrowed mud were identified in the Southern Trench pMPA during the benthic survey operations. Hence no loss of the burrowed mud habitat within the pMPA is expected. As such, there will be **no change** to this designated site in terms of its benthic ecology feature.

14.5.3.1.2 Very High Value Biotopes

As described above in Section 14.4.4, there were 12 different biotopes recorded within the consenting corridor. The value of these habitats varies from low to very high. Some pockmark areas are located within the consenting corridor and have been assessed as very high value receptors. In addition, areas of the following very high value biotopes are present within the consenting corridor:

- A3.1 - Atlantic and Mediterranean high energy infralittoral rock; and
- A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment.

Biotope A3.1 is assigned a very high value only for its potential to support EC Habitat Directive Annex I feature, Bedrock Reef or Stony Reef, rather than the presence of confirmed reef. It is located to the west of the HDD marine exit point, close to shore, and will therefore not be affected by the Project.

The areas of biotope A5.611 present within the consenting corridor are not reef forming and therefore have not been classified as an Annex I habitat. Only 5.1% out of a total of 0.14 km^2 (14 ha) of this habitat within the consenting corridor could be disturbed by cable installation, based on the habitat loss estimates presented in Table 14.14.

Pockmark areas will be avoided where possible due to the engineering challenges they present. This assessment is therefore considered to be worst-case. The pockmark areas are in soft sediment and an estimate of up to 0.1 km^2 of pockmark areas will be lost during installation activities for the Project which is 4.4% of the pockmark habitat within the consenting corridor. Pockmarks are created by seeping gas and it is likely that in areas with active gas seeps, the gas will find another route to the surface in the surrounding area and will create a new pockmark. The pockmark habitat is expected to have a high sensitivity to this effect. The communities associated with these areas are expected to re-establish as fauna migrate from the surrounding areas with recovery occurring in the medium term (2-10 years) (Tyler-Walters, 2018).

Due to the very low proportion of habitat affected within the consenting corridor and much lower proportion of the wider habitat present, the magnitude of this impact is assessed to be **negligible** on these **very high** value receptors. The overall significance of this effect is therefore assessed to be **minor, non-significant**.

14.5.3.1.3 High Value Biotopes

The high value biotopes recorded within the consenting corridor that may be lost within the area of disturbance during cable laying are:

- A5.13 - Infralittoral coarse sediment;
- A5.14 - Circalittoral coarse sediment;
- A5.15 - Deep circalittoral coarse sediment;
- A5.25 - Circalittoral fine sand;

- A5.27 - Deep circalittoral sand;
- A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud; and
- A5.45 - Deep circalittoral mixed sediments.

Based on the habitat loss estimates provided above in Table 14.14, the total area of high value biotopes that may be lost during installation of the cable is up to 3.02km^2. This represents approximately 3.6% of the high value biotopes present within the consenting corridor. In general, it is expected that the cable will be installed to a minimum depth of lowering of 0.4 m, which means that all infauna within these biotopes will be lost within the footprint of the cables.

Recovery of these biotopes is expected to occur within the medium (2-10 years) (Tillin, 2016a; De-Bastos, 2016) with the exception of A5.361, which is expected to occur in the long term (>10 years) (Hill & Tyler-Walter, 2018).

Due to the very low proportion of habitat affected and much lower proportion of the wider habitat present, the magnitude of this impact is assessed to be **negligible** on **high** value receptors and the overall significance of this effect is therefore assessed to be **minor, non-significant**.

14.5.3.1.4 Medium Value Biotopes

The only medium value biotope recorded within the consenting corridor is A5.44 - Circalittoral mixed sediment. Approximately 0.06 km^2 of the habitats and species present within the A5.44 habitat complex will be lost as a result of installation activities, which is approximately 4.5% of the total area of this biotope within the consenting corridor. In general, it is expected that the cable will be buried to a minimum depth of 0.4 m which means that all infauna within these biotopes will be lost within the footprint of the cables.

Recovery is expected to take a similar period of time as the high value biotopes based on the sediment types and range of species present, which is generally considered to occur within the medium term (2-10 years).

Due to the very low proportion of habitat affected and much lower proportion of the wider habitat present, the magnitude of this impact is assessed to be **negligible** on a **medium** value receptor and the overall significance of this effect is therefore assessed to be **negligible, non-significant**.

14.5.3.1.5 Low Value Biotopes

The low value biotopes within the consenting corridor are:

- A5.26 - Circalittoral muddy sand; and
- A5.35 - Circalittoral sandy mud.

Estimates from Table 14.14 of 0.461 km^2 of A5.26 and 1.025 km^2 of A5.35 will be lost as a result of installation activities, which is approximately 3.81% of of A5.26 and 3.6% of A5.35 within the consenting corridor. In general, it is expected that the cable will be buried to a minimum depth of 0.5 m in soft sediments which means that all infauna within these biotopes will be lost within the footprint of the cables.

These biotopes are common and support common species. The habitat is likely to be found in nearby areas and a loss of this habitat within the cable footprint is unlikely to result in a change of function for the wider habitat and supporting species. As such, the magnitude of this impact is assessed to be

negligible on a **low** value receptor and the overall significance of the effect is therefore **negligible, non-significant.**

14.5.3.2 Habitat Creation

In areas where the cable is protected with rock placement or other means, the presence of these structures will act as a new hard substrate in otherwise generally soft sediment environments. The introduction of new habitat in the form of rock placement has the potential to encourage species to colonise the area that would otherwise be unable to thrive in this area, and thus increase species diversity. This, however, also poses the risk of colonisation by invasive, non-native species.

Based on information provided in Section 14.5.3.1, introduction of new habitat beneath the rock placement in the UK EEZ will be a maximum of 300 m^2 for each cable crossing, 1,680 m^2 for each surface laid pipeline crossing, and 336 m^2 at each HDD exit point. Assuming a worst-case of two separately laid cables and three HDD exit points, altogether the introduction of new habitat beneath rock placement will total 5.0 ha (0.05 km^2). Rock will also be placed as cable protection on areas of rocky ground or hard substrate along the consenting corridor, however, this placement is unlikely to change the nature of the seabed substrate and so will not result in any habitat creation, and is not considered further.

The rock will remain in place for the lifetime of the Project.

14.5.3.2.1 Designated Sites

There will be no effect on the burrowed mud habitat of the Southern Trench Proposed MPA and no effect on any of the other nearby designated sites as a result of the introduction of new habitat, so this magnitude of impact is assessed as **no change**.

14.5.3.2.2 Very High Value Biotopes

The placement of rock may create hard substrate habitat in the limited areas where it is placed. The magnitude of the impact for hard substrate biotopes is assessed as **negligible**, and as **no change** for soft substrate receptors.

14.5.3.2.3 High, Medium and Low Value Biotopes

The high, medium and low value biotopes are all characterised by sedimentary habitat. The introduction of a hard substrate would not therefore result in creation of any habitat of these biotopes. The magnitude of the impact on these **high, medium** and **low** value biotopes is **no change**.

14.5.3.3 Physical Disturbance and Displacement

As discussed in Section 14.5.2.1, the area which may be affected by physical disturbance and displacement will be within the consenting corridor, and the total area of the corridor is approximately 4.6 km^2. In addition to the direct loss of habitat assessed above, benthic habitats and species may be smothered by sediments during side casting from the trench.

Smothering is most likely to affect sessile or limited mobility epifauna, or infauna in surficial sediments (near the sediment-water interface). However, given the limited extent of seabed disturbance likely to affect benthic habitats at any one time during the installation period, the magnitude of impact on benthic species is assessed to be **negligible**. The overall effect significance is therefore **minor, non-significant** for the species within **very high** and **high** value biotopes and **negligible, non-significant** for species within **medium** and **low** value biotopes. The benthic ecology feature of the Southern Trench proposed MPA will not be affected and given the distance between the consenting corridor and benthic qualifying features of the site (areas of burrowed mud). Hence, no change will occur in these sites and the magnitude of impact upon designated sites for benthic ecology features is assessed as **no change.**

14.5.3.4 Changes to Water Quality (Resuspension of Sediments and Increased Sediment Loading)

Trenching and rock placement activities, as well as the OOS cable removal, may re-suspend seabed sediments into the water column. Trenching (jetting) techniques will cause a greater level of suspended sediments compared to the use of ploughing equipment. Any sediment suspension and deposition as a result of the trenching and rock placement activities will be very localised and short-term in duration (see Chapter 11: Water Quality (Offshore)).

Larger, heavier particles of sediment such as sand are likely to settle quickly and within a short distance of the cable. Smaller, lighter particles of sediment such as silt may remain in the water column for a far longer period of time and may travel further from the cable before resettling. The consenting corridor comprises the following split of seabed substrate types:

- 69% muds and gravels;
- 29% sands and silts; and
- 2% rocky and hard substrates.

High levels of suspended solids can potentially clog filtering apparatus of filter feeding species, thereby reducing feeding efficiency (Yukihira *et al*. 1999) which could result in reduced survival and potentially mortality of individuals.

14.5.3.4.1 Designated Sites

There will not be any effect on the burrowed mud of the Southern Trench Proposed MPA or on any of the benthic ecology features of nearby designated sites and so there will be **no change**. Due to the distance between the Scanner Pockmark SAC and the consenting corridor, impacts on this site are also assessed as **no change**.

14.5.3.4.2 Very High Value Biotopes

Biotopes A3.1 and A5.611 are found in medium to high energy environments with high water movement. The characterising species of biotopes in medium to high energy environments are expected to be able to tolerate intermittent episodes of sediment deposition and the nature of this medium to high energy environments ensures that sediment plumes will be rapidly dissipated. Pockmark habitats are located in soft silty sediments which are depositional. As such their characterising species are adapted to this environment and are expected to be able to tolerate periods of sediment deposition (Tyler-Walters, 2018). The other Very High value biotopes outside of the consenting corridor are not expected to receive significant levels of sediments as a result of cable installation. This impact will be temporary during the construction phase of the Project and the magnitude is assessed to be **negligible**. The overall effect significance is therefore assessed to be **minor, non-significant**.

14.5.3.4.3 High Value Biotopes

Most of the characterising species in these high value biotopes (A5.13, A5.14, A5.15, A5.25, A5.27, A5.36/ A5.361, and A5.45) are active burrowing species that are expected to be able to burrow to the surface. However, not all species exhibit sufficient ability to burrow out especially if buried underneath a deep layer of sediments (for examples see Tillin, 2016b). Given the limited extent of this effect and the temporary nature, the magnitude of this impact is assessed to be **negligible** on a **high** value receptor. The overall effect significance is therefore assessed to be **minor, non-significant**.

14.5.3.4.4 Medium and Low Value Biotopes

The habitat complexes of medium and low value biotopes (A5.44, A5.26 and A5.35) support a wide range of species that are likely to exhibit a variety of responses to increases in sediment in the water column and turbidity. The sensitivity of these biotopes is therefore assessed on a precautionary basis as of very high sensitivity. However, given the limited increase in sediment loading within a localised extent, the magnitude of this impact is assessed to be **negligible**.

The overall effect on these **medium** and **low** value biotopes is assessed to be **negligible, non-signifcant**.

14.5.3.5 Changes to Water Quality (Release of Hazardous Substances)

Trenching, OOS cable removal and rock placement activities may resuspend seabed sediments which could contain contaminants. Sediment contamination was assessed from samples taken during the benthic survey and found elevated levels of cadmium, copper, nickel and chromium at some sampling locations within the consenting corridor (Section 14.4.6.1).

Any sediment, and thus contaminant resuspension and deposition as a result of the trenching and rock placement activities, will be very localised and short-term in duration (see Chapter 11: Water Quality (Offshore)). Chapter 11: Water Quality (Offshore) concludes there are very low levels of contaminants in the sediment and so any resuspension of sediments may not increase the levels of contaminants that come into contact with benthic habitats and species.

The running aground of a vessel or a collision could lead to a fuel release, and cleaning fluids, oils and hydraulic fluids used on board vessels and during ROV operations could be released overboard or accidentally discharged. Also, discharges of grey water, sewage, food waste and drain water from vessels outside of 12 nm may occur. These discharges can be potentially harmful and can lead to localised organic enrichment and a change in the balance of the food chain. As discussed further within Chapter 11: Water Quality (Marine Environment), given that all vessels will be compliant with IMO and MARPOL then the risk of oils and other contaminants entering the marine environment is very low. Neither organic enrichment nor oxygen depletion is considered likely, due to the relatively small cumulative volume of any discharges. Furthermore, in relation to the amount of shipping activity in the North Sea area, the additional activity of the installation vessels is considered to be negligible in terms of potential effects on water quality (Chapter 11: Water Quality (Offshore)), hence is not assessed further.

The effects of the release of drilling fluids for the HDD are considered separately in Section14.5.3.6.

14.5.3.5.1 Designated Sites

The burrowed mud feature of the Southern Trench Proposed MPA is too far from the consenting corridor to be affected by changes in water quality as a result of the Project. All other designated sites are also too far from the consenting corridor to be affected by any changes in water quality. This effect has been assessed to have **no change** on designated sites.

14.5.3.5.2 All Biotopes

There is potential for some metals to be released into the water column after re-suspension during installation activities which may have a localised effect on water quality. This temporary local effect on water quality is unlikely to cause a detectable change to the species and habitats along the consenting corridor and, therefore, the magnitude of impact upon all biotopes is assessed as **negligible**. The overall effect significance is assessed to be **minor, non-significant** for **very high** and **high** value biotopes and **negligible, non-significant** for **medium** and **low** value biotopes.

14.5.3.6 Changes to Water Quality (Release of Drilling Fluids)

From Chapter 2: Project Description, the estimated HDD fluid losses to the sea from the three HDD holes, for the two HVDC cables and one fibre optic cable, will be 3,000 m^3. The estimated solid losses to the sea will be 18 m^3. These losses will not be concurrent from all three HDD holes, but will be sequential as holes are drilled individually and so only 1,000 m^3 of water and 6 m^3 of solids will be discharged at any one time.

The drilling compound to be used during the HDD operations is bentonite, a naturally occurring clay. Hence the solids which will escape into the marine environment as a result of the release of drilling fluid will be a combination of bentonite and pulverised rock from the drilling operations. Hence, all of the solids are naturally occurring and environmentally inert. The potential impact on benthic habitats associated with the release of drilling fluids is, therefore, increased sediment loading and smothering when the solids drop out of suspension.

It is noted that the impacts resulting from the release of drilling fluids will be restricted to the immediate vicinity of the HDD exit point. This area is subject to high tidal currents and, hence, the solids released into the water column will be rapidly dispersed, and any solids which are deposited on the seabed will be removed quickly by natural scouring.

14.5.3.6.1 Designated Sites

The burrowed mud feature of the Southern Trench pMPA has only been found much further to the north of the HDD exit point. As such there will be **no change** to this feature within the Proposed MPA. No other designated sites will be affected by this activity.

14.5.3.6.2 High Value Biotopes

The HDD exit point is within the biotope A5.25 - Circalittoral fine sand which has been assessed to be high value. The majority of the characterising species within this biotope will be infauna. It is expected that most infaunal species will be able to burrow towards the surface following deposition of drilling solids given their likely dispersion within the strong tidal currents, however, there may be some mortality of individuals within the localised area as a result of smothering from the released drilling solids. The magnitude of this effect is assessed to be **negligible** as the impact is expected to be undetectable at the population level and in terms of habitat integrity on this **high** value biotope. The overall effect significance is therefore assessed to be **minor, non-significant**.

14.5.3.6.3 Very High, Medium and Low Value Biotopes

No other biotopes are expected to be affected by the release of drilling fluid at the HDD exit point, as these biotopes are not within the vicinity of the potential effect.

14.5.3.7 Introduction of Invasive Non-Native Species

Vessels to be used for installation have the potential to carry INNS via their ballast waters and hulls, depending upon the origin of the vessels or previous ports which, if released, could settle in the benthic environment. Once INNS become established and disperse within a new habitat they can outcompete local species for space and resources, prey directly on local species, or introduce pathogens (Roy *et al*., 2012). However, as the BWM Convention has been ratified and all vessels will be fully IMO compliant, which make the risk of an INNS being introduced very low.

14.5.3.7.1 Designated Sites

Any released INNS by the vessels to be used for installation could colonise the Project site and surrounding area and compete with benthic species for resources, causing a potential decline in population abundance. Whilst this is possible, it is considered to be unlikely given the existing extent of shipping activity which exists within the North Sea.

Scanner Pockmark SAC is approximately 450 m south of the consenting corridor but may be less than 100 m south of the consenting corridor, if proposed changes to the boundary of the SAC are approved. Without any mitigation, the potential effect significance on this **very high** value site is assessed to be **minor, non-significant**.

The burrowed mud feature of the Southern Trench Proposed MPA is too far from the consenting corridor to be affected by the potential introduction of INNS as a result of the Project. Given the distance between the consenting corridor and all other designated sites for benthic ecology features, there will not be any risk of effects from potential INNS colonising these sites and the magnitude of impact upon designated sites for benthic ecology features is assessed as **no change** giving an overall effect significance of **no change.**

14.5.3.7.2 Very High Value Biotopes

MarLIN assesses the biotopes A4.213, A4.2211 and A5.611 to not be sensitive to the introduction or spread of INNS (Tillin and Hiscock, 2016; Tillin *et al*. 2018a; Tillin *et al*. 2018b), but does not provide assessment for habitat complexes such as A3.1 and A4.2. Only biotopes A3.1 and A5.611 are actually within the consenting corridor, but the other biotopes close to the corridor have the potential to be affected by the introduction of non-native species. As such, a precautionary assessment of very high sensitivity has been made for these habitats including pockmarks. However, the risk of introduction of non-native species to these **very high** value habitats is considered low, the magnitude of impact upon all benthic ecology receptors is assessed as **negligible**. Without any mitigation, the potential effect on these biotopes is assessed to be **minor, non-significant**.

14.5.3.7.3 High Value Biotopes

The sensitivity of A5.251 is assessed to be high as INNS such as slipper limpet, *Crepidula fornicata*, *Didemnum* sp. and non-native predatory gastropods may find these habitats favourable and outcompete the native species. As a precautionary assessment, all **high** value biotopes are assessed to have very high sensitivity. The magnitude of impact upon all benthic ecology receptors is assessed as **negligible**. Without any mitigation, the potential effect significance on these biotopes is assessed to be **minor, non-significant**.

14.5.3.7.4 Medium and Low Value Biotopes

The habitat complexes of **medium** and **low** value biotopes support a wide range of species that are likely to exhibit a variety of responses to the introduction of INNS. The sensitivity of these biotopes is therefore assessed on a precautionary basis as of very high sensitivity. The magnitude of impact upon all benthic ecology receptors is assessed as **negligible**. Therefore, without any mitigation, the potential effect on these biotopes is assessed to be **minor, non-significant**.

14.5.4 Operation and Maintenance

14.5.4.1 Change in Hydrodynamic Regime

Where seabed type and morphology are expected to change, such as locations where rock has been placed on soft substrates, there may be localised changes in the flows causing scour and accretion, but these are likely to be very localised to near the areas of rock placement and only occur in the short term as an equilibrium re-establishes.

14.5.4.1.1 Designated Sites

The burrowed mud feature of the Southern Trench Proposed MPA is too far from the consenting corridor to be affected by changes in hydrodynamic regime as a result of the project. Given the distance between the consenting corridor and the other designated sites for benthic ecology features, any changes in the hydrodynamic regime will not be detectable in these sites or on their populations, and the magnitude of impact upon designated sites for benthic ecology features is therefore assessed as **no change.**

14.5.4.1.2 Very High Value Biotopes

A3.1 - Atlantic and Mediterranean high energy infralittoral rock is present within the consenting corridor, however, these habitats are located to the west of the HDD exit point, hence the cables will pass beneath them via HDD ducts. As such, no changes to hydrological regime will occur in these areas, and the impact is assessed as **no-change**.

Pockmarks are unlikely to be affected by the localised scour and abrasion effects caused by changes in seabed type and morphology. This impact is assessed to result in **no change** for pockmark habitats.

A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment has a medium sensitivity to scour and abrasion and it is possible that the *Sabellaria spinulosa* tubes could become damaged (Cook et al., 2014), however, this will be a localised impact of **negligible** magnitude to which these biotopes are expected to have a low sensitivity. The overall effect significance is assessed to be **minor,non-significant** for A5.611 habitats which are not Annex I features within the consenting corridor.

14.5.4.1.3 High Value Biotopes

A5.361 - Sea pens and burrowing megafauna in circalittoral fine mud are assessed to have a low sensitivity to the levels of scour and abrasion likely to be caused by changes in seabed type and morphology from the Project. However, bivalves and other species require contact with the surface for respiration and feeding, so siphons and delicate feeding structures may be damaged or withdraw because of scour. Overall, species are expected to be tolerant of the impact and so are assessed to have a low sensitivity to this effect. All high value biotopes are expected to have a similar tolerance of the impact and are therefore assessed to have low sensitivity to the effect.

The magnitude of this localised impact is assessed to be **negligible** and the overall effect significance is assessed to be **minor, non-significant** for all **high** value biotopes.

14.5.4.1.4 Medium and Low Value Biotopes

The medium value habitat complex A5.44 - Circalittoral mixed sediment generally supports infaunal species that are expected to have a high tolerance of minor changes in hydrodynamics. The biotopes within the low value A5.26 - Circalittoral muddy sand and A5.35 - Circalittoral sandy mud habitat complexes may be dominated by infaunal species or by epifauna such as brittlestars or other echinoderms. These biotopes are expected to have a high tolerance to this effect and so are considered to have a low sensitivity.

The magnitude of this localised impact is assessed to be **negligible** and the overall effect significance is assessed to be **negligible, non-significant** for all **medium** and **low** value biotopes.

14.5.4.2 Sediment Heating

When operational, the HVDC cables will emit heat. If bundled and placed at a depth of lowering of 0.5 m below the seabed (as a worst-case for soft substrates), the temperature rise at the seabed immediately above the cable will be 1°C above background levels, and will rapidly decrease within increased distance away from the cable.

A literature review of the likely sensitivity of benthic invertebrates to this heating was conducted but sparse information was available for specific thresholds at which effects could occur (see MMT 2018 for details), and from which the data and references for the assessment detailed below is sourced. For details on the specific effect on crustaceans and molluscs see relevant shellfish sections in Chapter 15: Fish and Shellfish.

14.5.4.2.1 Designated Sites

The burrowed mud feature of the Southern Trench Proposed MPA is too far from the consenting corridor to be affected by changes in sediment temperature as a result of the project. Given the distance between the consenting corridor and other designated sites for benthic ecology features, no change in sediment temperature will occur in these sites, and the magnitude of impact upon designated sites for benthic ecology features is assessed as **no change.**

14.5.4.2.2 Very High Value Biotopes

Pockmark habitats are not thought to be vulnerable to increases in temperature (Defra & JNCC, 2008). *Sabellaria spinulosa* appears to have a high tolerance for changes in temperature and so A5.611 is expected to have a low sensitivity to this effect. It is important to note that the A5.611 habitat within the consenting corridor is not reef-building and is not an Annex I habitat. Given the limited change in temperature within a localised extent, the magnitude of this impact is assessed to be **no change**. The overall effect significance on these **very high** value biotopes is assessed to be **no change**.

14.5.4.2.3 High Value Biotopes

The biotope A5.361 is assessed to have a low sensitivity to increases in sediment temperature as the characterising sea pens are distributed throughout the Mediterranean, where water temperatures are higher and so this biotope is expected to have a high tolerance to increases in sediment temperature. The other biotopes of **high** value are also assessed to have a low sensitivity to changes in temperature. Given the limited change in temperature within a localised extent, the magnitude of this impact is assessed to be **no change**.

The overall effect significance on these high value biotopes is assessed to be **no change**.

14.5.4.2.4 Medium and Low Value Biotopes

The habitat complexes of medium and low value biotopes support a wide range of species that are likely to exhibit a variety of responses to increases in sediment temperature. The sensitivity of these biotopes is therefore assessed on a precautionary basis as being of very high sensitivity. However, given the limited change in temperature within a localised extent, the magnitude of this impact is assessed to be **no change**. The overall effect significance on these **medium** and **low** value biotopes is assessed to be **no change**.

14.5.4.3 Electromagnetic Fields (EMFs)

When operational, the HVDC cables will emit a magnetic field. As they are direct current cables then no electric fields will be created, and any induced electric fields will be contained within the cables' armouring. An assessment of the EMFs created by the project is provided in Chapter 18: Electromagnetic Fields. At worst-case burial depths of 0.4 m in hard substrates and 0.5 m in soft substrates, then the magnetic field at the seabed would be at most 640 µT, and would reduce to <300 µT within 2 m of the seabed at both worst-case and best case separation distances.

A literature review of the likely sensitivity of benthic invertebrates to EMFs was conducted, but the literature reviewed found very little information on specific thresholds at which effects could occur (see Appendix E.1 for details), and from which the data and references for the assessment detailed below is sourced. For an assessment of effect on crustaceans and molluscs, see relevant shellfish sections in Chapter 15: Fish and Shellfish, respectively where the effect of EMF from the cables was assessed to be negligible. Polychaetes are not expected to have any sensitivity to EMFs. The embryos of the purple sea urchin, *Strongylocentrotus purpuratus*, have been shown to have a sensitivity to EMF (see Appendix E.1) where exposure to EMFs as low as 1-100 µT caused interference with embryonic development.

14.5.4.3.1 Designated Sites

The burrowed mud feature of the Southern Trench Proposed MPA is too far from the consenting corridor to be affected by changes in EMF as a result of the project. Given the distance between the consenting corridor and the other designated sites for benthic ecology feature, no change in EMF will occur in these sites, and the magnitude of impact upon designated sites for benthic ecology features is assessed as **no change.**

14.5.4.3.2 Very High, High, Medium and Low Value Biotopes

There is a paucity of data on the specific effects of EMF on benthic habitats and the species they support. As such, a precautionary assessment of high sensitivity has been assumed for all biotopes. The extent of the effect will be along the entire length of the cable and for several metres either side of each cable. Most species are expected to be unaffected by EMF but for those species that are sensitive to the effect the impact is not expected to cause a detectable effect on the integrity of the population and so magnitude of the impact is assessed to be **negligible**. The overall effect significance is therefore assessed to be **minor, non-significant** for all **very high** and **high** value biotopes and **negligible, non-significant** for **medium** and **low** value biotopes.

14.5.4.4 Introduction of Invasive Non-Native Species

Vessels to be used for repairs have the potential to carry INNS via their ballast waters and hulls, depending upon the origin of the vessels or previous ports which, if released and are mobile in nature, could compete with benthic ecology populations.

Any released INNS by the vessels to be used for repairs could compete with benthic ecology species for resources, causing a potential decline in population abundance.

Whilst this is possible, it is considered to be unlikely given the extent of shipping activity and habitat disturbance which currently exists within the North Sea and given that the BWM Convention has been ratified and all vessels will be fully IMO compliant. The magnitude of impact upon all benthic ecology receptors is assessed as **Negligible**.

14.5.4.5 Physical Disturbance During Inspection & Repair

To conduct repairs on the cables, they must be brought to the surface and then re-laid which will disturb the seabed along the consenting corridor for a distance that is determined by the water depth. Cable repairs in water depths of up to 100 m in the UKTW would result in 200 m of seabed disturbance, whereas between 12 nm to the UK EEZ limit seabed disturbance would occur over a distance of 300 m, due to increased water depths around of 150m. One repair every three years is assumed as a worst-case based on previous project experiences and so, over the lifetime of the project (40 years), repairs could occur 13times. This would disturb a maximum total of a 4.2 ha of seabed assuming the repair disturbs a 10 m wide strip of the seabed around the consenting corridor.

Smothering is most likely to affect sessile or limited mobility epifauna, or infauna in surficial sediments (near the sediment-water interface). Given the limited extent likely to be affected at any one time during the operation period, the magnitude of impact is assessed to be **negligible**. The overall effect significance is therefore **minor, non-significant** for **very high** and **high** value biotopes and **negligible, non-significant** for **medium** and **low** value biotopes. The benthic ecology feature of the Southern Trench proposed MPA will not be affected and given the distance between the consenting corridor and designated sites for benthic ecology features, then no change in sediment temperature will occur in these sites, and the magnitude of impact upon designated sites for benthic ecology features is assessed as **no change.**

14.5.5 Decommissioning Phase Impacts

Impacts during the decommissioning phase associated with the removal of the cable (if required), are anticipated to be of a similar or lesser magnitude than for cable installation. On a precautionary basis for the following impacts, the magnitude of impact is assessed to be of the same as for installation:

- Habitat loss;
- Physical disturbance and displacement;
- Changes to water quality (resuspension of sediments and increased sediment loading);
- Changes to water quality (release of hazardous substances); and
- Introduction of invasive non-native species.

No other impacts are anticipated during decommissioning.

14.5.6 Impact Assessment Summary

A summary table of the impact assessment for benthic ecology receptors is presented in Tables 15.15a-b, which also considers the overall significance of effect from the assigned receptor value/sensitivity and magnitude of impact, and the confidence in the assessment. No impacts are assessed as being significant under the provisions of the EIA regulations.

Table14.15a Benthic ecology impact assessment summary for the installation phase

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Habitat loss	Designated Sites	Southern Trench proposed MPA	High	No change	No change		High	Non-significant
		Scanner Pockmark SAC	Very High	No change	No change		High	Non-significant
	Very High Value Biotopes	A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	No change	No change		Medium	Non-significant
		A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	No change	No change		Medium	Non-significant
		Submarine structures made by leaking gases	Very High	No change	No change		Medium	Non-significant
		Pockmarks	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	No change	No change		Medium	Non-significant
		A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	Negligible	Minor	Adverse	Medium	Non-significant
	High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.14 - Circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.15 - Deep circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.25 - Circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.251 - *Echinocyamus pusillus, Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.27 - Deep circalittoral sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Habitat loss	High Value Biotopes	A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.45 - Deep circalittoral mixed sediments	High	Negligible	Minor	Adverse	Medium	Non-significant
	Medium Value Biotope	A5.44 - Circalittoral mixed sediment	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
	Low Value Biotopes	A5.26 - Circalittoral muddy sand	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		A5.35 - Circalittoral sandy mud	Low	Negligible	Negligible	Adverse	Medium	Non-significant
Habitat creation	Designated Sites	Southern Trench proposed MPA	High	No change	No change		High	Non-significant
		Scanner Pockmark SAC	Very High	No change	No change		High	Non-significant
		A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	Negligible	Minor	Beneficial	Medium	Non-significant
		A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	Negligible	Minor	Beneficial	Medium	Non-significant
		A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	Negligible	Minor	Beneficial	Medium	Non-significant
		Submarine structures made by leaking gases	Very High	No change	No change		High	Non-significant
		Pockmarks	Very High	No change	No change		High	Non-significant
		A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	Negligible	Minor	Beneficial	Medium	Non-significant
		A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	No change	No change		High	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Habitat creation	High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	No change	No change		Medium	Non-significant
		A5.14 - Circalittoral coarse sediment	High	No change	No change		Medium	Non-significant
		A5.15 - Deep circalittoral coarse sediment	High	No change	No change		Medium	Non-significant
		A5.25 - Circalittoral fine sand	High	No change	No change		Medium	Non-significant
		A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	High	No change	No change		Medium	Non-significant
		A5.27 - Deep circalittoral sand	High	No change	No change		Medium	Non-significant
		A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	No change	No change		Medium	Non-significant
		A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	No change	No change		Medium	Non-significant
		A5.45 - Deep circalittoral mixed sediments	High	No change	No change		Medium	Non-significant
	Medium Value Biotope	A5.44 - Circalittoral mixed sediment	Medium	No change	No change		High	Non-significant
	Low Value Biotopes	A5.26 - Circalittoral muddy sand	Low	No change	No change		Medium	Non-significant
		A5.35 - Circalittoral sandy mud	Low	No change	No change		Medium	Non-significant
Physical Disturbance	Designated Sites	Southern Trench proposed MPA	High	No change	No change		High	Non-significant
		Scanner Pockmark SAC	Very High	No change	No change		High	Non-significant
	Very High Value Biotopes	A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Physical Disturbance	Very High Value Biotopes	A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Submarine structures made by leaking gases	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Pockmarks	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	Negligible	Minor	Adverse	Medium	Non-significant
	High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.14 - Circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.15 - Deep circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.25 - Circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.27 - Deep circalittoral sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.45 - Deep circalittoral mixed sediments	High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Physical Disturbance	Medium Value Biotope	A5.44 - Circalittoral mixed sediment	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
	Low Value Biotopes	A5.26 - Circalittoral muddy sand	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		A5.35 - Circalittoral sandy mud	Low	Negligible	Negligible	Adverse	Medium	Non-significant
Changes to water quality (resuspension of sediments and increased sediment loading)	Designated Sites	Southern Trench proposed MPA	High	No change	No change		High	Non-significant
		Scanner Pockmark SAC	Very High	No change	No change		High	Non-significant
	Very High Value Biotopes	A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Submarine structures made by leaking gases	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Pockmarks	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	Negligible	Minor	Adverse	Medium	Non-significant
	High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.14 - Circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.15 - Deep circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.25 - Circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Changes to water quality (resuspension of sediments and increased sediment loading)	High Value Biotopes	A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.27 - Deep circalittoral sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.45 - Deep circalittoral mixed sediments	High	Negligible	Minor	Adverse	Medium	Non-significant
	Medium Value Biotope	A5.44 - Circalittoral mixed sediment	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
	Low Value Biotopes	A5.26 - Circalittoral muddy sand	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		A5.35 - Circalittoral sandy mud	Low	Negligible	Negligible	Adverse	Medium	Non-significant
Changes to water quality (release of hazardous substances)	Designated Sites	Southern Trench proposed MPA	High	No change	No change		High	Non-significant
		Scanner Pockmark SAC	Very High	No change	No change		High	Non-significant
	Very High Value Biotopes	A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Changes to water quality (release of hazardous substances)	Very High Value Biotopes	Submarine structures made by leaking gases	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Pockmarks	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	Negligible	Minor	Adverse	Medium	Non-significant
	High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.14 - Circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.15 - Deep circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.25 - Circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.251 - *Echinocyamus pusillus, Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.27 - Deep circalittoral sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.376 - *Paramphinome jeffreysii, Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.45 - Deep circalittoral mixed sediments	High	Negligible	Minor	Adverse	Medium	Non-significant
	Medium Value Biotope	A5.44 - Circalittoral mixed sediment	Medium	Negligible	Negligible	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Changes to water quality (release of hazardous substances)	Low Value Biotopes	A5.26 - Circalittoral muddy sand	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		A5.35 - Circalittoral sandy mud	Low	Negligible	Negligible	Adverse	Medium	Non-significant
Changes to water quality (release of drilling fluids)	Designated Sites	Southern Trench proposed MPA	High	No change	No change		High	Non-significant
		Scanner Pockmark SAC	Very High	No change	No change		High	Non-significant
	High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	No change	No change		Medium	Non-significant
		A5.14 - Circalittoral coarse sediment	High	No change	No change		Medium	Non-significant
		A5.15 - Deep circalittoral coarse sediment	High	No change	No change		Medium	Non-significant
		A5.25 - Circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	High	No change	No change		Medium	Non-significant
		A5.27 - Deep circalittoral sand	High	No change	No change		Medium	Non-significant
		A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	No change	No change		Medium	Non-significant
		A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	No change	No change		Medium	Non-significant
		A5.45 - Deep circalittoral mixed sediments	High	No change	No change		Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Introduction of invasive non-native species	Designated Sites	Southern Trench proposed MPA	High	No change	No change		High	Non-significant
		Scanner Pockmark SAC	Very High	Negligible	Minor	Adverse	High	Non-significant
	Very High Value Biotopes	A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	Negligible	Minor	Adverse	High	Non-significant
		A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	Negligible	Minor	Adverse	High	Non-significant
		A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	Negligible	Minor	Adverse	High	Non-significant
		Submarine structures made by leaking gases	Very High	Negligible	Minor	Adverse	High	Non-significant
		Pockmarks	Very High	Negligible	Minor	Adverse	High	Non-significant
		A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	Negligible	Minor	Adverse	High	Non-significant
		A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	Negligible	Minor	Adverse	High	Non-significant
	High Value Biotopes	A5.13 - Infralittoral coarse sediment	Very High	Negligible	Minor	Adverse	High	Non-significant
		A5.14 - Circalittoral coarse sediment	Very High	Negligible	Minor	Adverse	High	Non-significant
		A5.15 - Deep circalittoral coarse sediment	Very High	Negligible	Minor	Adverse	High	Non-significant
		A5.25 - Circalittoral fine sand	Very High	Negligible	Minor	Adverse	High	Non-significant
		A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	Very High	Negligible	Minor	Adverse	High	Non-significant
		A5.27 - Deep circalittoral sand	Very High	Negligible	Minor	Adverse	High	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Introduction of invasive non-native species	High Value Biotopes	A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	Very High	Negligible	Minor	Adverse	High	Non-significant
		A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	Very High	Negligible	Minor	Adverse	High	Non-significant
		A5.45 - Deep circalittoral mixed sediments	Very High	Negligible	Minor	Adverse	High	Non-significant
	Medium Value Biotope	A5.44 - Circalittoral mixed sediment	Very High	Negligible	Minor	Adverse	High	Non-significant
	Low Value Biotopes	A5.26 - Circalittoral muddy sand	Very High	Negligible	Minor	Adverse	High	Non-significant
		A5.35 - Circalittoral sandy mud	Very High	Negligible	Minor	Adverse	High	Non-significant

* The highest ranking is used so if the value is low but sensitivity is very high a ranking of very high is used.

Table14.15b Benthic ecology impact assessment summary for the operation phase

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Change in hydrodynamic regime	Designated Sites	Southern Trench proposed MPA	High	No change	No change		High	Non-significant
		Scanner Pockmark SAC	Very High	No change	No change		High	Non-significant
	Very High Value Biotopes	A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	No change	No change		Medium	Non-significant
		A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	No change	No change		Medium	Non-significant
		A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	No change	No change		Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Change in hydrodynamic regime	Very High Value Biotopes	Submarine structures made by leaking gases	Very High	No change	No change		Medium	Non-significant
		Pockmarks	Very High	No change	No change		Medium	Non-significant
		A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	No change	No change		Medium	Non-significant
		A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	Negligible	Minor	Adverse	Medium	Non-significant
	High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.14 - Circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.15 - Deep circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.25 - Circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.251 - *Echinocyamus pusillus*,	High	Negligible	Minor	Adverse	Medium	Non-significant
		Ophelia borealis and *Abra prismatica* in circalittoral fine sand						
		A5.27 - Deep circalittoral sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.45 - Deep circalittoral mixed sediments	High	Negligible	Minor	Adverse	Medium	Non-significant
	Medium Value Biotope	A5.44 - Circalittoral mixed sediment	Medium	Negligible	Negligible	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Change in hydrodynamic regime	Low Value Biotopes	A5.26 - Circalittoral muddy sand	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		A5.35 - Circalittoral sandy mud	Low	Negligible	Negligible	Adverse	Medium	Non-significant
Sediment heating	Designated Sites	Southern Trench proposed MPA	High	No change	No change		High	Non-significant
		Scanner Pockmark SAC	Very High	No change	No change		High	Non-significant
	Very High Value Biotopes	A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	No change	No change		Medium	Non-significant
		A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	No change	No change		Medium	Non-significant
		A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	No change	No change		Medium	Non-significant
		Submarine structures made by leaking gases	Very High	No change	No change		Medium	Non-significant
		Pockmarks	Very High	No change	No change		Medium	Non-significant
		A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	No change	No change		Medium	Non-significant
		A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	No change	No change		Medium	Non-significant
	High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	No change	No change		Medium	Non-significant
		A5.14 - Circalittoral coarse sediment	High	No change	No change		Medium	Non-significant
		A5.15 - Deep circalittoral coarse sediment	High	No change	No change		Medium	Non-significant
		A5.25 - Circalittoral fine sand	High	No change	No change		Medium	Non-significant
		A5.251 - *Echinocyamus pusillus, Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	High	No change	No change		Medium	Non-significant
		A5.27 - Deep circalittoral sand	High	No change	No change		Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Sediment heating	High Value Biotopes	A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	No change	No change		Medium	Non-significant
		A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	No change	No change		Medium	Non-significant
		A5.45 - Deep circalittoral mixed sediments	High	No change	No change		Medium	Non-significant
	Medium Value Biotope	A5.44 - Circalittoral mixed sediment	Medium	No change	No change		Medium	Non-significant
	Low Value Biotopes	A5.26 - Circalittoral muddy sand	Low	No change	No change		Medium	Non-significant
		A5.35 - Circalittoral sandy mud	Low	No change	No change		Medium	Non-significant
EMF from cable	Designated Sites	Southern Trench proposed MPA	High	No change	No change		High	Non-significant
		Scanner Pockmark SAC	Very High	No change	No change		High	Non-significant
	Very High Value Biotopes	A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Submarine structures made by leaking gases	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Pockmarks	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
EMF from cable	High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.14 - Circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.15 - Deep circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.25 - Circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.27 - Deep circalittoral sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.45 - Deep circalittoral mixed sediments	High	Negligible	Minor	Adverse	Medium	Non-significant
	Medium Value Biotope	A5.44 - Circalittoral mixed sediment	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
	Low Value Biotopes	A5.26 - Circalittoral muddy sand	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		A5.35 - Circalittoral sandy mud	Low	Negligible	Negligible	Adverse	Medium	Non-significant
Introduction of invasive non-native species	Designated Sites	Southern Trench proposed MPA	High	Negligible	Minor	Adverse	Medium	Non-significant
		Scanner Pockmark SAC	Very High	Negligible	Minor	Adverse	Medium	Non-significant
	Very High Value Biotopes	A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Introduction of invasive non-native species	Very High Value Biotopes	A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Submarine structures made by leaking gases	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Pockmarks	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	Negligible	Minor	Adverse	Medium	Non-significant
	High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.14 - Circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.15 - Deep circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.25 - Circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.27 - Deep circalittoral sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.45 - Deep circalittoral mixed sediments	High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Introduction of invasive non-native species	Medium Value Biotope	A5.44 - Circalittoral mixed sediment	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
	Low Value Biotopes	A5.26 - Circalittoral muddy sand	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		A5.35 - Circalittoral sandy mud	Low	Negligible	Negligible	Adverse	Medium	Non-significant
Physical disturbance during inspection and repair	Designated Sites	Southern Trench proposed MPA	High	No change	No change		Medium	Non-significant
		Scanner Pockmark SAC	Very High	No change	No change		Medium	Non-significant
	Very High Value Biotopes	A3.1 - Atlantic and Mediterranean high energy infralittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.213 - *Urticina felina* and sand-tolerant fauna on sand-scoured or covered circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Submarine structures made by leaking gases	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Pockmarks	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A4.2211 - *Sabellaria spinulosa* with a bryozoan turf and barnacles on silty turbid circalittoral rock	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	Very High	Negligible	Minor	Adverse	Medium	Non-significant
	High Value Biotopes	A5.13 - Infralittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.14 - Circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.15 - Deep circalittoral coarse sediment	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.25 - Circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value / Sensitivity of receptor*	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Physical disturbance during inspection and repair	High Value Biotopes	A5.251 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.27 - Deep circalittoral sand	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.36/ A5.361 - Circalittoral fine mud/ Sea pens and burrowing megafauna in circalittoral fine mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.376 - *Paramphinome jeffreysii*, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud	High	Negligible	Minor	Adverse	Medium	Non-significant
		A5.45 - Deep circalittoral mixed sediments	High	Negligible	Minor	Adverse	Medium	Non-significant
	Medium Value Biotope	A5.44 - Circalittoral mixed sediment	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
	Low Value Biotopes	A5.26 - Circalittoral muddy sand	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		A5.35 - Circalittoral sandy mud	Low	Negligible	Negligible	Adverse	Medium	Non-significant

* The highest ranking is used so if the value is low but sensitivity is very high a ranking of very high is used.

14.6 Mitigation Measures

As no effects were considered to be significant under the provisions of the EIA Regulations, then no secondary mitigation is required to be implemented.

As set out within section 14.3.5, the habitat mapping used for the assessment has been interpreted from geophysical survey data. This means that there is only limited confidence in the precise nature of the habitat boundaries mapped. It is therefore proposed to conduct a pre-installation visual survey of the final cable route to confirm the biotopes present, and biotope boundaries, and thus that the assessment of effects of the project upon benthic ecology are accurate.

14.7 Residual Effects

On the basis of the current data known given the statements in 14.6 no effects were assessed to be of moderate or greater significance. As such, no mitigation measures were required and there was no reduction in the residual significance of effects.

14.8 Cumulative Effects

The adult phases of benthic species are generally sessile or have limited mobility. Effects from this project and other developments will only have a cumulative interaction with the benthic habitat and species where the development is within a short distance of the project.

Cumulative impacts on benthic habitats and species have been considered from impacts originating from the installation, operation or decommissioning of the project as assessed in Sections 14.5-14.7 above, with impacts from other planned or consented projects upon the same receptor populations.

No cumulative assessment is conducted for existing operations or built projects as this forms part of the baseline environment that the assessment in Section 14.5 was conducted on. Furthermore, the potential for synergistic impacts from the project, where one impact may cause another impact, have been assessed in Section 14.5 above (for example an impact upon water quality leading to an impact upon benthic ecology receptors).

A list of cumulative projects requiring assessment within the Environmental Impact Assessment Report has been agreed with Marine Scotland and further detail is provided in Chapter 6: Cumulative Assessment. The relevant marine projects are considered individually below.

14.8.1 Moray East/West Offshore Windfarm Development

Given the distance between the project and the Moray East/West Offshore wind farm, 100 km to the north west of the project, there is unlikely to be any interactions between the effects of the project and the effects of the wind farm that will affect benthic habitats and species. As benthic species are generally sessile or have limited mobility, it is unlikely that any benthic populations (other than the shellfish assessed in Chapter 15: Fish and Shellfish) will overlap between the two sites. No cumulative impacts with this project are therefore anticipated.

14.8.2 Inch Cape Offshore Windfarm

Given the distance between the project and the Inch cape offshore wind farm, 110 km to the south of the project there is unlikely to be any interactions between the effects of the project and the effects of the wind farm that will affect benthic habitats and species. As benthic species are generally sessile or have limited mobility, it is unlikely that any benthic populations (other than the shellfish assessed in Chapter 15: Fish and Shellfish) will overlap between the two sites. No cumulative impacts with this project are therefore anticipated.

14.8.3 Neartna Gaoithe Offshore Windfarm

Given the distance between the project and the Neartna Gaoithe offshore wind farm, 130 km to the south of the project there is unlikely to be any interactions between the effects of the project and the effects of the wind farm that will affect benthic habitats and species. As benthic species are generally sessile or have limited mobility, it is unlikely that any benthic populations (other than the shellfish assessed in Chapter 15: Fish and Shellfish) will overlap between the two sites. No cumulative impacts with this project are therefore anticipated.

14.8.4 Seagreen Phase 1 Wind Farm

Given the distance between the project and the Seagreen Phase 1 offshore wind farm, 110 km to the south of the project there is unlikely to be any interactions between the effects of the project and the effects of the wind farm that will affect benthic habitats and species. As benthic species are generally sessile or have limited mobility, it is unlikely that any benthic populations (other than the shellfish assessed in Chapter 15: Fish and Shellfish) will overlap between the two sites. No cumulative impacts with this project are therefore anticipated.

14.8.5 Beatrice Offshore Wind Farm

Given the distance between the project and the Beatrice offshore wind farm, 100 km to the north west of the project there is unlikely to be any interactions between the effects of the project and the effects of the wind farm that will affect benthic habitats and species. As benthic species are generally sessile or have limited mobility, it is unlikely that any benthic populations (other than the shellfish assessed in Chapter 15: Fish and Shellfish) will overlap between the two sites. No cumulative impacts with this project are therefore anticipated.

14.8.6 European Offshore Wind Development Centre EOWDC, Aberdeen Bay

The European offshore wind deployment centre is situated 40 km to the south of the project. As this project is currently being constructed then no cumulative effects during installation are anticipated given there is no programme overlap. As benthic species are generally sessile or have limited mobility, it is unlikely that any benthic populations (other than the shellfish assessed in Chapter 15: Fish and Shellfish) will overlap between the two sites. No cumulative impacts with this project are therefore anticipated.

14.8.7 Hywind Scotland Pilot Park Offshore Wind Farm

The Hywind Scotland pilot park offshore wind farm is situated 20 km to the south of the project and is currently operational so has been considered as part of the baseline against which the project has been assessed.

14.8.8 Kincardine Offshore Windfarm, 86 MW floating turbines

The Kincardine offshore wind farm is situated 50 km to the south of the project. As benthic species are generally sessile or have limited mobility, it is unlikely that any benthic populations (other than the shellfish assessed in Chapter 15: Fish and Shellfish) will overlap between the two sites. No cumulative impacts with this project are therefore anticipated.

14.8.9 Aberdeen Harbour Dredge and Harbour Extension Project

The Aberdeen harbour dredge and harbour extension project is situated 40 km to the south of the project. As this project is currently being constructed then no cumulative effects during installation are anticipated given there is no programme overlap. Given the distance between the project and the Aberdeen harbour dredge and harbour extension project then no cumulative impacts with this project are anticipated that would be *'likely to have a significant effect on the environment'* (as termed in the EIA Regulations).

14.8.10 Peterhead Port Authority Harbour Masterplan

The Peterhead Port Authority Harbour Masterplan is limited in extent to within the existing breakwaters and existing harbours of Peterhead Port, 3 km to the north of the project. No cumulative impacts with this project are therefore anticipated that would be *'likely to have a significant effect on the environment'* (as termed in the EIA Regulations).

14.8.11 North Sea Network Link Interconnector Cable

The North Sea Network (NSN) Link Interconnector cable project is situated 130 km to the south of the project. Given the distance between the project and the NSN Link Interconnector cable project there is unlikely to be any interactions between the effects of the project and the effects of the NSN Link Interconnector cable that will affect benthic habitats and species. As benthic species are generally sessile or have limited mobility, it is unlikely that any benthic populations (other than the shellfish assessed in Chapter 15: Fish and Shellfish) will overlap between the two sites. No cumulative impacts with this project are therefore anticipated**.**

14.8.12 NorthConnect HVDC Subsea Cable (rest of the North Sea: from UK median line-start of Norwegian fjord)

The remaining section of the NorthConnect HVDC subsea cable, not assessed within this EIAR as it is situated within Norwegian waters, is anticipated to have similar effects to the project given that installation will occur from the Norwegian coast to the UK median line utilising similar installation methodologies and equipment, and operation will be transmitting the same electricity along the same cables so sediment heating and EMF levels will be the same. Whilst installation will be occurring at the same time as the project, impacts will not be synergistic given the distance occurring between the installation activities. Small losses of habitats within the UK section of the Project and within Norway waters will not have a significant effect on the functioning of these habitats. Similarly for operation, impacts will be occurring at the same magnitude along the length of the cable route, rather than being cumulatively greater than the individual impacts. Assuming similar mitigation as applied for the UK section of the project will be applied in Norwegian waters, then no cumulative impacts with this project are therefore anticipated that would be *'likely to have a significant effect on the environment'* (as termed in the EIA Regulations).

14.9 Summary

A summary of the potential effects of the project, alone, is presented in Table 14.15a-b. No potential effects have been assessed as an *'impact likely to have a significant effect on the environment'* (as termed in the EIA Regulations). Section 14.8 assesses the project cumulatively with other proposed plans or projects and there are not predicted to be any cumulative impacts that are considered to be an *'impact likely to have a significant effect on the environment'* (as termed in the EIA Regulations).

14.10 References

Birchenough, S.N.R.; Degraer, S.; Reiss, H.; Borja, A.; Braeckman, U.; Craeymeersch, J.; De Mesel, I.; Kerckhof, F.; Kröncke, I.; Mieszkowska, N.; Parra, S.; Rabaut, M.; Schröder, A.; Van Colen, C.; Van Hoey, G.; Vincx, M.; Wätjen, K. (2011). Responses of marine benthos to climate change, in: Reid, P.C. et al. (Ed.) ICES status report on climate change in the North Atlantic. ICES Cooperative Research Report, 310: pp. 123-146.

British Standard. (2010). Methods of test for soils for civil engineering purposes 1377-2:1990. BSI.

Canadian Council of Ministers of the Environment. (2002). Canadian sediment quality guidelines for the protection of aquatic life: Summary tables. Updated. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.Clarke, K. R., & Gorley, R. N. (2006). PRIMER v6: User Manual/Tutorial. PRIMER-E. Plymouth, 192pp.

Cefas (2014). Chemical Action Levels. Available from: https://www.gov.uk/guidance/marine-licensing-sediment-analysis-and-sample-plans#suitability-of-material. Accessed: 27/02/18.

CIEEM (Chartered Institute of Ecology and Environmental Management). (2016). Guidelines for Ecological Impact Assessment in the United Kingdom: Terrestrial, Freshwater and Coastal. 2nd Edition January 2016.

Clarke, K. R., & Warwick, R. M. (2001). Change in marine communities: An approach to statistical analysis and interpretation, 2nd edition. Plymouth: PRIMER-E.

Cook, E. J., Payne, R. D. and Macleod, A. (2014) Marine biosecurity planning – identification of best practice: A review. Scottish Natural Heritage Commissioned Report No. 748.

Dando, P.R. (2001). A review of pockmarks in the UK part of the North Sea, with particular respect to their biology. Technical report produced for Strategic Environmental Assessment – SEA2. Department of Trade and Industry Technical Report No. TR_001.

De-Bastos, E.S.R. (2016). Paramphinome jeffreysii, Thyasira spp. and Amphiura filiformis in offshore circalittoral sandy mud. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 22-03-2018]. Available from: https://www.marlin.ac.uk/habitat/detail/1109.

Defra & JNCC. (2008). Impact Assessment of Scanner Pockmark SAC. Options stage. Version 1. 22 pp. [cited 12-06-2018]. Available from: http://jncc.defra.gov.uk/PDF/ScannerPockmark_ImpactAssessment_18July08_.pdf.

European Commission. (2007). Interpretation manual of European Union Habitats - EUR 27. European Commission.

European Environment Agency (EEA). 2017. EUNIS habitat type hierarchical view. http://eunis.eea.europa.eu/habitats-code-browser.jsp

European Environment Agency (EEA). 2018. EUNIS habitat classification. Available from: https://www.eea.europa.eu/data-and-maps/data/eunis-habitat-classification#tab-european-data. Accessed: 05/07/18.

Gill AB, Huang Y, Gloyne - Philips I, Metcalfe J, Quayle V, Spencer J, & Wearmout HV, (2009). COWRIE 2.0 Electromagnetic Fields (EMF) Phase 2 : EMF - sensitive fish response to EM emissions from sub-sea electricity cables of the type used by the offshore renewable energy industry. Commissioned by COWRIE Ltd (project reference COWRIE - EMF - 1 - 06).

Gubbay, S. (2007). Defining and managing Sabellaria spinulosa reefs: Report of an inter-agency workshop Report of an inter-agency workshop. Joint Nature Conservation Committee.

Hin, J., Osté, L., & Schmidt, C. (2010). Guidance Document for Sediment Assessment, Methods to determine to what extent the realization of water quality objectives of a water system is impeded by contaminated sediments. Ministry of Infrastructure and the Environment - DG Water.

Irving, R. (2009). The identification of the main characteristics of stony reef habitats under the Habitats Directive. Summary report of an inter-agency workshop 26-27 March 2008. Peterborough: JNCC Report No.432.

Kröncke I. (2011). Changes in Dogger Bank macrofauna communities in the 20th century caused by fishing and climate. Estuarine, Coastal and Shelf Science 94: 234-245.

Künitzer A, Basford D, Craeymeersch JA, Dewarumez JM, Dörjes J, Duineveld GCA, Eleftheriou A, Heip C, Herman P, Kingston P, Niermann U, Rachor E, Rumohr H & de Wilde PAJ. (1992). The benthic infauna of the North Sea: species distribution and assemblages. ICES Journal of Marine Science 49: 127-143.

Hiddink, J.G., Burrows, M.T. & Molinos, J.G. (2014). Temperature tracking by North Sea benthic invertebrates in response to climate change. Global Change Biology, 21 (1): 117-129.

Hin, J., Osté, L., & Schmidt, C. (2010). Guidance Document for Sediment Assessment, Methods to determine to what extent the realization of water quality objectives of a water system is impeded by contaminated sediments. Ministry of Infrastructure and the Environment - DG Water.

Hill, J.M. & Tyler-Walters, H. (2018). Seapens and burrowing megafauna in circalittoral fine mud. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 22-03-2018]. Available from: https://www.marlin.ac.uk/habitat/detail/131.

MMT. (2018). Benthic Survey Report: NorthConnect - UK Nearshore, North Sea, and Norwegian Ford Survey In (Vol. Rev A): MMT.

NorthConnect. (2016). HVDC Cable Route Scoping Report. 93 pp.

NorthConnect. (2018). HVDC Cable Infrastructure – UK Construction Method Statement,

OSPAR. (2008). OSPAR List of Threatened and/or Declining Species and Habitats. retrieved from: https://www.ospar.org/documents?d=32794 (2017-09-05).

OSPAR. (2009). Agreement on CEMP Assessment Criteria for the QSR 2010. Agreement number: 2009-2, OSPAR Commission.

Pearce, B., Taylor, J., Seiderer, L.J. (2007). Recoverability of Sabellaria spinulosa Following Aggregate Extraction: Marine Ecological Surveys Limited.

Roy H. E., Bacon J., Beckmann B., Harrower C. A., Hill M. O., Isaac N. J. B., Preston C. D., Rathod B., Rorke S. L., Marchant J. H., Musgrove A., Noble D., Sewell J., Seeley B., Sweet N., Adams L., Bishop J., Jukes A. R., Walker K. J & Pearman D. (2012). Non-Native Species in Great Britain: establishment, detection and reporting to inform effective decision making. Report to Defra WC0738.

Saunders, G., Bedford, G.S., Trendall, J.R., and Sotheran, I. (2011). Guidance on survey and monitoring in relation to marine renewables deployments in Scotland. Volume 5. Benthic Habitats. Unpublished draft report to Scottish Natural Heritage and Marine Scotland.

Tillin, H.M., Marshall, C. & Gibb, N. (2018a). Sabellaria spinulosa with a bryozoan turf and barnacles on silty turbid circalittoral rock. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 26-03-2018]. Available from: https://www.marlin.ac.uk/habitat/detail/1171.

Tillin, H.M., Marshall, C. & Gibb, N. (2018b). Sabellaria spinulosa on stable circalittoral mixed sediment. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 26-03-2018]. Available from: https://www.marlin.ac.uk/habitat/detail/377.

Tillin, H.M., & Hiscock, K., (2016). Urticina felina and sand-tolerant fauna on sand-scoured or covered circalittoral rock. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 20-03-2018]. Available from: https://www.marlin.ac.uk/habitat/detail/290.

Tillin, H.M. (2016a). Echinocyamus pusillus, Ophelia borealis and Abra prismatica in circalittoral fine sand. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 22-03-2018]. Available from: https://www.marlin.ac.uk/habitat/detail/1131.

Tillin, H.M. (2016b). Moerella spp. with venerid bivalves in infralittoral gravelly sand. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 05-07-2018]. Available from: http://www.marlin.ac.uk/habitat/detail/1111.

Tyler-Walters, H. (2018). Seeps and vents in sublittoral sediments. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 22-03-2018]. Available from: https://www.marlin.ac.uk/habitat/detail/1161.

Weinert, M., Mathis, M., Kröncke, I., Neumann, H., Pohlmann, T., & Reiss, H. (2016). Modelling climate change effects on benthos: Distributional shifts in the North Sea from 2001 to 2099. Estuarine, Coastal and Shelf Science, 175, 157-168. doi:10.1016/j.ecss.2016.03.024.

Yukihira H., Klumpp D. W. & Lucas J. S. (1999). Feeding adaptations of the pearl oysters Pinctada margaritifera and P. maxima to variations in natural particulates. Mar Ecol Prog Ser 182:161-173.

Chapter 15: Fish and Shellfish Ecology

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15 Fish and Shellfish Ecology

15.1 Introduction

This chapter presents the fish and shellfish Ecological Impact Assessment (EcIA) of the proposed HVDC consenting corridor. Both fish and shellfish ecological receptors are considered in this chapter and are evaluated in the context of nature conservation legislation and relevant planning policy (see Chapter 5: Planning Policy). This EcIA presents baseline information, anticipated Impacts upon fish and shellfish receptors during installation and operation, as well as considering potential decommissioning impacts. Mitigation is proposed where appropriate, cumulative impacts are considered, and finally the residual impacts and their significance are assessed.

This chapter is supported by the following Appendices:

- E.1: Electromagnetic Field (EMF) and Sediment Heating literature review: Ecological Recommendations (NorthConnect, 2018)

15.2 Legislation, Policy and Guidance

This section outlines relevant legislation, policy and guidance applicable to the assessment of the potential effects on fish and shellfish ecology associated with installation, operation, and decommissioning phases of the project.

15.2.1 Legislative Framework

There are a number of different legislative instruments that are relevant to the assessment of potential impacts to fish and shellfish communities. These are detailed below:

International

- EC Directive 92/43/EEC on Conservation of Natural Habitats and of Wild Fauna and Flora known as the 'Habitats Directive', adopted in 1992. It was transposed into UK law via the Conservation (Natural Habitats, &c.) Regulations 1994 and Conservation of Habitats and Species Regulations 2010. In Scotland, the Habitats Directive is transposed through a combination of the 1994 and 2010 Regulations. For offshore UK waters (12 nautical miles from the coast out to 200 nm or the limit of the UK Continental Shelf Designated Area) the Habitat Directive is transposed via the Conservation of Offshore Marine Habitats and Species Regulations 2017. Under these regulations, fish species listed in Annex II of the European Union (EU) Habitats Directive which are native to the UK should be conserved through the designation of Special Areas of Conservation (SACs). A number of Special Areas of Conservation (SACs) are designated for the conservation of Atlantic salmon on the North-east coast of Scotland. This species is also included under Schedule IV of the Habitats regulations, as animals which must be captured or killed using certain methods.
- EC Directive 2000/60/EC known as the 'Water Framework Directive' (or WFD) which is the framework for an integrated approach to protection, improvement and sustainable use of water bodies in Europe, and necessitates member states to ensure that they meet 'good status' for ecological and chemical quality elements. This includes coastal waters up to 1 nautical mile offshore, and river and transitional water bodies have a fish quality element that is assessed to determine their status.
- EC Regulation 1100/2007 known as the 'Eel Recovery Plan', which aims to ensure recovery of European eel stocks. Scotland developed its own Eel Management Plan in 2010 under this

Regulation for the Scotland RBD area, and shares responsibility for the Solway-Tweed RBD area with England.

National

- Wildlife and Countryside Act 1981 as amended. Schedule 5 of the Wildlife and Countryside Act provides a list of threatened species for which killing, injuring or taking by any method is prohibited. 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.
- Marine (Scotland) Act 2010 which provides a framework system for improved management and protection of marine and coastal environments in Scottish territorial waters (up to 12NM). It included the establishment of Marine Scotland to act as the competent marine planning authority. It also included the designation of Scottish Marine Protected Areas (MPAs) to protect areas that are key in safeguarding the diversity of nationally rare or threatened and representative habitats and support functioning communities of species. The aim is to supplement existing marine protected areas such as SACs and SPAs. There are more than 180 MPAs in Scotland designated under the Marine (Scotland) Act 2010.
- Marine and Coastal Access Act (MCAA) 2009 which provides the legal mechanism to help ensure clean, healthy, safe, productive and biologically diverse oceans and seas by putting in place a new system for improved management and protection of the marine and coastal environment, for offshore waters around Scotland (from 12NM to the UK Exclusive Economic Zone (EEZ) limit).
- The Nature Conservation (Scotland) Act 2004, which was passed by Scottish Parliament to develop an integrated approach to long term protection and management enforcement measures surrounding Scotland's natural heritage. The Act placed obligations on public bodies to conserve biodiversity, increased protection for SSSIs, amended legislation on Nature Conservation Orders, provided for Land Management Orders for SSSIs and associated land, strengthens wildlife enforcement legislation, and requires the preparation of a Scottish Fossil Code.
- Scottish Biodiversity Strategy, which comprises the 2020 Challenge for Scotland's Biodiversity (response to the Aichi Targets set by the United Nations Convention on Biological Diversity, and the European Union's Biodiversity Strategy for 2020) and supplements Scotland's Biodiversity: It's in Your Hands (2004).

15.2.2 Policy Framework

Further to legislative drivers, there is a policy framework in place to guide the assessment of the project including the following policies:

- UK Marine Policy Statement (MPS) which aims to contribute to attaining sustainable development in marine UK waters and is the main policy in determining marine licence applications.
- United Kingdom Biodiversity Action Plan (UKBAP) which creates actions plans for UK BAP priority species and habitats in the UK. It is succeeded by the UK Post-2010 Biodiversity Framework (2012), which runs from 2011-2020.
- Scottish Biodiversity List which is a list of species and habitats that are considered to be of principal importance for biodiversity conservation in Scotland.

- OSPAR convention, which guides international collaboration on the protection of the marine environment of the North-East Atlantic. Scottish Natural Heritage (SNH) and the Joint Nature Conservation Committee (JNCC), in conjunction with Marine Scotland, have developed a priority list of marine habitats and species in Scotland's seas, known as Priority Marine Features (PMFs) (Howson *et al.*, 2012). The list is intended to ensure that marine planning decisions are consistent, and in line with Marine Scotland's vision for marine nature conservation outlined in the Marine Nature Conservation Strategy. This list of PMFs included a number of fish species which may be present along the proposed consenting corridor.
- Common Fisheries Policy, which comprise rules for managing European fishing fleets and for conserving fish stocks as a common resource. This is discussed further in the commercial fisheries chapter.

15.2.3 Guidance

The following guidance will apply to this assessment:

- The Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment (EcIA) in the UK and Ireland (2016) is the primary source of guidance for the assessment. The aim of the guidance is to promote good practice in EcIA relating to marine, coastal and estuarine environments of the UK. It updates CIEEM’s Terrestrial EcIA 2006 Guidelines and CIEEM’s Marine EcIA Guidelines 2010.
- The International Union for Conservation of Nature (IUCN) has compiled a Red list of threatened species that are facing a high risk of global extinction. The list (IUCN, 2017) includes fish species that may be present in the vicinity of the project.
- The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) produced the OSPAR List of Threatened and/or Declining Species and Habitats, considered to be of conservation concern within the north-east Atlantic (OSPAR, 2008). A number of fish species on the list may be present in the vicinity of the project.
- The Centre for Environment, Fisheries and Aquaculture Science (CEFAS) have developed a guidance document for Environmental Impact Assessment for the licensing of offshore windfarms (CEFAS, 2004). This guidance is not directly applicable to HVDC interconnectors; however, the document provides guidance on the impacts associated with windfarm HVDC transmission links, which are relevant to this project. The guidance states that the installation and operation of HVDC cables has the potential to impact fish. It goes on to state that an Environmental Impact Assessment (EIA) should present information that describes the baseline within the project site, and the wider area, in relation to the presence and importance of fish.
- Assessment of the environmental impacts of cables (OSPAR, 2009), which assesses the environmental impacts of sea cables in terms of their relevance for the area covered by the Convention.

15.2.4 Consultation

Responses to comments made in the Marine Scotland Scoping Opinion (July 2016) and Aberdeenshire Council Scoping Opinion (May 2016) are presented in Chapter 4: Consultation, Table 4.1. Post receipt of the Scoping Opinions, data requests have been placed with Scottish Natural Heritage (SNH), Scottish Environment Protection Agency (SEPA), Marine Scotland and a number of the District Salmon Fisheries Boards (DSFB’s) in January and February 2018. This was done to identify whether these organisations have existing available data, or have conducted any surveys, which may assist in the characterisation of the current status, abundance, distribution and/or diversity of the fish and shellfish populations of the relevant ICES areas IVa and IVb, and Scottish rivers upstream of the project.

A small amount of in-river electrofishing data was provided by SEPA, but no additional marine fisheries or shellfish survey or characterisation data was identified or made available.

15.3 Assessment Methodology

15.3.1 Overview

The identification and assessment of the potential fish and shellfish effects associated with the project was conducted in accordance with the CIEEM guidelines for EcIA (CIEEM, 2016). The method considers the importance (value / sensitivity) of the relevant ecological features and the magnitude of impacts, to determine an overall significance of effect upon these features. This method takes into account effect direction (beneficial or adverse), confidence, extent, duration, timing, frequency and reversibility.

The assessment approach was based on the conceptual 'source-pathway-receptor' model. This model was used to identify the likely impacts resulting from the installation, operation and decommissioning phases of the project. This model provided a transparent assessment route between impact sources and potentially sensitive receptors. The parameters of this model are defined as follows:

- **Source**: the origin of a potential impact (i.e. a project activity leading to an impact). Potential impact sources may have several pathways and receptors. For example, a potential impact source such as jetty foundation installation may result in several potential impacts such as resuspension of sediments, seabed abrasion and removal of substrata or underwater noise, which may each affect a number of receptors via different pathways.
- **Pathway**: the means by which the impact of the activity could influence a receptor. For the example above, resuspended sediment could settle across the seabed, or seabed disturbance could cause temporary or permanent habitat loss.
- **Receptor**: the element of the receiving environment which is affected by an impact. For the example above, demersal fish species living on or in the seabed could be smothered by the deposited sediments which could affect their movement, feeding or respiration.

The assessment was quantitative where suitable data, evaluation and assessment methods were available and otherwise was qualitative, based on a combination of empirical data, published literature and professional judgement.

Iterative steps involved in the assessment approach included:

- Determination of potential impact sources associated with the project (activities) and potential impacts;
- Definition of the fish and shellfish receptors within the zone of influence of the project;
- Determination of potential interactions between impacts and fish and shellfish receptors. At this point some impact / receptor combinations will be screened out, also considering those scoped out in the Scoping Report (NorthConnect, 2016);
- Determination of the value and sensitivity of fish and shellfish receptors;
- Assessment of the magnitude of impacts (considering embedded mitigation measures);
- Assessment of the significance of effects upon fish and shellfish receptors (with embedded mitigation measures in place), including interacting or synergistic effects from the project;

- Proposal of additional mitigation measures to reduce, prevent or where possible offset any significant adverse effects of the project;
- Assessment of the residual effects (i.e. effects after any additional mitigation measures have been considered); and
- Assessment of cumulative effects upon fish and shellfish receptors, considering other plans or projects in development. A full list of the other plans or projects considered is presented in Chapter 6: Cumulative Effects.

Further details for the assessment approach are provided in Section 15.3.4.

15.3.2 Desk Study

To enable the definition of fish and shellfish receptors and an assessment of potential effects of the project on these receptors, it was necessary to first establish the baseline (or existing) environment by conducting a desk-based review of grey and published literature, and examining available data including previous surveys conducted in the vicinity of the project.

Key data sources and information obtained from the desk-based review for fish and shellfish is summarised in Section 15.4 below. It was concluded that sufficient data for the fish and shellfish receptors likely to be affected by the project was available to conduct the assessment, supplemented by the detailed seabed habitat data collected by the benthic ecology field survey as described in Chapter 14: Benthic Ecology, Section 14.3.3, and no further targeted field surveys would significantly improve the confidence in the assessment.

15.3.3 Field Surveys

As discussed in Section 15.3.2 above, no targeted field surveys for fish and shellfish receptors have been conducted.

15.3.4 Impact Assessment Methodology

The general approach to the EIA is described in Chapter 3: Methodology, including the approach to assessing the significance of effects based on the magnitude of impact and value/sensitivity of receptor. The following section should therefore be read in conjunction with Chapter 3: Methodology.

The value of each fish and shellfish receptor was determined based on consideration of the factors outlined in Table 15.1.

Table 15.1 Receptor Value Criteria for Fish and Shellfish

Value	Definition
Very High	• An internationally designated site or potential/candidate site for designation (SPA, pSPA, SAC, cSAC, pSAC or Ramsar site) or an area which the Statutory Nature Conservation Body (SNCB) has determined meets the published selection criteria for such designation, irrespective of whether or not it has yet been notified. • Internationally significant and viable areas of a habitat type listed in Annex 1 of the Habitats Directive. • Globally threatened species (Critically endangered or endangered on IUCN Red list) or species listed on Annex 1 or 2 of the Bern Convention. • Regularly occurring populations of internationally important species that are rare or threatened in the UK or of uncertain conservation status. • A regularly occurring, nationally significant population/number of any internationally important species. • Habitats or species that are highly regarded for their important biodiversity, social, community and / or economic value.
High	• A nationally designated site (such as a Site of Special Scientific Interest (SSSI), National Nature Reserve (NNR), Marine Nature Reserve (MNR) or Marine Conservation Zone (MCZ)) or a discrete area which the SNCB has determined meets the published selection criteria for national designation (such as SSSI selection guidelines) irrespective of whether or not it has yet been notified. • Regularly occurring, globally threatened species (Vulnerable or lower on IUCN Red list) or species listed on Annex 3 of the Bern Convention. • UK Post-2010 Biodiversity Framework habitats and species, Priority Marine Features or Scottish Biodiversity List • Habitats or species that possess important biodiversity, social, community and / or economic value.
Medium	• Viable areas of key habitat identified in the Regional/County BAP or smaller areas of such habitat which are essential to maintain the viability of a larger whole. • Viable areas of key habitat identified as being of Regional value in the appropriate Natural Area profile. • Water Framework Directive biological quality element. • Any regularly occurring significant population that is listed in a Local Red Data Book. • Significant populations of a regionally/county important species. • Habitats or species that possess moderate biodiversity, social, community and / or economic value.

Value	Definition
Low	• Areas of habitat identified in a sub-County (District/Borough) BAP or in the relevant Natural Area profile. • District sites that the designating authority has determined meet the published ecological selection criteria for designation, including Local Nature Reserves selected on District/Borough ecological criteria (District sites, where they exist, will often have been identified in local plans). • Sites/features that are scarce within the District/Borough or which appreciably enrich the District/Borough habitat resource. • Habitats or species that are abundant, common or widely distributed. • Habitats or species that possess low biodiversity, social, community and / or economic value.
Negligible	• No site designation for areas of habitat. • Species present are common and widespread. • Habitats or species that are not considered important for their biodiversity, social, community and / or economic value.

The magnitude of impacts were assessed based on consideration of the criteria in Table 15.2 and taking into account the application of any embedded mitigation measures to be incorporated at the installation, operation or decommissioning phases. Where embedded mitigation has been considered this has been clearly indicated within the impact assessment.

Table 15.2 Impact Magnitude Criteria for Fish and Shellfish.

Magnitude	Definition
Major	**Habitat:** Impact causes changes to a large proportion of the receptor habitat extent or community composition, resulting in change of function of the wider habitat, that is not reversible through natural recruitment or recolonisation (permanent effect) or not reversible for several generations (temporary, long-term effect). **Species:** Impact causes changes to a large proportion of the receptor species population, resulting in a decline in the abundance of the overall population, that is not reversible through natural recruitment or recolonisation (permanent effect) or not reversible for several generations (temporary, long-term effect).
Moderate	**Habitat:** Impact causes a change to part of the receptor habitat extent or community composition, but does not result in change of function of the wider habitat, that is not reversible through natural recruitment or recolonisation (permanent effect) or not reversible for several generations (temporary, long-term effect) **or** impact causes changes to a large proportion of the receptor habitat extent or community composition, resulting in change of function of the wider habitat, that is reversible through natural recruitment or recolonisation in up to two generations (temporary, short-term effect). **Species:** Impact causes a change to part of the receptor species population but does not result in a decline in the abundance of the overall population, that is not reversible through natural recruitment or recolonisation (permanent effect) or not reversible for several generations (temporary, long-term effect) **or** impact causes a change to a large proportion of the receptor species population resulting in a decline in the abundance of the overall population, that is reversible through natural recruitment or recolonisation in up to two generations (temporary, short-term effect).
Minor	**Habitat:** Impact causes a change to part of the receptor habitat extent or community composition, but does not result in change of function of the wider habitat, that is reversible through natural recruitment or recolonisation in up to two generations (temporary, short-term effect). **Species:** Impact causes a change to part of the receptor species population but does not result in a decline in the abundance of the overall population that is reversible through natural recruitment or recolonisation in up to two generations (temporary, short-term effect).
Negligible	**Habitat:** Impact causes an effect on the receptor habitat that is not likely to change the extent or community composition of the wider habitat. **Species:** Impact causes an effect on the receptor species population that is undetectable or within the range of natural variation.
No Change	Impact causes no effect or has no interaction with the receptor.

Based on the value/sensitivity of the receptor and the magnitude of the potential impact, the significance of effect was then determined based on consideration of the matrix in Table 15.3.

Table 15.3 Categorising Significance of Effects for Fish and Shellfish.

Magnitude of Impact	Sensitivity/Value of Receptor				
	Very High	**High**	**Medium**	**Low**	**Negligible**
Major	Major	Major	Moderate	Minor	Minor
Moderate	Major	Moderate	Moderate	Minor	Negligible
Minor	Moderate	Moderate	Minor	Minor	Negligible
Negligible	Minor	Minor	Negligible	Negligible	Negligible
No Change	No Change	No Change	No Change	No Change	No Change

Key:

	Significant Effect
	Non-Significant Effect

For the purposes of this EIAR, an impact which has the potential to result in a significant effect on the environment has been defined as a moderate or major significance of effect (see Table), and mitigation is proposed where possible to prevent, reduce or offset the effect. Residual effects on fish and shellfish receptors (i.e. effects following implementation of specific mitigation measures) were then identified and their significance determined.

Consequently, a significance of effect determined to be minor or lower is considered not to be significant in terms of the EIA Regulations. For these effects, secondary mitigation measures have not been proposed to reduce the significance of the effect.

For each significance of effect determined for each receptor/impact combination, the assessment has indicated whether the effect is beneficial or adverse, and an assessment of the confidence in the assessment has been provided. The definitions for classifying the confidence in the assessment are provided in Table 15.4.

Table 15.4 Confidence in Assessment of Significance of Effects

Confidence	Guideline	Evidence base to evaluate likelihood of effects
High	Probability estimated at 95% chance or greater	Scientific evidence and project information is detailed, consistent and extensive. Studies are based on consideration of same pressures arising from similar activities, acting on the same type of receptor in comparable areas (i.e. UK).
Medium	Probability estimated above 50% but below 95%	Scientific evidence and project information is available but variable in detail, consistency and volume. Studies are based on consideration of same pressures arising from similar activities, acting on the same type of receptor in comparable areas (i.e. UK) or similar pressures on receptor/similar receptor in other areas (i.e. outside UK).
Low	Probability estimated at below 50%	Scientific evidence and project information is limited in availability, and variable in detail, consistency and volume. Studies are not based on consideration of same pressures arising from similar activities, acting on the same type of receptor in comparable areas (i.e. UK) or similar pressures on receptor/similar receptor in other areas (i.e. outside UK), but are based on more distant habitats, species or populations being affected by other pressures.

15.3.5 Limitations of Assessment

Conditions at or near to the project will be subject to change over time, with species movement both into and out of the area, and habitat changes. Therefore, this assessment reflects the conditions recorded at the time of the project-specific surveys and most recent desk study data available, as well as consideration of existing knowledge on the potential trends in the baseline in the future.

Description of the baseline for fish and shellfish has relied on a variety of published data sources of varying ages and survey methods, each with their own uncertainties and limitations, to develop the understanding of likely species populations present, and their extent, abundance and health.

15.4 Baseline Information

To develop an understanding of the fish and shellfish environmental baseline, a desk-based review was undertaken to characterise the diversity, abundance and distribution of relevant fish and shellfish species likely to be present within the vicinity of the project. This desk-based review was supported by the benthic ecology surveys conducted by NorthConnect (and described further in Chapter 14: Benthic Ecology) to identify the presence of certain habitats important for spawning fish. Sources of information included:

- Published data on diversity, abundance and spawning areas of fish and shellfish in the North Sea;
- Available fisheries survey data and records from Marine Scotland, SEPA and ICES; and

- Relevant academic literature and papers, reports and books.

The Greater North Sea, shown in Figure 15.1, is inhabited by approximately 230 species of fish (OSPAR, 2013). For the purposes of describing the fish and shellfish baseline for the project, species have been split into the following categories:

- Designated sites (for fish and shellfish species);
- Diadromous fish species;
- Elasmobranch species;
- Marine demersal fish species;
- Marine pelagic fish species;
- Cephalopods;
- Crustaceans;
- Molluscs; and
- Spawning and nursery grounds.

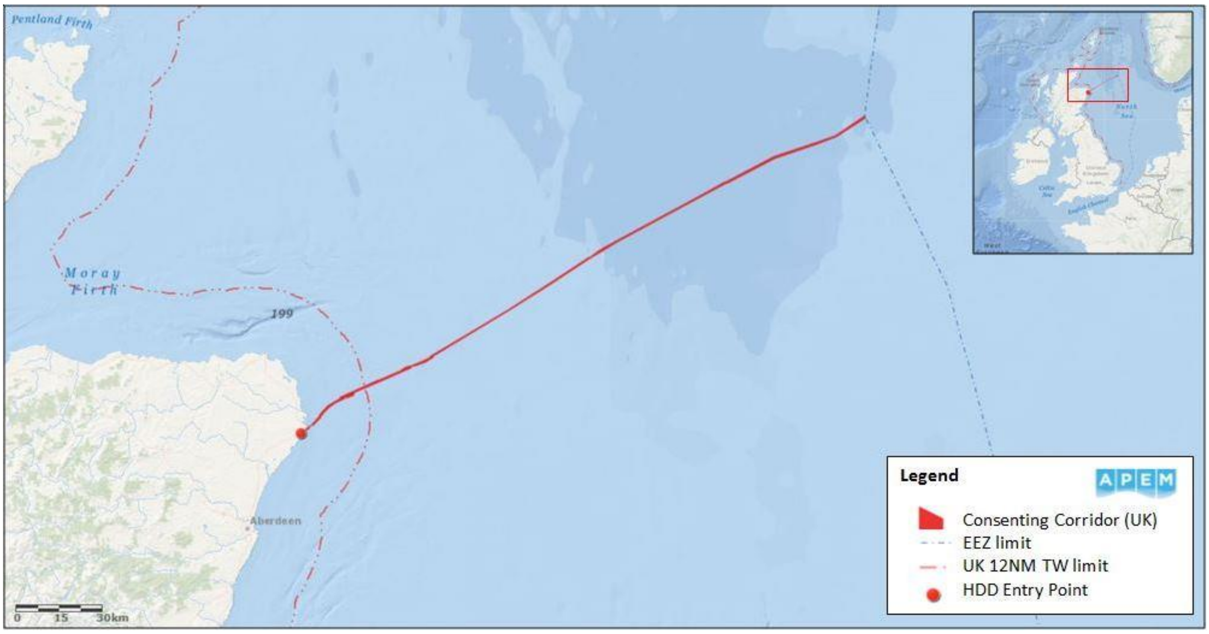


Figure 15.1 The Greater North Sea in UK Waters, between the coast of Scotland and Norway and the NorthConnect Consenting Corridor.

15.4.1 Designated Sites (for Fish and Shellfish Species)

The following sites within the vicinity of the project, shown in Figure 15.2, have been designated for their fish and shellfish species and populations under The Conservation of Habitats and Species Regulations 2010, Marine (Scotland) Act 2010, Conservation of Offshore Marine Habitats and Species Regulations 2017 and the Marine and Coastal Access Act 2009. Given the mobile nature of many fish species and their extensive migrations, those sites that the project is within or adjacent to are considered, and also those sites where individuals from the population may migrate past the consenting corridor as part of their lifecycle. These sites are designated for protection from development and other activities that may affect their biodiversity interest.

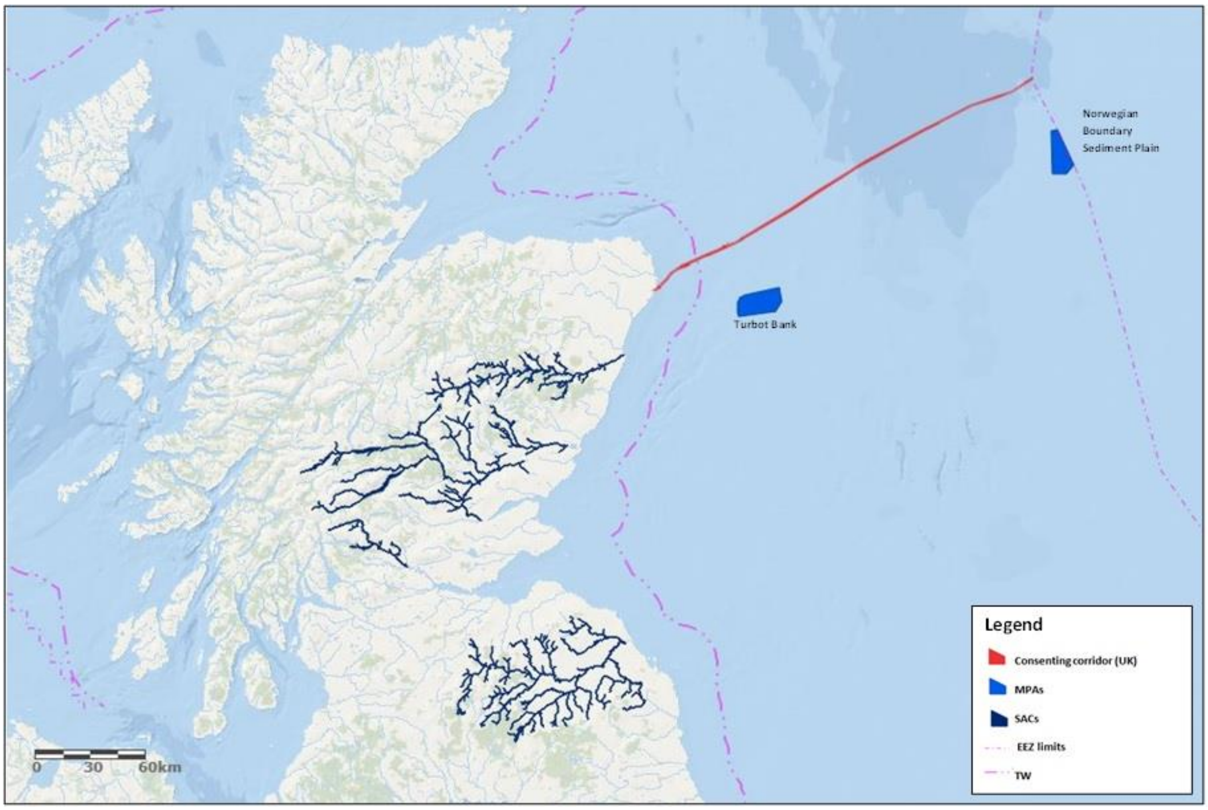


Figure 15.2 Designated sites (Special Areas of Conservation (SACs) and Marine Protected Areas (MPAs) within the Vicinity of the Project.

15.4.1.1 River Dee SAC

The River Dee and its tributaries, approximately 40km to the south west of the project, have been designated as a SAC as they provide a valuable habitat for important populations of several Annex II fish and shellfish species including Atlantic salmon *Salmo salar* and freshwater pearl mussel *Margaritifera margaritifera*.

15.4.1.2 River South Esk SAC

The River South Esk, approximately 95km to the south west of the project, has been designated as a SAC as it provides a valuable habitat for important populations of fish and shellfish species Atlantic salmon and freshwater pearl mussel.

15.4.1.3 River Tay SAC

The River Tay, approximately 125km to the south west of the project, has been designated as a SAC for its populations of Atlantic salmon, sea lamprey, brook lamprey and river lamprey *Lampetra fluviatilis*.

15.4.1.4 River Teith SAC

The River Teith, approximately 225km to the south west of the project, has been designated as a SAC for its populations of sea lamprey, brook lamprey, river lamprey and Atlantic salmon.

15.4.1.5 River Tweed SAC

The River Tweed, 200km to the south of the project, has been designated as a SAC for its populations of Atlantic salmon, sea lamprey, river lamprey and brook lamprey.

15.4.1.6 Turbot Bank MPA

The Turbot Bank Marine Protected Area (MPA) is located approximately 30km to the south of the project, and is designated for sandeels (*Ammodytes* spp.), as it encompasses an area where high numbers of sandeels have been found. Sandeels are designated as a Scottish Priority Marine Feature (PMF).

15.4.1.7 Norwegian Boundary Sediment Plain MPA

The Norwegian Boundary Sediment Plain MPA is located approximately 20km to the south of the project. It is designated for its ocean quahog *Arctica islandica* aggregations (including sands and gravels as their supporting habitat) and aims to protect them from potential deterioration from fishing activity. The ocean quahog is designated as a Scottish PMF.

15.4.1.8 Summary of Designated Sites

A summary of the fish and shellfish designated site receptors, along with their assigned value is presented in Table 15.5.

Table 15.5 Summary of Designated Site Receptors

Designated site receptor	Fish and shellfish qualifying feature species	Designated site receptor value	Justification
River Dee SAC	Atlantic salmon Freshwater pearl mussel	**Very high**	An internationally designated site (SAC)
River South Esk SAC	Atlantic salmon Freshwater pearl mussel	**Very high**	An internationally designated site (SAC)
River Tay SAC	Atlantic salmon River lamprey Sea lamprey Brook lamprey	**Very high**	An internationally designated site (SAC)
River Teith SAC	Atlantic salmon River lamprey Sea lamprey Brook lamprey	**Very high**	An internationally designated site (SAC)
River Tweed SAC	Atlantic salmon River lamprey Sea lamprey Brook lamprey	**Very high**	An internationally designated site (SAC)
Turbot Bank MPA	Sandeel species	**High**	A nationally designated site (MPA)
Norwegian Boundary Sediment Plain MPA	Ocean quahog	**High**	A nationally designated site (MPA)

15.4.2 Diadromous Fish Species

Diadromous fish species comprise those that migrate from saltwater to freshwater to spawn (anadromous migrants) and those that migrate from freshwater to saltwater to spawn (catadromous migrants). Relevant diadromous species that are likely to pass the project either as part of their spawning migrations, or during foraging or maturation lifestages are:

- Atlantic salmon *Salmo salar*;
- Anadromous brown trout (or "sea trout") *Salmo trutta*;
- Sea lamprey *Petromyzon marinus;*
- River lamprey *Lampetra fluviatilis;* and
- European eel *Anguilla anguilla*.

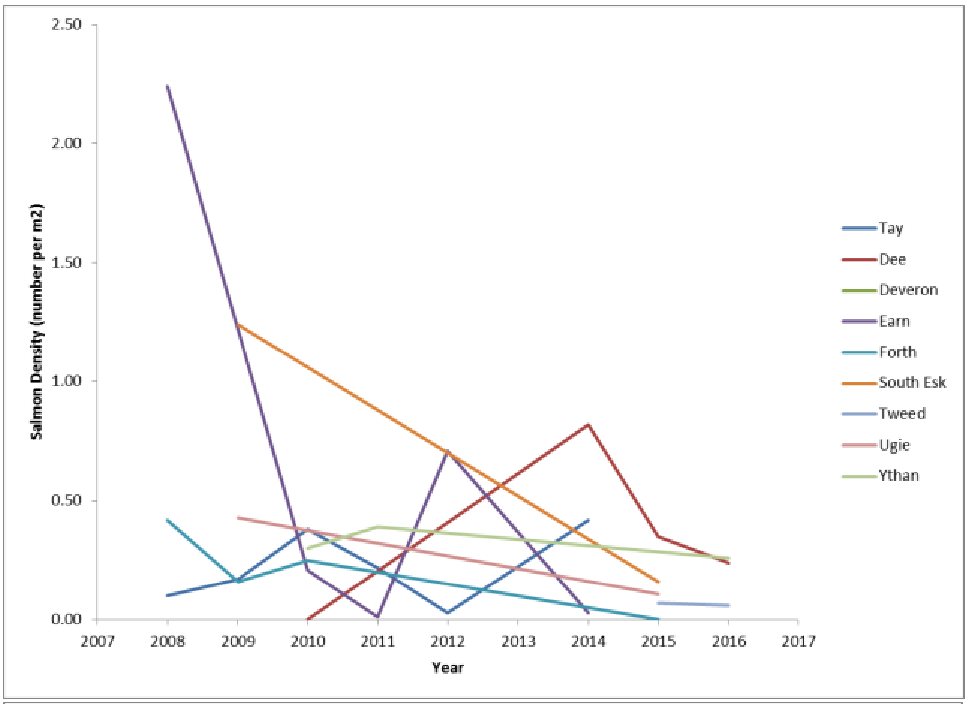
Atlantic salmon, sea trout, river lamprey and sea lamprey are all anadromous, and as such their spawning and nursery grounds are located in fresh water rivers (Maitland, 2004; Malcolm *et al.*, 2010). The European eel is catadromous, and reproduces in saltwater. Current understanding is that European eels spawn in the Sargasso Sea (Schmidt, 1923; Miller et al., 2014), but with the potential for other more distant spawning grounds (van Ginneken and Maes, 2005).

Spawning populations of Atlantic salmon are known to be present along numerous rivers on the eastern coast of Scotland and England, with the closest being the River Ugie, which enters the sea approximately 7km north of the project, and the River Ythan, 20km to the south. Other nearby rivers with larger Atlantic salmon populations are the River Tay, River Dee, River Deveron, River Earn, River Forth, River South Esk and River Tweed. Atlantic salmon post-smolts migrate to foraging grounds to the west of Greenland and the Faroe Islands, and as such the individuals leaving their rivers as post-smolts will migrate in a general northward direction to their foraging and maturation grounds (Malcolm *et al.*, 2010). Individuals departing from or returning to the rivers listed above will therefore, have to cross the consenting corridor during their migration.

Less information is available on the migration of sea trout on the east of Scotland, with only limited tracking work conducted on the Scottish West Coast and in Norway, as well as mark-recapture studies undertaken from the South Esk and Brvie (Malcolm, 2010; Nall, 1935; Shearer, 1990). These studies indicated that sea trout in general remain within approximately 10 nautical miles (NM) from their natal rivers, however some larger migrations exceeding 200NM were recorded. Individuals leaving their rivers along the east coast of Scotland as post-smolts may also therefore move into the vicinity of the project in the course of their marine migration and residency phase.

Juvenile electrofishing data and adult rod catch data from SEPA [received January 2018] for a series of rivers on the east coast of Scotland with appreciable Atlantic salmon and sea trout populations is presented in Figures 15.3-15.5. From this data, it would appear that densities of juvenile Atlantic salmon have declined in the last 10 years on the rivers Earn, South Esk, Ugie and Forth, whilst on the Dee and Ythan there has been an increase in density, before declines in recent years. Trout densities have varied historically in these rivers with no clear trend evident.

Rod catches of Atlantic salmon adults collated by SEPA [received January 2018] in the Rivers Deveron, Ythan, South Esk, Forth and Tay have remained relatively consistent since the 1950's. Catches in the Dee have declined since 1952, whilst catches in the Tweed have increased since 1952. Rod catches were highest in the Tweed and the Tay, which are two notable rivers for salmon populations and salmon fishing in Scotland. More recently, however, slight decreases in rod catches are noticeable from the time series. For trout, recorded rod catches decreased since 1952 in the Rivers Ythan and Ugie, remained stable on the Deveron and Tay and increased in the Dee, Forth and Tweed.



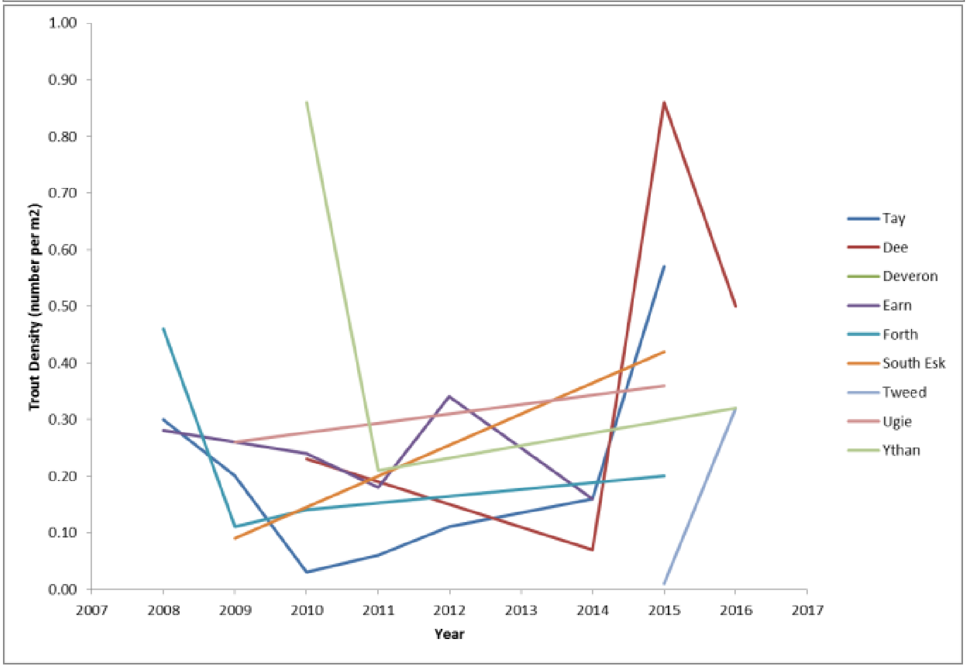
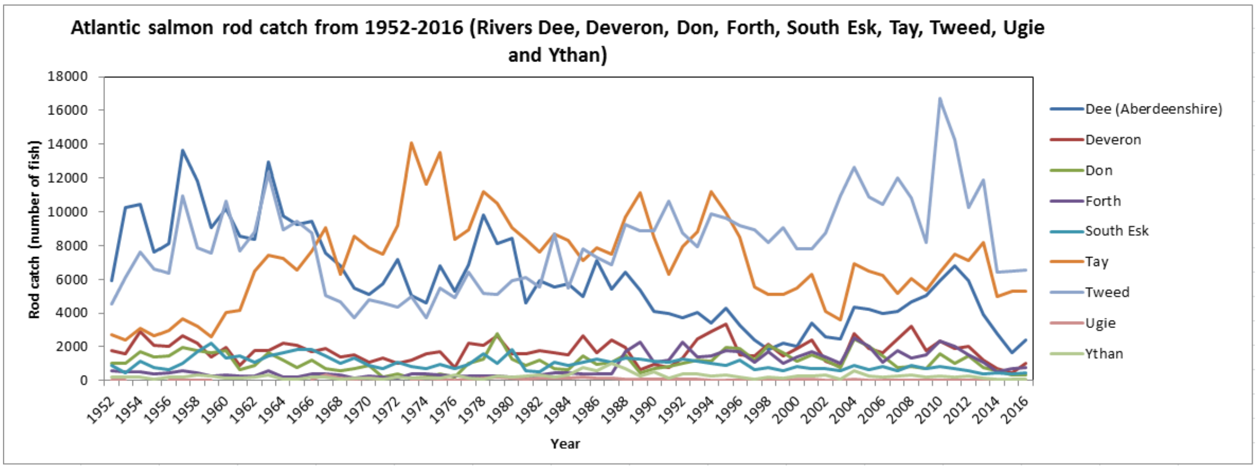


Figure 15.3 Atlantic Salmon and Sea Trout Juvenile Densities in Scottish Rivers from 2007 to 2016



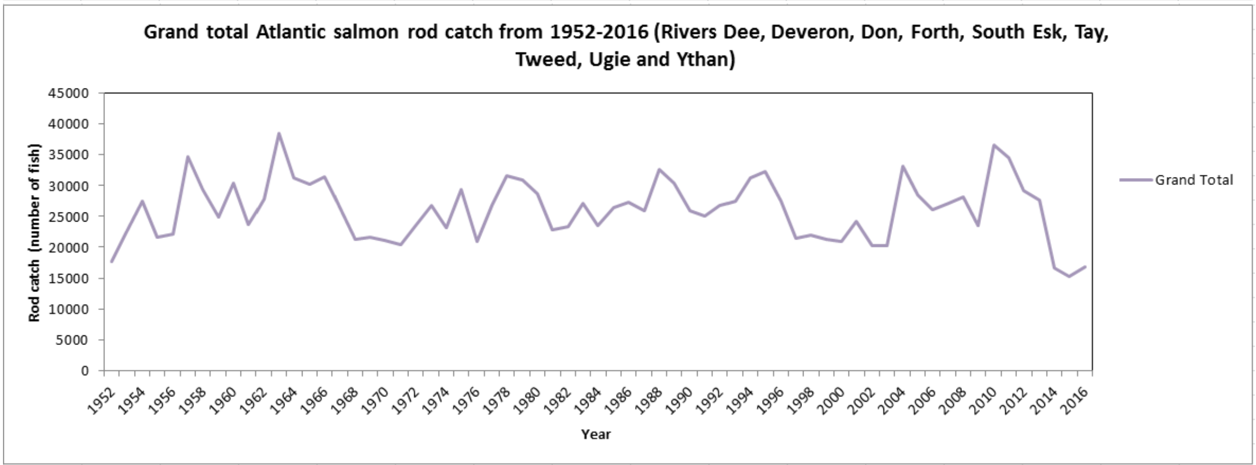


Figure 15.4 Atlantic Salmon Rod Catches in Scottish Rivers from 1952-2016.

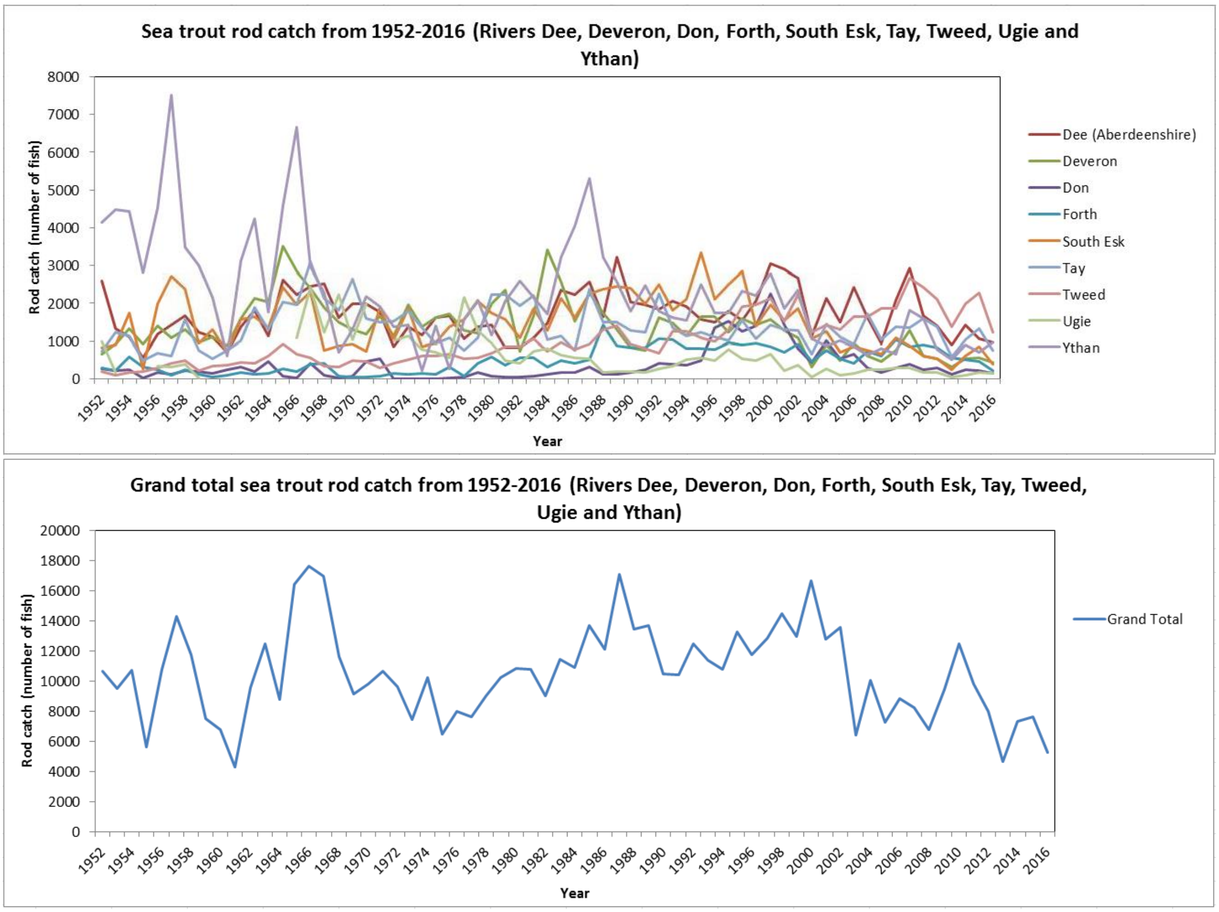


Figure 15.5 Sea Trout Rod Catches in Scottish rivers from 1952-2016

Very little information is known about the marine distribution and migration routes of the river lamprey, sea lamprey or European eel, however, the species are known to utilise rivers on the eastern coast of Scotland for spawning and foraging or, in the case of European eel, foraging only (Malcolm *et al.*, 2010; van Ginneken and Maes, 2005; Maitland, 2004). It is therefore likely that these species will be present within the vicinity of the consenting corridor during marine migration or residency.

European smelt *Osmerus eperlanus,* Atlantic sturgeon *Acipenser sturio,* twaite shad *Alosa fallax* and allis shad *Alosa alosa* may also be present in the vicinity of the consenting corridor during their periods of marine residency but their presence is likely to be rare given there are no spawning populations in Scottish Waters (Maitland, 2003; Aprahamian et al. 2003; Maitland and Lyle, 1996), and are therefore not considered further within the assessment.

Given the nature of the watercourses along the onshore cable corridor as small drains and the lack of connectivity with the sea due to the presence of the Longhaven Cliffs, they are not anticipated to support appreciable populations of any of these diadromous fish species and so are not considered further.

15.4.2.1 Summary of Diadromous Fish Species Receptors

A summary of the diadromous fish species receptors relevant to the project, along with their assigned value is presented in Table 15.6.

Table 15.6 Summary of Diadromous Fish Species Receptors

Diadromous fish species receptor	Diadromous fish species receptor value	Justification
Atlantic salmon *Salmo salar*	**Very high**	Habitats Directive Annex II Species
Sea trout *Salmo trutta*	**High**	Priority Marine Feature (PMF)
European eel *Anguilla anguilla*	**Very high**	IUCN Red List 'Critically Endangered'
Sea lamprey *Petromyzon marinus*	**Very high**	Habitats Directive Annex II Species
River lamprey *Lampetra fluviatilis*	**Very high**	Habitats Directive Annex II Species

15.4.3 Elasmobranch Species

Elasmobranchs are cartilaginous fish comprising sharks, skates and rays, and are characterised by slow growth, late maturity, low fecundity and productivity. Twelve of the elasmobranch species on the UK Post-2010 Biodiversity Framework list occur within Scottish waters. These are listed in Table 15.7 along with their associated legal and policy protection. The other elasmobranch species on the UK Post-2010 Biodiversity Framework which are excluded are the shortfin mako *Isurus oxyrinchus*, undulate ray *Raja undulata* and white skate *Rostroraja alba*, which given their geographic extent are unlikely to be present within the vicinity of the project. Other elasmobranch species, such as the Spotted ray *Raja montagui* and thornback ray *Raja clavata,* are also known to inhabit the waters around the project (Paramor *et al*, 2009).

Currently elasmobranch species in the North Sea are subject to spatial management measures, due to historic exploitation by targeted fisheries severely depleting stocks. In recent times, bycatch from demersal fisheries continues to impede recovery of many species (ICES, 2012).

Basking sharks are listed as "Endangered" on the Red List of European marine fish (Nieto *et al.*, 2015). Marked seasonality of basking shark sightings and significant correlation between the duration of the sightings season in each year and the North Atlantic Oscillation, has been reported (Witt *et al.*, 2012). Results within ICES (2017a) indicate a relatively large stock, and/or that the stock size may not be adequately traced by surface sightings.

Both the spurdog and tope shark give birth to live young, however, there is insufficient data available to establish the locations and temporal stability of the parturition grounds of these species (Ellis *et al.*, 2012). The common skate and spotted ray both deposit egg cases on hard substrate on the sea bed, but again, there is insufficient data on the occurrence of egg-cases, or egg-bearing females with which to delineate spawning grounds (Ellis *et al.*, 2012). As the majority of the consenting corridor is soft substrate (see Chapter 14: Benthic Ecology and MMT, 2017) then limited deposition of eggs of these species along the consenting corridor is expected.

Fisheries data indicates extremely high levels of population depletion of common skate around the UK since the early 20th century, and it has been extirpated from most inshore areas, but is still caught in Scottish waters (Abdulla, 2004; Dulvy *et al.*, 2006).

Table 15.7 Marine Elasmobranchs in Scottish Waters with Legislation and Convention Protection

Species	**UK Post-2010 Biodiversity Framework**	**Scottish Biodiversity List**	**OSPAR Annex V.**	**IUCN Red List**	**Priority Marine Feature**	**Wildlife and Countryside Act 1981 (as amended in 1985)**	**The Conservation of Habitats and Species Regulations 2010**	**Convention on the Conservation of European wildlife and natural habitats (Bern Convention)**	**Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)**
Angel Shark *Squatina squatina*	y		y	y		y			
Basking Shark *Cetorhinus maximus*	y	y	y	y	y	y		y	y
Blue Shark *Prionace glauca*	y			y					
Common Skate *Dipturus batis*	y	y	y	y	y				
Gulper Shark *Centrophorus granulosus*	y		y	y					
Kitefin Shark *Dalatias licha*	y								
Leafscale gulper shark *Centrophorus squamosus*	y		y	y	y				
Porbeagle Shark *Lamna nasus*	y		y	y	y			y	
Portuguese Dogfish *Centroscymnus coelolepis*	y		y	y	y				
Sandy Ray *Leucoraja circularis*	y			y	y				
Spurdog or Spiny Dogfish *Squalus acanthias*	y		y	y	y				
Tope Shark *Galeorhinus galeus*	y			y					

15.4.3.1 Summary of Elasmobranch Species Receptors

A summary of the elasmobranch species receptors relevant to the project, along with their assigned value is presented in Table 15.8.

Table 15.8 Summary of Elasmobranch Species Receptors

Elasmobranch species receptor	Elasmobranch species receptor value	Justification
Angel Shark *Squatina squatina*	**Very High**	IUCN Red List 'Critically Endangered'
Basking Shark *Cetorhinus maximus*	**Very High**	Habitats Directive Annex II Species
Blue Shark *Prionace glauca*	**High**	UK Post-2010 Biodiversity Framework Species
Common Skate *Dipturus batis*	**Very High**	IUCN Red List 'Critically Endangered'
Gulper Shark *Centrophorus granulosus*	**High**	UK Post-2010 Biodiversity Framework Species
Kitefin Shark *Dalatias licha*	**High**	UK Post-2010 Biodiversity Framework Species
Leafscale gulper shark *Centrophorus squamosus*	**High**	UK Post-2010 Biodiversity Framework Species, PMF
Porbeagle Shark *Lamna nasus*	**High**	Bern Convention Annex III Species, UK Post-2010 Biodiversity Framework Species, PMF
Portuguese Dogfish *Centroscymnus coelolepis*	**High**	UK Post-2010 Biodiversity Framework Species, PMF
Sandy Ray *Leucoraja circularis*	**Very High**	IUCN Red List 'Endangered'
Spurdog or Spiny Dogfish *Squalus acanthias*	**High**	UK Post-2010 Biodiversity Framework Species, PMF
Tope Shark *Galeorhinus galeus*	**High**	UK Post-2010 Biodiversity Framework Species
Other elasmobranch species (e.g. spotted ray *Raja montagui*, thornback ray *Raja clavata*)	**Medium**	Not UK Post-2010 Biodiversity Framework species, not PMFs, not IUCN Red List 'Endangered' or 'Critically Endangered', not on Habitats Directive Annex II or Bern Convention Annex III.

15.4.4 Marine Demersal Fish Species

Demersal fish live on, or near, the seabed and are bottom-feeders. Those found in the North Sea in the vicinity of the project area include Atlantic cod, haddock and plaice, and these are the three main demersal species landed by the UK fleet in terms of weight (MMO, 2016). Demersal fish distribution is driven predominantly by abiotic factors (e.g. sediment type hydrography), although biotic processes including predator-prey interactions and interspecific competition are also important. The following demersal species are likely to occur along the project area (Coull *et al.*, 1998, Paramor *et al.*, 2009, and Ellis *et al.*, 2012) as part of the wider demersal fish assemblage:

- Anglerfish / sea monkfish *Lophius piscatorius;*
- Atlantic cod *Gadus morhua;*
- Atlantic halibut *Hippoglossus hippoglossus*;
- Blue ling *Molva dypterygia;*
- Common goby *Pomatoschitus microps;*

- Common sole *Solea solea;*
- European hake *Merluccius merluccius;*
- European plaice *Pleuronectes platessa;*
- Greenland halibut *Reinhardtius hippoglossoides*;
- Haddock *Melanogrammus aeglefinus;*
- Lemon sole *Microstomus kitt;*
- Ling *Molva molva;*
- Norway pout *Trisopterus esmarkii;*
- Saithe *Pollachius virens;*
- Sand goby *Pomatoschitus minutus;*
- Sandeel *Ammodytes spp.; and*
- Whiting *Merlangius merlangus.*

Sandeel in particular are a keystone species, important to the food webs in the North Atlantic, as they are the primary prey species of numerous marine predators including marine mammals, seabirds, and other fish species (ICES, 2017b; JNCC, 2014; Marine Scotland, 2017). Their spawning habitat requirements are discussed in more detail in Section 15.4.9 below, whilst their relevance to Turbot Bank Marine Protected area is discussed in Section 15.4.1.6. Sandeel activity patterns have strong seasonal components. During autumn and winter they hibernate in the seabed, generally in coarse sands or fine gravel. During spring and summer they exhibit diurnal movements between the seafloor, where they bury themselves at night, and the water column, where they feed on plankton during daylight (Wright *et al.*, 2000; Holland *et al.*, 2005; Winslade, 1974; Freeman *et al.*, 2004). Wright *et al.* (2000) showed that 80-90% of sandeels were buried between 10pm and 6am, 20-50% were buried between 6am and 8am, 15-30% were buried between 8am, and 4pm and 20-60% were buried between 4pm and 10pm.

Atlantic cod is one the most popular commercial species and, as a result, has been fished considerably in UK waters. They can often be found in large, dense shoals. Atlantic cod are productive breeders and spawning occurs between February and April. Similarly, Haddock is a valuable commercial species, exploited commercially in both mixed trawl and seine fisheries. It is also bycaught in langoustine fisheries (Hedger *et al.*, 2004).

The majority of these species are either species listed on Annex III of the Bern Convention, are a Scottish Priority Marine Feature or are listed as a UK Post-2010 Biodiversity Framework species. Therefore, as a group, marine demersal fish species have been assigned a receptor value of **High**. Atlantic halibut is listed on the IUCN Red List as 'Endangered' and therefore has been assigned a receptor value of **Very High.**

15.4.5 Marine Pelagic Fish Species

Pelagic fish inhabit the water column, rather than being close to the bottom as demersal fish are. Distribution and abundance of pelagic fish are strongly linked to hydrographic conditions, although bathymetric and biotic conditions are also important (Maravelias, 1999). Hydrographic factors influence distribution, through the drift of larvae and eggs in ocean currents. Bathymetry is important in the selection of spawning and nursery grounds, while biotic factors such as food availability influence migration patterns between spawning and feeding grounds (Maravelias, 1999). This results in the spatial distribution and abundance of pelagic fish varying significantly between years. The following pelagic species are likely to occur in the vicinity of the consenting corridor (Coull *et al.*, 1998;

Paramor *et al.*, 2009; Ellis *et al.*, 2012) as part of the wider pelagic fish assemblage (also including the diadromous species and some of the elasmobranch species discussed above):

- Atlantic bluefin tuna *Thunnus thynnus*;
- Atlantic herring *Clupea harengus*;
- Atlantic mackerel *Scomber scombrus;*
- Black scabbardfish *Aphanopus carbo;*
- Blue whiting *Micromesistius poutassou;*
- European sprat *Sprattus sprattus;*
- Horse mackerel *Trachurus trachurus;*
- Orange roughy *Hoplostethus atlanticus;* and
- Roundnose grenadier *Coryphaenoides rupestris;*

The majority of these species are either species listed on Annex III of the Bern Convention, are a Scottish Priority Marine Feature or are listed as a UK Post-2010 Biodiversity Framework species. Therefore, as a group, marine pelagic fish species have been assigned a receptor value of **High**. Roundnose grenadier is listed on the IUCN Red List as ’Critically endangered’ and therefore has been assigned a receptor value of **Very High.**

15.4.6 Cephalopods

Cephalopods are short-lived, carnivorous invertebrates encompassing squids, nautiluses and octopuses. These species are characterised by rapid growth rates and play an important part in food-webs. There are at least 48 species of cephalopod in the UK (Stephen, 1944), but the main cephalopods of economic importance in the northeast Atlantic are:

- Long-finned (loliginid) squids *Loligo forbesi* and *Loligo vulgari;*
- Short-finned (ommastrephid) squids *Todarodes sagittatus, Todaropsis eblanae and Illex coindetii;*
- Cuttlefish *Sepia officinalis;* and
- Octopuses *Octopus vulgaris* and *Eledone cirrhosa.*

In general, the main Scottish fishery for long-finned squid takes place in coastal waters and exhibits a marked seasonal peak around October and November, corresponding to the occurrence of pre-breeding squid (Young *et al.*, 2006). Cuttlefish catches are mainly located in the English Channel and adjacent waters, the French Atlantic coast and the Bay of Biscay (Denis and Robin, 2001). Octopus fisheries are important in southern Europe, but landings from the North Sea are limited. No cephalopods are listed as Habitats Directive Annex II species, species listed on Annex III of the Bern Convention, PMFs or UK Post-2010 Biodiversity Framework species. The fishery is relatively small, and the species have limited biodiversity or community value, therefore they are considered to be of a **Low** receptor value.

15.4.7 Crustaceans

Crabs and langoustine (*Nephrops norvegicus*) are the two of the three main landings from the waters along the consenting corridor (MMO, 2016), with the third being scallops, discussed further in Section 15.4.8 below. Common lobster (*Homarus gammarus*) are also regularly fished within Scottish Waters and the North Sea. Commercial fisheries for crustaceans in the vicinity of the project are discussed further in Chapter 20: Commercial Fisheries.

Common lobster is found on rocky areas, living in holes and excavated tunnels from the lower shore to approximately 60m depth and can grow up to 1m in length, though 50cm individuals are more common (Wilson, 2008). Langoustine are smaller, growing to a maximum length of 25cm and are usually found in soft sediments and at water depths of greater than 200m (Sabatini and Hill, 2008). The consenting corridor crosses some areas of circalittoral muddy sand, which may be characterised by burrowing megafauna such as langoustine (MMT, 2017). The consenting corridor passes through Fladen Ground, which is indicated by OSPAR as a langoustine spawning area (OSPAR, 2010), and sea pen and burrowing megafauna communities were present along the consenting corridor from Kilometre Post (KP) 128.322 to the limit of the UK Exclusive Economic Zone (UK EEZ) (MMT, 2017).

Other crustaceans of note that may be present along the consenting corridor of the project are:

- Edible crabs (*Cancer pagurus*);
- Velvet swimming crab (*Necora puber*);
- Shore crab (*Carcinus maenas*);
- Squat lobster (*Munida rugosa*);
- Crayfish (*Palunirus elegans*); and
- European spiny lobster (*Palinurus elephas*).

In the vicinity of the consenting corridor, creel fisheries exist for lobsters (*Homarus gamarus*), edible crabs (*Cancer pagurus*) and velvet swimming crab (*Necora puber*), which predominantly take place in inshore waters, although an important offshore fishery for edible crabs has developed off the north coast of Scotland (Scottish Government, 2015). Commercial fisheries in the vicinity of the consenting corridor are discussed further in Chapter 20: Commercial Fisheries.

15.4.7.1 Summary of Crustacean Species Receptors

A summary of the crustacean species receptors relevant to the project, along with their assigned value, is presented in Table 15.9.

Table 15.9 Summary of Crustacean Species Receptors

Crustacean species receptor	Crustacean species receptor value	Justification
Langoustine *Nephrops norvegicus*	**Medium**	Not UK Post-2010 Biodiversity Framework species, not PMFs, not IUCN Red List 'Endangered' or 'Critically Endangered', not on Habitats Directive Annex II or Bern Convention Annex III. Economic value of fishery only
Common lobster *Homarus gammarus*	**High**	Bern Convention Annex III Species
European spiny lobster *Palinurus elephas*	**High**	Bern Convention Annex III Species , PMF, UK Post-2010 Biodiversity Framework Species
Squat lobster *Munida rugosa*	**Low**	Not UK Post-2010 Biodiversity Framework species, not PMFs, not IUCN Red List 'Endangered' or 'Critically Endangered', not on Habitats Directive Annex II or Bern Convention Annex III. Limited economic value of fishery.

Crustacean species receptor	Crustacean species receptor value	Justification
Edible crabs *Cancer pagurus*	**Medium**	Not UK Post-2010 Biodiversity Framework species, not PMFs, not IUCN Red List 'Endangered' or 'Critically Endangered', not on Habitats Directive Annex II or Bern Convention Annex III. Economic value of fishery only.
Velvet swimming crab *Necora puber*	**Medium**	Not UK Post-2010 Biodiversity Framework species, not PMFs, not IUCN Red List 'Endangered' or 'Critically Endangered', not on Habitats Directive Annex II or Bern Convention Annex III. Economic value of fishery only
Shore crab *Carcinus maenas*	**Low**	Not UK Post-2010 Biodiversity Framework species, not PMFs, not IUCN Red List 'Endangered' or 'Critically Endangered', not on Habitats Directive Annex II or Bern Convention Annex III. Limited economic value of fishery.
Crayfish *Palunirus elegans*	**Low**	Not UK Post-2010 Biodiversity Framework species, not PMFs, not IUCN Red List 'Endangered' or 'Critically Endangered', not on Habitats Directive Annex II or Bern Convention Annex III. Limited economic value of fishery.

15.4.8 Molluscs

Molluscs comprise bivalves and gastropods, with ocean quahog (*Artica Islandica*), common cockle (*Cerastoderma edule*), king scallop (*Pecten maximus)*, queen scallop (*Aequipecten opercularis)* and razorfish (*Ensis spp*.) all being species that may be found around the project area. Commercial fisheries for molluscs in the vicinity of the project area are discussed further in Chapter 20: Commercial fisheries.

The ocean quahog (*Artica Islandica)* is a large, cockle shaped bivalve which can grow up to 13cm across. They are a long-lived animal and can take up to 50 years to reach market size, and are regularly fished within Scottish Waters and the North Sea. Although found extensively throughout the North Sea, it is on the OSPAR list of threatened and/or declining species and habitats. They are at particular risk from bottom fishing gear, and are threatened due to their long growth periods. Ocean quahog is not characteristic of any particular habitat and is known to occur in a range of sediments from coarse clean sand to muddy sand and over a wide depth range up to 400m. The Norwegian Boundary Sediment Plain MPA is designated due to ocean quahog aggregations, discussed in Section 15.4.1 above. In the consenting corridor, only one replicate grab sample (S11, KP 95.411 (296200, 6420974) contained one individual of ocean quahog (MMT, 2017).

The king scallop *(Pecten maximus)* is the second most valuable of the shellfish species fished in Scottish waters, and is fished mainly with scallop dredges. A smaller fishery harvests the queen scallop *(Aequipecten opercularis)*, using dredges or trawls. In recent years hydraulic dredge fisheries have also developed for razorfish (*Ensis spp.*) and a range of other bivalve species. Both scallops and razorfish are also fished commercially by divers in some areas.

15.4.8.1 Summary of Mollusc Species Receptors

A summary of the mollusc species receptors relevant to the project, along with their assigned value is presented in Table 15.10.

Table 15.10 Summary of Mollusc Species Receptors

Mollusc species receptor	Mollusc species receptor value	Justification
Ocean quahog *Artica Islandica*	**High**	PMF
Common cockle *Cerastoderma edule*	**Low**	Not UK Post-2010 Biodiversity Framework species, not PMFs, not IUCN Red List 'Endangered' or 'Critically Endangered', not on Habitats Directive Annex II or Bern Convention Annex III. Limited economic value of fishery.
King scallop *Pecten maximus*	**Medium**	Not UK Post-2010 Biodiversity Framework species, not PMFs, not IUCN Red List 'Endangered' or 'Critically Endangered', not on Habitats Directive Annex II or Bern Convention Annex III. Economic value of fishery only
Queen scallop *Aequipecten opercularis*	**Low**	Not UK Post-2010 Biodiversity Framework species, not PMFs, not IUCN Red List 'Endangered' or 'Critically Endangered', not on Habitats Directive Annex II or Bern Convention Annex III. Limited economic value of fishery.
Razorfish *Ensis spp.*	**Low**	Not UK Post-2010 Biodiversity Framework species, not PMFs, not IUCN Red List 'Endangered' or 'Critically Endangered', not on Habitats Directive Annex II or Bern Convention Annex III. Limited economic value of fishery.

15.4.9 Spawning and Nursery Areas

Spawning and nursery habitats for a variety of fish species are found within the North Sea and species likely to be spawning along the consenting corridor include herring, sandeel, cod, whiting, and plaice (Coull *et al.*, 1998; Ellis *et al.*, 2012). Both sandeel and herring spawn on the seabed in specific habitat types and their eggs are demersal, remaining on the seabed and therefore may be at risk from the project. Conversely, cod, whiting and plaice eggs, once spawned, are pelagic and distributed through the water column and will therefore be carried by ocean currents, transient and potentially distant from the project and so are unlikely to be at risk of impacts.

Nursery areas of several demersal fish species will also be crossed by the consenting corridor (Coull *et al.*, 1998; Ellis *et al.*, 2012). High intensity nursery areas for both anglerfish and whiting, as well as low intensity areas for cod, European hake, ling, plaice and sandeels are predicted to be present along the consenting corridor. In addition, nursery areas for haddock, lemon sole, Norway pout, and saithe are also predicted by Coull *et al.* (1998), but no information on intensity is provided. Individuals of these species are assessed as receptors in their own right under the Marine demersal fish species group (see Section 15.4.4).

Sandeels *Ammodytes spp.* in particular are thought to be very sensitive to disturbance, due to the fact these fish have highly specific spawning habitat requirements, which results in tight zoning of their spawning grounds. Sandeels favour a particular seabed composition containing a high proportion of medium and coarse sand, (≥0.25-<2mm), and a very low silt content (Holland *et al.*, 2005). They are particularly sensitive to the silt content (particles ≤0.63µm) of the seabed, and are only rarely encountered in soils where this fraction exceeds 10% (Holland *et al.*, 2005). Juvenile sandeels have similar requirements for the substrate into which they will burrow following their larval stage, and this again results in the species having a patchy distribution. This, in conjunction with the fact that post-settled sandeels do not move far from their habitat, again results in sandeels being particularly sensitive to disturbance (Jensen *et al.*, 2011).

The cable corridor within Scottish Territorial Waters (STW) (the 12NM limit) is located within the Northeast UK sandeel closure, established for nature conservation purposes of sandeels. The area is subject to year round closure on sandeel fishing. During the benthic survey, sandeels were identified in the grab samples at sample locations within STW in the south western part of the consenting corridor. The sites are located within an area with coarse sediment, composed of 80 to 90 % sand and 8 to 18 % gravel. Sandeels were encountered in two of the grab replicates at grab sample location S03, and in one replicate at sample location S04 (MMT, 2017). The sediment at grab sample location S03 was predominantly composed of sand with shell gravel covering the surface, and S04 had a mixed sediment, consisting predominantly of sand with some coarser particles. Sediment potentially suitable for sandeels was found within the corridor, between KP 3.500 (215411, 6379261) to KP 17.500 (226101, 6388076), as illustrated in Figure 15.6 below.

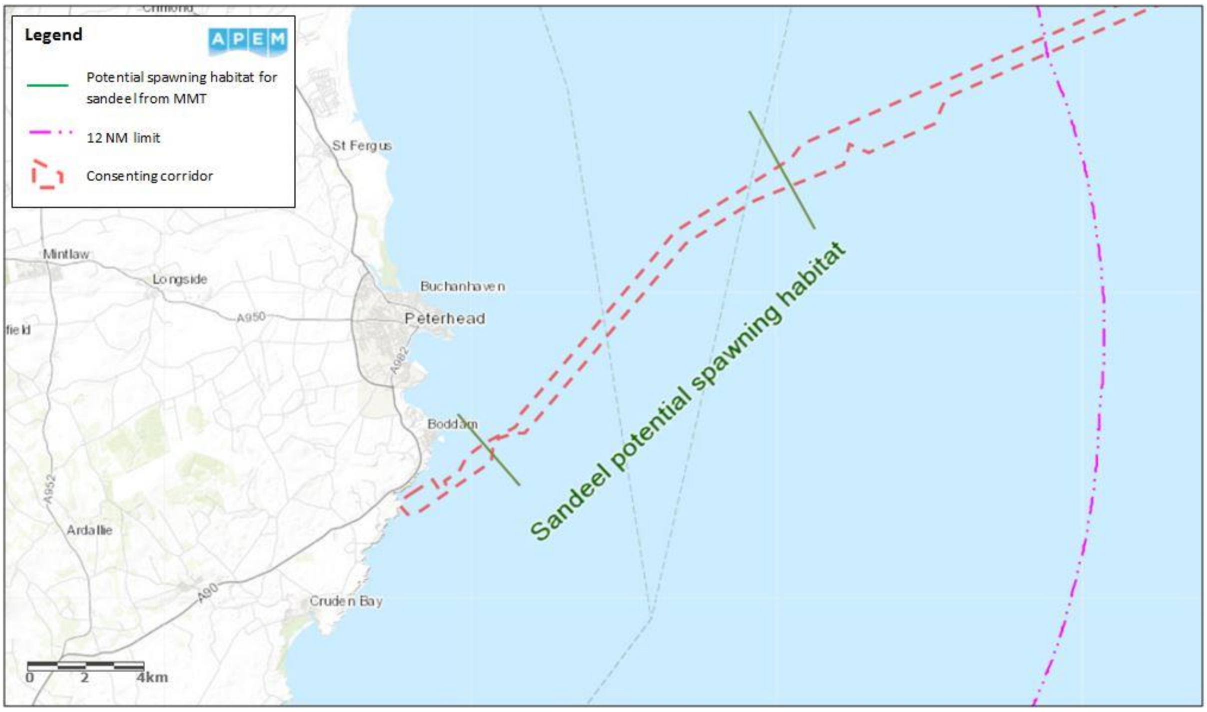


Figure 15.6 Areas of Consenting Corridor Identified as Potentially Suitable Sandeel Spawning Habitat by MMT (2017).

Herring is numerically one of the most important pelagic species in the North Sea, a keystone species and the target of a commercial fishery, and have therefore been considered separately. Like sandeels, herring have specific requirements for the substrate in their spawning areas and prefer to deposit their eggs on gravels, resulting in tightly geographically defined spawning grounds (Maravelias, 1997). The eggs of herring are demersal and the larval stages are pelagic (Ellis *et al.*, 2012; ICES, 2017c). The substrate in the preferred spawning beds is often coarse sand, maerl, shells or gravel, with a low proportion of fine sediment and well-oxygenated water (Ellis *et al.*, 2012). This makes the species particularly sensitive to anthropogenic activities which affect the sea bed.

The North Sea stock of Atlantic herring *Clupea harengus* is divided into different spawning stocks: the North Sea autumn spawning herring; and the spring spawning herring (Dickey-Collas *et al.*, 2010). The autumn spawning herring spawns in UK waters, primarily along the coast of north eastern Scotland and Shetland and Orkney. The spring spawning herring spawns primarily in Norwegian waters, but also in the Wash and in the Firth of Forth along the UK east coast (Dickey-Collas *et al.*, 2010; Ellis *et al.*, 2012; Dragesund *et al.*, 2008).

No herring and/or eggs from herring were found along the consenting corridor during the benthic survey operations, though the survey was conducted at the very beginning of the spawning season and before hatching, which generally occurs between August and September (ICES, 2017c). Substrates of the preferred geophysical characteristics for spawning, i.e. coarse sand and gravel, were found within the consenting corridor between KP 1.396 (213603, 6378185) and KP 4.947 (216591, 6380083), as illustrated in Figure 15.7 below.

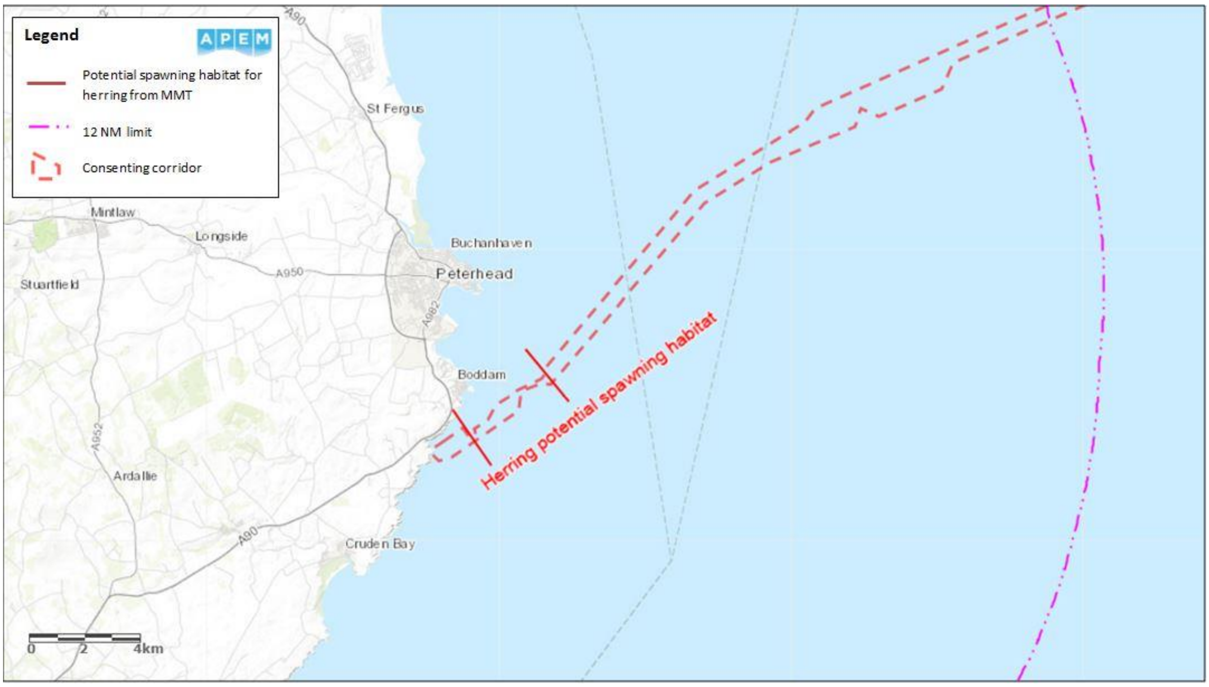


Figure 15.7 Areas of consenting corridor identified as suitable herring spawning habitat by MMT (2017).

The spawning and nursery habitat and grounds of sandeel species and Atlantic herring will therefore be assessed separately, and have both been assigned **High** receptor values, reflecting the receptor value of the individuals of the species.

15.4.10 Future Baseline

Given the anticipated lifetime of the project there is the potential that species populations or ranges may alter due to climate change. Species with a natural range that does not currently extend as far north as the corridor, may colonise this area in future decades as mean water temperatures increase, such as allis shad, twaite shad or common sturgeon. This is unlikely to occur by the time of cable installation, so no effects would be expected on these species during this phase. During operation and decommissioning, effects on these species are likely to be no greater than on other diadromous species given their similar life history strategies and so the conclusion of the assessment would remain unchanged should these species also be present. These species are therefore not considered further within this assessment.

Furthermore, a spawning population of invasive pink salmon *Oncorhynchus gorbuscha* is understood to be establishing within the Ness catchment in north east Scotland (Ness DSFB, 2017), and should this species spread and establish through other Scottish river catchments then it may pose a risk to native Atlantic salmon and brown trout populations through competition for food. As such, these species are likely to be more sensitive to additional pressures. This future sensitivity and risk to Atlantic salmon and brown trout populations has been considered through the assessment when assigning the magnitude of impact to these species.

15.5 Impact Assessment

The potential impacts of the project during the installation, operation and decommissioning phases have been assessed to determine their magnitude of impact upon the fish and shellfish receptors described in Section 15.4, and the subsequent significance of effect. The potential impacts of the project are summarised in Table 15.11, along with their pathways of impact to the relevant fish and shellfish receptors. A summary table of the assessment is provided in Tables 15.13a-c, which fully details the valuation of each receptor, the magnitude of each impact upon each receptor and also the final significance of effect from the combination of value and magnitude, and whether that effect is considered to be significant in terms of the EIA Regulations.

The assessment is based on the information that has been provided to date in relation to methods of installation, operation and decommissioning. Some aspects of the installation and operation of the project are not yet finalised, as discussed in Chapter 2: Project Description, and so a series of worst-case assumptions have been made for the purposes of the assessment, or the adoption of a Rochdale Envelope approach where relevant. The various worst-case assumptions for the purposes of the assessment are discussed below:

- **Number of cables and bundling arrangements** – there will be two HVDC cables laid in up to two trenches (either bundled and laid in one trench, or laid separately in two trenches). The fibre-optic cable will be laid in the same trench as one of the HVDC cables (or both if bundled). The assessment will consider bundled cables in a single trench as a worst-case for operational sediment heating effects, and unbundled cables in two trenches as a worst-case for electromagnetic field (EMF) effects, cable trenching and installation and associated effects on habitats and species;
- **Micro-siting of the cables within the 500m wide consenting corridor and cable separation distances** – the separation distance between the cables, if not laid bundled, is likely to vary along the consenting corridor. Separation will be a minimum of 20m and a maximum of 40m within STW (to 12NM). Separation will then likely be a minimum of 20m and maximum of the entire consenting corridor between 12NM to the UK EEZ limit. A bundled cable will be used as a worst-case for operational sediment heating effects, and the maximum separation distances will be used as a worst-case for the EMF effects. Other effects are expected to be similar regardless of separation distance;
- **Cable depth of lowering along the consenting corridor** – the minimum depth of lowering will be 0.4m in hard substrates and 0.5m in soft substrates, with an aim to achieve a 0.8m depth of lowering if possible, and a likely maximum depth of lowering of 1.5m. The minimum depth of lowering will be used for the assessment;
- **Cable burial methods** – a combination of jet-trenching, mechanical trenching or ploughing may be required to protect the cables. Burial will be assumed to be via natural infill rather than backfill rock placement as a worst-case for habitat recovery times. Within UK waters (to 200NM) rock placement will be in the region of 25m either side of the 4 cable crossings and 70m either side of the 14 surface laid pipeline crossings, and at a worst-case for extent of a 1:3 slope. Rock placement at the HDD exit point will be to a depth of 0.8m for a 70m distance at a 1:3 slope;
- **Cable trench** – methods of trenching will generate disturbance of the seabed around the trench and, depending upon the method used, the trench and excavated material footprint will be a maximum of 5m distance either side of the centre-line of the cable (a total of 10m width) as a worst-case;
- **HDD** – a number of different drilling materials could be used, but it is assumed that the drilling fluid will solely comprise Bentonite;
- **Installation programme** – the detailed installation programme and start date is not yet finalised and so it is assumed that installation could be conducted at any time of year as a

worst-case apart from the HDD, which will occur between September-March, and the cable laying, which will be between April-September;

- **Installation programme** – The cable installation programme may vary depending upon cable section length used (which will be between 75km and 170km) and cable production ability. The worst-case programme duration of 5 years has been used as shown in Chapter 2: Project Description, which is based on use of a 170km cable due to the time of production of a cable of this length. The cable installation programme in UK waters also assumes a worst-case programme of two separate HVDC cables being installed;
- **Operational repairs** – repairs could be once every 3 years as a likely worst-case and require disturbance of the seabed of up to twice the water depth at the repair location;
- **Decommissioning phase arrangements** – the majority of the cable will be removed at decommissioning; however, some sections may be left in-situ without transferring electricity. Full removal will be assessed as a worst-case.

Table 15.11 Summary of impacts of the project and the presence of impact pathways to receptors (indicated with a tick). Those without a tick indicate that effects upon receptors from the impacts were either scoped out during the Scoping process (habitat loss of adult fish and underwater noise effects from cable installation) or no pathway is considered to be present (Changes in hydrodynamic regime (scour and accretion) and sediment heating on pelagic fish species and cephalopods).

Receptor	**Designated sites (for fish and shellfish species)**	**Diadromous fish species**	**Elasmobranch species**	**Marine demersal fish species**	**Marine pelagic fish species**	**Cephalopods**	**Crustaceans**	**Molluscs**	**Spawning and nursery grounds**
Potential development impact									
Seabed Preparation and Cable Installation									
Habitat loss	✓						✓	✓	✓
Habitat creation	✓			✓			✓	✓	✓
Changes to water quality (resuspension of sediments and increased sediment loading)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Changes to water quality (release of hazardous substances)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Underwater noise and vibration	✓	✓	✓	✓	✓	✓	✓	✓	✓
Changes to water quality (Release of drilling fluids)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Introduction of invasive non-native species	✓	✓	✓	✓	✓	✓	✓	✓	✓
Operation									
Change in hydrodynamic regime (scour and accretion)	✓			✓			✓	✓	✓
Sediment heating	✓			✓			✓	✓	✓
Electro-magnetic fields (EMFs)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Introduction of invasive non-native species	✓	✓	✓	✓	✓	✓	✓	✓	✓
Physical disturbance during inspection and repair	✓	✓	✓	✓	✓	✓	✓	✓	✓
Decommissioning									

Receptor	Designated sites (for fish and shellfish species)	Diadromous fish species	Elasmobranch species	Marine demersal fish species	Marine pelagic fish species	Cephalopods	Crustaceans	Molluscs	Spawning and nursery grounds
Habitat loss	✓						✓	✓	✓
Changes to water quality (resuspension of sediments and increased sediment loading)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Changes to water quality (release of hazardous substances)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Underwater noise and vibration	✓	✓	✓	✓	✓	✓	✓	✓	✓
Introduction of invasive non-native species	✓	✓	✓	✓	✓	✓	✓	✓	✓

15.5.1 Primary and Tertiary Mitigation

The primary and tertiary mitigation measures (see Chapter 2: Project Description) that have been considered within the assessment are described below:

- For the consenting corridor, routing studies have been undertaken to minimise environmental impacts of the consenting corridor;
- For HDD activities, the drill will stop before it reaches the end point of the hole and all the excess material and drilling fluid will then be pumped out of the hole to minimise loss of HDD fluid. Therefore, only the final short drilling section will result in a loss of fluids and solids to the sea;
- For HDD activities, these will occur from September to March only, with activities commencing in September. No breakouts of the drilling will therefore occur during herring spawning season (August/September);
- For cable installation, this will occur from April to September only, which is outside of the sandeel spawning season (January/February).
- For cable operation, a depth of lowering of at least 0.4m in hard substrate and 0.5m in soft substrate will be achieved to reduce EMF and sediment heating effects. Greater depths of lowering will be achieved where possible;
- For cable operation, electric fields will be contained within cable armouring due to shielding effects. The use of direct currents in the marine cables will prevent the formation of induced electric fields outside the cable armouring. Magnetic fields can, however, be detected beyond the cable armouring (Gill *et al.*, 2005);
- To minimise the introduction of invasive non-native species, all vessels used during installation, operation and decommissioning will follow the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM) which entered into force in 2017;
- To minimise the introduction of invasive non-native species, all vessels used during installation, operation and decommissioning will be sourced from the North Atlantic Biogeographic region, or will be subject to appropriate decontamination procedures if sourced from elsewhere to remove the risk of INNS introduction – through the use of hull anti-fouling materials; and
- To minimise changes to water quality (release of hazardous substances), all vessels used during installation, operation and decommissioning will comply with the International Convention for the Prevention of Pollution from Ships (MARPOL) regulations.

15.5.2 Installation

15.5.2.1 Habitat Loss

Disturbance of the seabed will occur as a result of trenching during cable laying, removal of the two out of service (OOS) cables, and also from rock protection where cable burial is not possible (such as at crossing points).

The trenching during cable laying will disturb a worst-case of two 10m wide areas of seabed along the whole length of each cable being laid, totalling 30km length from MHWS to 12nm limit, and 200km length from 12nm to the limit of UK EEZ. Existing habitat loss beneath the trenching footprint will therefore be a maximum of 60ha from MHWS to 12nm limit, and 400ha from 12nm to the limit of UK EEZ. As a worst-case, if natural infilling of the trench is assumed to occur, rather than any backfill, then recovery of the habitats in this seabed strip is likely to take a number of years, but any disturbance of the seabed will still result in a temporary effect.

The removal of the two OOS cables will disturb around a 5.7km length of seabed within the consenting corridor.

The rock placement at crossing points will be to up to a 1m burial depth for the 4 cable crossings, and 2m burial depth for the 14 surface laid pipeline crossings. Existing habitat loss beneath the rock placement in the UK EEZ will therefore be a maximum of 300m^2 for each cable crossing, 1680m^2 for each surface laid pipeline crossing, and 336m^2 at each HDD exit point. Assuming a worst-case of two separately laid cables and three HDD exit points, altogether the habitat loss beneath rock placement will total 5.0ha. Rock will also be placed as cable protection on areas of rocky ground or hard substrate along the consenting corridor, however, this placement is unlikely to significantly change the nature of the seabed substrate and therefore the utilisation of this habitat by fish and shellfish receptors is unlikely to be affected.

The rock will remain in place for the lifetime of the project and therefore the loss of any existing soft substrate habitat beneath rock placement is expected to be a permanent effect.

15.5.2.1.1 Designated Sites (for Fish and Shellfish Species)

Given the separation achieved between the consenting corridor and designated sites for fish and shellfish species, then no habitat loss in these sites or for their populations is anticipated, and the magnitude of impact upon designated sites for fish and shellfish species is assessed as **No Change.**

15.5.2.1.2 Crustaceans

Given the limited extent of the habitat loss from trenching and the mobile nature of the crustaceans assessed, crustaceans along the consenting corridor will be able to move to alternative habitat nearby during cable installation and return once the trench has infilled. For rock placement, given the extent of the placement there may be some burial of individuals, and species favouring finer sediments may be deterred from recolonization of the hard substrates. This will, however, occur in just 0.04% of the consenting corridor, and an even smaller proportion of the wider habitats in the North Sea and so will have a highly localised effect that will not be detectable within crustacean populations locally or more regionally. As such, the magnitude of impact upon crustaceans is assessed as **Negligible**.

15.5.2.1.3 Molluscs

As the mollusc species assessed are generally sessile, then loss of habitats which these species are inhabiting during trenching may cause disturbance or burial of these species present in the footprint of the trench. As the trench infills, then this habitat will recover and the mollusc species are likely to recolonise it given their preferential habitation of optimum seabed and hydrodynamic conditions. Any effects from trenching are therefore anticipated to be temporary.

For rock placement, given the extent of the placement there may be some burial of individuals, and species favouring finer sediments may be deterred from recolonization of the hard substrates. This will, however, occur in just 0.04% of the consenting corridor, and an even smaller proportion of the wider habitats in the North Sea and so will have a highly localised effect that will not be detectable within mollusc populations locally or more regionally.

In the case of the ocean quahog, the benthic survey (MMT, 2017) found a very low abundance of the species along the consenting corridor and therefore the effect of trenching and rock placement causing habitat loss on this species wider population will be undetectable, especially given the high abundances associated with designated areas for this species in other locations in the North Sea. The magnitude of impact on the ocean quahog is therefore assessed as **Negligible**. There may be higher abundances of other sessile molluscs along the consenting corridor that will be subject to a temporary, short-term effect from habitat loss due to cable trenching (with rock placement effects being undetectable) and may cause a change to the local population abundance, but not the wider populations in the North Sea. The magnitude of impact on the remaining mollusc species is therefore assessed as **Minor**.

15.5.2.1.4 Spawning and Nursery Grounds

The project will result in the temporary disturbance to 28ha of suitable sandeel spawning habitat due to trenching, along the 14km length of suitable habitat within the consenting corridor identified by MMT (2017). This equates to 0.002% of the local sandeel spawning grounds as designated by Coull *et al.* (1998) and Ellis *et al.* (2012). The project will also result in placement of rock at 2 cable crossings within the suitable sandeel spawning habitat, causing a permanent loss of 0.06ha, and less than 0.0001% of the local sandeel spawning grounds. The removal of one of the service cables will be partly within the suitable sandeel habitat, for a length of around 1.7km. There are extensive wider spawning areas for this species around the Scottish coast and therefore this is a worst-case. As this habitat loss will be temporary or affect a very small proportion of the wider spawning ground, then the magnitude of impact is assessed as **Negligible**.

The project will result in the temporary disturbance to 7.2ha of suitable herring spawning habitat, due to trenching, along the 3.6km length of suitable habitat within the consenting corridor identified by MMT (2017). This equates to 0.0006% of the local herring spawning ground as designated by Coull *et al.* (1998) and Ellis *et al.* (2012). No cable or pipeline crossings are in areas of suitable herring spawning habitat and therefore rock placement will not result in the loss of any suitable habitat. The removal of the two service cables will also not be in areas of suitable herring spawning habitat. There are extensive wider spawning areas for this species around the Scottish coast and therefore this is a worst-case. As this habitat loss will be temporary or affect a very small proportion of the wider spawning ground, then the magnitude of impact is assessed as **Negligible**.

15.5.2.2 Habitat Creation

The rock placement at crossing points will be to up to a 1m burial depth for the 4 cable crossings, and 2m burial depth for the 14 surface laid pipeline crossings. Rock placement will be for 25m either side of the 4 cables and 70m either side of the 14 surface laid pipelines, and at a worst-case for extent of a 1:3 slope. Rock placement at the HDD exit point will be to a depth of 0.8m for a 70m distance at a 1:3 slope. Introduction of new habitat from the rock placement in the UK EEZ will therefore be a maximum of 300m^2 for each cable crossing, 1680m^2 for each surface laid pipeline crossing, and 336m^2 at each HDD exit point. Assuming a worst-case of two separately laid cables and three HDD exit points, altogether the introduction of new habitat beneath rock placement will total 5.0ha. Rock will also be placed as cable protection on areas of rocky ground or hard substrate along the consenting corridor, however, this placement is unlikely to change the nature of the seabed substrate and therefore the utilisation of this habitat by fish and shellfish receptors is unlikely to be affected.

The rock will remain in place for the lifetime of the project and therefore the creation of any hard substrate habitat is expected to be a permanent effect.

15.5.2.2.1 Designated Sites (for Fish and Shellfish Species)

Given the separation achieved between the consenting corridor and designated sites for fish and shellfish species, the rock placement will not create any new habitat in these sites or for their designated species, and the magnitude of impact upon designated sites for fish and shellfish species is assessed as **No Change.**

15.5.2.2.2 Marine Demersal Fish Species

Rock placement creates hard substrate habitat, which may be suitable for species such as cod, whiting, saithe and ling which prefer or utilise rocky seabed's. This will, however, occur in just 0.04% of the consenting corridor, and an even smaller proportion of the wider habitats in the North Sea and so will have a highly localised effect that will not be detectable within the populations of these species locally or more regionally. The magnitude of impact upon these marine demersal fish species is therefore assessed as **Negligible** (beneficial).

For all other marine demersal fish species, the rock placement will not create any suitable new habitat and therefore the magnitude of impact upon these species is assessed as **No Change**.

15.5.2.2.3 Crustaceans

Rock placement creating hard substrate habitat will not generally be suitable for crustacean inhabitation and therefore the magnitude of impact is assessed as **No Change**.

15.5.2.2.4 Molluscs

Rock placement creating hard substrate habitat will not generally be suitable for mollusc inhabitation and therefore the magnitude of impact is assessed as **No Change**.

15.5.2.2.5 Spawning and Nursery Grounds

Rock placement creating hard substrate habitat will not be suitable for sandeel or herring spawning and therefore the magnitude of impact is assessed as **No Change**.

15.5.2.3 Changes to Water Quality (Resuspension of Sediments and Increased Sediment Loading)

Trenching and rock placement activities, as well as the OOS cable removal, may resuspend seabed sediments into the water column. Any increases in water column sediment loading and deposition resulting from the trenching and rock placement activities will be very localised and short-term in duration (see Chapter11: Water Quality (Marine Environment)), and will occur sequentially along the consenting corridor given the nature of the cable installation.

Sands and silts released during trenching and rock placement activities will be temporarily deposited on the seabed but will be more likely to be remobilised and redistributed through natural hydrodynamic processes than gravels and clays which are likely to remain on the seabed for a longer period of time after settlement. The consenting corridor comprises the following split of seabed substrate types:

- 69% muds and gravels;
- 29% sands and silts; and
- 2% rocky and hard substrates.

15.5.2.3.1 Designated Sites (for Fish and Shellfish Species)

Given the separation achieved between the consenting corridor and designated sites for fish and shellfish species, then the trenching and rock placement activities will not cause increases in water column sediment loading in these sites, or on their designated species, and the magnitude of impact upon designated sites for fish and shellfish species is assessed as **No Change.**

15.5.2.3.2 Diadromous Fish Species

As migrating individuals of these species will be crossing the project during migration to or from freshwater, then they will be exposed to any increased water column sediment loading for only a very short period of time. Also, the increased sediment loading will be short-term and localised in nature along the consenting corridor, occurring sequentially with the location of the installation activity and near the seabed. Therefore, the likelihood of migrating or marine resident individuals of these pelagic species encountering an area of increased water column sediment loading is very low. Furthermore, as they are highly mobile species then, should they encounter an area of suspended sediment concentrations, they are capable of navigating away and avoiding the area. As these species are all highly mobile and pelagic then there is also no risk of smothering or burial. Therefore, the magnitude of impact upon diadromous fish species is assessed as **No Change**.

15.5.2.3.3 Elasmobranch Species

As individuals of these species, if present, will be foraging then there is a potential effect upon their feeding success from the increased water column sediment loading (Robertson *et al.*, 2006). As the increased sediment loading will be short-term and localised in nature along the consenting corridor, occurring sequentially with the location of the installation activity, and near the seabed, the likelihood of pelagic species encountering an area of increased sediment loading is very low. Encounter may be more likely for demersal elasmobranchs such as the common skate, sandy ray, Portuguese dogfish, spiny dogfish or other elasmobranch species (such as the spotted ray or thornback ray). However, as these are highly mobile species then should they encounter an area of increased sediment loading, they are capable of navigating away and avoiding the area. As these species are all highly mobile then there is no risk of smothering or burial, even for the demersal individuals. Therefore, the magnitude of impact upon the common skate, sandy ray, Portuguese dogfish, spiny dogfish, spotted ray and thornback ray is assessed as **Negligible** and, on all the elasmobranch fish species, is assessed as **No Change**.

15.5.2.3.4 Marine Demersal Fish Species

As individuals of these species, if present, will be foraging then there is a potential effect upon their feeding success from the increased water column sediment loading (Robertson *et al.*, 2006). As the increased sediment loading will be short-term and localised in nature along the consenting corridor, occurring sequentially with the location of the installation activity, the likelihood of demersal species encountering an area of increased sediment loading is low. As these are highly mobile species then should they encounter an area of increased sediment loading, they are capable of navigating away and avoiding the area. As these species are all highly mobile then there is no risk of smothering or burial. Any changes to behaviour or reduced feeding success as a result of the increased sediment loading for demersal species are anticipated to be short-term and temporary, and have no impact upon the structure and functioning of the populations of these species. The magnitude of impact upon marine demersal fish species is, therefore, assessed as **Negligible**.

15.5.2.3.5 Marine Pelagic Fish Species

As individuals of these species, if present, will be foraging then there is a potential effect upon their feeding success from the increased water column sediment loading (Robertson *et al.*, 2006). As the increased sediment loading will be short-term and localised in nature along the consenting corridor, occurring sequentially with the location of the installation activity, and near the seabed, the likelihood of pelagic species encountering an area of increased sediment loading is very low. These species are also highly mobile and so should they encounter an area of increased sediment loading, they are capable of navigating away and avoiding the area. As these species are all highly mobile and pelagic then there is no risk of smothering or burial. Therefore, the magnitude of impact upon marine pelagic fish species is assessed as **No Change**.

15.5.2.3.6 Cephalopods

As individuals of these species, if present, will be feeding and foraging then there is a potential effect upon their feeding success from the increased water column sediment loading (Robertson *et al.*, 2006). As the increased sediment loading will be short-term and localised in nature along the consenting corridor, occurring sequentially with the location of the installation activity, the likelihood of cephalopods encountering an area of increased sediment loading is low. As these are mobile species (though with lower swimming capacity than teleost fish species) then should they encounter an area of increased sediment loading, they are capable of navigating away and avoiding the area. As these species are all highly mobile then there is no risk of smothering or burial. Any changes to behaviour or reduced feeding success as a result of the increased suspended sediment concentrations for cephalopods are anticipated to be short-term and temporary and have no impact upon the structure and functioning of the populations of these species. The magnitude of impact upon marine demersal fish species is, therefore, assessed as **Negligible**.

15.5.2.3.7 Crustaceans

Crustacean species are less mobile and may not readily move away from areas of increased water column sediment loading, though some species, including Langoustine, are particularly tolerant of a degree of smothering (OSPAR, 2010). As the increased sediment loading will be short-term and localised in nature along the consenting corridor then, whilst there is a risk of some effect upon nearby individuals, the risk to the wider population is very limited and, therefore, the magnitude of impact upon crustaceans is assessed as **Negligible**.

15.5.2.3.8 Molluscs

Mollusc species have limited mobility with which to move away from areas of increased water column sediment loading, or to prevent themselves from being smothered. Some mollusc species show tolerance to increased suspended sediment concentrations (Mainwaring *et al.*, 2014). As the increased sediment loading will be short-term and localised in nature along the consenting corridor, whilst there is a risk of some effect upon nearby individuals, the risk to the wider population is very limited and therefore the magnitude of impact upon molluscs is assessed as **Negligible**.

15.5.2.3.9 Spawning and Nursery Grounds

The project will result in potential increased sediment loading across a 14km length of suitable sandeel spawning habitat identified by MMT (2017). However, as sandeels spawn in December and January with eggs hatching in February and March, and cable installation will only occur between April and September, there is no risk of smothering of sandeel eggs. As a result, the magnitude of effect is assessed as **No Change**.

The project will result in potential increased sediment loading across a 3.6km length of suitable herring spawning habitat identified by MMT (2017), which equates to just 0.0006% of the local herring spawning ground. As herring from the Buchan stock spawn in August and September, then some herring eggs in this area may be at risk of being smothered. The survival and development of herring eggs have been reported to be tolerant to even high levels of water column sediment loading, but studies have concluded that smothering is likely to be detrimental unless the material is removed rapidly by the current (Birklund and Wijsam, 2005). Given the limited extent of the wider spawning ground affected, and the temporary, short-term nature of the impact, then the magnitude of effect is assessed as **Negligible**.

15.5.2.4 Changes to Water Quality (Release of Hazardous Substances)

Trenching, OOS cable removal and rock placement activities may resuspend seabed sediments which could contain contaminants, though low concentrations were found within the sediment sampling survey for the project, as detailed in Chapter 7: Seabed Quality. Any sediment, and thus contaminant suspension and deposition, as a result of the trenching and rock placement activities will be very localised and short-term in duration (see Chapter 11: Water Quality (Marine Environment)).

The use of vessels could lead to a fuel release, or of cleaning fluids, oils and hydraulic fluids used on board vessels and during ROV operations, which could be released overboard or accidentally discharged. Also, discharges of grey water, sewage, food waste and drain water from vessels outside of 12NM may occur. These discharges can be potentially harmful and can lead to localised organic enrichment and a change in the balance of the food chain. As discussed further within Chapter 11: Water Quality (Marine Environment), given that all vessels will be compliant with IMO and MARPOL then the risk of oils and other contaminants entering the marine environment is very low. Neither organic enrichment nor oxygen depletion is considered likely, due to the relatively small cumulative volume of any discharges. Furthermore, the amount of shipping activity in the North Sea area is unlikely to be affected by addition of the installation vessels.

15.5.2.4.1 Designated Sites (for Fish and Shellfish Species)

Given the separation achieved between the consenting corridor and designated sites for fish and shellfish species, then the trenching and rock placement activities, and vessels will not cause changes to water quality in these sites or on their populations, and the magnitude of impact upon designated sites for fish and shellfish species is assessed as **No Change.**

15.5.2.4.2 Diadromous Fish Species

As migrating individuals of these species will be crossing the consenting corridor during migration to or from freshwater then they may be exposed to any reduced water quality for only a very short period of time. Also, the reduction of water quality will be short-term and localised in nature along the consenting corridor, occurring sequentially with the location of the installation activity and near the seabed. Therefore, the likelihood of migrating or marine resident individuals of these pelagic species encountering an area of reduced water quality is very low. Furthermore, as they are highly mobile species then should they encounter an area of reduced water quality they are capable of navigating away and avoiding the area. Therefore, the magnitude of impact upon diadromous fish species is assessed as **No Change**.

15.5.2.4.3 Elasmobranch Species

As any reduced water quality will be short-term and localised in nature along the consenting corridor, occurring sequentially with the location of the installation activity, and near the seabed the likelihood of pelagic species encountering an area of reduced water quality is very low. Encounter may be more likely for demersal elasmobranchs such as the common skate, sandy ray, Portuguese dogfish, spiny dogfish or other elasmobranch species (such as the spotted ray or thornback ray), however, as these are highly mobile species then, should they encounter an area of reduced water quality, they are capable of navigating away and avoiding the area. Therefore, the magnitude of impact upon the common skate, sandy ray, Portuguese dogfish, spiny dogfish, spotted ray and thornback ray is assessed as **Negligible**, and on all the elasmobranch fish species is assessed as **No Change**.

15.5.2.4.4 Marine Demersal Fish Species

As any reduced water quality will be short-term and localised in nature along the consenting corridor, occurring sequentially with the location of the installation activity, the likelihood of demersal species encountering an area of reduced water quality is low. As these are highly mobile species then, should they encounter an area of reduced water quality, they are capable of navigating away and avoiding the area. Any changes to behaviour or reduced feeding success as a result of the reduced water quality for demersal species are anticipated to be short-term and temporary and have no impact upon the structure and functioning of the populations of these species. The magnitude of impact upon marine demersal fish species is, therefore, assessed as **Negligible**.

15.5.2.4.5 Marine Pelagic Fish Species

As any reduced water quality will be short-term and localised in nature along the consenting corridor, occurring sequentially with the location of the installation activity, and near the seabed for the cable installation activities, the likelihood of pelagic species encountering an area of reduced water quality is very low. These species are also highly mobile and so, should they encounter an area of reduced water quality, they are capable of navigating away and avoiding the area. Therefore, the magnitude of impact upon marine pelagic fish species is assessed as **No Change**.

15.5.2.4.6 Cephalopods

As any reduced water quality will be short-term and localised in nature along the consenting corridor, occurring sequentially with the location of the installation activity, the likelihood of cephalopods encountering an area of reduced water quality is low. As these are mobile species (though with lower swimming capacity than teleost fish species) then should they encounter an area of reduced water quality they are capable of navigating away and avoiding the area. Any changes to behaviour or reduced feeding success as a result of reduced water quality for cephalopods are anticipated to be short-term and temporary and have no impact upon the structure and functioning of the populations of these species. The magnitude of impact upon marine demersal fish species is therefore assessed as **Negligible**.

15.5.2.4.7 Crustaceans

Crustacean species are less mobile and may not move away from areas of reduced water quality readily. Any reduction in water quality will be short-term and localised in nature along the consenting corridor then whilst there is a risk of some effect upon nearby individuals, the risk to the wider population is very limited and therefore the magnitude of impact upon crustaceans is assessed as **Negligible**.

15.5.2.4.8 Molluscs

Mollusc species have limited mobility with which to move away from areas of reduced water quality. As the reduced water quality will be short-term and localised in nature along the consenting corridor then, whilst there is a risk of some effect upon nearby individuals, the risk to the wider population is very limited and therefore the magnitude of impact upon molluscs is assessed as **Negligible**.

15.5.2.4.9 Spawning and Nursery Grounds

The project will result in potential reductions in water quality across a 14km length of suitable sandeel spawning habitat identified by MMT (2017). As sandeels, however, spawn in December and January with eggs hatching in February and March, and cable installation will only occur between April and September, then there is no risk of spawning individuals or eggs being exposed to reduced water quality. As a result, the magnitude of effect is assessed as **No Change**.

The project will result in potential reductions in water quality across a 3.6km length of suitable herring spawning habitat identified by MMT (2017), which equates to just 0.0006% of the local herring spawning ground. As herring from the Buchan stock spawn in August and September, then some herring eggs in this area may be at risk of being subjected to reduced water quality. Given the limited extent of the wider spawning ground affected and the temporary, short-term nature of the impact, then the magnitude of effect is assessed as **Negligible**.

15.5.2.5 Underwater Noise and Vibration (Cable Installation)

During cable installation, vessels and cable burial machinery will generate underwater noise. The underwater noise generated by the vessels and equipment has been assessed and modelled in Chapter 23: Noise and Vibration (Underwater). The sound generated during cable installation will be transient, and present in an area for only a short time, as installation moves along the consenting corridor in a sequential manner. The underwater noise generated by the HDD has also been considered within Chapter 23: Noise and Vibration (Underwater), and is reported as being within the range of baseline noise levels expected in the area.

Chapter 23: Noise and Vibration (Underwater) confirms that the noise sources associated with the installation of the NorthConnect HVDC cables do not have the potential to cause injury in fish species. However, sources are within the hearing thresholds of the fish species likely to be present within the consenting corridor, and have the potential to cause localised disturbance, including Dynamic Positioning (DP) vessel noise, conventional (non-DP) vessel noise, pre- and post-installation survey equipment noise (the greatest noise levels generated by the sub-bottom profiler), and cable burial noise. A summary of the predicted disturbance ranges detailed in Chapter 23: Noise and Vibration (Underwater) is provided in Table 15.12 below.

Table 15.12 Maximum predicted impact ranges on fish resulting from underwater noise associated with the installation of the marine HVDC cables.

	Dynamic Positioning Vessel Noise	Non-Dynamic Positioning vessel Noise	Sub-bottom profiler (SBP)	Cable Burial
Maximum Behavioural Disturbance Range	1359m	100m	2154m	215m

It is noted that there is a paucity of empirical data relating to underwater noise levels that provoke a behavioural response (disturbance) in fish and, as such, there are very few thresholds for the onset of disturbance published in the literature. The modelling presented in Chapter 23: Noise and Vibration (Underwater) uses a disturbance threshold for fish of 150dB re 1µPa, which is from the United States National Marine and Fisheries Service (US NMFS) Interim Injury and Disturbance criteria, since this is the only threshold available that is suitable for use in the calculation of disturbance ranges from continuous (non-impulse) noise sources. However, this threshold is acknowledged within published literature to be conservative and likely to be lower than the sound pressure level that would actually provoke a behavioural response for many species (Popper *et al.*, 2014). As such, the disturbance ranges detailed here should be considered to be conservative and precautionary.

Dynamic Positioning (DP) thruster noise results in potential disturbance during cable installation, at a range of approximately 1.4km, while non-DP vessel noise and cable burial have low potential disturbance ranges of 100m and 215m respectively. Vessels using DP will be used throughout the cable installation process, including the cable lay vessel, cable burial vessel, rock placement vessels and other support vessels. However, DP vessel noise resulting from the NorthConnect project must be set against the existing vessel usage of the area (see Chapter 19: Navigation and Shipping), which is high given the existing North Sea oil and gas activities. DP vessels are utilised regularly by the oil and gas industry to support the offshore infrastructure in the North Sea, and in the vicinity of the consenting corridor. In addition, the North Sea is a busy shipping area and is frequently transited by large vessels including bulk cargo ships, tankers, and cruise ships. Such vessels are reported as generating underwater noise levels ranging from 185-200dB re 1µPa at 1m and, therefore, the noise levels from the DP vessels associated with the project would be analogous to the reported levels for other vessel traffic which already operate in the area, and the project would not significantly increase the numbers of vessels present in the area (see Chapter 19: Navigation and Shipping).

The SBP results in potential disturbance during the pre- and post-installation surveys at a range of approximately 2.2km. The SBP is a geophysical survey device that will only be used during the pre-installation Marine Route Survey. The marine route geophysical survey in UK waters is anticipated to last no more than 14 days, and will be conducted prior to commencement of the cable installation works. The survey vessel will be moving at approximately 2kt during the survey operations and, as such, the SBP will only result in short lived, temporary and transient disturbance, confined to a relatively small area around the survey vessel. Given the extremely conservative disturbance threshold, transient nature of the survey and the duration of the exposure to this sound level, any avoidance of the sound field will be a temporary and short-term change in behaviour.

The consenting corridor passes through an area with numerous oil and gas assets and associated DP vessels, is frequently transited by existing vessel traffic and is on the approaches to a major port at Peterhead. The additional vessel noise from the cable installation will therefore not result in an appreciable change from baseline conditions and, as such, the magnitude of impact upon all fish and shellfish species and receptors is assessed as **Negligible.**

15.5.2.6 Changes to Water Quality (Release of Drilling Fluids)

From Chapter 2: Project Description, the estimated HDD fluid losses to the sea from the three HDD holes, for the two HVDC cables and one fibre optic cable, will be 3,000m^3. The estimated solid losses to the sea will be 18m^3. These losses will not be concurrent from all three HDD holes, but will be sequential as holes are drilled individually, and so only 1,000m^3 of fluid and 6m^3 of solids will be discharged at any one time. The solids will be a mixture of granite bedrock particles and bentonite, a naturally occurring substance. The HDD will be undertaken during the winter months.

15.5.2.6.1 Designated Sites (for Fish and Shellfish Species)

Given the separation achieved between the consenting corridor and designated sites for fish and shellfish species, and the highly localised nature of the HDD within the marine environment, then any

HDD fluids released at the HDD exit point will not affect these sites or on their populations, and the magnitude of impact upon designated sites for fish and shellfish species is assessed as **No Change.**

15.5.2.6.2 Diadromous Fish Species

Given the very small scale of the release from the HDD exit point into the water column, the likely dilution of the plume and the timing of the releases in the winter, there are unlikely to be high numbers of diadromous fish species present in this coastal environment, and hence the likelihood of individuals encountering the increased sediment loading is very low. Any that are present are pelagic and highly mobile, and so will be able to avoid the affected areas during either their migration or foraging activities. The magnitude of impact upon diadromous fish species is assessed as **No Change**.

15.5.2.6.3 Elasmobranch Species

Given the very small scale of the release from the HDD exit point into the water column and the likely dilution of the plume; the likelihood of individuals encountering the area of increased sediment loading is very low. Any elasmobranch species that do are highly mobile and so will be able to avoid these areas during either their migration or foraging activities. The magnitude of impact upon elasmobranch species is assessed as **No Change**.

15.5.2.6.4 Marine Demersal Fish Species

Given the very small scale of the release from the HDD exit point into the water column and the likely dilution of the plume, the likelihood of individuals encountering the area of increased sediment loading is very low and so few marine demersal species are likely to encounter it. Any marine demersal species that do are highly mobile species and so will be able to avoid these areas during either their migration or foraging activities. The magnitude of impact upon marine demersal species is therefore assessed as **No Change**.

15.5.2.6.5 Marine Pelagic Fish Species

Given the very small scale of the release from the HDD exit point into the water column and the likely dilution of the plume, the likelihood of individuals encountering the area of increased sediment loading is very low. Any marine pelagic species that do are highly mobile species and so will be able to avoid these areas during either their migration or foraging activities. The magnitude of impact upon marine pelagic species is therefore assessed as **No Change**.

15.5.2.6.6 Cephalopods

Given the very small scale of the release from the HDD exit point into the water column and the likely dilution of the plume, the likelihood of individuals encountering the area of increased sediment loading is very low. As these are mobile species (though with lower swimming capacity than teleost fish species) then should they encounter an area of increased sediment loading they are capable of navigating away and avoiding the area. The magnitude of impact upon cephalopods is therefore assessed as **No Change**.

15.5.2.6.7 Crustaceans

Given the very small scale of the release from the HDD exit point into the water column and the likely dilution of the plume, the extent of the effect upon the relevant crustacean species is expected to be limited. Whilst they do not have the same mobility as fish species to avoid the increased sediment loading, and so some settlement of material may occur on them, the numbers within the vicinity of the HDD exit point are not anticipated to comprise an appreciable proportion of the population and so the magnitude of impact is therefore assessed as **Negligible**.

15.5.2.6.8 Molluscs

Given the very small scale of the release from the HDD exit point into the water column and the likely dilution of the plume, the extent of the effect upon the relevant mollusc species is expected to be limited. Whilst they do not have the same mobility as fish species to avoid the increased sediment loading, and so some settlement of material may occur on them, the numbers within the vicinity of the HDD exit point are not anticipated to comprise an appreciable proportion of the population and so the magnitude of impact is therefore assessed as **Negligible**.

15.5.2.6.9 Spawning and Nursery Grounds

Given the very small scale of the release from the HDD exit point into the water column and the likely dilution of the plume, the effect on spawning and nursery grounds is limited. The HDD fluid discharge will occur in the winter, outside of the herring spawning season and so the magnitude of impact upon spawning herring or herring eggs is therefore assessed as **No Change**. The HDD fluid discharge may occur in the sandeel spawning season but suitable sandeel spawning habitat is sited over 3.5km offshore along the consenting corridor (MMT, 2017) and therefore no effects upon spawning sandeels or their habitat are likely. The magnitude of impact upon spawning sandeel or sandeel eggs is therefore assessed as **No Change**.

15.5.2.7 Introduction of Invasive Non-native Species

Vessels to be used for installation have the potential to carry INNS via their ballast waters and hulls, depending upon the origin of the vessels or previous ports, which if released and are mobile in nature could compete with fish and shellfish populations within the designated sites.

Any released INNS by the vessels to be used for installation could colonise existing designated sites for fish and shellfish species and compete with them for resources, causing a potential decline in population abundance. Whilst this is possible it is considered to be unlikely given the extent of shipping activity which exists within the North Sea and given that the BWM Convention has been ratified and all vessels will be fully IMO compliant. The magnitude of impact upon all fish and shellfish receptors is assessed as **Negligible**.

15.5.3 Operations

15.5.3.1 Change in Hydrodynamic Regime (Scour and Accretion)

Where seabed type and morphology have changed, such as in the case of the rock placement areas on soft substrates, there may be localised changes in the flows causing scour and accretion but these are likely to be very localised to near the areas of rock placement and only occur in the short term as an equilibrium re-establishes.

15.5.3.1.1 Designated Sites (for Fish and Shellfish Species)

Given the separation achieved between the consenting corridor and designated sites for fish and shellfish species, then any changes in the hydrodynamic regime will not be detectable in these sites or on their populations, and the magnitude of impact upon designated sites for fish and shellfish species is therefore assessed as **No Change.**

15.5.3.1.2 Marine Demersal Fish Species

Scour and accretion is likely to have little effect on marine demersal species individuals, as they can move away from areas to forage elsewhere. The magnitude of impact is therefore assessed as **No Change**.

15.5.3.1.3 Crustaceans

Localised accretion may cause burial or smothering of individuals as they are less mobile and may be unable to move away from the area. This is only anticipated to potentially occur in the immediate vicinity of the rock placement areas and therefore the extent of impacts will be highly localised and temporary and have no effect on wider populations. The magnitude of impact upon crustaceans is therefore assessed as **Negligible**.

15.5.3.1.4 Molluscs

Localised accretion may cause burial or smothering of individuals as they are less mobile and may be unable to move away from the area. This is only anticipated to potentially occur in the immediate vicinity of the rock placement areas and therefore the extent of impacts will be highly localised and temporary and have no effect on wider populations. The magnitude of impact upon crustaceans is therefore assessed as **Negligible**.

15.5.3.1.5 Spawning and Nursery Grounds

Localised accretion around areas of rock placement may cause burial or smothering of herring and sandeel eggs where the rock is placed in areas of suitable spawning habitat for these species, if these species spawn in these locations. However, given the change in substrate caused by the rock placement, and the assessment of habitat loss to the spawning grounds in Section 15.5.2.1.4, it is considered unlikely that individuals will choose to spawn in these locations given the unsuitability of the habitat. Therefore, the magnitude of impact is assessed as **No Change**.

15.5.3.2 Sediment Heating

When operational, the HVDC cables will emit heat. An assessment of the review of the changes caused to sediment temperatures by the HVDC cable is provided in Chapter 18: EMF and Sediment Heating, and the sensitivity of the relevant fish species to this heating is provided in Appendix E.1. If bundled, and placed at a depth of lowering of 0.5m below the seabed, as a worst-case for soft substrates, the temperature rise at the seabed immediately above the cable will be 1^{o}C above background levels, and will rapidly decrease away from this.

15.5.3.2.1 Designated Sites (for Fish and Shellfish Species)

Given the separation achieved between the consenting corridor and designated sites for fish and shellfish species, then no change in sediment temperature will occur in these sites, and the magnitude of impact upon designated sites for fish and shellfish species is assessed as **No Change.**

15.5.3.2.2 Marine Demersal Fish Species

As the marine demersal fish species are highly mobile, then they are unlikely to be exposed to increased sediment temperatures (and any associated increased water temperatures) for a period of time that may cause any adverse behavioural or physiological effects. They are likely to be actively foraging in the area and so may move in and out of the areas with increased sediment temperature (and any associated increased water temperatures), but no adverse effect is anticipated. Impacts upon demersal spawners and eggs are assessed separately in Section 15.5.3.2.5 below. The magnitude of impact upon demersal fish species is therefore assessed as **No Change**.

15.5.3.2.3 Crustaceans

Exposure to increased sediment temperatures (and any associated increased water temperatures) may displace or attract some individuals to inhabit the areas immediately above the cable, but this will only occur for a very limited distance from the cable. This effect may also be masked by any changes in behaviour or physiology associated with the EMF produced by the cables, and so the magnitude of impact upon crustaceans is assessed as **No Change**.

15.5.3.2.4 Molluscs

Exposure to increased sediment and water temperatures may displace or attract some individuals to inhabit the areas immediately above the cable, and may increase or decrease the mortality rates of individuals, but this will only occur for a very limited distance from the cable. This effect may also be masked by any changes in abundance, colonisation or physiology associated with the EMF produced by the cables, and so the magnitude of impact upon crustaceans is assessed as **No Change**.

15.5.3.2.5 Spawning and Nursery Grounds

Given that Atlantic herring from the Buchan / Shetland stock spawn in August and September, then the baseline water / sediment temperature is likely to be between 8-12^{o}C depending upon water depth (Berx and Hughes, 2008). If these eggs were exposed to a 1^{o}C temperature increase for the whole lifestage then it would result in a reduced survivorship from 23.8-33.2% to 21.6-30.8% (see Appendix E.1). As this small reduction in survivorship from a 1^{o}C temperature increase would occur on less than 0.0001% of the spawning habitat for the Buchan / Shetland stock in the local herring spawning ground, then the overall magnitude of impact on the population is assessed as **Negligible**.

Given that sandeel spawn in December and January, then the baseline water / sediment temperature is likely to be around 4-8^{o}C depending upon water depth (Berx and Hughes, 2008). If these eggs were exposed to a 1^{o}C temperature increase for the whole lifestage then it would result in a reduced survivorship from 33.2-42.9% to 30.8-40.5% (see Appendix E.1). As this small reduction in survivorship from a 1^{o}C temperature increase would occur on only 0.0001% of the local spawning ground for the sandeel spawning stock unit in the North Sea, then the overall magnitude of impact on the population is assessed as **Negligible**.

15.5.3.3 Electro-magnetic Fields (EMFs)

When operational, the HVDC will emit a magnetic field. As it is a direct current cable then no electric induced fields will be created, and any electric fields will be contained within the cable armouring. An assessment of the EMFs created by the project is provided in Chapter 18: Electro Magnetic Fields, and a literature review of the sensitivity of the relevant fish species to these EMFs is provided in Appendix E.1, from which the data and references for the assessment detailed below are sourced. At worst-case burial depths of 0.4m in hard substrates and 0.5m in soft substrates, then the magnetic field at the seabed would be at most 640µT, and would reduce to <300µT within 2m of the seabed at both worst-case and best case separation distances.

15.5.3.3.1 Designated Sites (for Fish and Shellfish Species)

Given the separation achieved between the consenting corridor and designated sites for fish and shellfish species, then no change in EMFs will occur in these sites, and the magnitude of impact upon designated sites for fish and shellfish species is therefore assessed as **No Change.**

15.5.3.3.2 Diadromous Fish Species

No behavioural change has been shown in Atlantic salmon or sea trout in magnetic fields below 600µT, with documented behavioural changes at 1000 µT. At very low level magnetic fields (<50µT), improvements in growth and performance have been shown for trout species, but deterioration in egg quality has been shown at magnetic fields of >2000µT. As these species are pelagic and likely to be swimming near the surface during migration, then they will not be at risk of encountering a magnetic field that could cause a behavioural change. The magnitude of impact upon Atlantic salmon and sea trout is therefore assessed as **No Change**.

European eels have shown to temporarily divert their migration because of magnetic fields as low as 5µT above background levels. They have also been shown to orientate towards a magnetic field at 200µT above background levels. Given their wide distribution through the water column during migrations, and exhibition of diurnal vertical migrations (Righton *et al.*, 2016), they may encounter the magnetic field from the project and be at risk of temporary diversions in their migration. As this will be only for a short distance and beyond the magnetic field, they will return to their original course, then the temporary diversion will only slightly delay migration and have no discernible effect upon glass eel migration success (given that these individuals are highly reliant on currents to migrate) or silver eel escapement success. The magnitude of impact upon European eels is therefore assessed as **Negligible**.

No studies are available to assess the sensitivity of lamprey species to magnetic fields, though it is likely that they may find some level of magnetic field undesirable. If this magnetic field level is below 640µT then they may show a response to this field. Whilst lampreys are feeding on a host then their movement is dependent upon that host. They may drop off their host if they encounter a magnetic field level that is undesirable to them, but will be able to swim away from the field in this case. As they are not natal spawners, and rely on pheromones of other lampreys to indicate suitable rivers to spawn in, then they do not migrate to a specific destination and so any changes or delays in migration will not result in an adverse impact upon these species. The magnitude of impact upon sea lamprey and river lamprey is therefore assessed as **No Change**.

15.5.3.3.3 Elasmobranch Species

The sharks, skate and rays present within the consenting corridor will be highly sensitive to electromagnetic frequencies (Gill *et al.*, 2009). Elasmobranch species are sensitive to electric fields and rely on electric sense in detecting prey and predators, orientating to ocean currents and sensing their magnetic compass headings. The ampullae of Lorenzini, their electro-sensory organs, can result in increased electro sensitivity 1,000 to 10,000 times greater than other marine fish.

Elasmobranchs have the ability to detect very low-level magnetic fields and have shown behavioural responses to fields as low as 25µT above background levels. Some elasmobranch species, such as rays and skates, are demersal and inhabit the lower sections of the water column and can feed on the seabed. These species would likely be able to detect even the very smallest perturbations in the earth's natural magnetic field, given their biology and presence of ampullae of Lorenzini, but behavioural changes have only been detected at magnetic fields of over 25µT. There may therefore be some behavioural avoidance shown by these species to the magnetic field produced by the project but given the mobile nature of the species they can either forage elsewhere outside of the magnetic field or navigate swiftly through it (or over it) if necessary. No effects upon the population levels are therefore anticipated. The magnitude of impact upon the common skate, sandy ray, Portuguese dogfish, spiny dogfish, spotted ray and thornback ray is therefore assessed as **Negligible**.

For the remaining pelagic elasmobranchs, they may also show behavioural avoidance of the field but as they occupy a much wider vertical range within the water column, they will be able to easily navigate over it. The magnitude of impact upon all other elasmobranchs is therefore assessed as **No Change**.

15.5.3.3.4 Marine Demersal Fish Species

Low-level magnetic fields may induce behavioural change in marine demersal species, but empirical evidence on this is limited. No physiological changes to these species have been found below 3,700µT. While marine demersal species will be seabed orientated, given their mobile nature and swimming capacities they would have the ability to swim higher into the water column above the magnetic field to avoid it should they have the propensity to do so. However, no negative physiological effects have been identified at magnetic fields below 3,700µT, should they not show this avoidance behaviour. The magnitude of impact upon marine demersal fish species is therefore assessed as **Negligible**.

15.5.3.3.5 Marine Pelagic Fish Species

Low-level magnetic fields may induce behavioural change in marine pelagic species, but empirical evidence on this is limited. No physiological changes to these species have been found below 3,700µT. As pelagic species will be widely distributed through the water column, given their mobile nature and swimming capacities they would have the ability to swim higher into the water column above the magnetic field to avoid it. However, no negative physiological effects have been identified at magnetic fields below 3,700µT, should they not show this avoidance behaviour. The magnitude of impact upon marine pelagic fish species is therefore assessed as **Negligible**.

15.5.3.3.6 Cephalopods

No studies are available to assess the sensitivity of cephalopod species to magnetic fields, though on a precautionary basis they may find some level of magnetic field undesirable. If this magnetic field level is below 640µT then they may show a response to this field but as they are mobile species then they could navigate away from the field. To reflect the potential for individuals to exhibit a response to the magnetic field generated by the project, on a precautionary basis, the magnitude of impact upon cephalopods is therefore assessed as **Negligible**.

15.5.3.3.7 Crustaceans

Crustacean species inhabit the seabed and so may be in close proximity to the cable, and thus be subjected higher magnetic fields than species in the water column. Behavioural changes of crab and lobster species have been observed between 314 and 1,103µT. No behavioural or physiological changes have, however, been identified in shellfish species below 300 µT. Given their significantly lower ability to move vertically into the water column than elasmobranch and marine demersal species, they would have less ability to avoid the magnetic fields if exposed to them, but they are likely to be able to move beyond the range of the field at which physiological effects could occur (c.2m), and therefore physiological effects upon these species will be limited. Given the geographical extent of the EMF from the project, these species will be capable of utilising their swimming capacity to move through the EMF quickly, in a matter of seconds. For example, langoustine have been reported to reach speeds of $0.8ms^{-1}$ (Stentiford et al., 2000). Also, many of these species will release larvae into the water column during reproduction, which is pelagic and carried by oceanic currents (Wilson, 1999), therefore, the presence of a small EMF will not affect the distribution of the species or present barriers to population range or growth. The magnitude of impact is therefore assessed as **Negligible**.

15.5.3.3.8 Molluscs

Mollusc species inhabit the seabed and so would be in closer proximity to the cable and thus higher magnetic fields. Changes in shapes of immunocytes, the cells that create antibodies, have been observed in Mediterranean mussels at 300µT. No behavioural or physiological changes have been identified to shellfish species below 300µT. Given their inability to move vertically into the water column, these species would be unable to avoid the magnetic fields if exposed to them, though would only be potentially exposed to an effect at field levels of above 300µT. As this will occur at a maximum distance of 2m either side of the seabed for each cable, then an overall area of 180ha is potentially affected. Given that the cable installation is likely to have disturbed a greater width of seabed along the consenting corridor, and therefore removed the molluscs present, then no direct mortalities are expected from the magnetic field. The effect will be limited to displacement of individuals from future colonisation of this area, or potentially reduced survival and/or fecundity of individuals that do recolonise this area. As many mollusc species release eggs into the water column for fertilisation (Galtsoff, 1961), which are then carried by oceanic currents, then the presence of a small EMF will not affect the distribution of the species or present barriers to population range or growth. As the extent of the potential effects is very limited considering the wider areas of production of these species within the North Sea, then the magnitude of impact is assessed as **Negligible**.

15.5.3.3.9 Spawning and Nursery Grounds

No physiological changes from magnetic fields have been shown upon marine pelagic or demersal fish species below 3,700µT and, therefore, any herring or sandeel eggs spawned in these areas are unlikely to be subject to any physiological effects. There may be some behavioural avoidance shown by these species prior to spawning, but this will be over a very limited area and with significant areas of available spawning grounds either side. The magnitude of impact upon spawning and nursery grounds is therefore assessed as **Negligible**.

15.5.3.4 Introduction of Invasive Non-native Species

Vessels to be used for repairs have the potential to carry INNS via their ballast waters and hulls, depending upon the origin of the vessels or previous ports, which if released and are mobile in nature could compete with fish and shellfish populations within the designated sites.

Any released INNS by the vessels to be used for installation could colonise existing designated sites for fish and shellfish species and compete with them for resources, causing a potential decline in population abundance. The disturbance of the seabed and introduction of rock will create uncolonised seabed surfaces which will be at risk of inhabitation by INNS during the first years of operation.

Whilst this is possible it is considered to be unlikely given the extent of shipping activity and habitat disturbance which currently exists within the North Sea and given that the BWM Convention has been ratified and all vessels will be fully IMO compliant. The magnitude of impact upon all fish and shellfish receptors is assessed as **Negligible**.

15.5.3.5 Physical Disturbance During Inspection and Repair

To conduct repairs on the cables, they must be brought to the surface and then re-laid which will disturb the seabed along the consenting corridor for a distance of twice the water depth, which within 12nm is a distance of ~200m, and between 12nm to the UK EEZ limit is a distance of ~300m. One repair every three years is assumed as a worst-case based on previous project experiences, and so over the lifetime of the project (40 years), repairs could occur 13times, disturbing a total of a maximum 4.2ha of seabed assuming the repair disturbs a 10m wide strip of the seabed around the consenting corridor. This area of disturbance, even if it wholly occurs in the sensitive herring and sandeel suitable spawning habitat would represent a tiny fraction of the available habitat and spawning ground. The magnitude of impact upon these spawning grounds is therefore assessed as **Negligible**. The magnitude of impact upon all other species is assessed as **No Change**.

15.5.4 Decommissioning Phase Impacts

Impacts during the decommissioning phase associated with the removal of the cable (if required), are anticipated to be of a similar or lesser magnitude than for cable installation. On a precautionary basis for the following decommissioning phase impacts, the magnitude of impact is assessed to be the same as for the installation phase:

- Habitat loss;
- Changes to water quality (resuspension of sediments and increased sediment loading);
- Changes to water quality (release of hazardous substances);
- Underwater noise and vibration (cable removal); and
- Introduction of invasive non-native species.

No other impacts are anticipated during decommissioning.

15.5.5 Impact Assessment Summary

A summary table of the impact assessment for fish and shellfish receptors is presented in Tables 15.13a-c, which also considers the overall significance of effect from the assigned receptor value/sensitivity and magnitude of impact, and the confidence in the assessment. No impacts are assessed as being significant under the provisions of the EIA regulations.

Table 15.13a Fish and Shellfish Impact Assessment Summary for Installation Phase

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Habitat loss	Designated sites	River Dee SAC	Very High	No Change	No Change		High	Non-significant
		River South Esk SAC	Very High	No Change	No Change		High	Non-significant
		River Tay SAC	Very High	No Change	No Change		High	Non-significant
		River Teith SAC	Very High	No Change	No Change		High	Non-significant
		River Tweed SAC	Very High	No Change	No Change		High	Non-significant
		Turbot Bank MPA	High	No Change	No Change		High	Non-significant
		Norwegian Boundary Sediment Plain MPA	High	No Change	No Change		High	Non-significant
	Crustaceans	Langoustine *Nephrops norvegicus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Common lobster *Homarus gammarus*	High	Negligible	Minor	Adverse	High	Non-significant
		European spiny lobster *Palinurus elephas*	High	Negligible	Minor	Adverse	High	Non-significant
		Squat lobster *Munida rugosa*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Edible crabs *Cancer pagurus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Velvet swimming crab *Necora puber*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Shore crab *Carcinus maenas*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	High	Non-significant
	Molluscs	Ocean quahog *Artica Islandica*	High	Negligible	Minor	Adverse	High	Non-significant
		Common cockle *Cerastoderma edule*	Low	Minor	Minor	Adverse	High	Non-significant
		King scallop *Pecten maximus*	Medium	Minor	Minor	Adverse	High	Non-significant
		Queen scallop *Aequipecten opercularis*	Low	Minor	Minor	Adverse	High	Non-significant
		Razorfish Ensis spp.	Low	Minor	Minor	Adverse	High	Non-significant
	Spawning and nursery grounds	Herring spawning and nursery grounds	High	Negligible	Minor	Adverse	High	Non-significant
		Sandeel spawning and nursery grounds	High	Negligible	Minor	Adverse	High	Non-significant
Habitat creation	Designated sites	River Dee SAC	Very High	No Change	No Change		High	Non-significant
		River South Esk SAC	Very High	No Change	No Change		High	Non-significant
		River Tay SAC	Very High	No Change	No Change		High	Non-significant
		River Teith SAC	Very High	No Change	No Change		High	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Habitat creation	Designated sites	River Tweed SAC	Very High	No Change	No Change		High	Non-significant
		Turbot Bank MPA	High	No Change	No Change		High	Non-significant
		Norwegian Boundary Sediment Plain MPA	High	No Change	No Change		High	Non-significant
	Marine demersal fish species	Anglerfish / sea monkfish *Lophius piscatorius*	High	No Change	No Change		High	Non-significant
		Atlantic cod *Gadus morhua*	High	No Change	Minor	Beneficial	Beneficial	Non-significant
		Atlantic halibut *Hippoglossus hippoglossus*	Very High	No Change	No Change		High	Non-significant
		Blue ling *Molva dypterygia*	High	No Change	No Change		High	Non-significant
		Common goby *Pomatoschitus microps*	High	No Change	No Change		High	Non-significant
		Common sole *Solea solea*	High	No Change	No Change		High	Non-significant
		European hake *Merluccius merluccius*	High	No Change	No Change		High	Non-significant
		European plaice *Pleuronectes platessa*	High	No Change	No Change		High	Non-significant
		Greenland halibut *Reinhardtius hippoglossoides*	High	No Change	No Change		High	Non-significant
		Haddock *Melanogrammus aeglefinus*	High	No Change	No Change		High	Non-significant
		Lemon sole *Microstomus kitt*	High	No Change	No Change		High	Non-significant
		Ling *Molva molva*	High	Negligible	Minor	Beneficial	Medium	Non-significant
		Norway pout *Trisopterus esmarkii*	High	No Change	No Change		High	Non-significant
		Saithe *Pollachius virens*	High	Negligible	Minor	Beneficial	Medium	Non-significant
		Sand goby *Pomatoschitus minutus*	High	No Change	No Change		High	Non-significant
		Sandeel *Ammodytes spp.*	High	No Change	No Change		High	Non-significant
		Whiting *Merlangius merlangus*	High	Negligible	Minor	Beneficial	Medium	Non-significant
	Crustaceans	Langoustine *Nephrops norvegicus*	Medium	No Change	No Change		High	Non-significant
		Common lobster *Homarus gammarus*	High	No Change	No Change		High	Non-significant
		European spiny lobster *Palinurus elephas*	High	No Change	No Change		High	Non-significant
		Squat lobster *Munida rugosa*	Low	No Change	No Change		High	Non-significant
		Edible crabs *Cancer pagurus*	Medium	No Change	No Change		High	Non-significant
		Velvet swimming crab *Necora puber*	Medium	No Change	No Change		High	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Habitat creation	Crustaceans	Shore crab *Carcinus maenas*	Low	No Change	No Change		High	Non-significant
		Crayfish *Palunirus elegans*	Low	No Change	No Change		High	Non-significant
	Molluscs	Ocean quahog *Artica Islandica*	High	No Change	No Change		High	Non-significant
		Common cockle *Cerastoderma edule*	Low	No Change	No Change		High	Non-significant
		King scallop *Pecten maximus*	Medium	No Change	No Change		High	Non-significant
		Queen scallop *Aequipecten opercularis*	Low	No Change	No Change		High	Non-significant
		Razorfish Ensis spp.	Low	No Change	No Change		High	Non-significant
	Spawning and nursery grounds	Herring spawning and nursery grounds	High	No Change	No Change		High	Non-significant
		Sandeel spawning and nursery grounds	High	No Change	No Change		High	Non-significant
Changes to water quality (resuspension of sediments and increased sediment loading)	Designated sites	River Dee SAC	Very High	No Change	No Change		High	Non-significant
		River South Esk SAC	Very High	No Change	No Change		High	Non-significant
		River Tay SAC	Very High	No Change	No Change		High	Non-significant
		River Teith SAC	Very High	No Change	No Change		High	Non-significant
		River Tweed SAC	Very High	No Change	No Change		High	Non-significant
		Turbot Bank MPA	High	No Change	No Change		High	Non-significant
		Norwegian Boundary Sediment Plain MPA	High	No Change	No Change		High	Non-significant
	Diadromous fish species	Atlantic salmon *Salmo salar*	Very High	No Change	No Change		High	Non-significant
		Sea trout *Salmo trutta*	High	No Change	No Change		High	Non-significant
		European eel *Anguilla anguilla*	Very High	No Change	No Change		High	Non-significant
		Sea lamprey *Petromyzon marinus*	Very High	No Change	No Change		High	Non-significant
		River lamprey *Lampetra fluviatilis*	Very High	No Change	No Change		High	Non-significant
	Elasmobranchs	Angel Shark *Squatina squatina*	Very High	No Change	No Change		High	Non-significant
		Basking Shark *Cetorhinus maximus*	Very High	No Change	No Change		High	Non-significant
		Blue Shark *Prionace glauca*	High	No Change	No Change		High	Non-significant
		Common Skate *Dipturus batis*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Gulper Shark *Centrophorus granulosus*	High	No Change	No Change		High	Non-significant
		Kitefin Shark *Dalatias licha*	High	No Change	No Change		High	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Changes to water quality (resuspension of sediments and increased sediment loading)	Elasmobranchs	Leafscale gulper shark *Centrophorus squamosus*	High	No Change	No Change		High	Non-significant
		Porbeagle Shark *Lamna nasus*	High	No Change	No Change		High	Non-significant
		Portuguese Dogfish *Centroscymnus coelolepis*	High	Negligible	Minor	Adverse	High	Non-significant
		Sandy Ray *Leucoraja circularis*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Spurdog or Spiny Dogfish *Squalus acanthias*	High	Negligible	Minor	Adverse	High	Non-significant
		Tope Shark *Galeorhinus galeus*	High	No Change	No Change		High	Non-significant
		Other elasmobranch species (e.g. spotted ray Raja montagui, thornback ray *Raja clavata*)	Medium	Negligible	Negligible	Adverse	High	Non-significant
	Marine demersal fish species	Anglerfish / sea monkfish *Lophius piscatorius*	High	Negligible	Minor	Adverse	High	Non-significant
		Atlantic cod *Gadus morhua*	High	Negligible	Minor	Adverse	High	Non-significant
		Atlantic halibut *Hippoglossus hippoglossus*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Blue ling *Molva dypterygia*	High	Negligible	Minor	Adverse	High	Non-significant
		Common goby *Pomatoschitus microps*	High	Negligible	Minor	Adverse	High	Non-significant
		Common sole *Solea solea*	High	Negligible	Minor	Adverse	High	Non-significant
		European hake *Merluccius merluccius*	High	Negligible	Minor	Adverse	High	Non-significant
		European plaice *Pleuronectes platessa*	High	Negligible	Minor	Adverse	High	Non-significant
		Greenland halibut *Reinhardtius hippoglossoides*	High	Negligible	Minor	Adverse	High	Non-significant
		Haddock *Melanogrammus aeglefinus*	High	Negligible	Minor	Adverse	High	Non-significant
		Lemon sole *Microstomus kitt*	High	Negligible	Minor	Adverse	High	Non-significant
		Ling *Molva molva*	High	Negligible	Minor	Adverse	High	Non-significant
		Norway pout *Trisopterus esmarkii*	High	Negligible	Minor	Adverse	High	Non-significant
		Saithe *Pollachius virens*	High	Negligible	Minor	Adverse	High	Non-significant
		Sand goby *Pomatoschitus minutus*	High	Negligible	Minor	Adverse	High	Non-significant
		Sandeel *Ammodytes spp.*	High	Negligible	Minor	Adverse	High	Non-significant
		Whiting *Merlangius merlangus*	High	Negligible	Minor	Adverse	High	Non-significant
	Marine pelagic fish species	Atlantic bluefin tuna *Thunnus thynnus*	High	No Change	No Change		High	Non-significant
		Atlantic herring *Clupea harengus*	High	No Change	No Change		High	Non-significant
		Atlantic mackerel *Scomber scombrus*	High	No Change	No Change		High	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Changes to water quality (resuspension of sediments and increased sediment loading)	Marine pelagic fish species	Black scabbardfish *Aphanopus carbo*	High	No Change	No Change		High	Non-significant
		Blue whiting *Micromesistius poutassou*	High	No Change	No Change		High	Non-significant
		European sprat *Sprattus sprattus*	High	No Change	No Change		High	Non-significant
		Horse mackerel *Trachurus trachurus*	High	No Change	No Change		High	Non-significant
		Orange roughy *Hoplostethus atlanticus*	High	No Change	No Change		High	Non-significant
		Roundnose grenadier *Coryphaenoides rupestris*	Very High	No Change	No Change		High	Non-significant
	Cephalopods	Long-finned (loliginid) squids *Loligo forbesi* and *Loligo vulgari*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Short-finned (ommastrephid) squids *Todarodes sagittatus, Todaropsis eblanae* and *Illex coindetii*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Cuttlefish *Sepia officinalis*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Octopuses *Octopus vulgaris and Eledone cirrhosa*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	High	Non-significant
	Crustaceans	Langoustine *Nephrops norvegicus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Common lobster *Homarus gammarus*	High	Negligible	Minor	Adverse	High	Non-significant
		European spiny lobster *Palinurus elephas*	High	Negligible	Minor	Adverse	High	Non-significant
		Squat lobster *Munida rugosa*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Edible crabs *Cancer pagurus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Velvet swimming crab *Necora puber*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Shore crab *Carcinus maenas*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	High	Non-significant
	Molluscs	Ocean quahog *Artica Islandica*	High	Negligible	Minor	Adverse	High	Non-significant
		Common cockle *Cerastoderma edule*	Low	Negligible	Negligible	Adverse	High	Non-significant
		King scallop *Pecten maximus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Queen scallop *Aequipecten opercularis*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Razorfish Ensis spp.	Low	Negligible	Negligible	Adverse	High	Non-significant
	Spawning and nursery grounds	Herring spawning and nursery grounds	High	Negligible	Minor	Adverse	High	Non-significant
		Sandeel spawning and nursery grounds	High	No Change	No Change		High	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Changes to water quality (release of hazardous substances)	Designated sites	River Dee SAC	Very High	No Change	No Change		Medium	Non-significant
		River South Esk SAC	Very High	No Change	No Change		Medium	Non-significant
		River Tay SAC	Very High	No Change	No Change		Medium	Non-significant
		River Teith SAC	Very High	No Change	No Change		Medium	Non-significant
		River Tweed SAC	Very High	No Change	No Change		Medium	Non-significant
		Turbot Bank MPA	High	No Change	No Change		Medium	Non-significant
		Norwegian Boundary Sediment Plain MPA	High	No Change	No Change		Medium	Non-significant
	Diadromous fish species	Atlantic salmon *Salmo salar*	Very High	No Change	No Change		Medium	Non-significant
		Sea trout *Salmo trutta*	High	No Change	No Change		Medium	Non-significant
		European eel *Anguilla anguilla*	Very High	No Change	No Change		Medium	Non-significant
		Sea lamprey *Petromyzon marinus*	Very High	No Change	No Change		Medium	Non-significant
		River lamprey *Lampetra fluviatilis*	Very High	No Change	No Change		Medium	Non-significant
	Elasmobranchs	Angel Shark *Squatina squatina*	Very High	No Change	No Change		Medium	Non-significant
		Basking Shark *Cetorhinus maximus*	Very High	No Change	No Change		Medium	Non-significant
		Blue Shark *Prionace glauca*	High	No Change	No Change		Medium	Non-significant
		Common Skate *Dipturus batis*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Gulper Shark *Centrophorus granulosus*	High	No Change	No Change		Medium	Non-significant
		Kitefin Shark *Dalatias licha*	High	No Change	No Change		Medium	Non-significant
		Leafscale gulper shark *Centrophorus squamosus*	High	No Change	No Change		Medium	Non-significant
		Porbeagle Shark *Lamna nasus*	High	No Change	No Change		Medium	Non-significant
		Portuguese Dogfish *Centroscymnus coelolepis*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Sandy Ray *Leucoraja circularis*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Spurdog or Spiny Dogfish *Squalus acanthias*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Tope Shark *Galeorhinus galeus*	High	No Change	No Change		Medium	Non-significant
		Other elasmobranch species (e.g. spotted ray Raja montagui, thornback ray *Raja clavata*)	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
	Marine demersal fish species	Anglerfish / sea monkfish *Lophius piscatorius*	High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Changes to water quality (release of hazardous substances)	Marine demersal fish species	Atlantic cod *Gadus morhua*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Atlantic halibut *Hippoglossus hippoglossus*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Blue ling *Molva dypterygia*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Common goby *Pomatoschitus microps*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Common sole *Solea solea*	High	Negligible	Minor	Adverse	Medium	Non-significant
		European hake *Merluccius merluccius*	High	Negligible	Minor	Adverse	Medium	Non-significant
		European plaice *Pleuronectes platessa*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Greenland halibut *Reinhardtius hippoglossoides*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Haddock *Melanogrammus aeglefinus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Lemon sole *Microstomus kitt*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Ling *Molva molva*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Norway pout *Trisopterus esmarkii*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Saithe *Pollachius virens*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Sand goby *Pomatoschitus minutus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Sandeel *Ammodytes spp.*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Whiting *Merlangius merlangus*	High	Negligible	Minor	Adverse	Medium	Non-significant
	Marine pelagic fish species	Atlantic bluefin tuna *Thunnus thynnus*	High	No Change	No Change		Medium	Non-significant
		Atlantic herring *Clupea harengus*	High	No Change	No Change		Medium	Non-significant
		Atlantic mackerel *Scomber scombrus*	High	No Change	No Change		Medium	Non-significant
		Black scabbardfish *Aphanopus carbo*	High	No Change	No Change		Medium	Non-significant
		Blue whiting *Micromesistius poutassou*	High	No Change	No Change		Medium	Non-significant
		European sprat *Sprattus sprattus*	High	No Change	No Change		Medium	Non-significant
		Horse mackerel *Trachurus trachurus*	High	No Change	No Change		Medium	Non-significant
		Orange roughy *Hoplostethus atlanticus*	High	No Change	No Change		Medium	Non-significant
		Roundnose grenadier *Coryphaenoides rupestris*	Very High	No Change	No Change		Medium	Non-significant
	Cephalopods	Long-finned (loliginid) squids *Loligo forbesi* and *Loligo vulgari*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Short-finned (ommastrephid) squids *Todarodes sagittatus, Todaropsis eblanae* and *Illex coindetii*	Low	Negligible	Negligible	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Changes to water quality (release of hazardous substances)	Cephalopods	Cuttlefish *Sepia officinalis*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Octopuses *Octopus vulgaris and Eledone cirrhosa*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
	Crustaceans	Langoustine *Nephrops norvegicus*	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
		Common lobster *Homarus gammarus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		European spiny lobster *Palinurus elephas*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Squat lobster *Munida rugosa*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Edible crabs *Cancer pagurus*	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
		Velvet swimming crab *Necora puber*	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
		Shore crab *Carcinus maenas*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
	Molluscs	Ocean quahog *Artica Islandica*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Common cockle *Cerastoderma edule*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		King scallop *Pecten maximus*	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
		Queen scallop *Aequipecten opercularis*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Razorfish Ensis spp.	Low	Negligible	Negligible	Adverse	Medium	Non-significant
	Spawning and nursery grounds	Herring spawning and nursery grounds	High	No Change	No Change		Medium	Non-significant
		Sandeel spawning and nursery grounds	High	Negligible	Minor	Adverse	Medium	Non-significant
Underwater noise and vibration	Designated sites	River Dee SAC	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		River South Esk SAC	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		River Tay SAC	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		River Teith SAC	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		River Tweed SAC	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Turbot Bank MPA	High	Negligible	Minor	Adverse	Medium	Non-significant
		Norwegian Boundary Sediment Plain MPA	High	Negligible	Minor	Adverse	Medium	Non-significant
	Diadromous fish species	Atlantic salmon *Salmo salar*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Sea trout *Salmo trutta*	High	Negligible	Minor	Adverse	Medium	Non-significant
		European eel *Anguilla anguilla*	Very High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Underwater noise and vibration	Diadromous fish species	Sea lamprey *Petromyzon marinus*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		River lamprey *Lampetra fluviatilis*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
	Elasmobranchs	Angel Shark *Squatina squatina*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Basking Shark *Cetorhinus maximus*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Blue Shark *Prionace glauca*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Common Skate *Dipturus batis*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Gulper Shark *Centrophorus granulosus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Kitefin Shark *Dalatias licha*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Leafscale gulper shark *Centrophorus squamosus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Porbeagle Shark *Lamna nasus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Portuguese Dogfish *Centroscymnus coelolepis*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Sandy Ray *Leucoraja circularis*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Spurdog or Spiny Dogfish *Squalus acanthias*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Tope Shark *Galeorhinus galeus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Other elasmobranch species (e.g. spotted ray Raja montagui, thornback ray *Raja clavata*)	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
	Marine demersal fish species	Anglerfish / sea monkfish *Lophius piscatorius*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Atlantic cod *Gadus morhua*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Atlantic halibut *Hippoglossus hippoglossus*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Blue ling *Molva dypterygia*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Common goby *Pomatoschitus microps*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Common sole *Solea solea*	High	Negligible	Minor	Adverse	Medium	Non-significant
		European hake *Merluccius merluccius*	High	Negligible	Minor	Adverse	Medium	Non-significant
		European plaice *Pleuronectes platessa*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Greenland halibut *Reinhardtius hippoglossoides*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Haddock *Melanogrammus aeglefinus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Lemon sole *Microstomus kitt*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Ling *Molva molva*	High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Underwater noise and vibration	Marine demersal fish species	Norway pout *Trisopterus esmarkii*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Saithe *Pollachius virens*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Sand goby *Pomatoschitus minutus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Sandeel *Ammodytes spp.*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Whiting *Merlangius merlangus*	High	Negligible	Minor	Adverse	Medium	Non-significant
	Marine pelagic fish species	Atlantic bluefin tuna *Thunnus thynnus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Atlantic herring *Clupea harengus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Atlantic mackerel *Scomber scombrus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Black scabbardfish *Aphanopus carbo*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Blue whiting *Micromesistius poutassou*	High	Negligible	Minor	Adverse	Medium	Non-significant
		European sprat *Sprattus sprattus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Horse mackerel *Trachurus trachurus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Orange roughy *Hoplostethus atlanticus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Roundnose grenadier *Coryphaenoides rupestris*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
	Cephalopods	Long-finned (loliginid) squids *Loligo forbesi* and *Loligo vulgari*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Short-finned (ommastrephid) squids *Todarodes sagittatus, Todaropsis eblanae* and *Illex coindetii*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Cuttlefish *Sepia officinalis*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Octopuses *Octopus vulgaris and Eledone cirrhosa*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
	Crustaceans	Langoustine *Nephrops norvegicus*	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
		Common lobster *Homarus gammarus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		European spiny lobster *Palinurus elephas*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Squat lobster *Munida rugosa*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Edible crabs *Cancer pagurus*	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
		Velvet swimming crab *Necora puber*	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
		Shore crab *Carcinus maenas*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Underwater noise and vibration	Molluscs	Ocean quahog *Artica Islandica*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Common cockle *Cerastoderma edule*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		King scallop *Pecten maximus*	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
		Queen scallop *Aequipecten opercularis*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Razorfish Ensis spp.	Low	Negligible	Negligible	Adverse	Medium	Non-significant
	Spawning and nursery grounds	Herring spawning and nursery grounds	High	Negligible	Minor	Adverse	Medium	Non-significant
		Sandeel spawning and nursery grounds	High	Negligible	Minor	Adverse	Medium	Non-significant
Changes to water quality (Release of drilling fluids)	Designated sites	River Dee SAC	Very High	No Change	No Change		High	Non-significant
		River South Esk SAC	Very High	No Change	No Change		High	Non-significant
		River Tay SAC	Very High	No Change	No Change		High	Non-significant
		River Teith SAC	Very High	No Change	No Change		High	Non-significant
		River Tweed SAC	Very High	No Change	No Change		High	Non-significant
		Turbot Bank MPA	High	No Change	No Change		High	Non-significant
		Norwegian Boundary Sediment Plain MPA	High	No Change	No Change		High	Non-significant
	Diadromous fish species	Atlantic salmon *Salmo salar*	Very High	No Change	No Change		High	Non-significant
		Sea trout *Salmo trutta*	High	No Change	No Change		High	Non-significant
		European eel *Anguilla anguilla*	Very High	No Change	No Change		High	Non-significant
		Sea lamprey *Petromyzon marinus*	Very High	No Change	No Change		High	Non-significant
		River lamprey *Lampetra fluviatilis*	Very High	No Change	No Change		High	Non-significant
	Elasmobranchs	Angel Shark *Squatina squatina*	Very High	No Change	No Change		High	Non-significant
		Basking Shark *Cetorhinus maximus*	Very High	No Change	No Change		High	Non-significant
		Blue Shark *Prionace glauca*	High	No Change	No Change		High	Non-significant
		Common Skate *Dipturus batis*	Very High	No Change	No Change		High	Non-significant
		Gulper Shark *Centrophorus granulosus*	High	No Change	No Change		High	Non-significant
		Kitefin Shark *Dalatias licha*	High	No Change	No Change		High	Non-significant
		Leafscale gulper shark *Centrophorus squamosus*	High	No Change	No Change		High	Non-significant
		Porbeagle Shark *Lamna nasus*	High	No Change	No Change		High	Non-significant
		Portuguese Dogfish *Centroscymnus coelolepis*	High	No Change	No Change		High	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Changes to water quality (Release of drilling fluids)	Elasmobranchs	Sandy Ray *Leucoraja circularis*	Very High	No Change	No Change		High	Non-significant
		Spurdog or Spiny Dogfish *Squalus acanthias*	High	No Change	No Change		High	Non-significant
		Tope Shark *Galeorhinus galeus*	High	No Change	No Change		High	Non-significant
		Other elasmobranch species (e.g. spotted ray Raja montagui, thornback ray *Raja clavata*)	Medium	No Change	No Change		High	Non-significant
	Marine demersal fish species	Anglerfish / sea monkfish *Lophius piscatorius*	High	No Change	No Change		High	Non-significant
		Atlantic cod *Gadus morhua*	High	No Change	No Change		High	Non-significant
		Atlantic halibut *Hippoglossus hippoglossus*	Very High	No Change	No Change		High	Non-significant
		Blue ling *Molva dypterygia*	High	No Change	No Change		High	Non-significant
		Common goby *Pomatoschitus microps*	High	No Change	No Change		High	Non-significant
		Common sole *Solea solea*	High	No Change	No Change		High	Non-significant
		European hake *Merluccius merluccius*	High	No Change	No Change		High	Non-significant
		European plaice *Pleuronectes platessa*	High	No Change	No Change		High	Non-significant
		Greenland halibut *Reinhardtius hippoglossoides*	High	No Change	No Change		High	Non-significant
		Haddock *Melanogrammus aeglefinus*	High	No Change	No Change		High	Non-significant
		Lemon sole *Microstomus kitt*	High	No Change	No Change		High	Non-significant
		Ling *Molva molva*	High	No Change	No Change		High	Non-significant
		Norway pout *Trisopterus esmarkii*	High	No Change	No Change		High	Non-significant
		Saithe *Pollachius virens*	High	No Change	No Change		High	Non-significant
		Sand goby *Pomatoschitus minutus*	High	No Change	No Change		High	Non-significant
		Sandeel *Ammodytes spp.*	High	No Change	No Change		High	Non-significant
		Whiting *Merlangius merlangus*	High	No Change	No Change		High	Non-significant
	Marine pelagic fish species	Atlantic bluefin tuna *Thunnus thynnus*	High	No Change	No Change		High	Non-significant
		Atlantic herring *Clupea harengus*	High	No Change	No Change		High	Non-significant
		Atlantic mackerel *Scomber scombrus*	High	No Change	No Change		High	Non-significant
		Black scabbardfish *Aphanopus carbo*	High	No Change	No Change		High	Non-significant
		Blue whiting *Micromesistius poutassou*	High	No Change	No Change		High	Non-significant
		European sprat *Sprattus sprattus*	High	No Change	No Change		High	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Changes to water quality (Release of drilling fluids)	Marine pelagic fish species	Horse mackerel *Trachurus trachurus*	High	No Change	No Change		High	Non-significant
		Orange roughy *Hoplostethus atlanticus*	High	No Change	No Change		High	Non-significant
		Roundnose grenadier *Coryphaenoides rupestris*	Very High	No Change	No Change		High	Non-significant
	Cephalopods	Long-finned (loliginid) squids *Loligo forbesi* and *Loligo vulgari*	Low	No Change	No Change		High	Non-significant
		Short-finned (ommastrephid) squids *Todarodes sagittatus, Todaropsis eblanae* and *Illex coindetii*	Low	No Change	No Change		High	Non-significant
		Cuttlefish *Sepia officinalis*	Low	No Change	No Change		High	Non-significant
		Octopuses *Octopus vulgaris and Eledone cirrhosa*	Low	No Change	No Change		High	Non-significant
		Crayfish *Palunirus elegans*	Low	No Change	No Change		High	Non-significant
	Crustaceans	Langoustine *Nephrops norvegicus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Common lobster *Homarus gammarus*	High	Negligible	Minor	Adverse	High	Non-significant
		European spiny lobster *Palinurus elephas*	High	Negligible	Minor	Adverse	High	Non-significant
		Squat lobster *Munida rugosa*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Edible crabs *Cancer pagurus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Velvet swimming crab *Necora puber*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Shore crab *Carcinus maenas*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	High	Non-significant
	Molluscs	Ocean quahog *Artica Islandica*	High	Negligible	Minor	Adverse	High	Non-significant
		Common cockle *Cerastoderma edule*	Low	Negligible	Negligible	Adverse	High	Non-significant
		King scallop *Pecten maximus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Queen scallop *Aequipecten opercularis*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Razorfish Ensis spp.	Low	Negligible	Negligible	Adverse	High	Non-significant
	Spawning and nursery grounds	Herring spawning and nursery grounds	High	No Change	No Change		High	Non-significant
		Sandeel spawning and nursery grounds	High	No Change	No Change		High	Non-significant
Introduction of invasive non-native species	Designated sites	River Dee SAC	Very High	Negligible	Minor	Adverse	High	Non-significant
		River South Esk SAC	Very High	Negligible	Minor	Adverse	High	Non-significant
		River Tay SAC	Very High	Negligible	Minor	Adverse	High	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Introduction of invasive non-native species	Designated sites	River Teith SAC	Very High	Negligible	Minor	Adverse	High	Non-significant
		River Tweed SAC	Very High	Negligible	Minor	Adverse	High	Non-significant
		Turbot Bank MPA	High	Negligible	Minor	Adverse	High	Non-significant
		Norwegian Boundary Sediment Plain MPA	High	Negligible	Minor	Adverse	High	Non-significant
	Diadromous fish species	Atlantic salmon *Salmo salar*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Sea trout *Salmo trutta*	High	Negligible	Minor	Adverse	High	Non-significant
		European eel *Anguilla anguilla*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Sea lamprey *Petromyzon marinus*	Very High	Negligible	Minor	Adverse	High	Non-significant
		River lamprey *Lampetra fluviatilis*	Very High	Negligible	Minor	Adverse	High	Non-significant
	Elasmobranchs	Angel Shark *Squatina squatina*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Basking Shark *Cetorhinus maximus*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Blue Shark *Prionace glauca*	High	Negligible	Minor	Adverse	High	Non-significant
		Common Skate *Dipturus batis*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Gulper Shark *Centrophorus granulosus*	High	Negligible	Minor	Adverse	High	Non-significant
		Kitefin Shark *Dalatias licha*	High	Negligible	Minor	Adverse	High	Non-significant
		Leafscale gulper shark *Centrophorus squamosus*	High	Negligible	Minor	Adverse	High	Non-significant
		Porbeagle Shark *Lamna nasus*	High	Negligible	Minor	Adverse	High	Non-significant
		Portuguese Dogfish *Centroscymnus coelolepis*	High	Negligible	Minor	Adverse	High	Non-significant
		Sandy Ray *Leucoraja circularis*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Spurdog or Spiny Dogfish *Squalus acanthias*	High	Negligible	Minor	Adverse	High	Non-significant
		Tope Shark *Galeorhinus galeus*	High	Negligible	Minor	Adverse	High	Non-significant
		Other elasmobranch species (e.g. spotted ray Raja montagui, thornback ray *Raja clavata*)	Medium	Negligible	Negligible	Adverse	High	Non-significant
	Marine demersal fish species	Anglerfish / sea monkfish *Lophius piscatorius*	High	Negligible	Minor	Adverse	High	Non-significant
		Atlantic cod *Gadus morhua*	High	Negligible	Minor	Adverse	High	Non-significant
		Atlantic halibut *Hippoglossus hippoglossus*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Blue ling *Molva dypterygia*	High	Negligible	Minor	Adverse	High	Non-significant
		Common goby *Pomatoschitus microps*	High	Negligible	Minor	Adverse	High	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Introduction of invasive non-native species	Marine demersal fish species	Common sole *Solea solea*	High	Negligible	Minor	Adverse	High	Non-significant
		European hake *Merluccius merluccius*	High	Negligible	Minor	Adverse	High	Non-significant
		European plaice *Pleuronectes platessa*	High	Negligible	Minor	Adverse	High	Non-significant
		Greenland halibut *Reinhardtius hippoglossoides*	High	Negligible	Minor	Adverse	High	Non-significant
		Haddock *Melanogrammus aeglefinus*	High	Negligible	Minor	Adverse	High	Non-significant
		Lemon sole *Microstomus kitt*	High	Negligible	Minor	Adverse	High	Non-significant
		Ling *Molva molva*	High	Negligible	Minor	Adverse	High	Non-significant
		Norway pout *Trisopterus esmarkii*	High	Negligible	Minor	Adverse	High	Non-significant
		Saithe *Pollachius virens*	High	Negligible	Minor	Adverse	High	Non-significant
		Sand goby *Pomatoschitus minutus*	High	Negligible	Minor	Adverse	High	Non-significant
		Sandeel *Ammodytes spp.*	High	Negligible	Minor	Adverse	High	Non-significant
		Whiting *Merlangius merlangus*	High	Negligible	Minor	Adverse	High	Non-significant
	Marine pelagic fish species	Atlantic bluefin tuna *Thunnus thynnus*	High	Negligible	Minor	Adverse	High	Non-significant
		Atlantic herring *Clupea harengus*	High	Negligible	Minor	Adverse	High	Non-significant
		Atlantic mackerel *Scomber scombrus*	High	Negligible	Minor	Adverse	High	Non-significant
		Black scabbardfish *Aphanopus carbo*	High	Negligible	Minor	Adverse	High	Non-significant
		Blue whiting *Micromesistius poutassou*	High	Negligible	Minor	Adverse	High	Non-significant
		European sprat *Sprattus sprattus*	High	Negligible	Minor	Adverse	High	Non-significant
		Horse mackerel *Trachurus trachurus*	High	Negligible	Minor	Adverse	High	Non-significant
		Orange roughy *Hoplostethus atlanticus*	High	Negligible	Minor	Adverse	High	Non-significant
		Roundnose grenadier *Coryphaenoides rupestris*	Very High	Negligible	Minor	Adverse	High	Non-significant
	Cephalopods	Long-finned (loliginid) squids *Loligo forbesi* and *Loligo vulgari*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Short-finned (ommastrephid) squids *Todarodes sagittatus, Todaropsis eblanae* and *Illex coindetii*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Cuttlefish *Sepia officinalis*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Octopuses *Octopus vulgaris and Eledone cirrhosa*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	High	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Beneficial	Confidence	Effect significant in terms of the EIA Regulations
Introduction of invasive non-native species	Crustaceans	Langoustine *Nephrops norvegicus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Common lobster *Homarus gammarus*	High	Negligible	Minor	Adverse	High	Non-significant
		European spiny lobster *Palinurus elephas*	High	Negligible	Minor	Adverse	High	Non-significant
		Squat lobster *Munida rugosa*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Edible crabs *Cancer pagurus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Velvet swimming crab *Necora puber*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Shore crab *Carcinus maenas*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	High	Non-significant
	Molluscs	Ocean quahog *Artica Islandica*	High	Negligible	Minor	Adverse	High	Non-significant
		Common cockle *Cerastoderma edule*	Low	Negligible	Negligible	Adverse	High	Non-significant
		King scallop *Pecten maximus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Queen scallop *Aequipecten opercularis*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Razorfish Ensis spp.	Low	Negligible	Negligible	Adverse	High	Non-significant
	Spawning and nursery grounds	Herring spawning and nursery grounds	High	Negligible	Minor	Adverse	High	Non-significant
		Sandeel spawning and nursery grounds	High	Negligible	Minor	Adverse	High	Non-significant

Table 15.13b Fish and Shellfish Impact Assessment Summary for the Operational Phase

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse of Beneficial	Confidence	EIA Regulations Significance
Change in hydro dynamic regime (scour and accretion)	Designated sites	River Dee SAC	Very High	No Change	No Change		High	Non-significant
		River South Esk SAC	Very High	No Change	No Change		High	Non-significant
		River Tay SAC	Very High	No Change	No Change		High	Non-significant
		River Teith SAC	Very High	No Change	No Change		High	Non-significant
		River Tweed SAC	Very High	No Change	No Change		High	Non-significant
		Turbot Bank MPA	High	No Change	No Change		High	Non-significant
		Norwegian Boundary Sediment Plain MPA	High	No Change	No Change		High	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse of Beneficial	Confidence	EIA Regulations Significance
Change in hydro dynamic regime (scour and accretion)	Marine demersal fish species	Anglerfish / sea monkfish *Lophius piscatorius*	High	No Change	No Change		High	Non-significant
		Atlantic cod *Gadus morhua*	High	No Change	No Change		High	Non-significant
		Atlantic halibut *Hippoglossus hippoglossus*	Very High	No Change	No Change		High	Non-significant
		Blue ling *Molva dypterygia*	High	No Change	No Change		High	Non-significant
		Common goby *Pomatoschitus microps*	High	No Change	No Change		High	Non-significant
		Common sole *Solea solea*	High	No Change	No Change		High	Non-significant
		European hake *Merluccius merluccius*	High	No Change	No Change		High	Non-significant
		European plaice *Pleuronectes platessa*	High	No Change	No Change		High	Non-significant
		Greenland halibut *Reinhardtius hippoglossoides*	High	No Change	No Change		High	Non-significant
		Haddock *Melanogrammus aeglefinus*	High	No Change	No Change		High	Non-significant
		Lemon sole *Microstomus kitt*	High	No Change	No Change		High	Non-significant
		Ling *Molva molva*	High	No Change	No Change		High	Non-significant
		Norway pout *Trisopterus esmarkii*	High	No Change	No Change		High	Non-significant
		Saithe *Pollachius virens*	High	No Change	No Change		High	Non-significant
		Sand goby *Pomatoschitus minutus*	High	No Change	No Change		High	Non-significant
		Sandeel *Ammodytes spp.*	High	No Change	No Change		High	Non-significant
		Whiting *Merlangius merlangus*	High	No Change	No Change		High	Non-significant
	Crustaceans	Langoustine *Nephrops norvegicus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Common lobster *Homarus gammarus*	High	Negligible	Minor	Adverse	High	Non-significant
		European spiny lobster *Palinurus elephas*	High	Negligible	Minor	Adverse	High	Non-significant
		Squat lobster *Munida rugosa*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Edible crabs *Cancer pagurus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Velvet swimming crab *Necora puber*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Shore crab *Carcinus maenas*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	High	Non-significant
	Molluscs	Ocean quahog *Artica Islandica*	High	Negligible	Minor	Adverse	High	Non-significant
		Common cockle *Cerastoderma edule*	Low	Negligible	Negligible	Adverse	High	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse of Beneficial	Confidence	EIA Regulations Significance
Change in hydro dynamic regime (scour and accretion)	Molluscs	King scallop *Pecten maximus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Queen scallop *Aequipecten opercularis*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Razorfish Ensis spp.	Low	Negligible	Negligible	Adverse	High	Non-significant
	Spawning and nursery grounds	Herring spawning and nursery grounds	High	No Change	No Change		High	Non-significant
		Sandeel spawning and nursery grounds	High	No Change	No Change		High	Non-significant
Sediment heating	Designated sites	River Dee SAC	Very High	No Change	No Change		Medium	Non-significant
		River South Esk SAC	Very High	No Change	No Change		Medium	Non-significant
		River Tay SAC	Very High	No Change	No Change		Medium	Non-significant
		River Teith SAC	Very High	No Change	No Change		Medium	Non-significant
		River Tweed SAC	Very High	No Change	No Change		Medium	Non-significant
		Turbot Bank MPA	High	No Change	No Change		Medium	Non-significant
		Norwegian Boundary Sediment Plain MPA	High	No Change	No Change		Medium	Non-significant
	Marine demersal fish species	Anglerfish / sea monkfish *Lophius piscatorius*	High	No Change	No Change		Medium	Non-significant
		Atlantic cod *Gadus morhua*	High	No Change	No Change		Medium	Non-significant
		Atlantic halibut *Hippoglossus hippoglossus*	Very High	No Change	No Change		Medium	Non-significant
		Blue ling *Molva dypterygia*	High	No Change	No Change		Medium	Non-significant
		Common goby *Pomatoschitus microps*	High	No Change	No Change		Medium	Non-significant
		Common sole *Solea solea*	High	No Change	No Change		Medium	Non-significant
		European hake *Merluccius merluccius*	High	No Change	No Change		Medium	Non-significant
		European plaice *Pleuronectes platessa*	High	No Change	No Change		Medium	Non-significant
		Greenland halibut *Reinhardtius hippoglossoides*	High	No Change	No Change		Medium	Non-significant
		Haddock *Melanogrammus aeglefinus*	High	No Change	No Change		Medium	Non-significant
		Lemon sole *Microstomus kitt*	High	No Change	No Change		Medium	Non-significant
		Ling *Molva molva*	High	No Change	No Change		Medium	Non-significant
		Norway pout *Trisopterus esmarkii*	High	No Change	No Change		Medium	Non-significant
		Saithe *Pollachius virens*	High	No Change	No Change		Medium	Non-significant
		Sand goby *Pomatoschitus minutus*	High	No Change	No Change		Medium	Non-significant
		Sandeel *Ammodytes spp.*	High	No Change	No Change		Medium	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse of Beneficial	Confidence	EIA Regulations Significance
Sediment heating	Marine demersal fish species	Whiting *Merlangius merlangus*	High	No Change	No Change		Medium	Non-significant
	Crustaceans	Langoustine *Nephrops norvegicus*	Medium	No Change	No Change		Medium	Non-significant
		Common lobster *Homarus gammarus*	High	No Change	No Change		Medium	Non-significant
		European spiny lobster *Palinurus elephas*	High	No Change	No Change		Medium	Non-significant
		Squat lobster *Munida rugosa*	Low	No Change	No Change		Medium	Non-significant
		Edible crabs *Cancer pagurus*	Medium	No Change	No Change		Medium	Non-significant
		Velvet swimming crab *Necora puber*	Medium	No Change	No Change		Medium	Non-significant
		Shore crab *Carcinus maenas*	Low	No Change	No Change		Medium	Non-significant
		Crayfish *Palunirus elegans*	Low	No Change	No Change		Medium	Non-significant
	Molluscs	Ocean quahog *Artica Islandica*	High	No Change	No Change		Medium	Non-significant
		Common cockle Cerastoderma edule	Low	No Change	No Change		Medium	Non-significant
		King scallop *Pecten maximus*	Medium	No Change	No Change		Medium	Non-significant
		Queen scallop *Aequipecten opercularis*	Low	No Change	No Change		Medium	Non-significant
		Razorfish Ensis spp.	Low	No Change	No Change		Medium	Non-significant
	Spawning and nursery grounds	Herring spawning and nursery grounds	High	Negligible	Minor	Adverse	High	Non-significant
		Sandeel spawning and nursery grounds	High	Negligible	Minor	Adverse	High	Non-significant
Magnetic fields	Designated sites	River Dee SAC	Very High	No Change	No Change		Medium	Non-significant
		River South Esk SAC	Very High	No Change	No Change		Medium	Non-significant
		River Tay SAC	Very High	No Change	No Change		Medium	Non-significant
		River Teith SAC	Very High	No Change	No Change		Medium	Non-significant
		River Tweed SAC	Very High	No Change	No Change		Medium	Non-significant
		Turbot Bank MPA	High	No Change	No Change		Medium	Non-significant
		Norwegian Boundary Sediment Plain MPA	High	No Change	No Change		Medium	Non-significant
	Diadromous fish species	Atlantic salmon *Salmo salar*	Very High	No Change	No Change		Medium	Non-significant
		Sea trout *Salmo trutta*	High	No Change	No Change		Medium	Non-significant
		European eel *Anguilla anguilla*	Very High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse of Beneficial	Confidence	EIA Regulations Significance
Magnetic fields	Diadromous fish species	Sea lamprey *Petromyzon marinus*	Very High	No Change	No Change		Medium	Non-significant
		River lamprey *Lampetra fluviatilis*	Very High	No Change	No Change		Medium	Non-significant
	Elasmobranchs	Angel Shark *Squatina squatina*	Very High	No Change	No change		Medium	Non-significant
		Basking Shark *Cetorhinus maximus*	Very High	No Change	No Change		Medium	Non-significant
		Blue Shark *Prionace glauca*	High	No Change	No Change		Medium	Non-significant
		Common Skate *Dipturus batis*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Gulper Shark *Centrophorus granulosus*	High	No Change	No Change		Medium	Non-significant
		Kitefin Shark *Dalatias licha*	High	No Change	No Change		Medium	Non-significant
		Leafscale gulper shark *Centrophorus squamosus*	High	No Change	No Change		Medium	Non-significant
		Porbeagle Shark *Lamna nasus*	High	No Change	No Change		Medium	Non-significant
		Portuguese Dogfish *Centroscymnus coelolepis*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Sandy Ray *Leucoraja circularis*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Spurdog or Spiny Dogfish *Squalus acanthias*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Tope Shark *Galeorhinus galeus*	High	No Change	No Change		Medium	Non-significant
		Other elasmobranch species (e.g. spotted ray Raja montagui, thornback ray *Raja clavata*)	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
	Marine demersal fish species	Anglerfish / sea monkfish *Lophius piscatorius*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Atlantic cod *Gadus morhua*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Atlantic halibut *Hippoglossus hippoglossus*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Blue ling *Molva dypterygia*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Common goby *Pomatoschitus microps*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Common sole *Solea solea*	High	Negligible	Minor	Adverse	Medium	Non-significant
		European hake *Merluccius merluccius*	High	Negligible	Minor	Adverse	Medium	Non-significant
		European plaice *Pleuronectes platessa*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Greenland halibut *Reinhardtius hippoglossoides*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Haddock *Melanogrammus aeglefinus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Lemon sole *Microstomus kitt*	High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse of Beneficial	Confidence	EIA Regulations Significance
Magnetic fields	Marine demersal fish species	Ling *Molva molva*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Norway pout *Trisopterus esmarkii*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Saithe *Pollachius virens*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Sand goby *Pomatoschitus minutus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Sandeel *Ammodytes spp.*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Whiting *Merlangius merlangus*	High	Negligible	Minor	Adverse	Medium	Non-significant
	Marine pelagic fish species	Atlantic bluefin tuna *Thunnus thynnus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Atlantic herring *Clupea harengus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Atlantic mackerel *Scomber scombrus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Black scabbardfish *Aphanopus carbo*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Blue whiting *Micromesistius poutassou*	High	Negligible	Minor	Adverse	Medium	Non-significant
		European sprat *Sprattus sprattus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Horse mackerel *Trachurus trachurus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Orange roughy *Hoplostethus atlanticus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Roundnose grenadier *Coryphaenoides rupestris*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
	Cephalopods	Long-finned (loliginid) squids *Loligo forbesi* and *Loligo vulgari*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Short-finned (ommastrephid) squids *Todarodes sagittatus, Todaropsis eblanae* and *Illex coindetii*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Cuttlefish *Sepia officinalis*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Octopuses *Octopus vulgaris and Eledone cirrhosa*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
	Crustaceans	Langoustine *Nephrops norvegicus*	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
		Common lobster *Homarus gammarus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		European spiny lobster *Palinurus elephas*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Squat lobster *Munida rugosa*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Edible crabs *Cancer pagurus*	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
		Velvet swimming crab *Necora puber*	Medium	Negligible	Negligible	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse of Beneficial	Confidence	EIA Regulations Significance
Magnetic fields	Crustaceans	Shore crab *Carcinus maenas*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
	Molluscs	Ocean quahog *Artica Islandica*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Common cockle *Cerastoderma edule*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		King scallop *Pecten maximus*	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
		Queen scallop *Aequipecten opercularis*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Razorfish Ensis spp.	Low	Negligible	Negligible	Adverse	Medium	Non-significant
	Spawning and nursery grounds	Herring spawning and nursery grounds	High	Negligible	Minor	Adverse	Medium	Non-significant
		Sandeel spawning and nursery grounds	High	Negligible	Minor	Adverse	Medium	Non-significant
Introduction of invasive non-native species during inspection and repair	Designated sites	River Dee SAC	Very High	Negligible	Minor	Adverse	High	Non-significant
		River South Esk SAC	Very High	Negligible	Minor	Adverse	High	Non-significant
		River Tay SAC	Very High	Negligible	Minor	Adverse	High	Non-significant
		River Teith SAC	Very High	Negligible	Minor	Adverse	High	Non-significant
		River Tweed SAC	Very High	Negligible	Minor	Adverse	High	Non-significant
		Turbot Bank MPA	High	Negligible	Minor	Adverse	High	Non-significant
		Norwegian Boundary Sediment Plain MPA	High	Negligible	Minor	Adverse	High	Non-significant
	Diadromous fish species	Atlantic salmon *Salmo salar*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Sea trout *Salmo trutta*	High	Negligible	Minor	Adverse	High	Non-significant
		European eel *Anguilla anguilla*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Sea lamprey *Petromyzon marinus*	Very High	Negligible	Minor	Adverse	High	Non-significant
		River lamprey *Lampetra fluviatilis*	Very High	Negligible	Minor	Adverse	High	Non-significant
	Elasmobranchs	Angel Shark *Squatina squatina*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Basking Shark *Cetorhinus maximus*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Blue Shark *Prionace glauca*	High	Negligible	Minor	Adverse	High	Non-significant
		Common Skate *Dipturus batis*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Gulper Shark *Centrophorus granulosus*	High	Negligible	Minor	Adverse	High	Non-significant
		Kitefin Shark *Dalatias licha*	High	Negligible	Minor	Adverse	High	Non-significant
		Leafscale gulper shark *Centrophorus squamosus*	High	Negligible	Minor	Adverse	High	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse of Beneficial	Confidence	EIA Regulations Significance
Introduction of invasive non-native species during inspection and repair	Elasmobranchs	Porbeagle Shark *Lamna nasus*	High	Negligible	Minor	Adverse	High	Non-significant
		Portuguese Dogfish *Centroscymnus coelolepis*	High	Negligible	Minor	Adverse	High	Non-significant
		Sandy Ray *Leucoraja circularis*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Spurdog or Spiny Dogfish *Squalus acanthias*	High	Negligible	Minor	Adverse	High	Non-significant
		Tope Shark *Galeorhinus galeus*	High	Negligible	Minor	Adverse	High	Non-significant
		Other elasmobranch species (e.g. spotted ray Raja montagui, thornback ray *Raja clavata*)	Medium	Negligible	Negligible	Adverse	High	Non-significant
	Marine demersal fish species	Anglerfish / sea monkfish *Lophius piscatorius*	High	Negligible	Minor	Adverse	High	Non-significant
		Atlantic cod *Gadus morhua*	High	Negligible	Minor	Adverse	High	Non-significant
		Atlantic halibut *Hippoglossus hippoglossus*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Blue ling *Molva dypterygia*	High	Negligible	Minor	Adverse	High	Non-significant
		Common goby *Pomatoschitus microps*	High	Negligible	Minor	Adverse	High	Non-significant
		Common sole *Solea solea*	High	Negligible	Minor	Adverse	High	Non-significant
		European hake *Merluccius merluccius*	High	Negligible	Minor	Adverse	High	Non-significant
		European plaice *Pleuronectes platessa*	High	Negligible	Minor	Adverse	High	Non-significant
		Greenland halibut *Reinhardtius hippoglossoides*	High	Negligible	Minor	Adverse	High	Non-significant
		Haddock *Melanogrammus aeglefinus*	High	Negligible	Minor	Adverse	High	Non-significant
		Lemon sole *Microstomus kitt*	High	Negligible	Minor	Adverse	High	Non-significant
		Ling *Molva molva*	High	Negligible	Minor	Adverse	High	Non-significant
		Norway pout *Trisopterus esmarkii*	High	Negligible	Minor	Adverse	High	Non-significant
		Saithe *Pollachius virens*	High	Negligible	Minor	Adverse	High	Non-significant
		Sand goby *Pomatoschitus minutus*	High	Negligible	Minor	Adverse	High	Non-significant
		Sandeel *Ammodytes spp.*	High	Negligible	Minor	Adverse	High	Non-significant
		Whiting *Merlangius merlangus*	High	Negligible	Minor	Adverse	High	Non-significant
	Marine pelagic fish species	Atlantic bluefin tuna *Thunnus thynnus*	High	Negligible	Minor	Adverse	High	Non-significant
		Atlantic herring *Clupea harengus*	High	Negligible	Minor	Adverse	High	Non-significant
		Atlantic mackerel *Scomber scombrus*	High	Negligible	Minor	Adverse	High	Non-significant
		Black scabbardfish *Aphanopus carbo*	High	Negligible	Minor	Adverse	High	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse of Beneficial	Confidence	EIA Regulations Significance
Introduction of invasive non-native species during inspection and repair	Marine pelagic fish species	Blue whiting *Micromesistius poutassou*	High	Negligible	Minor	Adverse	High	Non-significant
		European sprat *Sprattus sprattus*	High	Negligible	Minor	Adverse	High	Non-significant
		Horse mackerel *Trachurus trachurus*	High	Negligible	Minor	Adverse	High	Non-significant
		Orange roughy *Hoplostethus atlanticus*	High	Negligible	Minor	Adverse	High	Non-significant
		Roundnose grenadier *Coryphaenoides rupestris*	Very High	Negligible	Minor	Adverse	High	Non-significant
	Cephalopods	Long-finned (loliginid) squids *Loligo forbesi* and *Loligo vulgari*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Short-finned (ommastrephid) squids *Todarodes sagittatus, Todaropsis eblanae* and *Illex coindetii*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Cuttlefish *Sepia officinalis*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Octopuses *Octopus vulgaris and Eledone cirrhosa*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	High	Non-significant
	Crustaceans	Langoustine *Nephrops norvegicus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Common lobster *Homarus gammarus*	High	Negligible	Minor	Adverse	High	Non-significant
		European spiny lobster *Palinurus elephas*	High	Negligible	Minor	Adverse	High	Non-significant
		Squat lobster *Munida rugosa*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Edible crabs *Cancer pagurus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Velvet swimming crab *Necora puber*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Shore crab *Carcinus maenas*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	High	Non-significant
	Molluscs	Ocean quahog *Artica Islandica*	High	Negligible	Minor	Adverse	High	Non-significant
		Common cockle *Cerastoderma edule*	Low	Negligible	Negligible	Adverse	High	Non-significant
		King scallop *Pecten maximus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Queen scallop *Aequipecten opercularis*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Razorfish Ensis spp.	Low	Negligible	Negligible	Adverse	High	Non-significant
	Spawning and nursery grounds	Herring spawning and nursery grounds	High	Negligible	Minor	Adverse	High	Non-significant
		Sandeel spawning and nursery grounds	High	Negligible	Minor	Adverse	High	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse of Beneficial	Confidence	EIA Regulations Significance
Physical disturbance during inspection and repair	Designated sites	River Dee SAC	Very High	No Change	No Change		High	Non-significant
		River South Esk SAC	Very High	No Change	No Change		High	Non-significant
		River Tay SAC	Very High	No Change	No Change		High	Non-significant
		River Teith SAC	Very High	No Change	No Change		High	Non-significant
		River Tweed SAC	Very High	No Change	No Change		High	Non-significant
		Turbot Bank MPA	High	No Change	No Change		High	Non-significant
		Norwegian Boundary Sediment Plain MPA	High	No Change	No Change		High	Non-significant
	Diadromous fish species	Atlantic salmon *Salmo salar*	Very High	No Change	No Change		High	Non-significant
		Sea trout *Salmo trutta*	High	No Change	No Change		High	Non-significant
		European eel *Anguilla anguilla*	Very High	No Change	No Change		High	Non-significant
		Sea lamprey *Petromyzon marinus*	Very High	No Change	No Change		High	Non-significant
		River lamprey *Lampetra fluviatilis*	Very High	No Change	No Change		High	Non-significant
	Elasmobranchs	Angel Shark *Squatina squatina*	Very High	No Change	No Change		High	Non-significant
		Basking Shark *Cetorhinus maximus*	Very High	No Change	No Change		High	Non-significant
		Blue Shark *Prionace glauca*	High	No Change	No Change		High	Non-significant
		Common Skate *Dipturus batis*	Very High	No Change	No Change		High	Non-significant
		Gulper Shark *Centrophorus granulosus*	High	No Change	No Change		High	Non-significant
		Kitefin Shark *Dalatias licha*	High	No Change	No Change		High	Non-significant
		Leafscale gulper shark *Centrophorus squamosus*	High	No Change	No Change		High	Non-significant
		Porbeagle Shark *Lamna nasus*	High	No Change	No Change		High	Non-significant
		Portuguese Dogfish *Centroscymnus coelolepis*	High	No Change	No Change		High	Non-significant
		Sandy Ray *Leucoraja circularis*	Very High	No Change	No Change		High	Non-significant
		Spurdog or Spiny Dogfish *Squalus acanthias*	High	No Change	No Change		High	Non-significant
		Tope Shark *Galeorhinus galeus*	High	No Change	No Change		High	Non-significant
		Other elasmobranch species (e.g. spotted ray Raja montagui, thornback ray *Raja clavata*)	Medium	No Change	No Change		High	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse of Beneficial	Confidence	EIA Regulations Significance
Physical disturbance during inspection and repair	Marine demersal fish species	Anglerfish / sea monkfish *Lophius piscatorius*	High	No Change	No Change		High	Non-significant
	Marine demersal fish species	Atlantic cod *Gadus morhua*	High	No Change	No Change		High	Non-significant
		Atlantic halibut *Hippoglossus hippoglossus*	Very High	No Change	No Change		High	Non-significant
		Blue ling *Molva dypterygia*	High	No Change	No Change		High	Non-significant
		Common goby *Pomatoschitus microps*	High	No Change	No Change		High	Non-significant
		Common sole *Solea solea*	High	No Change	No Change		High	Non-significant
		European hake *Merluccius merluccius*	High	No Change	No Change		High	Non-significant
		European plaice *Pleuronectes platessa*	High	No Change	No Change		High	Non-significant
		Greenland halibut *Reinhardtius hippoglossoides*	High	No Change	No Change		High	Non-significant
		Haddock *Melanogrammus aeglefinus*	High	No Change	No Change		High	Non-significant
		Lemon sole *Microstomus kitt*	High	No Change	No Change		High	Non-significant
		Ling *Molva molva*	High	No Change	No Change		High	Non-significant
		Norway pout *Trisopterus esmarkii*	High	No Change	No Change		High	Non-significant
		Saithe *Pollachius virens*	High	No Change	No Change		High	Non-significant
		Sand goby *Pomatoschitus minutus*	High	No Change	No Change		High	Non-significant
		Sandeel *Ammodytes spp.*	High	No Change	No Change		High	Non-significant
		Whiting *Merlangius merlangus*	High	No Change	No Change		High	Non-significant
	Marine pelagic fish species	Atlantic bluefin tuna *Thunnus thynnus*	High	No Change	No Change		High	Non-significant
		Atlantic herring *Clupea harengus*	High	No Change	No Change		High	Non-significant
		Atlantic mackerel *Scomber scombrus*	High	No Change	No Change		High	Non-significant
		Black scabbardfish *Aphanopus carbo*	High	No Change	No Change		High	Non-significant
		Blue whiting *Micromesistius poutassou*	High	No Change	No Change		High	Non-significant
		European sprat *Sprattus sprattus*	High	No Change	No Change		High	Non-significant
		Horse mackerel *Trachurus trachurus*	High	No Change	No Change		High	Non-significant
		Orange roughy *Hoplostethus atlanticus*	High	No Change	No Change		High	Non-significant
		Roundnose grenadier *Coryphaenoides rupestris*	Very High	No Change	No Change		High	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse of Beneficial	Confidence	EIA Regulations Significance
Physical disturbance during inspection and repair	Cephalopods	Long-finned (loliginid) squids *Loligo forbesi* and *Loligo vulgari*	Low	No Change	No Change		High	Non-significant
		Short-finned (ommastrephid) squids *Todarodes sagittatus, Todaropsis eblanae* and *Illex coindetii*	Low	No Change	No Change		High	Non-significant
		Cuttlefish *Sepia officinalis*	Low	No Change	No Change		High	Non-significant
		Octopuses *Octopus vulgaris and Eledone cirrhosa*	Low	No Change	No Change		High	Non-significant
		Crayfish *Palunirus elegans*	Low	No Change	No Change		High	Non-significant
	Crustaceans	Langoustine *Nephrops norvegicus*	Medium	No Change	No Change		High	Non-significant
		Common lobster *Homarus gammarus*	High	No Change	No Change		High	Non-significant
		European spiny lobster *Palinurus elephas*	High	No Change	No Change		High	Non-significant
		Squat lobster *Munida rugosa*	Low	No Change	No Change		High	Non-significant
		Edible crabs *Cancer pagurus*	Medium	No Change	No Change		High	Non-significant
		Velvet swimming crab *Necora puber*	Medium	No Change	No Change		High	Non-significant
		Shore crab *Carcinus maenas*	Low	No Change	No Change		High	Non-significant
		Crayfish *Palunirus elegans*	Low	No Change	No Change		High	Non-significant
	Molluscs	Ocean quahog *Artica Islandica*	High	No Change	No Change		High	Non-significant
		Common cockle *Cerastoderma edule*	Low	No Change	No Change		High	Non-significant
		King scallop *Pecten maximus*	Medium	No Change	No Change		High	Non-significant
		Queen scallop *Aequipecten opercularis*	Low	No Change	No Change		High	Non-significant
		Razorfish Ensis spp.	Low	No Change	No Change		High	Non-significant
	Spawning and nursery grounds	Herring spawning and nursery grounds	High	Negligible	Minor	Adverse	High	Non-significant
		Sandeel spawning and nursery grounds	High	Negligible	Minor	Adverse	High	Non-significant

Table 15.13c Fish and Shellfish Impact Assessment Summary for the Decommissioning Phase.

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Benficial	Confidence	EIA Regulations Significance
Habitat loss	Designated sites	River Dee SAC	Very High	No Change	No Change		High	Non-significant
		River South Esk SAC	Very High	No Change	No Change		High	Non-significant
		River Tay SAC	Very High	No Change	No Change		High	Non-significant
		River Teith SAC	Very High	No Change	No Change		High	Non-significant
		River Tweed SAC	Very High	No Change	No Change		High	Non-significant
		Turbot Bank MPA	High	No Change	No Change		High	Non-significant
		Norwegian Boundary Sediment Plain MPA	High	No Change	No Change		High	Non-significant
	Crustaceans	Langoustine *Nephrops norvegicus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Common lobster *Homarus gammarus*	High	Negligible	Minor	Adverse	High	Non-significant
		European spiny lobster *Palinurus elephas*	High	Negligible	Minor	Adverse	High	Non-significant
		Squat lobster *Munida rugosa*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Edible crabs *Cancer pagurus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Velvet swimming crab *Necora puber*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Shore crab *Carcinus maenas*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	High	Non-significant
	Molluscs	Ocean quahog *Artica Islandica*	High	Negligible	Minor	Adverse	High	Non-significant
		Common cockle *Cerastoderma edule*	Low	Minor	Minor	Adverse	High	Non-significant
		King scallop *Pecten maximus*	Medium	Minor	Minor	Adverse	High	Non-significant
		Queen scallop *Aequipecten opercularis*	Low	Minor	Minor	Adverse	High	Non-significant
		Razorfish Ensis spp.	Low	Minor	Minor	Adverse	High	Non-significant
	Spawning and nursery grounds	Herring spawning and nursery grounds	High	Negligible	Minor	Adverse	High	Non-significant
		Sandeel spawning and nursery grounds	High	Negligible	Minor	Adverse	High	Non-significant
Changes to water quality (resuspension of sediments)	Designated sites	River Dee SAC	Very High	No Change	No Change		High	Non-significant
		River South Esk SAC	Very High	No Change	No Change		High	Non-significant
		River Tay SAC	Very High	No Change	No Change		High	Non-significant
		River Teith SAC	Very High	No Change	No Change		High	Non-significant
		River Tweed SAC	Very High	No Change	No Change		High	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Benficial	Confidence	EIA Regulations Significance
Changes to water quality (resuspension of sediments)	Designated sites	Turbot Bank MPA	High	No Change	No Change		High	Non-significant
		Norwegian Boundary Sediment Plain MPA	High	No Change	No Change		High	Non-significant
	Diadromous fish species	Atlantic salmon *Salmo salar*	Very High	No Change	No Change		High	Non-significant
		Sea trout *Salmo trutta*	High	No Change	No Change		High	Non-significant
		European eel *Anguilla anguilla*	Very High	No Change	No Change		High	Non-significant
		Sea lamprey *Petromyzon marinus*	Very High	No Change	No Change		High	Non-significant
		River lamprey *Lampetra fluviatilis*	Very High	No Change	No Change		High	Non-significant
	Elasmobranchs	Angel Shark *Squatina squatina*	Very High	No Change	No Change		High	Non-significant
		Basking Shark *Cetorhinus maximus*	Very High	No Change	No Change		High	Non-significant
		Blue Shark *Prionace glauca*	High	No Change	No Change		High	Non-significant
		Common Skate *Dipturus batis*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Gulper Shark *Centrophorus granulosus*	High	No Change	No Change		High	Non-significant
		Kitefin Shark *Dalatias licha*	High	No Change	No Change		High	Non-significant
		Leafscale gulper shark *Centrophorus squamosus*	High	No Change	No Change		High	Non-significant
		Porbeagle Shark *Lamna nasus*	High	No Change	No Change		High	Non-significant
		Portuguese Dogfish *Centroscymnus coelolepis*	High	Negligible	Minor	Adverse	High	Non-significant
		Sandy Ray *Leucoraja circularis*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Spurdog or Spiny Dogfish *Squalus acanthias*	High	Negligible	Minor	Adverse	High	Non-significant
		Tope Shark *Galeorhinus galeus*	High	No Change	No Change		High	Non-significant
		Other elasmobranch species (e.g. spotted ray Raja montagui, thornback ray *Raja clavata*)	Medium	Negligible	Negligible	Adverse	High	Non-significant
	Marine demersal fish species	Anglerfish / sea monkfish *Lophius piscatorius*	High	Negligible	Minor	Adverse	High	Non-significant
		Atlantic cod *Gadus morhua*	High	Negligible	Minor	Adverse	High	Non-significant
		Atlantic halibut *Hippoglossus hippoglossus*	Very High	Negligible	Minor	Adverse	High	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Benficial	Confidence	EIA Regulations Significance
Changes to water quality (resuspension of sediments)	Marine demersal fish species	Blue ling *Molva dypterygia*	High	Negligible	Minor	Adverse	High	Non-significant
		Common goby *Pomatoschitus microps*	High	Negligible	Minor	Adverse	High	Non-significant
		Common sole *Solea solea*	High	Negligible	Minor	Adverse	High	Non-significant
		European hake *Merluccius merluccius*	High	Negligible	Minor	Adverse	High	Non-significant
		European plaice *Pleuronectes platessa*	High	Negligible	Minor	Adverse	High	Non-significant
		Greenland halibut *Reinhardtius hippoglossoides*	High	Negligible	Minor	Adverse	High	Non-significant
		Haddock *Melanogrammus aeglefinus*	High	Negligible	Minor	Adverse	High	Non-significant
		Lemon sole *Microstomus kitt*	High	Negligible	Minor	Adverse	High	Non-significant
		Ling *Molva molva*	High	Negligible	Minor	Adverse	High	Non-significant
		Norway pout *Trisopterus esmarkii*	High	Negligible	Minor	Adverse	High	Non-significant
		Saithe *Pollachius virens*	High	Negligible	Minor	Adverse	High	Non-significant
		Sand goby *Pomatoschitus minutus*	High	Negligible	Minor	Adverse	High	Non-significant
		Sandeel *Ammodytes spp.*	High	Negligible	Minor	Adverse	High	Non-significant
		Whiting *Merlangius merlangus*	High	Negligible	Minor	Adverse	High	Non-significant
	Marine pelagic fish species	Atlantic bluefin tuna *Thunnus thynnus*	High	No Change	No Change		High	Non-significant
		Atlantic herring *Clupea harengus*	High	No Change	No Change		High	Non-significant
		Atlantic mackerel *Scomber scombrus*	High	No Change	No Change		High	Non-significant
		Black scabbardfish *Aphanopus carbo*	High	No Change	No Change		High	Non-significant
		Blue whiting *Micromesistius poutassou*	High	No Change	No Change		High	Non-significant
		European sprat *Sprattus sprattus*	High	No Change	No Change		High	Non-significant
		Horse mackerel *Trachurus trachurus*	High	No Change	No Change		High	Non-significant
		Orange roughy *Hoplostethus atlanticus*	High	No Change	No Change		High	Non-significant
		Roundnose grenadier *Coryphaenoides rupestris*	Very High	No Change	No Change		High	Non-significant
	Cephalopods	Long-finned (loliginid) squids *Loligo forbesi* and *Loligo vulgari*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Short-finned (ommastrephid) squids *Todarodes sagittatus, Todaropsis eblanae* and *Illex coindetii*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Cuttlefish *Sepia officinalis*	Low	Negligible	Negligible	Adverse	High	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Benficial	Confidence	EIA Regulations Significance
Changes to water quality (resuspension of sediments)	Cephalopods	Octopuses *Octopus vulgaris and Eledone cirrhosa*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	High	Non-significant
	Crustaceans	Langoustine *Nephrops norvegicus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Common lobster *Homarus gammarus*	High	Negligible	Minor	Adverse	High	Non-significant
		European spiny lobster *Palinurus elephas*	High	Negligible	Minor	Adverse	High	Non-significant
		Squat lobster *Munida rugosa*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Edible crabs *Cancer pagurus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Velvet swimming crab *Necora puber*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Shore crab *Carcinus maenas*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	High	Non-significant
	Molluscs	Ocean quahog *Artica Islandica*	High	Negligible	Minor	Adverse	High	Non-significant
		Common cockle *Cerastoderma edule*	Low	Negligible	Negligible	Adverse	High	Non-significant
		King scallop *Pecten maximus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Queen scallop *Aequipecten opercularis*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Razorfish Ensis spp.	Low	Negligible	Negligible	Adverse	High	Non-significant
	Spawning and nursery grounds	Herring spawning and nursery grounds	High	Negligible	Minor	Adverse	High	Non-significant
		Sandeel spawning and nursery grounds	High	No Change	No Change		High	Non-significant
Changes to water quality ((Increased sediment loading and release of hazardous substances)	Designated sites	River Dee SAC	Very High	No Change	No Change		Medium	Non-significant
		River South Esk SAC	Very High	No Change	No Change		Medium	Non-significant
		River Tay SAC	Very High	No Change	No Change		Medium	Non-significant
		River Teith SAC	Very High	No Change	No Change		Medium	Non-significant
		River Tweed SAC	Very High	No Change	No Change		Medium	Non-significant
		Turbot Bank MPA	High	No Change	No Change		Medium	Non-significant
		Norwegian Boundary Sediment Plain MPA	High	No Change	No Change		Medium	Non-significant
	Diadromous fish species	Atlantic salmon *Salmo salar*	Very High	No Change	No Change		Medium	Non-significant
		Sea trout *Salmo trutta*	High	No Change	No Change		Medium	Non-significant
		European eel *Anguilla anguilla*	Very High	No Change	No Change		Medium	Non-significant
		Sea lamprey *Petromyzon marinus*	Very High	No Change	No Change		Medium	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Benficial	Confidence	EIA Regulations Significance
Changes to water quality ((Increased sediment loading and release of hazardous substances)	Diadromous fish species	River lamprey *Lampetra fluviatilis*	Very High	No Change	No Change		Medium	Non-significant
	Elasmobranchs	Angel Shark *Squatina squatina*	Very High	No Change	No Change		Medium	Non-significant
		Basking Shark *Cetorhinus maximus*	Very High	No Change	No Change		Medium	Non-significant
		Blue Shark *Prionace glauca*	High	No Change	No Change		Medium	Non-significant
		Common Skate *Dipturus batis*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Gulper Shark *Centrophorus granulosus*	High	No Change	No Change		Medium	Non-significant
		Kitefin Shark *Dalatias licha*	High	No Change	No Change		Medium	Non-significant
		Leafscale gulper shark *Centrophorus squamosus*	High	No Change	No Change		Medium	Non-significant
		Porbeagle Shark *Lamna nasus*	High	No Change	No Change		Medium	Non-significant
		Portuguese Dogfish *Centroscymnus coelolepis*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Sandy Ray *Leucoraja circularis*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Spurdog or Spiny Dogfish *Squalus acanthias*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Tope Shark *Galeorhinus galeus*	High	No Change	No Change		Medium	Non-significant
		Other elasmobranch species (e.g. spotted ray Raja montagui, thornback ray *Raja clavata*)	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
	Marine demersal fish species	Anglerfish / sea monkfish *Lophius piscatorius*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Atlantic cod *Gadus morhua*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Atlantic halibut *Hippoglossus hippoglossus*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Blue ling *Molva dypterygia*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Common goby *Pomatoschitus microps*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Common sole *Solea solea*	High	Negligible	Minor	Adverse	Medium	Non-significant
		European hake *Merluccius merluccius*	High	Negligible	Minor	Adverse	Medium	Non-significant
		European plaice *Pleuronectes platessa*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Greenland halibut *Reinhardtius hippoglossoides*	High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Benficial	Confidence	EIA Regulations Significance
Changes to water quality ((Increased sediment loading and release of hazardous substances)	Marine demersal fish species	Haddock *Melanogrammus aeglefinus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Lemon sole *Microstomus kitt*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Ling *Molva molva*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Norway pout *Trisopterus esmarkii*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Saithe *Pollachius virens*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Sand goby *Pomatoschitus minutus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Sandeel *Ammodytes spp.*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Whiting *Merlangius merlangus*	High	Negligible	Minor	Adverse	Medium	Non-significant
	Marine pelagic fish species	Atlantic bluefin tuna *Thunnus thynnus*	High	No Change	No Change		Medium	Non-significant
		Atlantic herring *Clupea harengus*	High	No Change	No Change		Medium	Non-significant
		Atlantic mackerel *Scomber scombrus*	High	No Change	No Change		Medium	Non-significant
		Black scabbardfish *Aphanopus carbo*	High	No Change	No Change		Medium	Non-significant
		Blue whiting *Micromesistius poutassou*	High	No Change	No Change		Medium	Non-significant
		European sprat *Sprattus sprattus*	High	No Change	No Change		Medium	Non-significant
		Horse mackerel *Trachurus trachurus*	High	No Change	No Change		Medium	Non-significant
		Orange roughy *Hoplostethus atlanticus*	High	No Change	No Change		Medium	Non-significant
		Roundnose grenadier *Coryphaenoides rupestris*	Very High	No Change	No Change		Medium	Non-significant
	Cephalopods	Long-finned (loliginid) squids *Loligo forbesi* and *Loligo vulgari*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Short-finned (ommastrephid) squids *Todarodes sagittatus, Todaropsis eblanae* and *Illex coindetii*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Cuttlefish *Sepia officinalis*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Octopuses *Octopus vulgaris and Eledone cirrhosa*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
	Crustaceans	Langoustine *Nephrops norvegicus*	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
		Common lobster *Homarus gammarus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		European spiny lobster *Palinurus elephas*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Squat lobster *Munida rugosa*	Low	Negligible	Negligible	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Benficial	Confidence	EIA Regulations Significance
Changes to water quality ((Increased sediment loading and release of hazardous substances)	Crustaceans	Edible crabs *Cancer pagurus*	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
		Velvet swimming crab *Necora puber*	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
		Shore crab *Carcinus maenas*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
	Molluscs	Ocean quahog *Artica Islandica*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Common cockle *Cerastoderma edule*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		King scallop *Pecten maximus*	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
		Queen scallop *Aequipecten opercularis*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Razorfish Ensis spp.	Low	Negligible	Negligible	Adverse	Medium	Non-significant
	Spawning and nursery grounds	Herring spawning and nursery grounds	High	No Change	No Change		Medium	Non-significant
		Sandeel spawning and nursery grounds	High	Negligible	Minor	Adverse	Medium	Non-significant
Underwater noise and vibration	Designated sites	River Dee SAC	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		River South Esk SAC	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		River Tay SAC	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		River Teith SAC	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		River Tweed SAC	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Turbot Bank MPA	High	Negligible	Minor	Adverse	Medium	Non-significant
		Norwegian Boundary Sediment Plain MPA	High	Negligible	Minor	Adverse	Medium	Non-significant
	Diadromous fish species	Atlantic salmon *Salmo salar*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Sea trout *Salmo trutta*	High	Negligible	Minor	Adverse	Medium	Non-significant
		European eel *Anguilla anguilla*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Sea lamprey *Petromyzon marinus*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		River lamprey *Lampetra fluviatilis*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
	Elasmobranchs	Angel Shark *Squatina squatina*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Basking Shark *Cetorhinus maximus*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Blue Shark *Prionace glauca*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Common Skate *Dipturus batis*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Gulper Shark *Centrophorus granulosus*	High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Benficial	Confidence	EIA Regulations Significance
Underwater noise and vibration	Elasmobranchs	Kitefin Shark *Dalatias licha*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Leafscale gulper shark *Centrophorus squamosus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Porbeagle Shark *Lamna nasus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Portuguese Dogfish *Centroscymnus coelolepis*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Sandy Ray *Leucoraja circularis*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Spurdog or Spiny Dogfish *Squalus acanthias*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Tope Shark *Galeorhinus galeus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Other elasmobranch species (e.g. spotted ray Raja montagui, thornback ray *Raja clavata*)	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
	Marine demersal fish species	Anglerfish / sea monkfish *Lophius piscatorius*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Atlantic cod *Gadus morhua*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Atlantic halibut *Hippoglossus hippoglossus*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
		Blue ling *Molva dypterygia*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Common goby *Pomatoschitus microps*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Common sole *Solea solea*	High	Negligible	Minor	Adverse	Medium	Non-significant
		European hake *Merluccius merluccius*	High	Negligible	Minor	Adverse	Medium	Non-significant
		European plaice *Pleuronectes platessa*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Greenland halibut *Reinhardtius hippoglossoides*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Haddock *Melanogrammus aeglefinus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Lemon sole *Microstomus kitt*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Ling *Molva molva*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Norway pout *Trisopterus esmarkii*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Saithe *Pollachius virens*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Sand goby *Pomatoschitus minutus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Sandeel *Ammodytes spp.*	High	Negligible	Minor	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Benficial	Confidence	EIA Regulations Significance
Underwater noise and vibration	Marine demersal fish species	Whiting *Merlangius merlangus*	High	Negligible	Minor	Adverse	Medium	Non-significant
	Marine pelagic fish species	Atlantic bluefin tuna *Thunnus thynnus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Atlantic herring *Clupea harengus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Atlantic mackerel *Scomber scombrus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Black scabbardfish *Aphanopus carbo*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Blue whiting *Micromesistius poutassou*	High	Negligible	Minor	Adverse	Medium	Non-significant
		European sprat *Sprattus sprattus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Horse mackerel *Trachurus trachurus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Orange roughy *Hoplostethus atlanticus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Roundnose grenadier *Coryphaenoides rupestris*	Very High	Negligible	Minor	Adverse	Medium	Non-significant
	Cephalopods	Long-finned (loliginid) squids *Loligo forbesi* and *Loligo vulgari*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Short-finned (ommastrephid) squids *Todarodes sagittatus, Todaropsis eblanae* and *Illex coindetii*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Cuttlefish *Sepia officinalis*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Octopuses *Octopus vulgaris and Eledone cirrhosa*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
	Crustaceans	Langoustine *Nephrops norvegicus*	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
		Common lobster *Homarus gammarus*	High	Negligible	Minor	Adverse	Medium	Non-significant
		European spiny lobster *Palinurus elephas*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Squat lobster *Munida rugosa*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Edible crabs *Cancer pagurus*	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
		Velvet swimming crab *Necora puber*	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
		Shore crab *Carcinus maenas*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
	Molluscs	Ocean quahog *Artica Islandica*	High	Negligible	Minor	Adverse	Medium	Non-significant
		Common cockle *Cerastoderma edule*	Low	Negligible	Negligible	Adverse	Medium	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Benficial	Confidence	EIA Regulations Significance
Underwater noise and vibration	Molluscs	King scallop *Pecten maximus*	Medium	Negligible	Negligible	Adverse	Medium	Non-significant
		Queen scallop *Aequipecten opercularis*	Low	Negligible	Negligible	Adverse	Medium	Non-significant
		Razorfish Ensis spp.	Low	Negligible	Negligible	Adverse	Medium	Non-significant
	Spawning and nursery grounds	Herring spawning and nursery grounds	High	Negligible	Minor	Adverse	Medium	Non-significant
		Sandeel spawning and nursery grounds	High	Negligible	Minor	Adverse	Medium	Non-significant
Introduction of invasive non-native species	Designated sites	River Dee SAC	Very High	Negligible	Minor	Adverse	High	Non-significant
		River South Esk SAC	Very High	Negligible	Minor	Adverse	High	Non-significant
		River Tay SAC	Very High	Negligible	Minor	Adverse	High	Non-significant
		River Teith SAC	Very High	Negligible	Minor	Adverse	High	Non-significant
		River Tweed SAC	Very High	Negligible	Minor	Adverse	High	Non-significant
		Turbot Bank MPA	High	Negligible	Minor	Adverse	High	Non-significant
		Norwegian Boundary Sediment Plain MPA	High	Negligible	Minor	Adverse	High	Non-significant
	Diadromous fish species	Atlantic salmon *Salmo salar*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Sea trout *Salmo trutta*	High	Negligible	Minor	Adverse	High	Non-significant
		European eel *Anguilla anguilla*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Sea lamprey *Petromyzon marinus*	Very High	Negligible	Minor	Adverse	High	Non-significant
		River lamprey *Lampetra fluviatilis*	Very High	Negligible	Minor	Adverse	High	Non-significant
	Elasmobranchs	Angel Shark *Squatina squatina*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Basking Shark *Cetorhinus maximus*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Blue Shark *Prionace glauca*	High	Negligible	Minor	Adverse	High	Non-significant
		Common Skate *Dipturus batis*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Gulper Shark *Centrophorus granulosus*	High	Negligible	Minor	Adverse	High	Non-significant
		Kitefin Shark *Dalatias licha*	High	Negligible	Minor	Adverse	High	Non-significant
		Leafscale gulper shark *Centrophorus squamosus*	High	Negligible	Minor	Adverse	High	Non-significant
		Porbeagle Shark *Lamna nasus*	High	Negligible	Minor	Adverse	High	Non-significant
		Portuguese Dogfish *Centroscymnus coelolepis*	High	Negligible	Minor	Adverse	High	Non-significant
		Sandy Ray *Leucoraja circularis*	Very High	Negligible	Minor	Adverse	High	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Benficial	Confidence	EIA Regulations Significance
Introduction of invasive non-native species	Elasmobranchs	Spurdog or Spiny Dogfish *Squalus acanthias*	High	Negligible	Minor	Adverse	High	Non-significant
		Tope Shark *Galeorhinus galeus*	High	Negligible	Minor	Adverse	High	Non-significant
		Other elasmobranch species (e.g. spotted ray Raja montagui, thornback ray *Raja clavata*)	Medium	Negligible	Negligible	Adverse	High	Non-significant
	Marine demersal fish species	Anglerfish / sea monkfish *Lophius piscatorius*	High	Negligible	Minor	Adverse	High	Non-significant
		Atlantic cod *Gadus morhua*	High	Negligible	Minor	Adverse	High	Non-significant
		Atlantic halibut *Hippoglossus hippoglossus*	Very High	Negligible	Minor	Adverse	High	Non-significant
		Blue ling *Molva dypterygia*	High	Negligible	Minor	Adverse	High	Non-significant
		Common goby *Pomatoschitus microps*	High	Negligible	Minor	Adverse	High	Non-significant
		Common sole *Solea solea*	High	Negligible	Minor	Adverse	High	Non-significant
		European hake *Merluccius merluccius*	High	Negligible	Minor	Adverse	High	Non-significant
		European plaice *Pleuronectes platessa*	High	Negligible	Minor	Adverse	High	Non-significant
		Greenland halibut *Reinhardtius hippoglossoides*	High	Negligible	Minor	Adverse	High	Non-significant
		Haddock *Melanogrammus aeglefinus*	High	Negligible	Minor	Adverse	High	Non-significant
		Lemon sole *Microstomus kitt*	High	Negligible	Minor	Adverse	High	Non-significant
		Ling *Molva molva*	High	Negligible	Minor	Adverse	High	Non-significant
		Norway pout *Trisopterus esmarkii*	High	Negligible	Minor	Adverse	High	Non-significant
		Saithe *Pollachius virens*	High	Negligible	Minor	Adverse	High	Non-significant
		Sand goby *Pomatoschitus minutus*	High	Negligible	Minor	Adverse	High	Non-significant
		Sandeel *Ammodytes spp.*	High	Negligible	Minor	Adverse	High	Non-significant
		Whiting *Merlangius merlangus*	High	Negligible	Minor	Adverse	High	Non-significant
	Marine pelagic fish species	Atlantic bluefin tuna *Thunnus thynnus*	High	Negligible	Minor	Adverse	High	Non-significant
		Atlantic herring *Clupea harengus*	High	Negligible	Minor	Adverse	High	Non-significant
		Atlantic mackerel *Scomber scombrus*	High	Negligible	Minor	Adverse	High	Non-significant
		Black scabbardfish *Aphanopus carbo*	High	Negligible	Minor	Adverse	High	Non-significant
		Blue whiting *Micromesistius poutassou*	High	Negligible	Minor	Adverse	High	Non-significant

Impact	Receptor Group	Receptor	Value	Magnitude of impact	Significance of effect	Adverse or Benficial	Confidence	EIA Regulations Significance
Introduction of invasive non-native species	Marine pelagic fish species	European sprat *Sprattus sprattus*	High	Negligible	Minor	Adverse	High	Non-significant
		Horse mackerel *Trachurus trachurus*	High	Negligible	Minor	Adverse	High	Non-significant
		Orange roughy *Hoplostethus atlanticus*	High	Negligible	Minor	Adverse	High	Non-significant
		Roundnose grenadier *Coryphaenoides rupestris*	Very High	Negligible	Minor	Adverse	High	Non-significant
	Cephalopods	Long-finned (loliginid) squids *Loligo forbesi* and *Loligo vulgari*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Short-finned (ommastrephid) squids *Todarodes sagittatus, Todaropsis eblanae* and *Illex coindetii*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Cuttlefish *Sepia officinalis*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Octopuses *Octopus vulgaris and Eledone cirrhosa*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	High	Non-significant
	Crustaceans	Langoustine *Nephrops norvegicus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Common lobster *Homarus gammarus*	High	Negligible	Minor	Adverse	High	Non-significant
		European spiny lobster *Palinurus elephas*	High	Negligible	Minor	Adverse	High	Non-significant
		Squat lobster *Munida rugosa*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Edible crabs *Cancer pagurus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Velvet swimming crab *Necora puber*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Shore crab *Carcinus maenas*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Crayfish *Palunirus elegans*	Low	Negligible	Negligible	Adverse	High	Non-significant
	Molluscs	Ocean quahog *Artica Islandica*	High	Negligible	Minor	Adverse	High	Non-significant
		Common cockle *Cerastoderma edule*	Low	Negligible	Negligible	Adverse	High	Non-significant
		King scallop *Pecten maximus*	Medium	Negligible	Negligible	Adverse	High	Non-significant
		Queen scallop *Aequipecten opercularis*	Low	Negligible	Negligible	Adverse	High	Non-significant
		Razorfish Ensis spp.	Low	Negligible	Negligible	Adverse	High	Non-significant
	Spawning and nursery grounds	Herring spawning and nursery grounds	High	Negligible	Minor	Adverse	High	Non-significant
		Sandeel spawning and nursery grounds	High	Negligible	Minor	Adverse	High	Non-significant

15.6 Mitigation Measures
As no effects were considered to be significant under the provisions of the EIA Regulations, then no secondary mitigation is required to be implemented.

15.7 Residual Effects
No effects were assessed to be of moderate or greater significance. As such, no mitigation measures were required and there was no reduction in the residual significance of effects.

15.8 Cumulative Effects
Fish species are largely mobile species which range widely throughout the region, either during foraging or migration activities. Cumulative impacts on fish and shellfish receptors may arise from impacts originating from the installation, operation or decommissioning of the project as assessed in Sections 15.5-15.7 above, with impacts from other planned or consented projects upon the same receptor populations.

No cumulative assessment is conducted for existing operations or built projects as this forms part of the baseline environment that the assessment in Sections 15.5-15.7 was conducted on. Furthermore, the potential for synergistic impacts from the project, where one impact may cause another impact, have been assessed in Section 15.5 above (for example an impact upon water quality leading to an impact upon fish receptors).

A list of cumulative projects requiring assessment within the Environmental Statement has been agreed with Marine Scotland and further detail is provided in Chapter 6: Cumulative Assessment. The relevant marine projects are considered individually below.

15.8.1 Moray East/West Offshore Windfarm Development
Given the distance between the project and the Moray East/West Offshore wind farm, 100km to the north west of the project, there is likely to be limited overlap between populations of the less mobile fish and shellfish species (e.g. cephalopods, crustaceans, molluscs). For mobile species, the likelihood of individuals encountering both projects is low, and being affected by both projects is even lower. The adverse impacts of offshore wind farms upon fish species are generally associated with their installation and physical presence causing disturbance and habitat loss, as well as through the cabling causing EMF and sediment heating. The NorthConnect project's impacts of this nature are no greater than Negligible in their magnitude, therefore, causing at most an imperceptible change within the population, and the project is not predicted to cause any impacts that are '*likely to have a significant effect on the environment'* (as termed in the EIA Regulations). No cumulative impacts with this project are therefore anticipated that would be *'likely to have a significant effect on the environment'* (as termed in the EIA Regulations).

15.8.2 Inch Cape Offshore Windfarm
Given the distance between the project and the Inch cape offshore wind farm, 110km to the south of the project, there is likely to be limited overlap between populations of the less mobile fish and shellfish species (e.g. cephalopods, crustaceans, molluscs). For mobile species, the likelihood of individuals encountering both projects is low, and being affected by both projects is even lower. The adverse impacts of offshore wind farms upon fish species are generally associated with their installation and physical presence causing disturbance and habitat loss, as well as through the cabling causing EMF and sediment heating. The NorthConnect project's impacts of this nature are no greater

than Negligible in their magnitude, therefore, causing at most an imperceptible change within the population, and the project is not predicted to cause any impacts that are '*likely to have a significant effect on the environment'* (as termed in the EIA Regulations). No cumulative impacts with this project are therefore anticipated that would be *'likely to have a significant effect on the environment'* (as termed in the EIA Regulations).

15.8.3 Neartna Gaoithe Offshore Windfarm

Given the distance between the project and the Neartna Gaoithe offshore wind farm, 130km to the south of the project, there is likely to be limited overlap between populations of the less mobile fish and shellfish species (e.g. cephalopods, crustaceans, molluscs). For mobile species, the likelihood of individuals encountering both projects is low, and being affected by both projects is even lower. The adverse impacts of offshore wind farms upon fish species are generally associated with their installation and physical presence causing disturbance and habitat loss, as well as through the cabling causing EMF and sediment heating. The NorthConnect project's impacts of this nature are no greater than Negligible in their magnitude, therefore, causing at most an imperceptible change within the population, and the project is not predicted to cause any impacts that are '*likely to have a significant effect on the environment*' (as termed in the EIA Regulations). No cumulative impacts with this project are therefore anticipated that would be *'likely to have a significant effect on the environment'* (as termed in the EIA Regulations).

15.8.4 Seagreen Phase 1 Wind Farm

Given the distance between the project and the Seagreen Phase 1 offshore wind farm, 110km to the south of the project, there is likely to be limited overlap between populations of the less mobile fish and shellfish species (e.g. cephalopods, crustaceans, molluscs). For mobile species, the likelihood of individuals encountering both projects is low, and being affected by both projects is even lower. The adverse impacts of offshore wind farms upon fish species are generally associated with their installation and physical presence causing disturbance and habitat loss, as well as through the cabling causing EMF and sediment heating. The NorthConnect project's impacts of this nature are no greater than Negligible in their magnitude, therefore, causing at most an imperceptible change within the population, and the project is not predicted to cause any impacts that are '*likely to have a significant effect on the environment*' (as termed in the EIA Regulations). No cumulative impacts with this project are therefore anticipated that would be *'likely to have a significant effect on the environment'* (as termed in the EIA Regulations).

15.8.5 Beatrice Offshore Windfarm

Given the distance between the project and the Beatrice offshore wind farm, 100km to the north west of the project, there is likely to be limited overlap between populations of the less mobile fish and shellfish species (e.g. cephalopods, crustaceans, molluscs). For mobile species, the likelihood of individuals encountering both projects is low, and being affected by both projects is even lower. The adverse impacts of offshore wind farms upon fish species are generally associated with their installation and physical presence causing disturbance and habitat loss, as well as through the cabling causing EMF and sediment heating. The NorthConnect project's impacts of this nature are no greater than Negligible in their magnitude, therefore, causing at most an imperceptible change within the population, and the project is not predicted to cause any impacts that are '*likely to have a significant* *effect on the environment'* (as termed in the EIA Regulations). No cumulative impacts with this project are therefore anticipated that would be *'likely to have a significant effect on the environment'* (as termed in the EIA Regulations).

15.8.6 European Offshore Wind Development Centre (EOWDC), Aberdeen Bay

The European offshore wind deployment centre is situated 40km to the south of the project. As this project is currently being constructed then no cumulative effects during installation are anticipated given there is no programme overlap. The adverse impacts of offshore wind farms upon fish species during operation are generally associated with their physical presence causing habitat loss and through the cabling causing EMF and sediment heating. The NorthConnect project's impacts of this nature are no greater than Negligible in their magnitude, therefore, causing at most an imperceptible change within the population, and the project is not predicted to cause any impacts that are '*likely to have a significant effect on the environment'* (as termed in the EIA Regulations). No cumulative impacts with this project are therefore anticipated that would be *'likely to have a significant effect on the environment'* (as termed in the EIA Regulations).

15.8.7 Hywind Scotland Pilot Park Offshore Wind Farm

The Hywind Scotland pilot park offshore wind farm is situated 20km to the north of the project and is currently operational so has been considered as part of the baseline against which the project has been assessed.

15.8.8 Kincardine Offshore Wind Farm, 8 6MW Floating Turbines

The Kincardine offshore wind farm is situated 50km to the south of the project. The adverse impacts of offshore wind farms upon fish species are generally associated with their installation and physical presence causing disturbance and habitat loss, as well as through the cabling causing EMF and sediment heating. The NorthConnect project's impacts of this nature are no greater than Negligible in their magnitude, therefore, causing at most an imperceptible change within the population, and the project is not predicted to cause any impacts that are '*likely to have a significant effect on the environment*' (as termed in the EIA Regulations). No cumulative impacts with this project are therefore anticipated that would be *'likely to have a significant effect on the environment'* (as termed in the EIA Regulations).

15.8.9 Aberdeen Harbour Dredge and Harbour Extension Project

The Aberdeen harbour dredge and harbour extension project is situated 40km to the south of the project. As this project is currently being constructed then no cumulative effects during installation are anticipated, given there is no programme overlap. Given the separation between the project and the Aberdeen harbour dredge and harbour extension project, the coastal nature of the works conducted for the Aberdeen harbour dredge and harbour extension project, and the lack of any EMF or sediment heating effects cause, then no cumulative impacts with this project are therefore anticipated that would be *'likely to have a significant effect on the environment'* (as termed in the EIA Regulations).

15.8.10 Peterhead Port Authority Harbour Masterplan

The Peterhead Port Authority Harbour Masterplan is limited in extent to within the existing breakwaters and existing harbours of Peterhead Port, 3km to the north of the project. No cumulative impacts with this project are therefore anticipated that would be *'likely to have a significant effect on the environment'* (as termed in the EIA Regulations).

15.8.11 North Sea Network Link Interconnector Cable

The North Sea Network (NSN) Link Interconnector cable project is situated 130km to the south of the project. Given the distance between the project and the NSN Link Interconnector cable project, 130km to the south of the project, there is likely to be limited overlap between populations of the less mobile fish and shellfish species (e.g. cephalopods, crustaceans, molluscs). Similarly to the project, the NSN Link Interconnector cable project did not predict any impacts would be *'likely to have a significant effect on the environment'* (as termed in the EIA Regulations), and therefore, no cumulative impacts with this project are anticipated that would be *'likely to have a significant effect on the environment'* (as termed in the EIA Regulations).

15.8.12 NorthConnect HVDC Subsea Cable (Rest of the North Sea: from UK Median Line-Start of Norwegian Fjord)

The remaining section of the NorthConnect HVDC subsea cable, not assessed within this EIAR as it is situated within Norwegian waters, is anticipated to have similar effects to the project given that installation will occur from the Norwegian coast to the UK median line utilising similar installation methodologies and equipment, and operation will be transmitting the same electricity along the same wires so sediment heating and EMF levels will be the same. Whilst installation will be occurring at the same time as the project, impacts will not be synergistic given the distance occurring between the installation activities. Similarly, for operation, impacts will be occurring at the same magnitude along the length of the cable route, rather than being cumulatively greater than the individual impacts. Assuming similar mitigation as applied for the UK section of the project will be applied in Norwegian waters, then no cumulative impacts with this project are therefore anticipated that would be *'likely to have a significant effect on the environment'* (as termed in the EIA Regulations).

15.9 Summary

A summary of the potential effects of the project, alone, is presented in Tables 15.13a-c at the end of Section 15.5. There are not predicted to be any residual significance of effects from the project alone that are considered to be an *'impact likely to have a significant effect on the environment'* (as termed in the EIA Regulations). Section 15.8 then assesses the project cumulatively with other proposed plans or projects and there are not predicted to be any cumulative impacts that are considered to be an *'impact likely to have a significant effect on the environment'* (as termed in the EIA Regulations).

15.10 References

Abdulla, A. (2004) Status and Conservation of Sharks in the Mediterranean Sea. IUCN Global Marine Programme.

Aberdeenshire Council (2016) NorthConnect HVDC EIA Scoping Opinion Ref: B/ENQ/2016/0878 23 May 2016.

Aprahamian, M. W., Aprahamian, C. D., Bagliniere, J. L., Sabatie, R. and Alexandrino, P. (2003) Alosa alosa and Alosa fallax spp. Literature review and bibliography. Environment Agency R&D Technical Report W1-014/TR

Berx, B. and Hughes, S. (2008) Climatology of Surface and Near-bed Temperature and Salinity on the North-West European Continental Shelf for 1971–2000.

Birklund, J. and Wijsman, J. W. M. (2005) Aggregate extraction: A review on the effect of ecological functions. Sandpit project report WL Z3297.

Cefas (2004) Guidance Note for Environmental Impact Assessment in Respect of FEPA and CPA Requirements.

Chartered Institute of Ecology and Environmental Management (CIEEM) (2006) Guidelines for Ecological Impact Assessment in the UK and Ireland. Chartered Institute of Ecology and Environmental Management, Winchester.

Chartered Institute of Ecology and Environmental Management (CIEEM) (2010) Guidelines for Ecological Impact Assessment in the Britain and Ireland: Marine and Coastal. Chartered Institute of Ecology and Environmental Management, Winchester.

Chartered Institute of Ecology and Environmental Management (CIEEM) (2016) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal. Second Edition. Chartered Institute of Ecology and Environmental Management, Winchester.

Coull, K. A., Johnstone, R., and Rogers, S. I. (1998) Fisheries sensitivity maps in British waters. Published and distributed by UKOOA Ltd, 9.

Denis, V. and Robin, J.-P. (2001) Present status of French Atlantic fishery for cuttlefish (Sepia officinalis). Fisheries Research 182, 1-12.

Dickey-Collas, M., Nash, R. D., Brunel, T., Van Damme, C. J., Marshall, C. T., Payne, M. R., Corten, A., Geffen, A. J., Peck, M. A., Hatfield, E. M. and Hintzen, N. T., (2010) Lessons learned from stock collapse and recovery of North Sea herring: a review. ICES Journal of Marine Science 67: 1875-1886.

Dragesund, O., Østvedt, O. J. & Toresen, R. (2008) Norwegian spring-spawning herring: history of fisheries, biology and stock assessment. In Nakken, O. (Eds.) Norwegian spring-spawning herring & Northeast Arctic cod: 100 years of research and management.

Dulvy, N. K., Notobartolo di Sciara, G., Serena, F., Tinti, F., Ungaro, N., Mancusi, C. and Ellis, J. (2006) Dipturus batis. In: IUCN 2008. 2008 IUCN Red List of Threatened Species. www.iucnredlist.org.

Ellis, J. R., Milligan, S. P., Readdy, L., Taylor, N. and Brown, M. J. (2012) Spawning and nursery grounds of selected fish species in UK waters. Sci. Ser. Tech. Rep., CEFAS Lowestoft, 147: 56.

Freeman, S., Mackinson, S., Flatt R (2004) Diel patterns in the habitat utilisation of sandeels revealed using integrated acoustic surveys. J Exp Mar Biol Ecol 305,141–154.

Galtsoff, P. S. (1961) Physiology of reproduction in molluscs. American Zoologist 1: 273-289.

Gill, A. B., Gloyne-Phillips, I. T., Neal, K. J. and Kimber, J. A. (2005) The potential effects of electromagnetic fields generated by sub-sea power cables associated with offshore wind farm developments on electrically and magnetically sensitive marine organisms – a review. Report to COWRIE, London, 90pp.

Gill, A. B., Huang, Y., Gloyne-Philips, I., Metcalfe, J., Quayle, V., Spencer, J., and Wearmout, H. V. (2009) COWRIE 2.0 Electromagnetic Fields (EMF) Phase 2: EMF - sensitive fish response to EM emissions from sub-sea electricity cables of the type used by the offshore renewable energy industry. Commissioned by COWRIE Ltd (project reference COWRIE - EMF - 1 - 06).

Hedger, R., McKenzie, E., Heath, M., Wright, P., Scott, B., Gallego, A. and Andrews, J. (2004) Analysis of the spatial distributions of mature cod (Gadus morhua) and haddock (Melanogrammus aeglefinus) abundance in the North Sea (1980-1999) using generalised additive models. Fisheries Research 70: 17-25.

Holland, G. J., Greenstreet, S. P. R., Gibb, I. M., Fraser, H. M. and Robertson, M. R. (2005) Identifying sandeel Ammodytes marinus sediment habitat preferences in the marine environment. Marine Ecological Progress Series 30: 269–282.

Howson, C. M., Steel. L., Carruthers, M. and Gillham, K., (2012) Identification of Priority Marine Features in Scottish territorial waters. Scottish Natural Heritage Commissioned Report No. 388.

ICES (2012) Report of the Working Group on Elasmobranch Fishes (WGEF), 19–26 June 2012, Lisbon, Portugal. ICES CM 2012/ACOM:19. 547pp.

ICES (2017a) Report of the Working Group on Elasmobranchs (2017) 31 May-7 June 2017, Lisbon, Portugal. ICES CM 2017/ACOM:16 1018 pp.

ICES (2017b) Report of the Benchmark on Sandeel (WKSand 2016), 31 October - 4 November 2016, Bergen, Norway. ICES CM 2016/ACOM:33 319 pp.

ICES (2017c) Species factsheet - herring – ICES. Available at: http://www.ices.dk/explore-us/projects/EU-RFP/EU%20Repository/ICES%20FIshMap/ICES%20FishMap%20species%20factsheet-herring.pdf

IUCN (2017) The IUCN Red List of Threatened Species. Version 2017-3. Available at http://www.iucnredlist.org [Accessed 05 March 2018].

Jensen, H., Rindorf, A., Wright, P. J. and Mosegaard, H. (2011) Inferring the location and scale of mixing between habitat areas of lesser sandeel through information from the fishery. ICES Journal of Marine Science 68: 43-51.

JNCC (2014) Scottish MPA Project Fisheries Management Guidance: Sandeels (Ammodytes marinus and A. tobianus). Available at http://jncc.defra.gov.uk/pdf/Sandeels_Fisheries_Management_Guidance_v2_0_July14.pdf [Accessed 05 March 2018]

JNCC and Defra (on behalf of the Four Countries' Biodiversity Group) (2012) UK Post-2010 Biodiversity Framework. July 2012. Available from: http://jncc.defra.gov.uk/page-6189.

Mainwaring, K., Tillin, H. and Tyler-Walters, H. (2014) Assessing the sensitivity of blue mussels (Mytilus edulis) to pressures associated with human activities. JNCC Report No. 506.

Maitland, P. S. (2003) The status of smelt Osmerus eperlanus in England. English Nature Research Report Number 516.

Maitland P. S. (2004) Evaluating the ecological and conservation status of freshwater fish communities in the United Kingdom. Scottish Natural Heritage Commissioned Report No. 001 (ROAME No. F01AC6).

Maitland, P. S. and Lyle, A. A. (1996) Threatened freshwater fishes of Great Britain. In Kirchhofer, A. and Hefti, D. (eds.) Conservation of Endangered Freshwater Fish in Europe.

Malcolm, I. A., Godfrey, J. and Youngson, A. F. (2010) Review of migratory routes and behaviour of Atlantic salmon, Sea trout and European eel in Scotland's coastal environment: implications for the development of marine renewables. Scottish Marine and Freshwater Science 1: 14-82.

Maravelias, C. D. (1999) Habitat selection and clustering of a pelagic fish: effects of topography and bathymetry on species dynamics. Canadian Journal of Fisheries and Aquatic Sciences 56: 437-450.

Maravelias, C. D (1997) Trends in abundance and geographic distribution of North Sea herring in relation to environmental factors. Marine Ecology Progress Series 159: 151-164.

Marine Scotland (2016) NorthConnect HVDC Scoping Opinion.

Marine Scotland (2017) Sandeels. Accessible at http://www.gov.scot/Topics/marine/marine-environment/species/fish/sandeels [Accessed 05 March 2018].

Miller, M. J., Bonhommeau, S., Munk, P., Castonguay, M., Hanel, R. and McCleave, J. D. (2014) A century of research on the larval distributions of the Atlantic eels: a re-examination of the data. Biological reviews doi: 10.1111/brv.12144.

MMO (2016) UK Sea Fisheries Statistics 2016. London, UK.

MMT (2017) NorthConnect – UK Nearshore and North Sea Survey. Geophysical, Benthic and Geotechnical Route Survey December 2016 and July 2017.

Nall, G. H. (1935) Sea-Trout of the Montrose District – The Migrations of Sea-Trout. Fisheries, Scotland, Salmon, Fish, 1935, No. III.

Ness DSFB (2017) Pacific pink salmon in the River Ness. Available online at: http://ness.dsfb.org.uk/pacific-pink-salmon-in-the-river-ness-2017-the-year-of-the-humpback/ [Accessed 12th June 2018]

Nieto, A., Ralph, G.M., Comeros-Raynal, M.T., Kemp, J., García Criado, M., Allen, D.J., Dulvy, N.K., Walls, R.H.L., Russell, B., Pollard, D., García, S., Craig, M., Collette, B.B., Pollom, R., Biscoito, M., Labbish Chao, N., Abella, A., Afonso, P., Álvarez, H., Carpenter, K.E., Clò, S., Cook, R., Costa, M.J., Delgado, J., Dureuil, M., Ellis, J.R., Farrell, E.D., Fernandes, P., Florin, A-B., Fordham, S., Fowler, S., Gil de Sola, L., Gil Herrera, J., Goodpaster, A., Harvey, M., Heessen, H., Herler, J., Jung, A., Karmovskaya, E., Keskin, C., Knudsen, S.W., Kobyliansky, S., Kovačić, M., Lawson, J.M., Lorance, P., McCully Phillips, S., Munroe, T., Nedreaas, K., Nielsen, J., Papaconstantinou, C., Polidoro, B., Pollock, C.M., Rijnsdorp, A.D., Sayer, C., Scott, J., Serena, F., Smith-Vaniz, W.F., Soldo, A., Stump, E. and Williams, J.T. (2015) European Red List of marine fishes. Luxembourg: Publications Office of the European Union.

NorthConnect (2016) EIA Scoping Report.

NorthConnect (2018) Electromagnetic Field (EMF) and Sediment Heating literature review: Ecological Recommendations. [Full document included as Appendix E.1 to this EIAR].

OSPAR (2008) OSPAR List of Threatened and/or Declining Species and Habitats. Ref. 2008-6.

OSPAR (2009) Assessment of the environmental impacts of cables. Biodiversity Series. Germany: OSPAR Convention.

OSPAR (2010) Background document for Seapen and Burrowing Megafauna communities. OSPAR Commission Biodiversity Series. OSPAR Commission: London. Available from: http://qsr2010.ospar.org/media/assessments/Species/P00481_Seapen_and_burrowing_megafauna.pdf [Accessed 05 March 2018].

OSPAR (2013) Region II: Greater North Sea. Available at https://www.ospar.org/convention/the-north-east-atlantic/ii [Accessed 05 March 2018].

Paramor, O. A. L., Allen, K. A., Aanesen, M., Armstrong, C., Hegland, T., Le Quesne, W., Piet, G. J., Raakær, J., Rogers, S., van Hal, R., van Hoof, L. J. W., van Overzee, H. M. J., and Frid C. L. J. (2009) MEFEPO North Sea Atlas. University of Liverpool. ISBN 0906370604.

Popper, A. N., Hawkins, A. D., Fay, R. R., Mann, D. A., Bartol, S., Carlson, T. J., Coombs, S., Ellison, W. T., Gentry, R. L., Halvorsen, M. B., Lokkeborg, S., Rogers, P. H., Southall, B. L., Zeddies, D. G. & Tavolga, W. N. (2014) Sound exposure guidelines for fishes and sea turtles: A technical report prepared by ANSI-accredited standards committee S3/SC1 and registered with ANSI. Report ASA S3/SC1.4 TR-2014.

Righton, D., Westerberg, H., Feunteun, E., Økland, F., Gargan, P., Amilhat, E., Metcalfe, J., Lobon-Cervia, J., Sjöberg, N., Simon, J. and Acou, A. (2016) Empirical observations of the spawning migration of European eels: The long and dangerous road to the Sargasso Sea. Science Advances, 2: p.e1501694.

Robertson, M. J., Scruton, D. A., Gregory, R. S. and Clarke, K. D. (2006) Effect of suspended sediment on freshwater fish and fish habitat. Canadian Technical Report of Fisheries and Aquatic Sciences 2644.

Sabatini, M. and Hill, J. M. (2008) Nephrops norvegicus Norway lobster. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 04-04-2018]. Available from: https://www.marlin.ac.uk/species/detail/1672

Schmidt, J. (1923) Breeding places and migrations of the eel. Nature 111: 51-54.

Scottish Biodiversity Strategy (2013) 2020 Challenge for Scotland's Biodiversity - A Strategy for the conservation and enhancement of biodiversity in Scotland. Available at http://www.gov.scot/Publications/2013/06/5538

Scottish Government (2015) Shellfish. Available at http://www.gov.scot/Topics/marine/marine-environment/species/fish/shellfish [Accessed 05 March 2018]

Shearer, W. M (1990) North Esk Sea Trout. In Picken, M.J. and Shearer, W.M. (eds) The sea trout in Scotland. Proceedings of a Symposium held at The Dunstaffnage Marine Research Laboratory 18-19 June 1987. 35-45

Stephen, A. C. (1944) The cephalopoda of Scottish and adjacent waters. Transactions of the Royal Society of Edinburgh 61, 247-270.

van Ginneken, V. J. T, and Maes, G. E. (2005) The European eel (Anguilla anguilla, Linnaeus), its Lifecycle, Evolution and Reproduction: A Literature Review. Rev Fish Biol Fisheries 15, 367.

Wilson, E. (1999) Cancer pagurus. Edible crab. Marine Life Information Network: Biology and Sensitivity Key Information Sub-programme [on-line]. Plymouth: Marine Biological Association of the United Kingdom. http://www.marlin.ac.uk/species/Cancerpagurus.htm

Wilson, E. (2008) Homarus gammarus Common lobster. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 04-04-2018]. Available from: https://www.marlin.ac.uk/species/detail/1171

Winslade P (1974) Behavioural studies on the lesser sandeel Ammodytes marinus (Raitt). I. The effect of food availability on activity and the role of olfaction in food detection. Journal of Fish Biology 6: 565–576.

Witt, M. J., Hardy, T., Johnson, L., McClellan, C. M., Pikesley, S. K., Ranger, S., Richardson, P. B., Solandt, J. L., Speedie, C., Williams, R. and Godley, B. J. (2012) Basking sharks in the northeast Atlantic: spatio-temporal trends from sightings in UK waters. Marine Ecology Progress Series 459: 121-134.

Wright, P. J., Jensen, H. and Tuck, I. (2000) The influence of sediment type on the distribution of the lesser sandeel, Ammodytes marinus. Journal of Sea Research 44: 243–256.

Young, I. A. G., Pierce, G. J., Stowasser, G., Santos, M. B., Wang, J., Boyle, P. R., Shaw, P. W., Bailey, N., Tuck, I. and Collins, M. A. (2006) The Moray Firth directed squid fishery. Fisheries Research 78: 39–43.

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Chapter 16: Marine Mammals

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Contents

16 Marine Mammals

16.1 Introduction

This chapter presents the marine mammal Ecological Impact Assessment (EcIA) of the proposed marine HVDC cable installation. Marine mammal receptors are considered in this chapter and are evaluated in the context of nature conservation legislation and relevant planning policy (see Chapter 5: Planning Policy). Impacts on receptors are identified and subject to detailed impact assessment. Mitigation is proposed, cumulative impacts are considered, and finally the residual impacts and their significance are assessed.

This chapter is supported by Chapter 23: Noise and Vibration (Underwater).

16.2 Sources of Information

International and national legislation assists in identifying sensitive marine mammal species whose presence on a site should be given greater consideration during assessment. This legislation also allows for designation of sites for marine mammal interests. Further guidance for sensitive species was sought from the latest Biodiversity Action Plans (BAPs).

16.2.1 European and International Regulations

Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, known as the 'Habitats Directive' was adopted in 1992 (European Commission, 1992). The Directive is the means by which the European Union meets its obligations under the Bern Convention. All species of cetacean occurring in UK waters are listed in Annex IV of the Habitats Directive as European Protected Species (EPS) where the deliberate killing, disturbance or the destruction of these species or their habitat is banned.

In addition, species listed in Annex II of the Habitats Directive, which are native to the UK should be conserved through the designation of Special Areas of Conservation (SACs). Two species of cetacean present in UK waters are listed in Annexe II; the bottlenose dolphin *Tursiops truncatus* and the harbour porpoise *Phocoena phocoena*. Since 1994 all SACs, in combination with Special Protection Areas (SPAs) comprise the UK contribution to the Natura 2000 ecological network of protected sites.

Although not afforded the strict protection of EPS through the Habitats Directive, pinniped species occurring in UK waters are listed in in Annex V of the Habitats Directive, and as such that are defined as species of community interest; therefore, taking in the wild may be subject to management measures. Two species, the grey *Halichoerus grypus,* and common *Phoca vitulina* seals, are also listed in Annex II of the Habitat Directive, as species whose conservation requires the designation of SACs.

As such, species listed on Annexes II, IV, and V of the Habitats Directive are considered sensitive species for the purposes of this assessment.

16.2.2 National Legislation

The primary legislative instrument transposing the Habitats Directive into UK law is The Conservation (Natural Habitats, &c.) Regulations 1994 (the Habitats Regulations). All cetaceans are listed under Schedule 2 of the Habitats Regulations meaning it is an offence to:

- Deliberately to capture or kill a wild animal of a European protected species;
- Deliberately to disturb any such animal;
- Deliberately to take or destroy the eggs of such an animal; or
- To damage or destroy a breeding site or resting place of such an animal.

The Habitats regulations also provide protection to SACs, since they require that any proposal which has the potential to result in a negative likely significant effect (LSE) to an SAC or its designated features, to be subject to a Habitats Regulations Appraisal (HRA), and if necessary an Appropriate Assessment (AA). The HRA and AA process ensures that no development can be consented if it may cause adverse effects on the integrity of a Natura Site, unless there no alternatives, and there is an Imperative Reason of Overriding Public Importance for the development to be constructed.

Th Wildlife and Countryside Act 1981, and Nature Conservation (Scotland) Act 2004 provide further protection to marine mammals. Cetaceans are listed in Schedule 5 of the Wildlife and Countryside Act 1981, which prohibits their deliberate killing, injuring or disturbance. The Nature Conservation (Scotland) Act 2004 makes amendments to the Wildlife and Countryside Act in Scottish waters, including the addition of 'reckless' acts to offenses against species protection, which makes it an offence to intentionally or recklessly disturb a cetacean.

The Marine (Scotland) Act 2010 and Marine and Coastal Access Act (2009) make it an offence to disturb seals at any designated haul out location and to kill, injure or take seals anywhere.

16.2.3 Planning Framework

The Scottish National Marine Plan provides General Planning Principles (GEN), of which the following apply to the Marine Mammal assessment:

- **GEN 9 Natural heritage**: Development and use of the marine environment must:
    - Comply with legal requirements for protected areas and protected species;
    - Not result in significant impact on the national status of Priority Marine Features;
    - Protect and, where appropriate, enhance the health of the marine area;

- **GEN 13 Noise**: Development and use of the marine environment should avoid significant adverse effects of man-made noise and vibration, especially on species sensitive to such effects.

16.2.4 Other Guidance

The Marine (Scotland) Act 2010, and the Marine and Coastal Access Act 2009, sets out duties on the Scottish Minister to ensure Scotland's seas are managed sustainably. In order to help meet this requirement, the Joint Nature Conservation Committee (JNCC) and Scottish Natural Heritage (SNH) have produced a list of habitats and species occurring in Scottish Waters, which are noted for their conservation importance; these are referred to as Priority Marine Features (PMFs). Thirteen cetacean species, and both grey and common seals are included in the PMF list (Tyler-Walters et al., 2016). Inclusion in the PMF list does not provide any additional legal protection, due consideration must be provided in Impact Assessments, and as such all PMFs are considered sensitive for the purpose of this assessment.

Guidance is also provided by JNCC and SNH regarding possible mitigation measures to reduce impacts on marine mammal species. These include:

- JNCC, 2017. JNCC Guidelines for minimising the risk of injury to marine mammals from geophysical survey operations.
- SNH, Undated. The Scottish Marine Wildlife Watching Code.

16.3 Assessment Methodology

16.3.1 Desk Study

A desk study and literature search was undertaken to inform the characterisation of the existing marine mammal baseline conditions. The following data sources were consulted to aid in identifying and assessing the marine mammals which may be utilising the proposed development area, and surrounding waters, including gaining information on population sizes, seasonal trends, foraging characteristics, and associated designated sites:

- SNH interactive map facility at SiteLink (SNH, 2018);
- North-East Scotland Biological Records Centre (NESBReC, 2018);
- The UK PMF list (Tyler-Walters et al, 2016)
- National Marine Plan Interactive (Marine Scotland, 2018);
- Management Units for cetaceans in UK waters (IAMMWG, 2015);
- Scientific Advice on Matters Related to the Management of Seal Populations: 2017 (SCOS, 2017);
- Hywind Scotland Pilot Park – Environmental Statement (Statoil, 2015); and
- Various scientific reports and journal articles regarding marine mammal distribution and movements in the North Sea region.

16.3.2 Impact Assessment Methodology

The same principles of impact assessment methodology as carried out in the other ecological chapters, are also employed here. The assessment of the significance of predicted impacts on ecological receptors is based on both the 'value' of a receptor and the nature and magnitude of the impact that the development will have on it. Effects on biodiversity may be direct (e.g. the loss of species or habitats), or indirect (e.g. effects due to noise or disturbance), on receptors located within or out with the respective survey area. This EcIA has, in principle, followed the assessment methodology outlined in Chapter 3: Methodology with the specific ecological assessment methods and criteria detailed below.

16.3.2.1 Evaluation of Ecological Receptors

The evaluation methodology has been adapted from the Guidelines for ecological impact assessment in the UK and Ireland: terrestrial, freshwater and coastal (CIEEM, 2016). A key consideration in assessing the effects of any development on flora and fauna is to define the areas of habitat and the species that need to be considered. This required the identification of a potential zone of influence, which is defined as those areas and resources that may be affected by biophysical changes caused by project activities, however remote from the respective survey area.

The approach that has been undertaken throughout this EcIA is to identify 'valued ecological receptors' i.e. species and habitats that are both valued in some way and could be affected by the proposed development and separately, to consider legally protected species. Both species populations and habitats have been valued using a broad geographical basis with full details in Table 16.1.

The approach taken in this assessment is that a species population or habitat area that is of Regional or greater importance in biodiversity conservation terms is considered to be a valued ecological receptor. Therefore, if a species population is considered to be of High Local value or less, the proposed development is not anticipated to have as great an effect on the species population as a whole. Exceptions are made if the species population or habitat area has been identified as having a high social or economic value, or if the species is legally protected, for example if they are a Schedule 1 or Schedule 5 species, or an EPS.

Table 16.1 Nature Conservation Receptor Evaluation Criteria

Value	Criteria
International	• An internationally important site (SAC) or a site proposed for, or considered worthy of designation; • A regularly occurring substantial population of internationally important species (E.G. EPS listed on Annex IV of the Habitats Directive).
National	• A nationally designated site (MPA), or a site proposed for, or considered worthy of such designation; • A viable area of habitat type listed in Annex I of the Habitats Directive or of smaller areas of such habitat which are essential to maintain the viability of a larger whole; or • A regularly occurring substantial population of a nationally important species, e.g. listed on Schedule 5 & 8 of the 1981 Wildlife and Countryside Act.
Regional	• Areas of internationally or nationally important habitats which are degraded but are considered readily restored; • Viable habitats or populations of a species identified as a PMF, or smaller areas/populations which are essential to maintain the viability of a larger area/population as a whole; • Regionally important population/assemblage of an EPS, Schedule 1 and/or 5 species. • Regionally important assemblages of other species or habitats.
High Local	• Locally important population/assemblage of an EPS, Schedule 1 and/or 5 species; or • Sites containing viable breeding populations of species known to be county rarities, or supplying critical elements of their habitat requirements.
Moderate Local	• Undesignated sites, features or species considered to appreciably enrich the habitat resource within the local context (within 2km radius from the site) and may benefit from mitigation as a good practice measure.
Low Local	• Undesignated sites, features or species considered to appreciably enrich the habitat resource within the immediate environs of the site and may benefit from mitigation as a good practice measure.
Negligible	• Common and widespread or modified habitats or species.
Negative	• Invasive, alien species often scheduled under Section 14, Schedule 9 of the Wildlife and Countryside Act 1981 (as amended).

The approach of this assessment is to consider the value of the Site for the species under consideration, rather than the nature conservation importance of the species itself, although this is a factor in the evaluation process with the level of use of the Site (number of individuals using the site and nature and level of use) taken into consideration. An assessment is then made of the value of the Site to that species, based upon a combination of data sources, professional judgment and knowledge of the Site and wider area.

16.3.2.2 Legal Protection of Species

There is a need to identify all legally protected species that could be affected by the proposed development to ensure that the development complies with all relevant nature conservation legislation. It is, therefore, appropriate to take into full consideration the legal protection of a species within the evaluation process.

16.3.2.3 Nature and Magnitude of Impact

Impacts can be: permanent or temporary; direct or indirect; adverse or beneficial; reversible or irreversible; and may also have a cumulative function with other activities outwith the assessed development. These factors are taken into consideration in the context of the sensitivity of the valued ecological receptor and the range of potential effects. To identify whether impacts are significant or not it is important to undertake the assessment in terms of the integrity (coherence of the ecological structure and function) and conservation status (ability of the receptor to maintain its distribution and/or extent/size) of the receptor.

Table 16.2 provides an overview of the range of impact magnitudes referred to within this assessment. In addition, impacts may also be positive in nature.

Table 16.2 Definition of Magnitude of Impact.

Magnitude	Description
Negligible / None	Very slight change from the baseline conditions. Changes barely detectable, approximating to the 'no change' situation. Any effects likely to be reversible within 12 months and not affect the conservation status or integrity of the receptor.
Low	Minor shift away from baseline conditions. Effects will be detectable but unlikely to be of a scale or duration to have a significant effect on the conservation status or integrity of the receptor in the short term (1-5 years). Overall baseline character of site will not alter substantially.
Medium	Clear effect on the conservation status or integrity of the receptor in the short to medium term (6-15 years), although this is likely to be reversible or replaceable in the long-term (15 years plus).
High	Total loss of, or major alteration to conservation status or integrity of a receptor with situation likely to be irreversible, even in the long term. Fundamental alteration to the character and composition of the Site.

16.3.2.4 Impact significance

The significance of an effect is a product of the value of the ecological receptor and the magnitude of the impact on it, moderated by professional judgment. Table 16.3 illustrates a matrix based on these two parameters which is used for guidance in the assessment of significance. In terms of the EIA Regulations, only effects which are 'moderate' or 'major' are considered significant, the others constituting a non-significant effect. The level of effect has been assessed as either major, moderate, minor or negligible, or beneficial in accordance with the definitions provided in Chapter 3: Methodology.

Table 16.3 Significance of Effects Matrix

Magnitude of Impact	Value				
	International	National	Regional	Moderate Local/ High Local	Low Local /Negligible
High	Major	Major	Moderate	Moderate	Minor
Medium	Major	Moderate	Moderate	Minor	Minor
Low	Moderate	Minor	Minor	Minor	Negligible
Negligible	Minor	Negligible	Negligible	Negligible	Negligible

Key

	Significant Effect
	Non-significant Effect

16.4 Baseline Information

16.4.1 Statutory Designated Sites

There are several designated sites relevant to the proposed development site. The sites taken forward for assessment which are relevant to marine mammals are shown in Table 16.4, along with their qualifying features. Figure 16.1 provides a map showing the locations of the designated sites relative to the proposed development.

Table 16.4. Designated Sites Relevant to the Marine Mammal Receptors

Site	Direction and Distance by Sea	Value	Relevant Qualifying Feature(s)
Southern Trench pMPA	Crossed by Cable Corridor	National	• Minke whale (*Balaenoptera acutorostrata*)
Moray Firth SAC	105km North West	International	• Designated for bottlenose dolphin (*Tursiops truncatus*)
Firth of Tay & Eden Estuary SAC	120km South West	International	• Common seal (*Phoca vitulina*)
Dornoch Firth & Morrich More SAC	140km North West	International	• Common seal (*Phoca vitulina*)

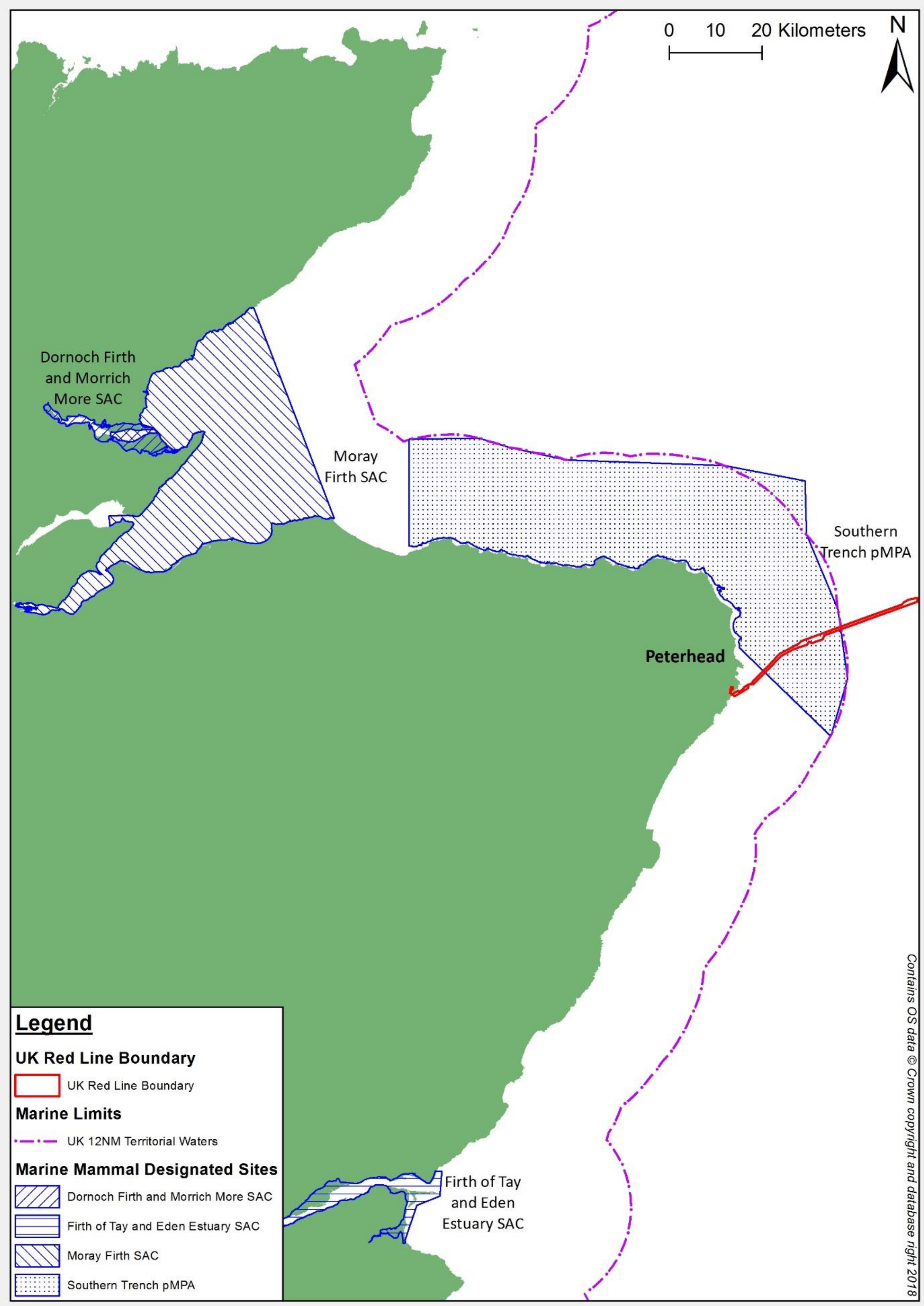

Figure 16.1. Designated sites relevant to the marine mammal receptors associated with the NorthConnect HVDC interconnector development.

16.4.1.1 Southern Trench pMPA

The Southern Trench proposed Marine Protected Area (pMPA) is designated in part due to the presence of ocean fronts, which accumulate nutrients, plankton and fish species. As a result, the area can be considered a biodiversity hotspot, which attracts higher trophic level foragers; minke whales (*Balaenoptera* acutorostrata) are noted as being sighted particularly frequently in the northern section of the pMPA (SNH, 2014). Paxton et al., (2014) state that the pMPA is persistently predicted to support above average densities of minke whales, compared to the wider Scottish territorial waters.

16.4.1.2 Moray Firth SAC

The Moray Firth SAC is designated for the conservation of bottlenose dolphins (*Tursiops truncatus*), under the European Habitats Directive. The area is of key importance to the UK east coast bottlenose dolphin population, and is regularly utilised by over 100 individuals annually, which equates >50% of the population (Cheney et al., 2018). It has been shown that the percentage of the population utilising the SAC has declined, however this is likely due to the fact that the population size is increasing, and hence the population is utilising a larger habitat area (Cheney et al., 2018).

16.4.1.3 Firth of Tay and Eden Estuary SAC

The Firth or Tay and Eden Estuary SAC is designated for supporting a nationally important breeding colony of common seals (*Phoca vitulina*), under the European Habitats Directive. It is estimated that approximately 600 seals use the area as a haul out, which comprises approximately 2% of the UK common seal population (JNCC, 2018). Given the relatively short distances of common seal foraging trips, (typically 50 km), it is considered unlikely that common seals from the Firth of Tay and Eden Estuary SAC will be in the vicinity of the proposed development. As such, this site will not be considered further.

16.4.1.4 Dornoch Firth and Morrich More SAC

The Dornoch Firth and Morrich More SAC is designated in part due to its importance to the Moray Firth common seal (*Phoca vitulina*) population, under the European Habitats Directive. The seals use the sand banks and shorelines as haul outs and breeding sites, and it is estimated that nearly 2% of the UK common seal population utilise the area (JNCC, 2018). Given the relatively short distances of common seal foraging trips, (typically 50 km), it is considered unlikely that common seals from the Dornoch Firth and Morrich More SAC will be in the vicinity of the proposed development. As such, this site will not be considered further.

16.4.2 General Information

The North Sea ecoregion is comparatively rich in cetaceans (whales, dolphins and porpoises); 9 species are regularly recorded in the region (Reid et al, 2003). Four species occur commonly, or are resident within the survey corridor including: harbour porpoise, bottlenose dolphin, minke whales, white beaked dolphin. A further five species are considered regular but less common, including: short-beaked common dolphin, Atlantic white-sided dolphin, long-finned pilot whale, killer whale, and Risso's dolphin.

The Moray Firth is of national importance for its bottlenose dolphin population and is designated as a Special Area of Conservation (SAC) for this species. The Southern Trench pMPA), as shown in Figure 1, is designated in part for minke whales.

Two species of pinniped are resident in this region of the North Sea; the grey and common seal. Both species use coastal sites for breeding/pupping and hauling out, and feed in inshore and offshore waters. Marine Scotland has designated 194 coastal sites around Scotland as seal haul-out sites, under the Marine (Scotland) Act 2010. No such sites occur within the vicinity (20km) of the survey area.

16.4.3 Cetaceans

16.4.3.1 Harbour Porpoise (*Phocoena phocoena*)

Harbour porpoises are the UK's most abundant cetacean, with the highest densities occurring along the North Sea coast, around the Northern Isles and the Outer Hebrides (Northridge et al., and Reid et al., 2003); as such are expected to be most frequently encountered during the HVDC cable installation operations. The harbour porpoises occurring within the vicinity of the Consenting Corridor are likely to be members of the North Sea population group, which is estimated to be composed of 227,298 individuals (IAMMWG, 2015).

Reid et al., (2003) reports that Harbour porpoises occur commonly on the Scottish East Coast, in waters shallower than 100m, making it very likely that they will be common within the marine Consenting Corridor. This is confirmed by the results of Ecological Line Transect Surveys conducted for the Hywind Pilot Park, which reported that harbour porpoises were the most frequently sighted marine mammals, with 229 animals being observed. This equates to 1.765 animals per hour and 0.091 animals per km (Statoil, 2015). During the year-round bird survey work at Longhaven Bay, 3 opportunistic harbour porpoises sightings were recorded, including 2 in February 2017, and a single observation in September 2017 (NRP, 2017), further information is provided in Appendix F.1.

Harbour porpoises are present year-round in the North Sea, and little is known of seasonal migration (Evans et al., 2003; Reid et al., 2003).

16.4.3.2 Bottlenose Dolphin (*Tursiops truncatus*)

Bottlenose dolphins are distributed throughout the UK shelf waters, primarily close to shore. Two larger aggregations are found in the Moray Firth, approximately 115km by sea to the north west of the survey corridor, as well as in Cardigan Bay (Wales) (Reid et al., 2003), both of which are designated as Special Areas of Conservation.

There are six management units for bottlenose dolphins in UK waters (IAMMWG, 2015). Bottlenose dolphins are most commonly recorded within the 20m depth contour, and as such individuals occurring within the Consenting Corridor are likely to belong to 'Coastal East Scotland' population, which estimated to hold 189 individuals, with a 95% highest posterior density interval of 155-216 (Cheney et al., 2018). The Consenting Corridor is not reported to be of particular importance to bottlenose dolphins, although it is likely to cross the migration route between the Moray Firth, and other key areas to the south, including the Firths of Forth and Tay. No bottlenose dolphins were recorded during the Hywind Pilot Park Surveys (Statoil, 2015).

The highest bottlenose dolphin numbers are reported in Scotland during July and October, with some areas including the Tay Estuary having an additional peak in March to April. Some nearshore animals have permanent dolphin presence, including the Moray Firth population (Reid et al., 2003).

16.4.3.3 Minke Whale (*Balaenoptera acutorostrata*)

The minke whale is the most common baleen species recorded in British shelf waters, including in the north western North Sea (Reid et al, 2003, and Evans 2008). They feed mainly in shallower water over the continental shelf, rather than out in the open ocean. They regularly appear around sandbanks or where upwellings bring nutrients and fish near the surface, or in the strong currents around headlands and small islands (Reid et al., 2003).

Minke whales throughout British and Irish waters are considered a single population of 23,528 individuals, although this is considered to be an underestimate (IAMMWG, 2015). Minke whales were the fourth most frequently observed marine mammal during the Hywind Pilot Park Surveys, with 16 animals recorded, equating to a sighting rate of 0.123 animals per hour and 0.006 animals per km (Statoil, 2015). It is considered likely that minke whales will be present within the Consenting Corridor.

Minke are most frequently observed in Scottish waters between July and September but are present from May to October (Reid et al., 2003).

16.4.3.4 White-Beaked Dolphin (*Lagenorhynchus albirostris*)

The UK is in the Southern extent of the range of white beaked dolphins, and as such the UK distribution is centred in the north; Scottish shelf waters are considered to be the main stronghold of this species in Europe particularly in the Minch, to the north of the Outer Hebrides, the outer Moray Firth, and off the coast of Aberdeenshire (Northridge et al, 1995, and Reid et al, 2003). The species typically inhabits waters of moderate depth, but less than 200m (Reid et al., 2003).

White-beaked dolphins from British and Irish waters are considered a single population of 15,895 individuals (IAMMWG, 2015). The high densities of this species reported off the Aberdeenshire coast make it likely that this species will be present within the Consenting Corridor. This is confirmed by the results of Hywind Pilot Park surveys, which found this species to be the second most commonly recorded, with a total of 39 animals, equating to a detection rate of 0.301 animals per hour and 0.016 animals per km during transect surveys (Statoil, 2015).

Sightings of white-beaked dolphin in the UK peak between June and October, although they are present year-round (Reid et al., 2003).

16.4.3.5 Other Cetaceans

In addition to the species detailed above, several other cetaceans are considered to be rare visitors to the waters in the vicinity of the Consenting Corridor, and are outlined below for completeness.

16.4.3.5.1 Short-Beaked Common Dolphin *(Delphinus delphis)*

Comparatively rare in the North Sea but when sighted are usually seen in summer (Reid et al., 2003). There have been few sightings in the vicinity of the Consenting Corridor (Reid et al, 2003; NMPI, 2014) and the majority of sightings in the North Sea are to the north or south east of the Consenting Corridor; east of Orkney and east of Dundee respectively (Marine Scotland, 2018).

16.4.3.5.2 Atlantic White-Sided Dolphin (*Lagenorhynchus acutus*)

This species is relatively rare in the North Sea, however there are some records off the north-east coast of Scotland and in close proximity to the Consenting Corridor. The species appears to enter the North Sea during summer (Reid et al., 2003).

16.4.3.5.3 Long-Finned Pilot Whale *(Globicephala melas)*

Although there are some sightings along the east coast of Scotland, particularly to the east of the Moray Firth, long- finned pilot whales are not considered common in the vicinity of the Consenting Corridor (Reid et al., 2003; Marine Scotland, 2018). When present, they are most commonly sighted between November and January.

16.4.3.5.4 Killer Whale *(Orcinus orca)*

Killer whales recorded year-round throughout the North Sea, although they are primarily recorded off northern Scotland and around the Norwegian coast in the summer (Evans et al., 2010). There have been sightings in the area of the Consenting Corridor, although only occasionally and more often close to land, (Reid et al., 2003 and Marine Scotland, 2018).

16.4.3.5.5 Risso's Dolphin (*Grampus griseus)*

Risso’s dolphins in UK waters are primarily concentrated in The Minch in north west Scotland, in parts of the Irish Sea and off south west Ireland (Reid et al., 200). Risso’s dolphins in the North Sea, west of Scotland and Irish and Celtic seas are considered a single population, however no population estimate for the species is available as it is comparatively uncommon (IAMMWG, 2015).

16.4.4 Pinnipeds

16.4.4.1 Grey Seal (*Halichoerus grypus*)

Grey seals distributed throughout UK waters, although the population is concentrated in Scotland, with major concentrations in the Outer Hebrides, Orkney, and the Firth of Forth; in 2014, the total UK grey seal population was estimated to be 141,000 individuals (SCOS, 2017). Seals were frequently observed during the Hywind Pilot Park surveys, with 38 animals being sighted at a rate of 0.293 animals per hour and 0.019 animals per km (Statoil, 2015).

Designated breeding seal colony haul out sites are concentrated in the Northern Isles, Orkney and Shetland, and in the Outer Hebrides. Non-breeding haul out sites are also concentrated at these locations, in addition to various sites along the west coast of Scotland and along some of the east coast as far south as the Moray Firth. There are also some designated breeding sites in the Firth of Forth. There are no designated grey seal haul out sites within 140km of the Consenting Corridor (Marine Scotland, 2018).

Grey seals are present in Scottish waters all year round, however in northern Scotland the breeding season occurs between October and late November, and the grey seal moult takes place between December and April (Hammond et al., 2003). During these periods seals spend more time ashore, and as such it is anticipated that the at sea density of grey seals will be lower during the months of November – January (Hammond et al., 2003). Opportunistic marine mammal observations conducted during the 2017 year-round bird survey work at Longhaven Bay recorded a total of 73 grey seals, the largest number observed was 30 individuals that had hauled out along in January 2017. Grey seals were present in the area during every month of the year (NRP, 2017), further information is provided in Appendix F.1.

16.4.4.2 Common Seal (*Phoca vitulina vitulina*)

In UK waters, common seals are widespread around the west coast of Scotland, throughout the Hebrides and Northern Isles. On the east coast their distribution is more restricted with concentrations in the major estuaries of the Firth of Tay and the Moray Firth (SCOS, 2017). The UK common seal count population estimate for 2014 was 43,500 (SCOS, 2017). Common seals were only rarely encountered during the Hywind Pilot Park survey, with a total of 4 animals recorded, giving a sighting rate of 0.031 animals per hour and 0.002 animals per km during transect surveys.

There are no designated haul out sites, breeding or otherwise, within 100km of the Consenting Corridor, and the closest common seal haul out is in the Firth of Tay, within the Firth of Tay and Eden Estuary SAC (Marine Scotland, 2018).

Common seals are present year around in UK waters, the breeding period in Scotland is between June – July, and the moult occurs in August (Hammond et al, 2003). Only 2 common seals were observed opportunistically during the year-round bird surveys, one in May 2017, and a second in August 2017 (NRP, 2017), further information is provided in Appendix F.1.

16.4.5 Valuation of Key Receptors

Table 16.5 provides a summary of the evaluation of the marine mammal receptors identified from the desktop study.

Table 16.5 Evaluation of Marine Mammal Receptors.

Ecological Receptor	Evaluation Rationale	Site Ecological Receptor Value
Designated Sites		
Southern Trench pMPA	The Consenting Corridor passes through the southern extent of the Southern Trench pMPA. The site is designated in part due to its importance to minke whales. The proposed site is designated to meet the requirements of the Marine (Scotland) Act 2010.	National
Moray Firth SAC	The Consenting Corridor is located approximately 105km by sea SW of the Moray firth SAC, which is designated for bottlenose dolphins. This is a highly mobile species, and animals from the Moray Firth are known to travel as far south as the Firth of Forth, and as such may be present within the Consenting Corridor. The site is designated to fulfil the requirements of the European Habitats Directive.	International
Firth of Tay & Eden Estuary SAC	The Consenting Corridor is located approximately 120km by sea NE of this site which is designated for common seals. The site is designated to fulfil the requirements of the European Habitats Directive. Common seals have relatively short ranges, generally less than 50km, and hence seals from this site are unlikely to be present in the Consenting Corridor.	International: Scoped out of further assessment.
Dornoch Firth & Morrich More SAC	The Consenting Corridor is located approximately 140km by sea SE of this site; designated for common seals. The site is designated to fulfil the requirements of the European Habitats Directive. Common seals have relatively short ranges, generally less than 50km, and hence seals from this site are unlikely to be present in the Consenting Corridor.	International: Scoped out of further assessment.
Marine Mammal Species		
Harbour Porpoise	Harbour porpoises are likely to be present throughout the UK section of the Consenting Corridor. All cetaceans in UK water are designated as EPS and are included in Annex IV of the Habitats Directive.	International
Bottlenose Dolphin	Bottlenose dolphins may be present in the nearshore reaches of the UK Consenting Corridor. All cetaceans in UK water are designated as EPS and are included in Annex IV of the Habitats Directive.	International
Minke Whale	Minke whale may be present throughout UK Consenting Corridor. All cetaceans in UK water are designated as EPS and are included in Annex IV of the Habitats Directive.	International
White-Beaked Dolphin	White-beaked dolphins are likely to be present throughout UK Consenting Corridor. All cetaceans in UK water are designated as EPS and are included in Annex IV of the Habitats Directive.	International
Other Cetaceans	Other cetacean species not listed above may be occasional visitors to the UK Consenting Corridor, as detailed in Section 16.4.3.5. All cetaceans in UK water are designated as EPS and are included in Annexe IV of the Habitats Directive.	International
Grey Seal	Grey seals may be present though the Consenting Corridor but are most likely to be encountered in the nearshore reaches. Grey seals are included in Annexes II and V of the Habitats Directive.	International
Common Seal	Common seals may be present in the nearshore reaches of the UK Consenting Corridor. Grey seals are included in Annexes II and V of the Habitats Directive.	International

16.5 Impact Assessment

16.5.1 Installation

Potential impacts on marine mammal receptors during the installation of the NorthConnect marine HVDC cables include:

- Deterioration in water quality;
- Underwater noise emissions;
- Risk of physical injury; and
- Indirect effects on prey species.

16.5.1.1 Water Quality

16.5.1.1.1 Resuspension of Sediments and Increased Water Column Sediment Loading

The cable burial, rock placement, and removal of out of service (OOS) cable operations detailed in Chapter 2: Project Description have the potential to increase sediment loading in the water column, through the resuspension of sediments and release of fines into the marine environment. Further information is provided in Chapter 11: Water Quality (Marine Environment). Increases in sediment loading in the water column, and the resultant increase in turbidity can reduce the foraging success of marine mammals, particularly visual predators such as seals. Increased turbidity may also cause marine mammals to avoid the affected area; potentially resulting in displacement of animals or interruption of transiting animals. As such, negative effects may result for species which utilise the waters in the vicinity of the Consenting Corridor for foraging, socialising, or migration (Priotta et al., 2013).

Any increases in water column sediment loading resulting from the NorthConnect marine HVDC cable installation activities will be very localised and short-term in duration (see Chapter 11: Water Quality (Marine Environment)). In additional, the effect will only occur in a few isolated locations (associated with the positions of cable burial and rock placement vessels) along the Consenting Corridor at any time, given the sequential nature of the cable installation operations, as detailed in Chapter 2: Project Description. Any sediment plumes resulting from the installation works will also be confined to the lower reaches of the water column, in the immediate vicinity of the cable burial tool, or rock placement fall pipe. The activities which could give rise to increased sediment loading will occur during five isolated periods over the 4-year marine installation period, including:

- A 6-month period of route clearance and pre-crossing rock placement; and
- Four individual 3-month long cable burial and protection campaigns.

As the increased sediment loading will be short-term and localised in nature along the Consenting Corridor, occurring sequentially with the location of the installation activity, and near the seabed; the likelihood of marine mammal species encountering an area of increased sediment loading is very low. Marine mammals are also highly mobile, and so should they encounter an area of increased sediment loading, are capable of navigating away and avoiding the area. The demersal environment in the Consenting Corridor, which is where the greatest impact will occur, is not identified as a particularly important marine mammal habitat. As such, the potential magnitude of impact on marine mammal species and their associated designated sites are assessed **negligible, short term, and reversible**, and the resulting effect is **minor: non-significant**.

16.5.1.1.2 Release of Hazardous Substances

A release of oils or other potential pollutants has the potential to result in both short and long-term impacts on both cetaceans and seals. Short term effects include reduction in the thermal properties of seals' fur, resulting in hypothermia and potentially death, as well as poisoning of both seals and cetaceans through inhalation or ingestion of the contaminant, resulting in sickness or death. Both seals and cetaceans may also avoid a contaminated area, which could impact foraging behaviour. In the longer term, both seals and cetaceans may accumulate toxic pollutants through the ingestion of contaminated food, or through a prolonged exposure to low levels of pollution. Such a toxic build-up may lead to reductions in reproductive success, illness, and increased mortality rates (Gubbay & Earll, 2000).

The Consenting Corridor is located within the Southern Trench pMPA, and as such there is the potential to cause direct effects on this site. A spill could result in indirect significant effects to the mobile designated features of other designated sites detailed in Section 16.4.1; if they are present within the contaminated area for long enough to ingest a toxic load of the contaminant, or for it to accumulate on their skin or fur.

For all marine mammal receptors, the magnitude of potential impacts arising from a release of contaminants would depend on the nature and quantity of material released into the environment. There is the potential for a spill of hazardous material to have long term major impacts, through changes to the health and behaviour of the receptors on a regional scale. However, as detailed in Chapter 11: Water Quality (Marine Environment), all vessels working on the project will be compliant with the conventions of the International Maritime Organisation (IMO), including the International Convention for the Prevention of Pollution from Ships (MARPOL). Compliance with the MARPOL convention provides rigorous pollution prevention and incident response procedures, which significantly reduces or removes the risk of a release of hazardous substances occurring. As such, it is considered extremely unlikely that release of hazardous material of a scale with the potential to negatively impact marine mammals or their designated sites will occur. Therefore, the potential impact magnitude is assessed as **negligible, short term,** and **reversible,** and the resulting effect is **minor: non-significant.**

16.5.1.1.3 Release of Drilling Fluids

As detailed in Chapter 2: Project Description, despite the primary mitigation of pumping out the drilling fluids prior to the Horizontal Directional Drilled (HDD) ducts breaking out into the sea, it is not possible to prevent any fluid escaping. The drilling fluid will contain a mixture of fresh water, bentonite, and pulverised rock fragments. It is estimated that the total HDD fluid losses to the sea from the three HDD holes, for the two HVDC cables and one fibre optic cable, will be 3,000m^3. The total estimated solid losses to the sea will be 18m^3. However, these losses will not be concurrent from all three HDD holes, but will be sequential as holes are drilled individually, and so only 1,0010m^3 of fluid and 6m^3 of solids will be discharged at any one time.

Bentonite is a naturally occurring clay-based material, which is non-toxic, however the release of the drilling fluids will result in increased sediment loading in the water column, resulting from the bentonite and pulverised rock entering the marine environment. As detailed in section 16.5.2.1.1, increased sediment loading can impact marine mammals through reducing foraging success, and causing displacement from the affected area.

The release of drilling fluids will occur at the HDD Exit point, which is located approximately 200m from the coast. Due to the volume of materials concerned, and the mechanism of release, and increase in water column sediment loading will be temporary and localised in the immediate area of the exit point. The only marine mammal species which was regularly observed in the vicinity of the HDD exit point location during the year-round seabird surveys were grey seals. Hence it is only grey seals that are likely be affected by the release of drilling fluids. Due to the highly localised and temporary nature of the increased sediment loading resulting from the release of drilling fluids, it is unlikely to result in effects at the individual level for grey seals, and has no potential for population level effects. As such the effects are assessed a **negligible, short term, and reversible**, and the resulting impact is **minor: non-significant.** The impacts on all other marine mammal species, and associated designated sites is assessed as **no change**.

16.5.1.2 Noise and Vibration (Underwater)

Underwater noise emissions will result from the activities associated with the installation of the proposed NorthConnect marine HVDC cables. Further detail on the proposed installation activities is provided in Chapter 2: Project Description. Marine mammals use acoustics for both communication and foraging, and as such are particularly sensitive to underwater noise. Underwater noise emissions can result in disruption of foraging behaviour, displacement, masking of communications, disturbance, and injury (Southall et al., 2007). A detailed underwater noise assessment has been undertaken for installation activities likely to be conducted during the installation of the marine HVDC cables; the results of which are presented in Chapter 23: Noise and Vibration (Underwater).

The noise assessment compared the predicted underwater noise emission levels and frequency ranges which are likely to result from the activities associated with the NorthConnect installation works, against the marine mammal hearing thresholds and precautionary auditory injury and disturbance criteria presented by Southall et al., (2007). This was in order to identify which activities have the potential to produce underwater noise at a frequency and intensity that could result in injury or disturbance to marine mammals. The activities assessed included:

- Vessel Noise;
- Subsea survey equipment including;
    - Multibeam Echo Sounder (MBES),
    - Side-Scan Sonar (SSS), and
    - Sub Bottom Profiler (SBP).
- Horizontal Directional Drilling (HDD);
- Cable Burial; and
- Rock placement.

As detailed in Chapter 23, none of these activities will produce underwater noise emissions at a frequency and source level that could result in auditory injury; either permanent or temporary threshold shift (PTS or TTS respectively). However, it was identified that the following activities did have the potential to cause disturbance to marine mammal species which may be present in the vicinity of the Consenting Corridor:

- Vessel noise;
- The use of SBP during subsea survey operations; and
- Cable burial works.

For these activities the range from the noise source to which marine mammal disturbance may occur was predicted, in order to inform the impact assessment. The predicted impact ranges were calculated by taking the published source noise levels for each activity and using a simple propagation loss model, in order to determine how the noise attenuates with distance from the source. A summary of the impact ranges is presented in Table 16.6.

The potential marine mammal impacts resulting from each of the three activities detailed above are considered in turn below.

Table 16.6 Maximum predicted marine mammal impact ranges resulting from underwater noise associated with the installation of the marine HVDC cables (after Southall et al., 2007).

Noise Sensitive Receptor	**Effect Criteria**	**Exposure Limit (dB re 1 µPa)**	**Maximum Predicted Impact Ranges**			
			DP Vessel Noise	Non-DP vessel Noise	Sub Bottom Profiler	Cable Burial
			Source Level 197dB re 1µPa	Source Level 180dB re 1µPa	Source Level 200dB re 1µPa	Source Level 185dB re 1µPa
Marine Mammals	PTS Onset - Cetaceans	230	*Effect Criteria Exposure Limit Not Reached*			
	PTS Onset - Seals	218	*Effect Criteria Exposure Limit Not Reached*			
	TTS Onset - Cetaceans	224	*Effect Criteria Exposure Limit Not Reached*			
	TTS Onset - Seals	212	*Effect Criteria Exposure Limit Not Reached*			
	Disturbance - All Groups	160	293m	22m	464m	46m

16.5.1.2.1 Vessel Noise

Installation of the marine HVDC cables will require multiple vessels including cable lay vessels, support vessels (cable burial/trenching, rock placement, route clearance vessels etc.), as well as guard vessels to protect exposed sections of cable. These vessels were broadly separated into two categories for the purpose of the assessment;

- DP Vessels: large vessels potentially exceeding 150m operating Dynamic Positioning (DP) propulsion systems.
    - These include the cable laying, support, and survey vessels.
- Non-DP Vessel: small vessels less than 50m in length operating conventional propulsion systems.
    - These include guard vessels, which are usually fishing vessel that are appointed to the project.

While the actual properties of the underwater vessel noise will depend on the vessels selected by the installation contractor; numerous studies have detailed the characteristics of various vessel types ranging from large DP vessels equivalent to the cable lay and support vessels, to smaller tugs and fishing vessels which are analogous to the Non-DP Vessels. These published figures were utilised for the assessment.

DP Vessels

Vessel noise from large DP vessels is described as being a low frequency broadband sound, with some tonal components ranging from 30Hz to 3kHz, making them detectable to all marine mammal species likely to be present in the vicinity of the Consenting Corridor. The sound pressure levels are reported as being between 180 to 197 dB re 1µPa at 1m, resulting in a maximum potential marine mammal disturbance range of 293m (Table 16.6), meaning that a marine mammal would need to be within 300m of the vessel in order to be subjected to disturbance. Considering the vessels will be operating in isolated areas of the Consenting Corridor and will be moving continuously as works progress, means that this disturbance can be seen as a highly localised, temporary, and transient effect.

Over the course of the 4-year marine HVDC cable installation works, DP Vessels will be utilised for the during several phases in UK waters, details of the DP vessel requirements and expected durations are provided in Table 16.7.

Table 16.7 Expected DP Vessel requirements and indicative duration for each marine cable installation activity.

Phase	DP Vessels Required	Total DP Vessel Requirement	Duration within UK waters
UXO Survey	Survey vessel (1)	1	3 months
Marine Route Surveys	Survey vessel (1)	1	3 months
Route Clearance	Clearance vessel (1)	1	1 month
Pre-lay Grapnel Run	Clearance vessel (1)	1	1 month
Cable Installation: Laying and Trenching	Cable lay vessel (1) Cable trenching vessel (1) Survey vessel (1)	3	4 months: (4 x 1-month campaigns over 4 years)
Further Cable Protection: Rock Placement	Rock-placement vessel (1) Survey vessel (1)	2	8 months: (4 x 2-month campaigns over 4 years)
As-built survey	Survey vessel (1)	1	1 month
	Totals:	**10**	**21 months**

As detailed in Table 16.7, the NorthConnect marine HVDC cable installation works will result in an additional 10 DP Vessels operating for a total of 21-months over the 4-year installation campaign. The additional underwater noise resulting from NorthConnect's DP vessel noise is set against a background of existing DP Vessel noise within the North Sea region. Chapter 19: Navigation and Shipping indicated that the area of the North Sea crossed by the Consenting Corridor is utilised by the oil and gas sector, and numerous large DP Vessels are used by the sector to support the industry's offshore assets.

As such, the additional vessels that will be present in the area only constitute a negligible change from baseline. This together with the highly localised, temporary and transient nature of the resulting disturbance means that the impact of DP Vessel noise in marine mammals and their associated designated sites are assessed as **negligible, short term,** and **reversible,** and the resulting effect is **minor: non-significant.**

Non-DP Vessels

Non-DP vessels are reported as emitting broadband noise with tonal components, in a bandwidth concentrated between 50Hz and 2kHz, making them detectable to all marine mammal species likely to be present in the vicinity of the Consenting Corridor. The reported sound pressure levels are lower than for the larger DP vessels, and range between 170 to 180 dB re 1µPa at 1m. This results in a worst-case marine mammal disturbance range of 22m (Table 16.6), meaning that marine mammals would need to be within 22m of the vessel in order to be subjected to acoustic disturbance.

A disturbance range of 22m is unlikely to constitute a significant change from baseline conditions, especially considering Non-DP vessels will comprise largely of fishing vessels working as guard vessels on the project. As detailed in Chapter 20: Commercial Fisheries, fishing vessels are prevalent in the vicinity of the Consenting Corridor, and as such the potential effects on marine mammals and their associated designated sites resulting from the use of Non-DP vessels is assessed as **no change.**

16.5.1.2.2 Cable Burial Operations

The noise emissions resulting from the cable burial operations area reported as being a mixture of broadband noise, tonal components, and transients associated with rock interactions, with a source level in the region of 185 dB re 1µPa at 1m. As a broadband sound, cable burial noise will be detectable to all marine mammal species likely to be present in the vicinity of the Consenting Corridor. This results in a worst-case marine mammal disturbance range of 46m (Table 16.6).

The zone of marine mammal disturbance resulting from cable burial operations will therefore be highly localised around the burial tool. In additional, the effect will only occur in a single location (associated with the position of cable burial tool) along the Consenting Corridor at any one time, given the sequential nature of the cable installation operations. Since the burial tool will be located on the sea bed, the disturbance zone will also be confined to the lower reaches of the water column, in the immediate vicinity of the cable burial tool. The cable burial operations will be limited to four isolated 2-month periods over the 4-year marine installation phase.

As the disturbance resulting from cable burial noise will be short-term and localised in nature along the Consenting Corridor, and near the seabed; the likelihood of marine mammal species entering the disturbance zone for this activity is very low. If a marine mammal did enter the disturbance zone, it is only likely to be displaced from an area extending 46m from the burial tool, which will not lead to any significant displacement effects. The demersal environment in the Consenting Corridor, which is where the greatest impact will occur, is not identified as particularly important marine mammal habitat. As such the potential impact magnitude on marine mammal species and their associated designated sites are assessed **negligible, short term, and reversible**, and the resulting effect is **minor: non-significant**.

16.5.1.2.3 Sub Bottom Profiler Survey Operations

Geophysical surveys will be conducted within the Consenting Corridor before, during and after the cable installation works, in order to inform the final route design, verify the as-built position of the cables, and ensure they are adequately protected. SBP is used to investigate the shallow (generally < 10m) subsurface structure beneath the seabed. The SBP directs a focussed acoustic pulse toward the seafloor, and will likely be deployed on an ROV or towed device, close to the sea floor. It is likely that a Chirp SBP system will be used during the pre and post-installation surveys, which generates acoustic pulses in a frequency range from 1kHz to 10kHz, with sound pressure levels up to 200dB re 1µPa at 1 m. The frequency range of the SBP means it will be detectable by all marine mammal species likely to be present in the vicinity of the Consenting Corridor. This results in a worst-case marine mammal disturbance range of 464m from the SBP (Table 16.6).

The marine mammal disturbance zone resulting from the SBP operations is therefore localised, and confined to the lower reaches of the water column, adjacent to the SBP. A single survey vessel will be used during all survey operations, and as such the disturbance zone will be limited to a single point within the Consenting Corridor at any one time. The SBP will move through the Consenting Corridor as the survey progresses and can therefore be seen as transient. The survey operations which will involve the use of SBPs will occur during five isolated periods over the 4-year marine installation period, including:

- Pre-installation marine route surveys – 3 months;

- Four individual 3-month long cable burial and protection campaigns; and
- Post installation survey – 1 month.

As such, SBP operations will occur during a total of 16 months during the 4-year installation phase. The zone of disturbance could inhibit marine mammal foraging in the vicinity of the survey vessel, mask communication and result in displacement from the area. It is also noted that the disturbance from SBP is transient, and will move with the survey vessel, and hence marine mammals will be able to return to the area or resume normal foraging, and communication as soon as the vessel moves past. In addition, the zone of disturbance will be confined to the lower reaches of the water column which is not identified as being important habitat to the marine mammal receptors. As such, the SBP noise may result in some disturbance to marine mammals but is unlikely to result in population level effects. The impacts are therefore assessed as **low, short term, and reversible**, and the resulting effect is **moderate: Significant.**

Since marine mammals are highly mobile, it is also necessary to assess the potential for indirect impacts on the marine mammal designated sites, through impacts on their designated features. As detailed in Section 16.4.1, the relevant sites are the Moray Firth SAC designated for bottlenose dolphins and the Southern Trench pMPA designated in part for minke whales. Bottlenose dolphins primarily utilise coastal waters in Scotland, and so their exposure to the SBP noise will be further limited, as the survey operations progress offshore, as such no impacts on the conservation objects of the Moray Firth SAC are expected. With regard the Southern Trench pMPA, the SBP noise may result in low level disturbance and displacement to individual minke whales in the vicinity of the survey vessel. However, the localised and temporary nature of the disturbance means it is not likely to result in population level effects, hence no impact on the conservation status of the site is expected. As such the indirect impacts on the marine mammal designated sites resulting from SBP noise are assessed as **no change.**

Since the survey corridor passes through the Southern Trench pMPA, the direct impacts on this site are assessed separately. As detailed above, without mitigation the use of SBP could result in indirect impacts on the pMPA through the effects on the minke whale designated features of the site, although these are unlikely to compromise the conservation objectives of the site. With regard to direct effects, 19km of the Consenting Corridor is within the pMPA, hence considering the disturbance range of 464m, minke whales within 1763Ha of the site will be subject to disturbance as a result of the SBP operations. This equates to 0.7% of the total area of the designated site. It is unlikely that temporary, transient, and localised disturbance within such a small proportion of the Southern Trench pMPA will affect the site's conservation objectives. As such the direct impacts on this site are assessed as **negligible, short term,** and **reversible,** and the resulting effect is **negligible: non-significant.**

16.5.1.3 Physical Injury

The concurrent underwater noise, disturbance, and increased sediment loading in the immediate vicinity of the cable installation tools, vessels, and associated equipment make it extremely unlikely that a marine mammal would enter an area where it is at risk of being injured through a direct interaction with the installation equipment. In addition, cable installation is a slow process, and as such the vessel and tools utilised will be moving slowly. Marine mammals are highly manoeuvrable and acutely aware of their environment; making it further unlikely that an interaction leading to injury will occur. The impact on marine mammals and their associated designated sites is therefore assessed as **no change**.

16.5.1.4 Indirect Effects on Prey Species

Chapter 15: Fish and Shellfish identified potential impacts on the fish and shellfish species within the cable installation corridor and surrounding area, which include the primary prey items of marine mammals. No significant impacts were identified on any species by the Fish and Shellfish EcIA, and as such no substantial changes in the distribution or abundance of marine mammal prey species are expected. There the potential indirect impacts on marine mammals and their associated designated sites through changes to prey availability are assessed as **no change.**

16.5.2 Operation Phase Impacts

16.5.2.1 Water Quality

The only activities that could lead to a degradation in water quality during the operation of the NorthConnect interconnector are repairs to the marine infrastructure. As detailed in Chapter 2: Project Descriptions, repairs to the HVDC cables and associated infrastructure may be necessary during the life span of the project, in the event of damage or to maintain rock berms if they become eroded. One repair every three years is assumed as a worst-case based on previous project experiences, and so over the lifetime of the project (40 years), repairs could occur 14 times. Repairs to the HVDC cable will involve recovering the damaged section of the cable to the surface and making the necessary repair, before re-laying and trenching using similar techniques to those employed during the installation phase. Where rock berms need to be repaired, a rock placement vessel will be used to place remedial rock.

The effects to changes in water quality on marine mammal and their associated designated sites are assessed in Section 16.5.2.1 as being negligible, short term, and reversible, with a resulting impact of minor: non-significant. Since the techniques used for cable repair will be similar to those used in installation, the effects on water quality will be broadly similar. However, given the anticipated infrequency of repair operations and the short duration required in comparison to the cable installation, the impacts on marine mammals are assessed as **no change.**

16.5.2.2 Noise and Vibration (Underwater)

The activities associated with the operation of the NorthConnect interconnector which could give rise to underwater noise emissions are repair operations, and routine surveys of the HVDC cables. Details of the repair operations are provided in Section 16.5.3.1; given the repair operations will employ similar techniques and vessels to those used during in the installation phase, the underwater noise emission will be analogous to those assessed in Section 16.5.2.2. The impacts of vessel noise and cable burial activities during installation are assessed as being non-significant. Given the similarity in the techniques and equipment which will be employed, and the infrequent nature of repair works; the underwater noise impacts on marine mammals and their designated sites associated with repairs to the cable infrastructure are assessed as **no change**.

Routine surveys of the HVDC cables will be required throughout the operation of the NorthConnect interconnector in order to ensure the cables remain properly protected and aren't being exposed through scour. The survey schedule can only be determined once the cables are installed and full details of the final burial depths and external protection measures are understood. However, as a base case; the full cable route will be inspected 2 years following commissioning, thereafter every 5 years. Some critical sections of the route, such as those in areas of mobile sediments may need to be surveyed more frequently.

The operational surveys of the cable will utilise similar SBPs to those employed during the installation surveys, as detailed in Section 16.2.2.3. As such, the underwater noise impacts on marine mammal species resulting from the use of SBP during the operational surveys are assessed as **low, short term, and reversible**, and the resulting effect is **moderate: Significant**. However, given the infrequency of the survey operations during the operational phase, the impacts on the Moray Firth SAC and the Southern Trench pMPA are assessed as **no change**.

16.5.2.3 Electromagnetic Fields

When operational, the HVDC will emit a magnetic field. As it is a direct current cable then no electric induced fields will be created, and any electric fields will be contained within the cable armouring. An assessment of the EMFs created by the project is provided in Chapter 18: Electromagnetic Fields & Sediment Heating. As a worst-case of burial depths of 0.4m in hard substrates and 0.5m in soft substrates, then the magnetic field at the seabed would be at most 640µT, and would reduce to <300µT within 2m of the seabed at both worst-case and best-case separation distances.

With the exception of minke whales, white beaked dolphins, and killer whales; all cetaceans likely to be present in the vicinity of the Consenting Corridor are magnetosensitive and have shown to respond directly to geomagnetic or magnetic fields (Gill et al., 2005). No magnetosensitivity has been identified in pinniped species. The impact on minke whales and the Southern Trench pMPA, white beaked dolphins, killer whales, grey seals, and common seals is therefore assessed as **no change**.

Magnetosensitive cetaceans are considered to use the Earth's natural magnetic field to aid navigation during migrations. Therefore, magnetic fields generated by the NorthConnect HVDC cables may cause disruption to migrations by affecting an animal's ability to navigate (Gill et al., 2005). However cetacean migration generally occurs in open water, and the strength of the magnetic fields generated by the cables will attenuate to baseline within a few metres from the cable to will not affect animals in the pelagic environment. As such, it is very unlikely that a migrating cetacean will encounter the magnetic anomaly resulting from the NorthConnect cables, and if they do, any effect on navigation will be extremely localised and short lived, and will not lead to any significant effect deviation from an animal's natural migration route. The impacts of EMF on magneto sensitive cetaceans and the Moray Firth SAC is therefore assessed as **negligible, long term, and reversible**, with a resulting effect of **minor: non-significant**.

16.6 Mitigation Measures

Where potential significant effects on marine mammals have been identified in Section 16.5, appropriate mitigation will be provided in order to reduce the magnitude of the impact. A summary of the marine mammal mitigation proposed installation of the NorthConnect marine HVDC cables is outlined below, this will be implemented via a Marine Mammal Protection Plan.

16.6.1 Scottish Marine Wildlife Watching Code

In order to prevent excessive harassment of marine mammals by vessels working on the NorthConnect Project, all vessels will be required to follow the guidance set out in SNH's 'Scottish Marine Wildlife Watching Code' (SNH, Undated). This document provides best practice guidance on how to navigate vessels in the vicinity of marine mammals.

16.6.2 Sub Bottom Profiler Marine Mammal Mitigation

The only aspects of the NorthConnect project assessed has having the potential to result in significant impacts on marine mammals is the use of SBP during the installation and operation phases. In order to minimise these impacts, Marine Mammal Observation (MMO) and Passive Acoustic Monitoring (PAM) protocols will be utilised for the start-up of SBP operations, based on the JNCC guidelines for minimising the risk of injury and disturbance to marine mammals from geophysical surveys (JNCC, 2017).

It should be noted that the protocols set out in JNCC guidance have been modified to take account of the fact that the SBP devices likely to be utilised will not have the capacity to perform a soft start. The level of mitigation has also been reduced to ensure it is proportionate to the greatly reduced risk to marine mammals posed by the marine survey, compared to the seismic survey operations for which the guidelines are broadly intended.

The SBP mammal mitigation will be utilised for all SBP operations both during installation and operation, and will provide the following measures:

- A 200m mitigation zone will be established around SBP device (noise source);
- Trained marine mammal observers (MMO) will conduct a 20min pre-watch prior to the commencement of SBP operations;
  - If the 200m mitigation zone remains clear of marine mammals during the watch, permission will be given to start up the SBP; and
  - If a marine mammal is sighted within the mitigation zone, SBP operations will be delayed until the zone has been clear of marine mammals for at least 10min.
- If conditions are unsuitable for visual observations (darkness, fog reducing visibility to <200m, or sea states >Beaufort 4); passive acoustic monitoring (PAM) will be utilised by a trained PAM operator to monitor the mitigation zone;
- Once SBP operations have commenced, there will be no requirement to stop works if a marine mammal enters the mitigation zone, as long as SBP operations have been continuous, with no breaks exceeding 10min;
- If a break in operations exceeds 10min but is less than 30min in duration; the following conditions will apply:
  - If an MMO/PAM operator has been on watch during the break, and the mitigation zone remains clear of marine mammals, the SBP can be restarted immediately;
  - If an MMO/PAM operator has been on watch during the break, and a marine mammal is observed within the mitigation, the SBP will not be restarted the zone has been clear of marine mammals for at least 10min; and
  - If no marine mammal observations have been conducted during a break exceeding 10min, a 20min pre-watch will be conducted before the SBP can be restarted, as detailed above.
- If a break in operation exceeds 30min in duration, a 20min pre-watch will be required before restarting the SBP.
- When a turn between survey lines is required, the following provisions will be made:
  - If the turn duration will not exceed 40min; the SBP shall continue to operate. As such the survey operation will be continuous and no additional watches are required.
  - If the turn duration will exceed 40min; the SBP will be shut down, and a 20min pre-watch will be required to restart the SBP on the new line.

- All MMO/PAM operations will be recorded using the JNCC marine mammal reporting forms template and submitted to Marine Scotland once the works are complete.

16.7 Residual Effects

Following the identification of appropriate mitigation for the impacts assessed to be significant in Section 16.5, these aspects have been reassessed in order to ascertain the residual impacts.

16.7.1 Sub Bottom Profiler Operations

The implementation of SBP marine mammal protocols will ensure that animals are not present within the immediate vicinity of the noise source when the SBP is started. As a result, the risk of causing disturbance is considerably reduced. A residual risk remains that marine mammals may be displaced from the area around survey vessel during SBP operations, however the magnitude of displacement is low, and the area of displacement will move as the survey operations progress, hence marine mammals will quickly be able to return to the area. The residual impact magnitude is therefore assessed as **negligible, short term and reversible**, meaning that the residual effect on marine mammals and their designated sites is **minor: non-significant.**

Note that this assessment applies to the residual impacts of SBP operations during both the installation and operational phases.

16.8 Cumulative Impacts

Marine mammals are wide-ranging and hence there may be cumulative impacts arising as a result of the installation or operation of other marine developments. Effects are considered in relation to the marine installation phase of the NorthConnect HVDC cabling, but not for the operation phase as once installed the subsea cables are not expected to have any impact on the marine mammal receptors.

The following developments have been considered as part of this assessment:

- **Moray East/West Offshore Windfarm Development**
- **Inch cape Offshore Windfarm**
- **Neart na Gaoithe Offshore Windfarm**
- **Seagreen Phase 1 Windfarm**
- Beatrice Offshore Windfarm*
- European Offshore Wind Development Centre EOWDC, Aberdeen Bay*
- Hywind Scotland Pilot Park Offshore Windfarm*
- Kincardine Offshore Windfarm, 8 6MW Floating Turbines*
- Aberdeen Harbour Dredge and Harbour Extension Project*
- Peterhead Port Authority Harbour Masterplan*
- **North Sea Network Link Interconnector cable**
- **NorthConnect HVDC subsea cable** (rest of the North Sea: from UK median line-start of Norwegian fjord)

Any cumulative effects on the marine mammal receptors are most likely to occur during the installation phase of the NorthConnect HVDC cabling project, as no cumulative effects during the operational phase are expected. Therefore, those projects which do not overlap in construction phases do not require further consideration as part of the cumulative assessment and are marked with an * in the above list.

The potential effects during construction of the remaining projects (marked in bold in the above list) are then considered. Table 16.8 provides the minimum distances between the NorthConnect Consenting Corridor and each of the projects identified as having an overlapping construction period.

Table 16.8 Distances to Marine Projects with Overlapping Construction Periods.

Project	Distance from NorthConnect Consenting Corridor
NorthConnect HVDC Subsea Cables (Norwegian waters)	Adjacent
Moray East/West Offshore Windfarm Development	100km
Inch Cape Offshore Windfarm	110km
Seagreen Phase 1 Windfarm	110km
Neart na Gaoithe Offshore Windfarm	130km
North Sea Network Link Interconnector	130km

The only aspect of the NorthConnect project with the potential to result in cumulative effects with other projects with overlapping construction period is the disturbance resulting from underwater noise generated by SBP survey operations. Of the 6 projects identified as having overlapping construction period, 5 are windfarms. Windfarm construction can result in significant underwater noise emissions, due to the piling operations required to install their subsea elements. Typical marine mammal disturbance ranges resulting from wind farm piling noise are provided in Table 16.9.

Table 16.9 Marine Mammal Disturbance Ranges from Offshore Windfarm Construction (BOWL 2012, EDP 2013, & Mainstream 2016).

Marine mammal Hearing Group	Relevant Species	Predicted Disturbance Range
High Frequency Cetaceans	Harbour Porpoise	~55km
Mid Frequency Cetaceans	Bottlenose Dolphin, White beaked Dolphin, Short Beaked Common Dolphin, Atlantic White Sided Dolphin, Long Finned Pilot Whale, Killer Whale, and Risso's Dolphin.	~40km
Low Frequency Cetaceans	Minke Whale	~85km
Pinnipeds	Grey Seal and Common Seal	~50km

The predicted disturbance ranges resulting from the construction of the relevant offshore wind projects are not predicted to overlap with the NorthConnect Consenting Corridor (Tables 16.8 and 16.9), hence there is no potential for direct cumulative impacts between these projects and NorthConnect. With regard to indirect cumulative effects, due to the wide-ranging nature of marine mammals, it is likely that animals present in the vicinity of the NorthConnect Consenting Corridor may also utilise the waters affected by the windfarm project underwater noise emissions, hence there is the potential for indirect cumulative effects resulting from the SBP noise emissions. However, the disturbance range resulting from the SBP operations is only 464m, hence the additional area affected by underwater noise emissions from NorthConnect does not constitute a significant change from baseline, in comparisons to the areas affected by the windfarm projects. Hence the cumulative impact resulting from SBP noise emissions is assessed as **minor: non-significant**.

With regard the cumulative impacts with the NorthConnect HVDC cable installation in Norwegian waters, installation will be occurring concurrently with the installation in UK waters. Since the construction techniques, cable specification, and maintenance requirements in Norwegian will be analogous to those detailed above for UK waters, the potential impacts on marine mammals will also be the same. Impacts will not be synergistic given the distance occurring between the majority of installation activities. It is also assumed that the same mitigation will be applied in Norwegian Waters, as has been detailed in this EIAR. As such the cumulative impacts are assessed as **minor: non-significant**.

16.9 Summary

This chapter has considered the potential impacts of construction and operation of the NorthConnect Development on relevant marine mammal receptors. The summary of the effects is shown in Table 16.10. The NorthConnect HVDC cable installation is expected to result in only temporary, non-significant residual impacts during the installation phase for marine mammals in the vicinity of the Consenting Corridor. Operationally, some longer-term effects are predicted, but again with mitigation, these are assessed as being non-significant.

Table 16.10. Summary of Marine Mammal Impacts and Mitigation.

Receptor and Value Relevant Species		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Southern Trench pMPA	National	Installation	Displacement/foraging impairment due to increased sediment loading from cable burial and rock placement works.	Negligible Negative Short Term Reversible	Likely	Negligible: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Negligible: non-significant
		Installation	Injury/displacement due to release of hazardous substances.	Negligible Negative Short Term Reversible	Unlikely	Negligible: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Negligible: non-significant
		Installation	Displacement/foraging impairment due to release of drilling fluids.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Disturbance due to DP vessel noise.	Negligible Negative Short Term Reversible	Likely	Negligible: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Negligible: non-significant
		Installation	Disturbance due to Non-DP vessel noise.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Disturbance due to cable burial noise.	Negligible Negative Short Term Reversible	Likely	Negligible: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Negligible: non-significant
		Installation	Disturbance due to SBP survey operation noise.	Negligible Negative Short Term Reversible	Likely	Negligible: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Negligible: non-significant

Receptor and Value Relevant Species		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Southern Trench pMPA	National	Installation	Injury through interactions with cable installation equipment.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Foraging impairment due to indirect effects on prey species.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Displacement/foraging impairment due to increased sediment loading from cable repair operations.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Disturbance due to cable burial noise during cable repairs.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Disturbance due to SBP survey operation noise.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Disruption of migration due to EMF.	No Change	-	None	No Specific mitigation required.	No Change	None
Moray Firth SAC	International	Installation	Displacement/foraging impairment due to increased sediment loading from cable burial and rock placement works.	Negligible Negative Short Term Reversible	Unlikely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Injury/displacement due to release of hazardous substances.	Negligible Negative Short Term Reversible	Unlikely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant

Receptor and Value Relevant Species		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Moray Firth SAC	International	Installation	Displacement/foraging impairment due to release of drilling fluids.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Disturbance due to DP vessel noise.	Negligible Negative Short Term Reversible	Likely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Disturbance due to Non-DP vessel noise.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Disturbance due to cable burial noise.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Disturbance due to SBP survey operations.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Injury through interactions with cable installation equipment.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Foraging impairment due to indirect effects on prey species.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Displacement/foraging impairment due to increased sediment loading from cable repair operations.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Disturbance due to cable burial noise during cable repairs.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Disturbance due to SBP survey operations.	No Change	-	None	No Specific mitigation required.	No Change	None

Receptor and Value Relevant Species		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Moray Firth SAC	International	Operation	Disruption of migration due to EMF.	Negligible Negative Long Term Reversible	Unlikely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Long Term Reversible	Minor: non-significant
Harbour Porpoise	International	Installation	Displacement/foraging impairment due to increased sediment loading from cable burial and rock placement works.	Negligible Negative Short Term Reversible	Unlikely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Injury/displacement due to release of hazardous substances.	Negligible Negative Short Term Reversible	Unlikely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Displacement/foraging impairment due to release of drilling fluids.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Disturbance due to DP vessel noise.	Negligible Negative Short Term	Likely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term	Minor: non-significant
		Installation	Disturbance due to Non-DP vessel noise.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Disturbance due to cable burial noise.	Negligible Negative Short Term Reversible	Likely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant

Receptor and Value Relevant Species		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Harbour Porpoise	International	Installation	Disturbance due to SBP survey operations.	Low Negative Short Term Reversible	Likely	**Moderate: Significant**	Provision of SBP marine mammal protocol, and adherence to the Scottish Marine Wildlife Watching Code.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Injury through interactions with cable installation equipment.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Foraging impairment due to indirect effects on prey species.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Displacement/foraging impairment due to increased sediment loading from cable repair operations.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Disturbance due to cable burial noise during cable repairs.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Disturbance due to SBP survey operations.	Low Negative Short Term Reversible	Likely	**Moderate: Significant**	Provision of SBP marine mammal protocol, and adherence to the Scottish Marine Wildlife Watching Code.	Negative Negligible Short Term Reversible	Minor: non-significant

Receptor and Value Relevant Species		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Harbour Porpoise	International	Operation	Disruption of migration due to EMF.	Negligible Negative Long Term Reversible	Unlikely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Long Term Reversible	Minor: non-significant
Bottlenose Dolphin	International	Installation	Displacement/foraging impairment due to increased sediment loading from cable burial and rock placement works.	Negligible Negative Short Term Reversible	Unlikely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Injury/displacement due to release of hazardous substances.	Negligible Negative Short Term Reversible	Unlikely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Displacement/foraging impairment due to release of drilling fluids.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Disturbance due to DP vessel noise.	Negligible Negative Short Term Reversible	Likely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Disturbance due to Non-DP vessel noise.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Disturbance due to cable burial noise.	Negligible Negative Short Term Reversible	Likely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant

Receptor and Value Relevant Species		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Bottlenose Dolphin	International	Installation	Disturbance due to SBP survey operations.	Low Negative Short Term Reversible	Likely	**Moderate: Significant**	Provision of SBP marine mammal protocol, and adherence to the Scottish Marine Wildlife Watching Code.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Injury through interactions with cable installation equipment.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Foraging impairment due to indirect effects on prey species.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Displacement/foraging impairment due to increased sediment loading from cable repair operations.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Disturbance due to cable burial noise during cable repairs.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Disturbance due to SBP survey operations.	Low Negative Short Term Reversible	Likely	**Moderate: Significant**	Provision of SBP marine mammal protocol, and adherence to the Scottish Marine Wildlife Watching Code.	Negative Negligible Short Term Reversible	Minor: non-significant

Receptor and Value Relevant Species		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Bottlenose Dolphin	International	Operation	Disruption of migration due to EMF.	Negligible Negative Long Term Reversible	Unlikely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Long Term Reversible	Minor: non-significant
Minke Whale	International	Installation	Displacement/foraging impairment due to increased sediment loading from cable burial and rock placement works.	Negligible Negative Short Term Reversible	Unlikely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Injury/displacement due to release of hazardous substances.	Negligible Negative Short Term Reversible	Unlikely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Displacement/foraging impairment due to release of drilling fluids.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Disturbance due to DP vessel noise.	Negligible Negative Short Term Reversible	Likely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Disturbance due to Non-DP vessel noise.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Disturbance due to cable burial noise.	Negligible Negative Short Term Reversible	Likely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant

Receptor and Value Relevant Species		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Minke Whale	International	Installation	Disturbance due to SBP survey operations.	Low Negative Short Term Reversible	Likely	**Moderate: Significant**	Provision of SBP marine mammal protocol, and adherence to the Scottish Marine Wildlife Watching Code.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Injury through interactions with cable installation equipment.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Foraging impairment due to indirect effects on prey species.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Displacement/foraging impairment due to increased sediment loading from cable repair operations.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Disturbance due to cable burial noise during cable repairs.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Disturbance due to SBP survey operations.	Low Negative Short Term Reversible	Likely	**Moderate: Significant**	Provision of SBP marine mammal protocol, and adherence to the Scottish Marine Wildlife Watching Code.	Negative Negligible Short Term Reversible	Minor: non-significant
		Operation	Disruption of migration due to EMF.	No Change	-	None	No Specific mitigation required.	No Change	None

Receptor and Value Relevant Species		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
White-Beaked Dolphin	International	Installation	Displacement/foraging impairment due to increased sediment loading from cable burial and rock placement works.	Negligible Negative Short Term Reversible	Unlikely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Injury/displacement due to release of hazardous substances.	Negligible Negative Short Term Reversible	Unlikely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Displacement/foraging impairment due to release of drilling fluids.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Disturbance due to DP vessel noise.	Negligible Negative Short Term Reversible	Likely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Disturbance due to Non-DP vessel noise.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Disturbance due to cable burial noise.	Negligible Negative Short Term Reversible	Likely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Disturbance due to SBP survey operations.	Low Negative Short Term Reversible	Likely	**Moderate: Significant**	Provision of SBP marine mammal protocol, and adherence to the Scottish Marine Wildlife Watching Code.	Negative Negligible Short Term Reversible	Minor: non-significant

Receptor and Value Relevant Species		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
White-Beaked Dolphin	International	Installation	Injury through interactions with cable installation equipment.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Foraging impairment due to indirect effects on prey species.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Displacement/foraging impairment due to increased sediment loading from cable repair operations.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Disturbance due to cable burial noise during cable repairs.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Disturbance due to SBP survey operations.	Low Negative Short Term Reversible	Likely	**Moderate: Significant**	Provision of SBP marine mammal protocol, and adherence to the Scottish Marine Wildlife Watching Code.	Negative Negligible Short Term Reversible	Minor: non-significant
		Operation	Disruption of migration due to EMF.	No Change	-	None	No Specific mitigation required.	No Change	None
Other Cetaceans	International	Installation	Displacement/foraging impairment due to increased sediment loading from cable burial and rock placement works.	Negligible Negative Short Term Reversible	Unlikely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant

Receptor and Value Relevant Species		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Other Cetaceans	International	Installation	Injury/displacement due to release of hazardous substances.	Negligible Negative Short Term Reversible	Unlikely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Displacement/foraging impairment due to release of drilling fluids.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Disturbance due to DP vessel noise.	Negligible Negative Short Term Reversible	Unlikely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Disturbance due to Non-DP vessel noise.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Disturbance due to cable burial noise.	Negligible Negative Short Term Reversible	Unlikely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Disturbance due to SBP survey operations.	Low Negative Short Term Reversible	Unlikely	**Moderate: Significant**	Provision of SBP marine mammal protocol, and adherence to the Scottish Marine Wildlife Watching Code.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Injury through interactions with cable installation equipment.	No Change	-	None	No Specific mitigation required.	No Change	None

Receptor and Value Relevant Species		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Other Cetaceans	International	Installation	Foraging impairment due to indirect effects on prey species.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Displacement/foraging impairment due to increased sediment loading from cable repair operations.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Disturbance due to cable burial noise during cable repairs.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Disturbance due to SBP survey operations.	Low Negative Short Term Reversible	Unlikely	**Moderate: Significant**	Provision of SBP marine mammal protocol, and adherence to the Scottish Marine Wildlife Watching Code.	Negative Negligible Short Term Reversible	Minor: non-significant
		Operation	Disruption of migration due to EMF (All species except Killer Whales)	Negligible Negative Long Term Reversible	Unlikely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Long Term Reversible	Minor: non-significant
		Operation	Disruption of migration due to EMF (Killer Whales Only)	No Change	-	None	No Specific mitigation required.	No Change	None
Grey Seal	International	Installation	Displacement/foraging impairment due to increased sediment loading from cable burial and rock placement works.	Negligible Negative Short Term Reversible	Unlikely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant

Receptor and Value Relevant Species		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Grey Seal	International	Installation	Injury/displacement due to release of hazardous substances.	Negligible Negative Short Term Reversible	Unlikely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Displacement/foraging impairment due to release of drilling fluids.	Negligible Negative Short Term Reversible	Likely	Minor: non-significant	Drilling fluids pumped out prior to breakout into marine environment.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Disturbance due to DP vessel noise.	Negligible Negative Short Term Reversible	Likely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Disturbance due to Non-DP vessel noise.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Disturbance due to cable burial noise.	Negligible Negative Short Term Reversible	Likely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Disturbance due to SBP survey operations.	Low Negative Short Term Reversible	Likely	**Moderate: Significant**	Provision of SBP marine mammal protocol, and adherence to the Scottish Marine Wildlife Watching Code.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Injury through interactions with cable installation equipment.	No Change	-	None	No Specific mitigation required.	No Change	None

Receptor and Value	Relevant Species	Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Grey Seal	International	Installation	Foraging impairment due to indirect effects on prey species.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Displacement/foraging impairment due to increased sediment loading from cable repair operations.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Disturbance due to cable burial noise during cable repairs.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Disturbance due to SBP survey operations.	Low Negative Short Term Reversible	Likely	**Moderate: Significant**	Provision of SBP marine mammal protocol, and adherence to the Scottish Marine Wildlife Watching Code.	Negative Negligible Short Term Reversible	Minor: non-significant
		Operation	Disruption of migration due to EMF.	No Change	-	None	No Specific mitigation required.	No Change	None
Common Seal	International	Installation	Displacement/foraging impairment due to increased sediment loading from cable burial and rock placement works.	Negligible Negative Short Term Reversible	Unlikely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Injury/displacement due to release of hazardous substances.	Negligible Negative Short Term Reversible	Unlikely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant

Receptor and Value Relevant Species		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Common Seal	International	Installation	Displacement/foraging impairment due to release of drilling fluids.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Disturbance due to DP vessel noise.	Negligible Negative Short Term Reversible	Likely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Disturbance due to Non-DP vessel noise.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Disturbance due to cable burial noise.	Negligible Negative Short Term Reversible	Likely	Minor: non-significant	No Specific mitigation required.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Disturbance due to SBP survey operations.	Low Negative Short Term Reversible	Likely	**Moderate: Significant**	Provision of SBP marine mammal protocol, and adherence to the Scottish Marine Wildlife Watching Code.	Negative Negligible Short Term Reversible	Minor: non-significant
		Installation	Injury through interactions with cable installation equipment.	No Change	-	None	No Specific mitigation required.	No Change	None
		Installation	Foraging impairment due to indirect effects on prey species.	No Change	-	None	No Specific mitigation required.	No Change	None

Receptor and Value	Relevant Species	Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Common Seal	Common Seal	Operation	Displacement/foraging impairment due to increased sediment loading from cable repair operations.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Disturbance due to cable burial noise during cable repairs.	No Change	-	None	No Specific mitigation required.	No Change	None
		Operation	Disturbance due to SBP survey operations.	Low Negative Short Term Reversible	Likely	**Moderate: Significant**	Provision of SBP marine mammal protocol, and adherence to the Scottish Marine Wildlife Watching Code.	Negative Negligible Short Term Reversible	Minor: non-significant
		Operation	Disruption of migration due to EMF.	No Change	-	None	No Specific mitigation required.	No Change	None

Key

	Significant Effect

16.10 References

Cheney, B., Graham, I.M., Barton, T.R., Hammond, P.S. and Thompson, P.M. 2018. Site Condition Monitoring of bottlenose dolphins within the Moray Firth Special Area of Conservation: 2014-2016. Scottish Natural Heritage Research Report No. 1021.

CIEEM, 2016. Guidelines for ecological impact assessment in the UK and Ireland: terrestrial, freshwater and coastal. In (2nd ed.): Chartered Institute of Ecology and Environmental Management.

BOWL, 2012. Beatrice Offshore Windfarm Environmental Statement.

Bureau of Ocean Energy Management (BOEM) Office of Renewable Energy Programs, 2012. Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Massachusetts, Environmental Assessment. *Published by U.S. Department of the Interior, October 2012.*

EDP Renewables, 2013. Inch Cape Offshore Windfarm – Offshore Environmental Statement.

Evans, P.G.H., Anderwald, P. & Baines, M.E. 2003. UK cetacean status review. Report to English Nature and the Countryside Council for Wales. *Sea Watch Foundation, Oxford. 160pp.*

European Commission, 1992. Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.

Gill, A.B., Gloyne-Phillips, I., Neal, K.J. & Kimber, J.A., 2005. The potential effects of electromagnetic fields generated by sub-sea power cables associated with offshore wind farm developments on electrically and magnetically sensitive marine organisms – a review. Report to Collaborative Offshore Wind Research into the Environment (COWRIE) group, Crown Estates.

Gubbay S, Earll R, 2000. Review of literature on the effects of oil spills on cetaceans. SNH Review No. 3.

Hammond, P.S., MacLeod, K., Northridge, S.P., Thompson, D. & Matthiopoulos, J., 2003. Background information on marine mammals relevant to Strategic Environmental Assessment 4. *Sea Mammal Research Unit, St Andrews.*

IAMMWG, 2015. Management Units for cetaceans in UK waters (January 2015). *JNCC Report No. 547, JNCC Peterborough*.

JNCC, 2010. The protection of marine European Protected Species from injury and disturbance. Guidance for the marine are in England and Wales and the UK offshore marine area. *Joint Nature Conservation Committee, Natural England and Countryside Council for Wales. 119pp.*

JNCC, 2018. UK SAC Site List. http://jncc.defra.gov.uk/page-1458. Accessed 17/04/2018.

LGL Alaska Research Associates and Jasco Applied Sciences, 2010. Marine Mammal Monitoring and Mitigation During Marine Geophysical Surveys by Shell Offshore Inc. in the Alaskan Chukchi and Beaufort Seas. *July – October 2010:90 - Day Report.*

Mainstream Renewable Power, 2016. Neart na Gaoithe Offshore Windfarm Environmental Statement.

Marine Scotland, 2018. National Marine Plan Interactive Website: https://marinescotland.atkinsgeospatial.com/nmpi/. *Accessed 23/03/18.*

Northridge, S.P., Tasker, M.L., Webb, A. & Williams, J.M. 1995. Distribution and relative abundance of harbour porpoises (*Phocoena phocoena L.*), white-beaked dolphins (*Lagenorhynchus albirostris Gray*), and minke whales (*Balaenoptera acutorostrata Lacepède*) around the British Isles. *ICES Journal of Marine Science. 52, 55-66.*

NRP. (2017). NorthConnect technical report on Ornithological surveys.

Paxton, C.G.M., Scott-Hayward, L.A.S. and Rexstad, E., 2014. Statistical approaches to aid the identification of Marine Protected Areas for minke whale, Risso's dolphin, white-beaked dolphin and basking shark. Scottish Natural Heritage Commissioned Report No. 594.

Pirotta E, Eva Laesser B, Hardaker A, Riddoch N, Marcoux M, & Lusseau D. 2013. Dredging displaces bottlenose dolphins from an urbanised foraging patch. Marine Pollution Bulletin: Vol 74, Issue 1, Pages 396-402.

Reid, J.B., Evans, P.G.H., & Northridge, S.P., 2003. Atlas of Cetacean distribution in north-west European waters, 76 pages, colour photos, maps. *Paperback, ISBN 1 86107 550 2.*

SCOS. 2017. Scientific Advice on Matters Related to the Management of Seal Populations: 2017.

SNH, 2014. Scottish MPA Project Data Confidence Assessment – Southern Trench MPA Proposal

SNH, (Undated). The Scottish Marine Wildlife Watching Code (SMWWC).

Southall B. L., Bowles A. E., Ellison W. T., Finneran J. J., Gentry R. L., Greene Jr. C. R., Kastak D., Ketten D. R., Miller J. H., Nachtigall P. E., Richardson W. J., Thomas J. A., and Tyack P. L., 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. *Aquatic Mammals 33, 411 - 521.*

Statoil, 2015. Hywind Scotland Pilot Park – Environmental Statement.

Tyler-Walters, H., James, B., Carruthers, M. (eds.), Wilding, C., Durkin, O., Lacey, C., Philpott, E., Adams, L., Chaniotis, P.D., Wilkes, P.T.V., Seeley, R., Neilly, M., Dargie, J. & Crawford-Avis, O.T. 2016. Descriptions of Scottish Priority Marine Features (PMFs). Scottish Natural Heritage Commissioned Report No. 406.

Chapter 17: Ornithology

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17.1 Introduction

This chapter presents the avian Ecological Impact Assessment (EcIA) of the proposed onshore and marine HVDC cable installation. Both terrestrial and marine ornithological receptors are considered in this chapter and are evaluated in the context of nature conservation legislation and relevant planning policy (see Chapter 5: Planning Policy). Impacts on receptors are identified and subject to detailed impact assessment. This EcIA presents baseline information, anticipated impacts both onshore and offshore for avian receptors during installation and operational phases of the project.

Mitigation is proposed, cumulative impacts are considered, and finally the residual impacts and their significance are assessed.

This chapter is supported by the following Appendices:

- F.1: Survey Report: NorthConnect Report on Ornithological Surveys (NRP, 2017);
- F.2: Technical Report: Temporal and Spatial Variation in Seabird Attendance at Longhaven Cliffs (Affric Limited, 2018); and
- F.3: Summary Data of Buchan Ness to Collieston SPA Seabirds Between 100m and 1000m from HDD Entrance and Exit Locations.

17.2 Sources of Information

International and national legislation assists in identifying sensitive bird species whose presence on a site should be given greater consideration during assessment. This legislation also allows for designation of sites for ornithological interests (as laid out in section 17.4.1). Further guidance for sensitive species was sought from the latest Biodiversity Action Plans (BAPs) and the Birds of Conservation Concern (BoCC) lists.

17.2.1 European and International Legislation

The primary European legislation relating to bird interests is the Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (codified version), commonly referred to as the Birds Directive (European Commission, 2010). This provides a framework for the management and conservation for wild birds throughout the EU.

The Birds Directive allows for the classification of Special Protection Areas (SPAs) for rare or vulnerable species listed on Annex 1 of the Directive, or for where there are regular concentrations of migratory, particularly wetland, species (Article 4). Since 1994 all SPAs in combination with Special Areas of Conservation (SACs) comprise the UK contribution to the Natura 2000 ecological network of protected sites.

As such, species listed on Annex 1 are considered sensitive species for the purposes of this assessment.

In addition to European legislation, there are also international agreements on the protection of birds. The most relevant here is the Ramsar Convention on Wetlands, an international agreement signed in 1971 in Ramsar, Iran, to protect wetland birds (Ramsar, 1971). The Convention has subsequently been extended to focus on the protection of wetland habitats, as well as wetland birds (Ramsar, 2014). The UK is a contracting party of the Convention and has designated a number of wetland sites in the UK as Ramsar sites. All Scottish Ramsar sites are included as part of the Natura 2000 network, and many are also recognised as Sites of Special Scientific Interest (SSSI). Although there is no specific legal framework that safeguards Scottish Ramsar sites, they benefit from the measures required to protect and enhance the Natura sites and SSSIs which overlap them.

17.2.2 National Legislation

The primary legislation transferring the Birds Directive into UK law is the Wildlife and Countryside Act 1981, as amended (UK Parliament, 1981) and the Nature Conservation (Natural Scotland) Act 2004 (Scottish Parliament, 2004). Under these acts, all wild birds are protected under UK law and may not be taken, injured or killed without a licence at any time (with exceptions). Additionally, nests are also protected from damage or destruction while in use and eggs may not be taken or destroyed without a licence. For certain species, listed on Schedule 1 of the Act, special protection is provided, and it is an offence to disturb those species at their nest while it is in use.

As such, species listed on Schedule 1 of the WCA are considered sensitive species for the purposes of this assessment. In certain circumstances, where no significant effect is found following the assessment, but the works have the potential to disturb Schedule 1 species at their nest, this would be considered a significant effect. This is to ensure the works are legally compliant with the WCA, and to allow mitigation to be identified to protect the nests of Schedule 1 species from potential disturbance.

17.2.3 Other Guidance

In addition to the legislation identified above, there are two other key reviews that are considered when carrying out an impact assessment for ornithological receptors.

National and local Biodiversity Action Plans (BAPs) list species which have been identified as threatened, and for which action plans have been developed to aid recovery. Any species listed on a national BAP are given special consideration for this impact assessment (JNCC, 2016c). Species listed on the local BAP (LBAP) are also identified (Aberdeenshire Council, 2014).

Birds of Conservation Concern (BoCC) (Eaton et al., 2015) is a review carried out to assess the status of bird species in the UK, Channel Islands and Isle of Man. This review also considers Globally Threatened species that have occurred in the UK over the last 25 years, taken from the IUCN Red List for birds (BirdLife International, 2015). A total of 244 species are assessed, and those for which populations or range are declining are identified. All bird species are classified into one of three groupings:

Red – species which are globally threatened, or which have suffered a historical population decline in the UK, or which have undergone a severe population decline or a severe range decline;

Amber – species of conservation concern across Europe, or which have undergone a historical population decline but are now recovering, or have undergone a moderate decline in breeding or non-breeding population or range, or are a rare breeder or have a restricted range or are internationally important; and

Green – species which do not fall into the previous two categories.

For the purposes of the assessment, all red list species will be taken forward for consideration. Amber list species will be taken forward for consideration where they are recorded breeding.

17.3 Assessment Methodology

17.3.1 Desktop Study

A desk study and literature search were undertaken to inform the characterisation of the existing baseline conditions. The following data sources were consulted to aid in identifying and assessing the avian species which may be utilising the proposed development area, and surrounding areas, including gaining information on annual cycle timings and foraging characteristics:

- SNH interactive map facility at SiteLink (SNH, 2017a);
- Defra MAGIC website (Defra, 2017);
- North-East Scotland Biological Records Centre (NESBReC, 2018);
- The UK BAP and the North-East Scotland LBAP (Aberdeenshire Council, 2014; JNCC, 2016b);
- Breeding birds of North-East Scotland (Francis & Cook, 2011);
- National Biodiversity Network (NBN) gateway information service (NBN, 2017);
- NorthConnect Converter Building – Winter walkover bird surveys and Breeding Bird Surveys (Agroecosystems, 2014; Atmos Consulting, 2015);
- Seabird Monitoring Programme (JNCC, 2018a); and
- Suggested seasonal definition for birds in the Scottish Marine Environment (SNH, 2017b).

17.3.2 Field Surveys

In addition to the wintering and breeding bird surveys carried out as part of the EIA for the converter station site and HVAC cable route, a series of bird surveys and studies were commissioned specifically for the HVDC cable route and landfall site. These incorporated those birds predominantly using the terrestrial environment and those using both terrestrial and marine environments. The summary of surveys that took place are shown in Table 17.1.

Table 17.1 Summary of Survey Data Collected

Survey Date	Survey Description	Survey company	HVDC cable corridor section
18-May-2014	Initial survey of Longhaven cliffs	Affric Limited	Landfall site
April 2016-July 2016	Breeding Bird Survey	Natural Research Projects Ltd	Onshore cable route and landfall
October 2016-November 2016	Migrant survey	Natural Research Projects Ltd	Onshore cable route and landfall
February 2016-January 2017	Peregrine falcon survey	Natural Research Projects Ltd	Onshore cable route and landfall
February 2016-January 2017	Colonial seabird count	Natural Research Projects Ltd	Landfall site
February 2016-January 2017	Vantage Point watches	Natural Research Projects Ltd	Offshore cable route
April 2016-June 2017	Time-lapse seabird study	Affric Limited	Landfall site

17.3.2.1 Initial Seabird Ornithological Survey of Longhaven Cliffs

An ornithological survey took place, not for a complete count of each bird species within the Longhaven cliff section, but rather as an initial census of what species were utilising the cliffs and, crucially, which sections of the cliff were less dense. Photographs were taken of the cliff in sequence and any cliff sections which were devoid of, or almost completely devoid of, apparent seabird breeding activity, were noted on the map and photographed in further detail.

17.3.2.2 Breeding Bird Survey (BBS)

The BBS undertaken between April 2016 and July 2016 followed guidelines adapted from the British Trust for Ornithology (BTO), extending the usual three site visits for breeding birds, to four. The survey was carried out along the proposed onshore cable corridor with a 500m buffer (Figure 17.1). A 500m buffer was used as when the survey was initially carried out the cable corridor had not been worked out, so the survey could help inform the routeing. The route devised ensured all parts of the defined bird survey area were approached to within 200m, and habitat features such as trees and walls were specifically visited.

Bird locations and behaviour were recorded on a map during each visit and a summary map for those species of conservation concern was produced. The location and activity of birds were mapped onto enlarged 1:25000 scale Ordnance Survey maps using standard codes. The position of each bird was mapped at the point of first detection and flight lines recorded. At the end of each visit, a summary map was compiled showing the locations of each identified territory or breeding pair. The following evidence was considered diagnostic of breeding:

- song, courtship or territorial display;
- territorial dispute;
- nest building and hole excavation;
- agitated behaviour by adult bird(s) indicative of the presence of a nearby nest or young (e.g. repetitive alarm calling, distraction display);
- adult(s) carrying food; presence of newly fledged young;
- adult(s) removing faecal sac.

Where a number of breeding individuals were present, and it was not possible to determine the exact number of breeding pairs, a method was devised to allow the number of discrete territories to be estimated. Registrations of individual birds were deemed to represent discrete breeding territories / pairs if the distance between them was more than 250 m (200 m for small passerines). Whilst it is recognised that these distances are arbitrary, and the territory size varies both inter- and intra-specifically, this approach produces a standardised index of abundance based on the distance that members of a breeding pair are likely to move during the survey period. In cases where two individuals were considered to constitute a pair of birds, the location of the pair was placed centrally by convention.

Population estimates were derived by comparing the summary maps for the four survey visits. A method was developed to estimate discrete territories. Territories plotted during each visit were considered to be separate from one another if they were located more than 1000 m apart (500 m for snipe and skylark, 300 m for other small passerines). These distances were chosen to reflect the distances birds could plausibly move between survey dates. The locations of territories mapped in more than one survey period were plotted centrally.

Surveys were not undertaken in conditions considered likely to affect bird detection, for example, strong winds (greater than Beaufort Force 5), persistent precipitation, poor visibility (less than 300m) or in unusually hot or cold temperatures.

17.3.2.3 Migrant Survey

The bird survey area detailed in Figure 17.1 was covered during two visits between October and November 2016 were made to record migrating birds, particularly geese and waders. Summary maps were produced for the species recorded.

17.3.2.4 Peregrine Falcon Survey

Monthly surveys from February 2016-Janurary 2017 recorded the presence of peregrine falcons along the cliff. The survey utilised the same sub-division of cliff areas (Figure 17.1), as described in more detail below in section 17.3.2.5. Surveyors were SNH licenced and every effort was made to minimise disturbance. The location and sex of any peregrines seen was noted, together with information on likely nest sites.

17.3.2.5 Colonial Seabird Count

The cliffs from Boddam to Collieston are part of the seabird colony register (SCR) census, and sub-divisions have been defined by JNCC. The cliff area surveyed for the colonial seabird count encompassed 47 of these (Figure 17.1). One additional area, termed "2Z" was added to the cliff survey area. Monthly counts were made between February 2016 and January 2017, targeting the seabird species utilising the cliffs both during breeding and non-breeding periods.

On each visit the surveyor systematically examined each count section from the cliff tops and recorded:

- The numbers of birds present and whether these are at breeding or loafing sites;
- Where possible, adult and immature birds were counted separately based on plumage, and breeding birds were distinguished from non-breeding birds based on behaviour;
- During the breeding season, where possible, the numbers of apparently occupied nests (Thaxter et al.) or apparently occupied breeding sites (AOS) were estimated.

The recording units of AON and AOS are the preferred units as stated in seabird monitoring handbook (Walsh et al., 1995). For European shag *Phalacrocorax aristotelis* (hereafter "shag"), black-legged kittiwake *Rissa tridactyla* (hereafter "kittiwake"), and herring gull *Larus argentatus*, estimates of apparently occupied nests (Thaxter et al.) are suggested, whilst for northern fulmar *Fulmarus glacialis* (hereafter "fulmar") apparently occupied breeding sites (AOS) are the standard count. For the other species especially razorbill *Alca torda* and common guillemot *Uria aalge* (hereafter "guillemot"), the total count of individual birds was used to estimate use of each section of the survey area. Surveyors also recorded other breeding species which were present, such as common eider *Somateria mollissima* (hereafter "eider"), Atlantic puffin *Fratercula arctica* (hereafter "puffin"), lesser black-backed gull *Larus fuscus* and great black-backed gull *Larus marinus*.

Attention was paid to cover all parts of each count section, which meant that some sections were observed from a few locations and totals derived by summing the counts. In such cases the limits of each partial section already counted was noted on the map by the observer to avoid double counts.

Care was also taken to avoid disturbing breeding birds by keeping an appropriate distance from breeding sites which were closer to the cliff tops.

Information on disturbance such as the birds' response to potential disturbance stimuli, such as passing walkers or vessels was noted, if seen during field visits. Information on meteorological conditions was recorded, in particular sea state (using the Douglas Sea State numeric scale), wind speed (using the Beaufort Wind Force numeric scale) and direction, and visibility. Section counts were generally done under dry conditions with good visibility. During the section counts sea state ranged from 1 to 4 and sea swell from 0.25 m to 1.5 m. Wind conditions ranged between Beaufort Force 1 to 5.

As recommended by SNH, a distance-based approach was taken when considering how many birds were within the vicinity to the different activities. Distance radii from key activities ranged from 100m up to 1000m.

Data from their 2007 survey was provided by JNCC from their survey from Buchan Ness to Collieston, and this was used to obtain totals for seabird species throughout the whole area.

17.3.2.6 Vantage Point Seabird Watches

Two vantage points (VPs) were identified (Figure 17.1) which allowed all parts of the coastal waters within 2km of the coast to be observed from at least one VP. The VPs were located (one at the north of the site (VPN) and one at the south (VPS)) to minimise overlap and therefore the possibility of double counting.

VP watches aimed to quantify the numbers and distribution of seabirds on the sea out to 2 km from the coast. This was achieved by systematically and steadily scanning the area using a spotting scope fitted with an inclinometer. This allowed for detection of birds that may be temporally obscured from view by wave crests or when diving. Surveys were generally done under dry conditions with good visibility. During VP counts sea state ranged from 0 to 4 and sea swell from 0 to 1.5m. Wind conditions ranged from Beaufort Force 1 to 5.

During each VP scan, individual birds or group of birds were identified, counted, their location (in a distance band on a compass bearing) recorded, and behaviour (e.g. foraging, loafing, preening, flying etc.) noted.

Figure 17.1 Bird Survey areas for the HVDC Ecological assessment.

17.3.2.7 Time-lapse Seabird Study

Two cameras were placed at locations along the cliff (Figure 17.1), termed "North cam" and "South cam" due to their locations. One picture every 10 minutes during the dawn to dusk period was taken. The cameras were deployed from April 2016 to June 2017. For analysis, one picture was chosen at random during the morning (before noon), afternoon (between noon-5pm) and evening (after 5pm), for each day, over a full year period. Where the camera image was obscured due to weather or sun glare, the image was not included in further analysis. Fulmar, kittiwake and guillemot were counted with AONS/AOSs/total counts as per the colonial seabird study. Birds were counted manually, using the software ImageJ. For shags, the cameras were not set up at sites where shags were breeding. Instead, shags were recorded as roosting during the non-breeding period at this site, and were recorded as a binary data point, being either "present" (1) or "absent" (0). A summary of the species recorded from each camera and number of images analysed is provided in Table 17.2. The data was then analysed for seasonal and diurnal differences in cliff presence within each species, using the software R version 3.4.2.

Further details on the camera type and settings can be found in Appendix F.2.

Table 17.2 Summary of Time-lapse Camera Images Counted

Camera	Species counted/presence recorded*	No. of images analysed
North cam	Kittiwake Fulmar Shag*	977 974 987
South cam	Guillemot Shag*	1085 1095

17.3.3 Impact Assessment Methodology

The assessment of the significance of predicted impacts on ecological receptors is based on both the 'value' of a receptor and the nature and magnitude of the impact that the development will have on it. Effects on biodiversity may be direct (e.g. the loss of species or habitats), or indirect (e.g. effects due to noise, light or disturbance), on receptors located within or out with the respective survey area. This EcIA has, in principle, followed the assessment methodology outlined in Chapter 3 with the specific ecological assessment methods and criteria detailed below.

17.3.3.1 Evaluation of Ecological Receptors

The evaluation methodology has been adapted from the Guidelines for Ecological Impact Assessment in the United Kingdom (CIEEM, 2016). A key consideration in assessing the effects of any development on flora and fauna is to define the areas of habitat and the species that need to be considered. This required the identification of a potential zone of influence, which is defined as those areas and resources that may be affected by biophysical changes caused by project activities, however remote from the respective survey area.

The approach that has been undertaken throughout this EcIA is to identify 'valued ecological receptors' i.e. species and habitats that are both valued in some way and could be affected by the proposed development and separately, to consider legally protected species. Both species populations and habitats have been valued using a broad geographical basis with full details in Table 17.3.

The approach taken in this assessment is that a species population or habitat area that is of Regional or greater importance in biodiversity conservation terms is considered to be a valued ecological receptor. Therefore, if a species population is considered to be of High Local value or less, the proposed development is not anticipated to have as great an effect on the species population as a whole. Exceptions are made if the species population or habitat area has been identified as having a high social or economic value, or if the species is legally protected, for example if they are a Schedule 1 or Schedule 5 species, or are a European Protected Species (EPS).

Table 17.3 Nature Conservation Receptor Evaluation Criteria.

Value	Criteria
International	• An internationally important site (SPA or SAC) or a site proposed for, or considered worthy of designation; • A regularly occurring substantial population of internationally important species (listed on Annex I of the Birds Directive).
National	• A nationally designated site, SSSI, or a site proposed for, or considered worthy of such designation; • A regularly occurring substantial population of a nationally important species, e.g. listed on Schedule 5 & 8 of the 1981 Wildlife and Countryside Act.
Regional	• Areas of internationally or nationally important habitats which are degraded but are considered readily restored; • Viable populations identified in the UKBAP or smaller areas/populations which are essential to maintain the viability of a larger area/population as a whole; • Regionally important population/assemblage of an EPS, Schedule 1 and/or 5 species. • Regionally important assemblages of other species.
High Local	• Locally important population/assemblage of an EPS, Schedule 1 and/or 5 species; or • Sites containing viable breeding populations of species known to be county rarities (e.g. included in the LBAP) or supplying critical elements of their habitat requirements.
Moderate Local	• Undesignated sites, features or species considered to appreciably enrich the habitat resource within the local context (within 2km radius from the site) and may benefit from mitigation as a good practice measure.
Low Local	• Undesignated species considered to appreciably enrich the habitat resource within the immediate environs of the site and may benefit from mitigation as a good practice measure.
Negligible	• Common and widespread species.

The approach of this assessment is to consider the value of the Site for the species under consideration, rather than the nature conservation importance of the species itself, although this is a factor in the evaluation process with the level of use of the Site (number of individuals using the site and nature and level of use) taken into consideration. An assessment is then made of the value of the Site to that species, based upon a combination of data sources, professional judgment and knowledge of the Site and wider area.

17.3.3.2 Legal Protection of Species

There is a need to identify all legally protected species that could be affected by the proposed development to ensure that the development complies with all relevant nature conservation legislation. It is, therefore, appropriate to take into full consideration the legal protection of a species within the evaluation process.

17.3.3.3 Nature and Magnitude of Impact

Impacts can be: permanent or temporary; direct or indirect; adverse or beneficial; reversible or irreversible; and may also have a cumulative function with other activities outwith the assessed development. These factors are taken into consideration in the context of the sensitivity of the valued ecological receptor and the range of potential effects. To identify whether impacts are significant or not it is important to undertake the assessment in terms of the integrity (coherence of the ecological structure and function) and conservation status (ability of the receptor to maintain its distribution and/or extent/size) of the receptor.

Table 17.4 provides an overview of the range of impact magnitudes referred to within this assessment. Impacts may be either positive or negative in nature.

Table 17.4 Definition of Magnitude of Impact.

Magnitude	Description
Negligible / None	Very slight change from the baseline conditions. Changes barely detectable, approximating to the 'no-change' situation. Any effects likely to be reversible within 12 months and not affect the conservation status or integrity of the receptor.
Low	Minor shift away from baseline conditions. Effects will be detectable but unlikely to be of a scale or duration to have a significant effect on the conservation status or integrity of the receptor in the short term (1-5 years). Overall baseline character of site will not alter substantially.
Medium	Clear effect on the conservation status or integrity of the receptor in the short to medium term (6-15 years), although this is likely to be reversible or replaceable in the long-term (15 years plus).
High	Total loss of, or major alteration to conservation status or integrity of a receptor with situation likely to be irreversible, even in the long term. Fundamental alteration to the character and composition of the Site.

17.3.3.4 Impact Significance

The significance of an effect is a product of the value of the ecological receptor and the magnitude of the impact on it, moderated by professional judgment. Table 17.5 illustrates a matrix based on these two parameters which is used for guidance in the assessment of significance. In terms of the EIA Regulations, only effects which are 'moderate' or 'major' are considered significant, the others constituting a non-significant effect. The level of effect has been assessed as either major, moderate, minor or negligible, or beneficial in accordance with the definitions provided in Chapter 3: Methodology.

Table 17.5 Significance of Effects Matrix.

Magnitude of Impact	Sensitivity				
	International	**National**	**Regional**	**High Local/ Moderate Local**	**Low Local /Negligible**
High	Major	Major	Moderate	Moderate	Minor
Medium	Major	Moderate	Moderate	Minor	Minor
Low	Moderate	Minor	Minor	Minor	Negligible
Negligible	Minor	Negligible	Negligible	Negligible	Negligible

Key

	Significant Effect
	Non-Significant Effect

17.4 Baseline Information

17.4.1 Statutory Designated Sites

Table 17.6 details the sites near the development that have been designated in full or part for avian nature conservation interests, as well as one which has been designated for a feature which indirectly benefits those birds utilising the marine environment. The boundaries of these are mapped in Drawing NCFFS-NCT-X-XG-0005-01, hereafter named Drawing 0005-01. The distance given is the closest distance to the cable corridor from the centre point of the designated site.

Table 17.6 Designated Sites Relevant to the Avian Receptors

Site	Distance from Cable Corridor	Relevant designated Interests	Feature's importance (from JNCC site and species information pages)
Buchan Ness to Collieston Coast (includes marine extension) SPA.	Crossed at HVDC cable landfall.	Northern fulmar, breeding Common guillemot, breeding Herring gull, breeding Kittiwake, breeding Eurasian shag, breeding Seabird assemblage, breeding	0.3% national population 1.2% national population 2.7% national population 6.2% of national population 2.8% national population Under Article 4.2 of the Directive (79/409/EEC), over 95,000 seabrids supported.
Bullers of Buchan Coast SSSI	Crossed at HVDC cable landfall.	Seabird colony, breeding Common guillemot, breeding Kittiwake, breeding Eurasian shag, breeding	All as designated under SPA.

Site	Distance from Cable Corridor	Relevant designated Interests	Feature's importance (from JNCC site and species information pages)
Collieston to Whinnyfold Coast SSSI	8km south of HVDC cable landfall	Northern fulmar, breeding Common guillemot, breeding Herring gull, breeding Kittiwake, breeding Razorbill, breeding Seabird assemblage, breeding	As designated under SPA, except razorbill.
Ythan Estuary, Sands of Forvie and Meikle Loch SPA and SSSI	20km south of HVDC cable landfall	Arctic tern, breeding Common tern, breeding Little tern, breeding Sandwich tern, breeding Pink-footed goose, non-breeding Waterfowl assemblage (eider, lapwing, redshank, pink-fooed goose), non-breeding	SSSI designation only 2.2% national population 1.7% national population 4.3% national population 7.7% of the wintering Eastern Greenland/Iceland/UK population Under Article 4.2 of the Directive (79/409/EEC) over 20,000 waterfowl
Turbot Bank MPA	30km South of HVDC cable corridor	Sandeel ground.	Potential prey resource for marine ornitholoigcal interests.
Troup, Pennan and Lion's Heads SPA	60km north-west of UK landfall	Common guillemot, breeding Seabird assemblage, breeding	1.3 % of East Atlantic population Under Article 4.2 of the Directive (79/409/EEC), over 15,000 seabrids supported
Fowlsheugh SPA	75km south of UK landfall	Common guillemot, breeding Kittiwake, breeding Seabird assemblage, breeding	1.8% of East Atlantic population 1.1% of East Atlantic population Under Article 4.2 of the Directive (79/409/EEC), over 170,000 seabrids supported
Moray Firth pSPA	145km north-west of UK landfall	European shag, breeding Common eider, non-breeding Common goldeneye, non-breeding Common scoter, non-breeding Great northern diver, non-breeding Greater scaup, non-breeding Long-tailed duck, non-breeding Red-breasted merganser, non-breeding Red-throated diver, non-breeding Slavonian grebe, non-breeding Velvet scoter, non-breeding	Important breeding population of European shags. Important non-breeding populations of diver and seaduck species.

Site	Distance from Cable Corridor	Relevant designated Interests	Feature's importance (from JNCC site and species information pages)
Outer Firth of Forth and St Andrews Bay pSPA	160km south-west of UK landfall	Arctic tern, breeding Atlantic puffin, breeding Common guillemot, breeding and non-breeding Common tern, breeding European shag, breeding and non-breeding Herring gull, breeding and non-breeding Kittiwake, breeding and non-breeding Manx shearwater, breeding Northern gannet, breeding Black-headed gull, non-breeding Common eider, non-breeding Common goldeneye, non-breeding Common gull, non-breeding Common scoter, non-breeding Little gull, non-breeding Long-tailed duck, non-breeding Razorbill, non-breeding Red-breasted merganser, non-breeding Red-throated diver, non-breeding Slavonian grebe, non-breeding Velvet scoter, non-breeding	Important area for both breeding and non-breeding populations of seabirds, divers and seaducks.
Firth of Forth Islands SPA	185km south-west of UK landfall.	Arctic terns, breeding Common tern, breeding Roseate tern, breeding Sandwich tern, breeding Gannet, breeding Lesser black-backed gull, breeding Puffin, breeding European shag, breeding Seabird assemblage, breeding	1.2 % national population 6.5% national population 15% national population 0.2% national population 13.1% breeding N. Atlantic population 2.4 % of Western Europe population. 2.3% of breeding population. 2.3 % breeding population of Northern Europe. Under Article 4.2 of the Directive (79/409/EEC), over 90,000 seabrids supported

17.4.1.1 Buchan Ness to Collieston Coast SPA

Buchan Ness to Collieston coast SPA (with marine extension) regularly supports over 95,000 seabirds (JNCC, 2001a). The SPA covers a 15km stretch of coastline, formed of granite, quartzite and rocky cliffs as well as a sandy beach section by Cruden Bay. The cliffs are in general less than 50m high and there are many stacks just off the cliffs. The marine extension means that the waters 2km off the cliffs are also protected. The overarching conservation objectives of the site is:

"To avoid the deterioration of the habitats of the qualifying species…or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained', (SNH, 2018)

and the subsequent conservation objectives are:

"To ensure for the qualifying species that the following are maintained in the long term: Population of the species as a viable component of the site; Distribution of the species within the site; Distribution and extent of habitats supporting the species; Structure, function and supporting processes of habitats supporting the species; and No significant disturbance of the species". (SNH, 2018)

All species designated for this SPA are considered for the assessment due to the cable corridor passing through the designated site. Following discussions with SNH, it is acknowledged that an appropriate assessment will be required for this designated site. Therefore, information is provided in this chapter to aid Marine Scotland in their assessment of the effects of the development on the designated site.

The three most recent surveys are shown in Table 17.7. Note that 2007 is the latest publicly available data (JNCC, 2018a). As this data is more than 10 years old, NorthConnect specifically commissioned seabird surveys for an approximate stretch of 3km of coastline within the Buchan Ness to Collieston Coast SPA, as described more in section 17.3.2.5.

Table 17.7 Buchan Ness to Collieston Coast SPA data from 2001, 2004, and 2007 (JNCC, 2018a).

Qualifying Species	2001	2004	2007
Northern fulmar	1976	Not counted	1389
Common guillemot	29389	Not counted	19296
Herring gull	3126	3217	3079
Kittiwake	14093	13330	12542
Eurasian shag	415	594	331

17.4.1.2 Bullers of Buchan Coast SSSI

As well as being designated for maritime cliff and for geological features of the coastline, this coastal SSSI supports internationally important numbers of seabirds. The SSSI fits within the Buchan Ness to Collieston Coast SPA up to the Cruden Bay section of the SPA. As such, this site is considered in conjunction with the SPA designation. As such, all associated species will be considered within the assessment.

17.4.1.3 Collieston to Whinnyfold Coast SSSI

This coastal SSSI supports internationally important numbers of seabirds. The SSSI fits within the Buchan Ness to Collieston Coast SPA. As such, this site is considered in conjunction with the SPA designation. Associated species will be considered within the assessment of the SPA. Razorbills, not on the SPA designation are considered within the separate species accounts.

17.4.1.4 Ythan Estuary, Sands of Forvie and Meikle Loch SPA/Sands of Forvie and Ythan Estuary SSSI

This designated site encompasses an area of estuary, a sand dune system and mudflats (JNCC, 2005). Meikle Loch provides a roost for migratory geese at night. There is potential connectivity between the goose roost and the farmland within the HVDC cable corridor, therefore this site is taken forward for further consideration.

17.4.1.5 Turbot Bank MPA

Sandeels provide an important food source for many seabirds and as such this MPA for sandeels will benefit the seabirds feeding on them. The site area is 251km^2 of largely sandy ground with a shelf bank and mound feature present (JNCC, 2018b). The area is particularly important for the Raitt's sandeel *Ammodytes marinus*. This MPA is considered in greater detail in Chapter 15: Fish and Shellfish. The result of the impact assessment on the Turbot Bank MPA revealed a 'no change' scenario for the site. Therefore, no effects are expected on the seabirds' prey items. This MPA is subsequently scoped out of further assessment.

17.4.1.6 Troup, Pennan and Lion's Head SPA

The Troup, Pennan and Lion's Head SPA is between the Banff and Buchan coast and includes a 9km stretch of sea cliffs (JNCC, 2001c). The cliffs are known to be particularly important for breeding auks, as such guillemots are the key designated feature of this SPA. Breeding guillemots at this SPA are within the breeding foraging range to overlap with the HVDC cable corridor (Table 17.10). Therefore, this site is included within the assessment.

17.4.1.7 Fowlsheugh SPA

Fowlsheugh SPA encompasses an area of sheer cliffs between 30-60m high (JNCC, 2001b). The SPA supports large numbers of breeding gulls and auks. The designated guillemot and kittiwake are within the breeding foraging range to overlap with the HVDC cable corridor (Table 17.10). Therefore, this site is included within the assessment.

17.4.1.8 Moray Firth pSPA

This proposed SPA is predominantly designated for wintering waterfowl and diver species. The Moray Firth has a variety of habitats available for the diving birds, including sheltered bays and rocky outcrops. The only breeding species on the qualifying interest list for shags, that have an important breeding population north of Helmsdale (SNH, 2016b). Due to the foraging distances of shags in the breeding period being 14±3.5km (Table 17.10), and the distance between this pSPA and the HVDC cable corridor being 145km north (Table 17.6), this designated site can be scoped out of any further assessment.

17.4.1.9 Outer Firth of Forth and St Andrews Bay pSPA

This proposed SPA encompasses an area of 2,721km^2 from Arbroath down to St Abb's Head (SNH, 2016c). The sheltered waters are an important foraging habitat for both breeding and non-breeding birds. Despite the distance between this site and the HVDC cable corridor (160km), many of the designated seabird species have large foraging ranges during in the non-breeding period when they are no longer as constrained by a nest site (Table 17.10). Arctic terns are known to have a relatively short foraging range compared to other seabird species (Eglington & Perrow, 2014), having a maximum foraging range of 30km (Thaxter et al., 2012). Therefore, arctic terns are excluded from further assessment due to not overlapping with the development. The coastal area around the HVDC cable corridor is not an important site for divers or seaducks and it is unlikely there will be any overlap between the designated seaduck and diver species between the proposed SPA and the development area. As such, these species are excluded. For the purposes of assessment breeding seabird assemblage and non-breeding seabird assemblages are taken forward for valuation.

17.4.1.10 Firth of Forth Island SPA

This SPA comprises of a number of islands, including: Inchmickery, Fidra, Lamb, Craigleith, Bass Rock and Isle of May. Bass Rock is recorded as being the world's largest colony of northern gannets following a recent count in 2014 (JNCC, 2016a). Terns species are known to have a relatively short foraging range compared to other seabird species (Eglington & Perrow, 2014), having a maximum foraging range of 30km (Thaxter et al., 2012). Therefore, the tern species can be excluded from further assessment due to not overlapping with the development. Due to the foraging distances of shags in the breeding period being 14±3.5km, shags can also be excluded from further assessment of this SPA. The remaining species; puffin, lesser black-backed gull, and gannet are all within the foraging range and therefore with be included in further assessment.

17.4.2 Other sites

The Scottish Wildlife Trust (SWT) Longhaven Cliffs Reserve is within the boundaries of the designated sites Buchan Ness to Collieston SAC and Bullers of Buchan Coast SSSI. The landfall site will fall within the cliffside section of the Reserve. As such, this will be considered in conjunction with the assessment of the SPA/SSSI. There is also an inland area of the Reserve which will be taken forward for assessment.

17.5 Field Survey Results

17.5.1 Initial Seabird Ornithological Walkover

The initial walkover in May 2014 revealed two areas with very low densities of seabirds utilising the cliffs during on the peak breeding months. One area was a bay with grassy banks and a small stony beach at the base (Photo 1). Minimal breeding seabirds were noted here, though kittiwakes were noted collecting nesting material in the bay.

Photo 1 Section of Longhaven cliffs May 2014

The second area is a bay with large amounts of rubble at the base from a disused quarry (Photo 2). This bay, and the associated headland to the south had less suitable nesting habitat than other cliff sections.


Photo 2 Section of Longhaven cliffs May 2014.

This initial survey helped inform where the landfall selection would be, which ended up being in the area by Photo 2, south of the disused quarry. From the beginning, the designated seabirds were an integral part of the design process in choosing a suitable landfall section.

17.5.2 Breeding Bird Survey (BBS)

17.5.2.1 Passerines and Waders

A total of four Northern lapwing *Vanellus vanellus* (“lapwing”) and two common snipe *Gallinago gallinago* (“snipe”) territories were recorded in the BBS area (Appendix F.1: Figure 12). Passerine species territories recorded included Eurasian skylark *Alauda arvensis* (“skylark”), song thrush *Turdus philomelos*, dunnock *Prunella modularis*, common linnet *Linaria cannabina* (“linnet”), yellowhammer *Emberiza citrinella* and common reed bunting *Emberiza schoeniclus* (“reed bunting”) (Appendix F.1: Figure 13) (Table 17.8). The latest numbers of these species across their UK breeding population is also included in the table (BTO, 2018).

Table 17.8 Territories Noted of Passerine and Wader Species in the HVDC Breeding Bird Survey Area.

	Territories		Breeding Time-period	UK Population Territories
Species	**Confirmed**	**Probable**		
NRP Report 2016 BBS Survey				
Lapwing	4		Late March-early June	156,000
Snipe	2		April – mid July	59,300
Skylark	18		April-August	1,785,000
Song thrush	3		March-August	1,144,000
Dunnock	7		April-July	2,163,000
Linnet	4	1	April-July	556,000
Yellowhammer	8		April-July	792,000
Reed bunting	3		April-August	192,000
Agroecosystems 2014 Pre-liminary BBS: additional species				
Sedge warbler	1		April-July	321,000
Goldfinch	7		April-August	313,000
Lesser redpoll	2		April-July	26,900
Willow warbler	4		April-July	2,400,000
Wren	9		March-July	8,512,000
Blackbird	1		April-July	4,935,000
Tree sparrow	1		April-August	68,000
House sparrow	1		April-August	2,100,000

Table 17.8 also shows the breeding period times for each of the species recorded. The most common passerine recorded during the BBS were skylarks. One skylark territory was recorded as being within the Landfall area by the Longhaven cliffs. Skylarks prefer vegetation to be around 20-50cm in height and may have two to three nesting attempts during the season (RSPB, 2018d). Similarly, passerines such as song thrushes will also have several attempts at breeding throughout their long breeding season. Many passerines will build nests amongst trees and shrubs, along walls, on ledges and sometimes on the ground within thick vegetation or crops. Lapwings nest in either bare ground or short vegetation and their individual territories are around 0.4-0.8 hectares (RSPB, 2018b). Snipe require a mixture of short and tall vegetation types in wet ground.

In the autumn of 2016, a flock of 13 Eurasian curlew *Numenius arquata* ("curlew") was recorded feeding in the southern end of the bird survey area with a second flock of 20 nearby. It is known that over the non-breeding period coastal numbers build up and peak in January and February, before they then return to their breeding grounds (RSPB, 2018a).

Outside the BBS area but within the Seabird Survey Area, a Raven *Corvus corvus* was recorded nesting in area 2H.

17.5.2.2 Migratory Birds

During the two extra visits to the BBS area over the non-breeding period to assess migratory birds, no geese or migratory wading birds were recorded during the October visit. In November, a flock of 45 pink-footed geese *Anser brachyrhynchus* was observed in the far north of the area. Pink-footed geese migrate from Spitsbergen, Iceland and Greenland to winter in the U.K, to feed on winter grains, cereals and grasses. The total UK wintering population is at approximately 360,000 birds, a large proportion of which winter in eastern Scotland (RSPB, 2018c).

Outside the BBS area but within the Seabird Survey Area, one non-breeding adult Common redshank *Tringa tetanus* was recorded in October, and 2 were recorded in November.

17.5.2.3 Peregrine and Other Birds of Prey

Adults were recorded at a breeding site in February at a confidential location within the survey area, but not within the cable corridor. An adult sitting on 4 eggs was recorded in April. Three small chicks were recorded in May, three juveniles in June and 3 fledged juveniles in July. The peregrines have been observed hunting by the seabird cliffs, so during the breeding season it is likely that the seabirds provide a source of food for the peregrines. The adults were resident throughout the year and were recorded in every month except January 2017. The maximum number of adults seen together was three.

Other birds of prey were recorded during the surveys. A single buzzard was noted in November 2016 and one was noted flying past in January 2017. Immature and juvenile kestrels were also noted: 3 in September 2016 (one of which flew past), and 3 in October 2016. During the 2014 breeding bird survey which was carried out as part of the EIA for the HVAC cabling and converter station works, a barn owl pellet was noted in the eastern part of the HVDC cable corridor though no signs of a barn owl breeding in the survey area was noted. No barn owls were not recorded in the more recent breeding bird surveys.

17.5.3 Seabird Surveys

See Appendix F.1 for the NRP Ornithology report and the associated data tables for the complete data set recorded. What presented here is summary analysis which was carried out as part of a technical ornithological report by NorthConnect (Affric Limited, 2018), with further information on the key seabird species recorded as using these cliffs, and the surrounding waters.

17.5.3.1 General Seabird Information and Summary Tables.

Seabirds are long-lived species and can take several years to reach sexual maturity. Though it is species-specific, seabirds generally only produce one or two young per season, with exceptions existing, such as shags which can produce broods of four young. Once a seabird chooses a breeding colony, they will often remain site faithful to that breeding site, returning each year, often consistently to the same nest. Seabirds do not breed every year, sometimes deferring breeding for a year either due to not finding a partner that year, or due to being in a poor body condition. However, non-breeding birds may still return to the colony and will loaf around the colony. As breeding is such an energetically expensive activity, in general a seabird's annual moult (i.e. replacement of new feathers) will occur after the breeding season has completed. Moult can begin at the breeding site however it is more common for moult to be completed at sea, during the non-breeding period. During the moulting period the birds may be less agile in flight and in swimming.

These seabird species recorded during the year-long seabird surveys along with their associated vulnerability index are shown in Table 17.9, where a score of 1 is the lowest vulnerability and 5 is the highest (Furness, Wade, & Masden, 2013). This vulnerability index is related to likelihood of eliciting a response whilst the birds are on the sea. As the seabirds at Buchan Ness to Collieston Coast SPA may be affected both on sea and on land, a flushing distance due to human disturbance is also given.

Table 17.9 Seabird Vulnerability scores to Vessel and Human Disturbance.

Species	Vulnerability score to disturbance by vessels on sea	Response whilst on sea	Vulnerability/Flushing distance on land
Fulmar	1	Little response (Garthe & Hüppop, 2004)	May be between 10m-100m, depending on how disturbed the colony is already (Quinn, pers.comm.)
Kittiwake	2	Slight avoidance at short range (Garthe & Hüppop, 2004)	40-180m based on assessment of gulls and terns and human disturbance effects (Carney & Sydeman, 1999) and Canadian Arctic gulls (Mallory, 2016)
Herring gull	2	Slight avoidance at short range (Garthe & Hüppop, 2004)	40-180m based on assessment of gulls and terns and human disturbance effects (Carney & Sydeman, 1999) and Canadian arctic gulls (Mallory, 2016)
Guillemot	3	Moderate avoidance at short range (Bellefleur, Lee, & Ronconi, 2009; Garthe & Hüppop, 2004)	50m if vessel remains for extended periods of time (Rojek, Parker, Carter, & McChesney, 2007)
Razorbill	3	Moderate avoidance at short range (Bellefleur et al., 2009; Garthe & Hüppop, 2004)	Due to similarity in ecology, taken to be as for guillemot.
Shag	4	Moderate flush distance and alert to vessels at 500m (Velando & Munilla, 2011)	70m for a small (4.3m) motorised boat approaching the nests directly (for double-crested cormorant, as similar nesting habits) (Rodgers & Smith, 1995)
Puffin	2	Slight avoidance at short range (Garthe and Hüppop 2004)	N/A for nest flushing as nests in burrows.
Gannet	2	Slight avoidance at short range (Garthe and Hüppop 2004)	N/A for land flushing as none nest on the Buchan Ness cliffs.

Table 17.10 presents a summary of the key seabird species recorded during the year-long breeding survey and what their annual cycle and foraging characteristics are in broad terms.

Table 17.11 is a summary of the number of adults and breeding adults recorded for the main seabird species recorded along the seabird study area during each month of the survey year. For a full breakdown of other species recorded during the seabird surveys, see Appendix F.1.

Table 17.12 summarises the number of immature and juvenile birds recorded either on sea or on land during the surveys.

The vantage point (VP) surveys revealed what birds were utilising waters up to 500m from the seabird cliffs off the Buchan Ness to Collieston Coast SPA. A total of 13 seabird species were recorded from the two VPs, a full break down of which is found in Appendix F.1. Overall, the largest combined monthly counts were between May-July, and the lowest combined count of birds on sea was in February.

As recommended by SNH, a distance-based approach of assessment of numbers of birds along the cliffs was undertaken, with differing radii from key activities: 100m, 200m, 300m, 400m, 500m, 750m, and 1000m. Due to the far-ranging nature of seabirds, it is likely that birds across the cliffs will be in proximity to the development when flying over or resting on the sea. However, disturbance is at its greatest when a bird is disturbed from its nest. Nest disturbance can cause breeding attempt abandonment, or can cause predation of the egg or chick, if the adult is flushed from the nest. Therefore, it is more appropriate to assess based on the zones within which nest disturbance is more likely. The 100m distance encompassed the adjacent area to the activity and is a disturbance distance identified for the main species during a literature review (see Table 17.9). For the purposes of this EIA, birds on land within 100m is used as a key distance to assess effects. A summary for birds on land within 200m is also presented as a precautionary value. The results of the numbers of birds within each distance radii are provided in Appendix F.3 to help inform the later Appropriate Assessment. Table 17.13 is a summary of the numbers and proportions of key seabird species recorded in the 100m radii from the HDD landfall site, as identified from Drawing NCFFS-NCT-X-XG-0006-01, hereafter Drawing 0006-1 (area 2Z), and in the areas within 200m of the HDD landfall (areas 2W to 3C).

Table 17.14 is a summary of the numbers and proportions of key seabird species recorded in the 200m radii from the HDD marine exit, as identified from Drawing NCFFS-NCT-X-XG-0007-01, hereafter Drawing 0007-1 (areas 3A and 3B). There are no breeding seabirds within the adjacent 100m of the HDD exit.

Table 17.10 Key Seabird Species Breeding and Non-breeding Period Timings and their Foraging Characteristics

Species	Annual cycle				Foraging range (km from breeding colony)		Foraging depth	Predominant foraging strategy
	Breeding period			Non-breeding period				
	Pre-laying	Egg Incubation	Chick-rearing	Wintering	Breeding	Non-breeding		
Fulmar	April	May-June (52-53 days)	June-August (46-51days)	September-March	400km±246km (mean maximum) (Thaxter et al., 2012)	1016km (D., M., & C.),3500km (max) (Quinn, 2014)	<5m (Edwards, Quinn, Wakefield, Miller, & Thompson, 2013)	Surface feeding
Kittiwake	April	May-June (25-32 days)	June-July (33-54 days)	September-March	60.0±23.3 (mean maximum) (Thaxter et al., 2012)	<100km->3000km (median) (Frederiksen et al., 2012)	<4m (Daunt et al., 2002)	Surface feeding
Guillemot	March	April-June (28-37 days)	May-July (18-25 days)	August-February	84.2±50.1 (mean maximum) (Thaxter et al., 2012)	<1000km (Tranquilla et al., 2013)	Up to 200m (BirdLife International 2018)	Pursuit diving
Razorbill	March	April-June (32-39 days)	May-July (14-24 days)	August-February	48.5±35.0km (mean maximum) (Thaxter et al., 2012)	<950km (Linnebjerg et al., 2013)	Up to 140m (Piatt & Nettleship, 1985)	Pursuit diving
Shag	March	April-June (30-31 days)	June-August (48-58 days)	September-February	14.5±3.5km (mean maximum) (Thaxter et al., 2012)	486km (Grist et al., 2014)	Up to 80m (BirdLife International 2018)	Benthic feeding
Herring gull	March	April-June (28-36 days)	June-July (35-40 days)	September-February	61.1±44km (mean maximum) (Thaxter et al., 2012)	41km (BirdLife International, 2018)	<2m (Lilliendahl & Sólmundsson, 2006)	Surface feeder/Scavenger

Lesser black-backed gull	March	April-June (24-27 days	June-July (30-40 days)	September-February	141.0±50.8km (mean maximum) (Thaxter et al., 2012)	1672km-7585km (Bustnes, Moe, Helberg, & Phillips, 2013; Klaassen, Ens, Shamoun-Baranes, Exo, & Bairlein, 2012)	<2m (BirdLife International 2018)	Surface feeder/Scavenger
Great black-backed	March	April-June (27-28 days	June-July (50-55 days)	September-February	39km (Wernham, 2002)	54.5km (median) (Wernham, 2002)	<2m (BirdLife International 2018)	Scavenger/Kleptoparasite
Puffin	April	May-June (36-43 days)	June-July (34-44 days)	August-March	105.4±46.0km (mean maximum), (Thaxter et al., 2012)	<700km (Harris, Daunt, Newell, Phillips, & Wanless, 2010)	Up to 70m (BirdLife International 2018)	Pursuit diving
Gannet	February	March-June (42-46 days)	May-September (84-97 days)	October-February	229.4±124.3km (mean maximum), (Thaxter et al., 2012)	343km-4654km (range),2766km±1658km (D. et al.) (Kubetzki, Garthe, Fifield, Mendel, & Furness, 2009)	Up to 34m (BirdLife International, 2018)	Plunge diving

Table 17.11 Summary of Number of Adults (AD) and Breeding Sites (AOS/AON) for Mean Seabird Species Recorded during the Year-long Survey Maximum count shown in bold.

Month	Fulmar		Shag		Herring Gull		Kittiwake		Guillemot		Razorbill		Puffin		Great black-backed gull		Total AD	Total AON
	AD	AOS	AD	AON	AD	AON	AD	AON	AD	AOS*	AD	AOS*	AD	AOS*	AD	AON		
Jan	436	278	3	0	130	0	0	0	3091	3091	0	0	0	0	0	0	3660	3369
Feb	201	135	39	0	417	85	0	0	0	0	0	0	0	0	2	2	659	222
Mar	352	236	52	25	663	**232**	1567	783	**6219**	**6219**	334	334	0	0	6	**5**	9193	7834
Apr	**450**	**288**	95	37	474	121	2403	1186	4541	4541	649	649	8	5	4	2	8624	6829
May	268	217	144	57	629	206	4000	2000	5447	5271	1026	954	25	17	4	3	11543	8725
Jun	331	256	149	**80**	636	230	4003	2001	6149	6091	1165	1139	29	**19**	5	3	**12467**	**9819**
Jul	275	130	184	43	**721**	92	**4358**	**2179**	5264	5264	**1178**	**1148**	**71**	4	**7**	1	12058	8861
Aug	64	49	**192**	13	688	0	3561	1780	9	9	2	2	0	0	3	1	4519	1854
Sep	37	22	86	2	56	0	17	3	0	0	0	0	0	0	5	1	201	25
Oct	0	0	29	0	1	0	0	0	0	0	0	0	0	0	2	0	32	0
Nov	11	6	1	0	122	2	0	0	0	0	0	0	0	0	0	0	134	8
Dec	221	144	3	0	14	0	0	0	64	64	0	0	0	0	2	1	304	209

Table 17.12 Summary of Number of Immature Birds (IMM) Recorded on Land or Sea and Juvenile Birds (JUV) on Land

Month	Fulmar			Shag			Kittiwake			Herring Gull			Total IMM and JUV
	IMM (land)	IMM (sea)	JUV	IMM (land)	IMM (sea)	JUV	IMM (land)	IMM (sea)	JUV	IMM (land)	IMM (sea)	JUV	
Jan										8	15		23
Feb								1		33	8		42
Mar							9			85			94
Apr				7				2		9			18
May				22						46			68
Jun				11		90	3		1	39		140	284
Jul				35	1	14	2			104	18	4	178
Aug			46	96	2	14	3		1687	58	74	109	2089
Sep	1			30	2					54			87
Oct				7								3	10
Nov										4	8		12
Dec				1						4			5
Total	1	0	46	209	5	118	17	3	1688	444	123	256	2910

Table 17.13 Summary of number of key seabird species recorded within the 100m and 200m buffer zones from HDD landfall site. Proportion of birds recorded in relation to the Buchan Ness to Collieston Coast SPA count is shown in brackets as a percentage (JNCC counts, unknown date).

Month	Fulmar AOS		Kittiwake AON		Guillemot total		Razorbill total		Herring gulls AON		Shag AON	
	100m (%)	200m (%)	100m (%)	200m (%)	100m (%)	200m (%)	100m (%)	200m (%)	100m (%)	200m (%)	100m (%)	200m (%)
January	0	3 (0.22)	0	0	0	230 (1.19)	0	0	0	0	0	0
February	3 (0.22)	8 (0.58)	0	0	0	412 (2.14)	0	0	0	16 (0.52)	0	0
March	3 (0.22)	9 (0.65)	0	81 (0.65)	0	524 (2.72)	0	24 (0.57)	4 (0.13)	61 (1.98)	0	9 (2.72)
April	6 (0.43)	16 (1.15)	0	88 (0.70)	0	352 (1.82)	0	145 (3.47)	0	21 (0.68)	0	14 (4.23)
May	4 (0.29)	6 (0.29)	0	176 (1.40)	0	422 (2.19)	0	194 (4.64)	0	42 (1.36)	0	12 (3.63)
June	5 (0.36)	10 (0.36)	0	153 (1.22)	0	482 (2.50)	0	185 (4.43)	0	48 (1.56)	0	19 (5.74)
July	8 (0.58)	12 (0.58)	0	186 (1.48)	0	2 (0.01)	0	182 (4.36)	2 (0.06)	4 (0.13)	0	4 (1.21)
August	1 (0.07)	1 (0.07)	0	145 (1.15)	0	0	0	0	0	0	0	0
September	0	0	0	0	0	0	0	0	0	0	0	0
October	0	0	0	0	0	0	0	0	0	0	0	0
November	0	0	0	0	0	0	0	0	0	0	0	0
December	1 (0.07)	1 (0.07)	0	0	0	0	0	0	0	0	0	0

Table 17.14 Summary of number of key seabird species recorded within 200m buffer zone from the HDD exit point. Proportion of birds recorded in relation to the Buchan Ness to Collieston Coast SPA count is also shown as a percentage.

	Fulmar AOS		**Kittiwake AON**		**Guillemot total**		**Razorbill total**		**Herring gulls AON**		**Shag AON**	
	200m	Proportion	200m	Proportion	200m	Proportion	200m	Proportion	200m	Proportion	200m	Proportion
January	0	0	0	0	230	1.19	0	0	0	0	0	0
February	0	0	0	0	0	0	0	0	14	0.45	0	0
March	0	0	41	0.33	412	2.14	16	0.38	31	1.01	7	2.11
April	1	0.07	26.5	0.21	524	2.72	105	2.51	12	0.39	10	3.02
May	0	0	76	0.61	352	1.82	104	2.49	26	0.84	12	3.63
June	0	0	25	0.20	422	2.19	108	2.58	30	0.97	14	4.23
July	0	0	92	0.73	482	2.50	118	2.82	2	0.06	4	1.21
August	0	0	66	0.53	2	0.01	0	0	0	0	0	0
September	0	0	0	0	0	0	0	0	0	0	0	0
October	0	0	0	0	0	0	0	0	0	0	0	0
November	0	0	0	0	0	0	0	0	0	0	0	0
December	0	0	0	0	0	0	0	0	0	0	0	0

Figure 17.2 presents a summary of the year-round seabird survey data with total breeding sites being recorded in each month and the total number of adults recorded on the cliffs which will include breeders and loafers. The results demonstrate that seabirds were recorded as being present along the cliffs in large numbers particularly in the breeding period from March-August. The maximum number of birds recorded in one survey month was in June where 12, 500 adults (approximately 9,900 breeding sites) were recorded. In the non-breeding period, the maximum number of birds recorded in any one month was in January when 3,660 individuals were recorded, 3000 of which were guillemots. Certain seabird species are known to return during the non-breeding period, most likely in relation to maintaining a territory over the nest site for the subsequent breeding season. Visits to the colony over the non-breeding period may also relate in part to reaffirming pair bonds, or as a way to meet potential new mates. When birds return to their colonies over the non-breeding period they are not as tied to their nest site as they are during the breeding period.

September to December shows there is a lower seabird presence in these months, but in January numbers rise again. The peak months for numbers of breeding birds (as shown in the blue in Figure 17.2) are May (8725), June (9819) and July (8861). This confirms the information gathered for Table 17.10 that these months are the busiest ones for the breeding period. In May, most seabird species will be egg laying and therefore incubating (Table 17.8). In June and July, these are key chick-rearing periods (Table 17.8).

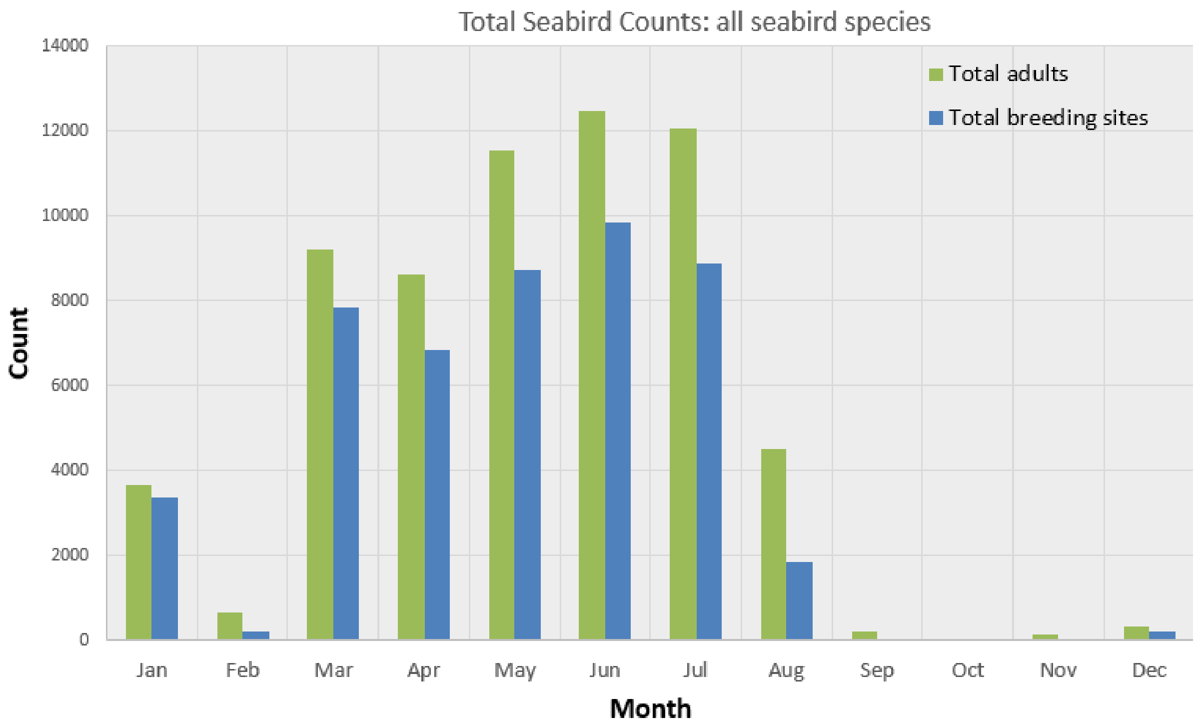

Figure 17.2 Total number of breeders (GreenBlue) and adult loafing birds (GreenBlue) recorded across the entire 3km stretch of coastline, per month.

17.5.3.2 Guillemot

Guillemots are the most numerous of the species recorded both on land and at sea. They return in large numbers in January, with their peak number in March (the pre-laying period) (Figure 17.3). From August to December they are not present on the cliffs or are present only in very small numbers (Figure 17.3). At sea, guillemots were recorded from at least one vantage point in all 12 survey months. In

May, June and July there were 378, 405 and 817 birds recorded on sea, respectively. No immature guillemots were recorded on land or on sea. A total of 7 juveniles were noted in August.

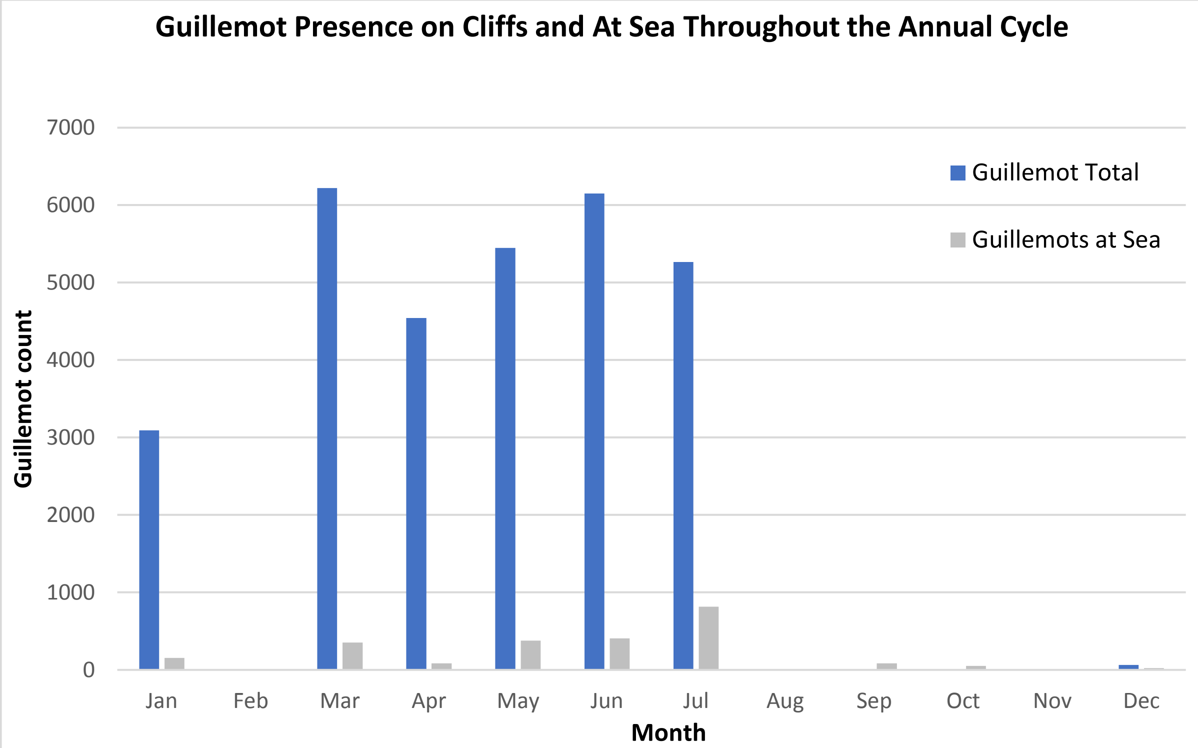

Figure 17.3 Total Number of Guillemots Recorded each Month

Appendix F.1, Figures 7 and 8 show the spatial distribution of the guillemots during both breeding and non-breeding periods. There are dense patches of breeding guillemots present, with two offshore stacks having the largest number of guillemots recorded out of all the areas (area 2P and 2V with 2550 and 1075 birds respectively). A further stack to the south of the landfall site in area 3B also had a large number of guillemots recorded during the breeding period (512). No guillemots were recorded breeding within 100m of the landfall site during the breeding period.

In the non-breeding period, most guillemots are recorded in area 2P, with 1804 being recorded. Stacks at 2V and 3B also recorded the second and third highest numbers of 520 and 230 respectively. No guillemots were recorded in the areas adjacent to the landfall site in the non-breeding period.

Guillemots were recorded in higher numbers in the morning compared to the afternoon or evening time (Figure 17.4 and Appendix F.2). These differences between times of day and the numbers recorded were statistically significant ($F_{(2,1073)}$=7.00, p<0.001). Post-hoc tests revealed that differences between numbers recorded in the evening and afternoon were not statistically significant across the whole year (Tukey HSD p=0.849), but differences were significant between the morning and the afternoon (Tukey HSD p=0.001) and the morning and the evening (Tukey HSD p=0.010).

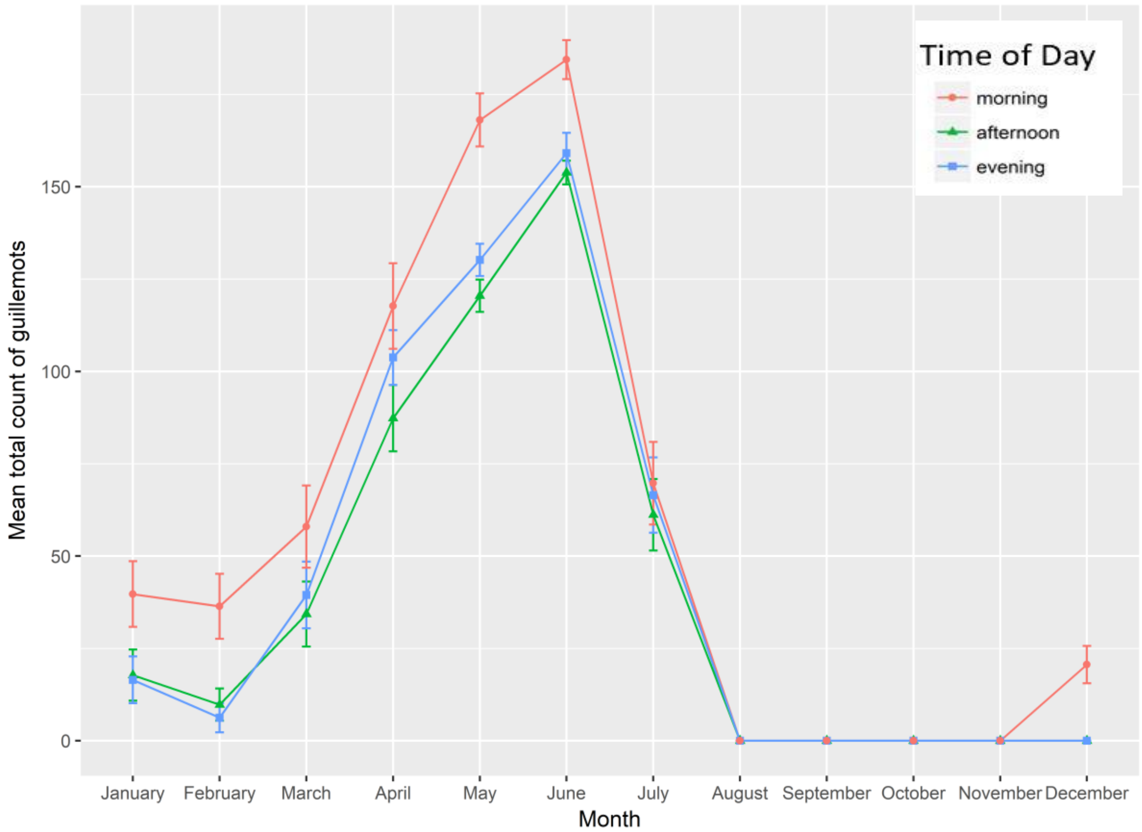

Figure 17.4 Diurnal differences in guillemot presence from time lapse camera study.

17.5.3.3 Kittiwake

Kittiwakes were the second most numerous species recorded during the surveys, both on land and on sea with adults being present from March to August. Immatures were also noted throughout the breeding season sporadically between March and August. A large number (1687 individuals) of juveniles were recorded in August. The vantage point surveys recorded them on the sea between March and September; April had the peak number of individuals recorded on the sea with 344 individuals noted.

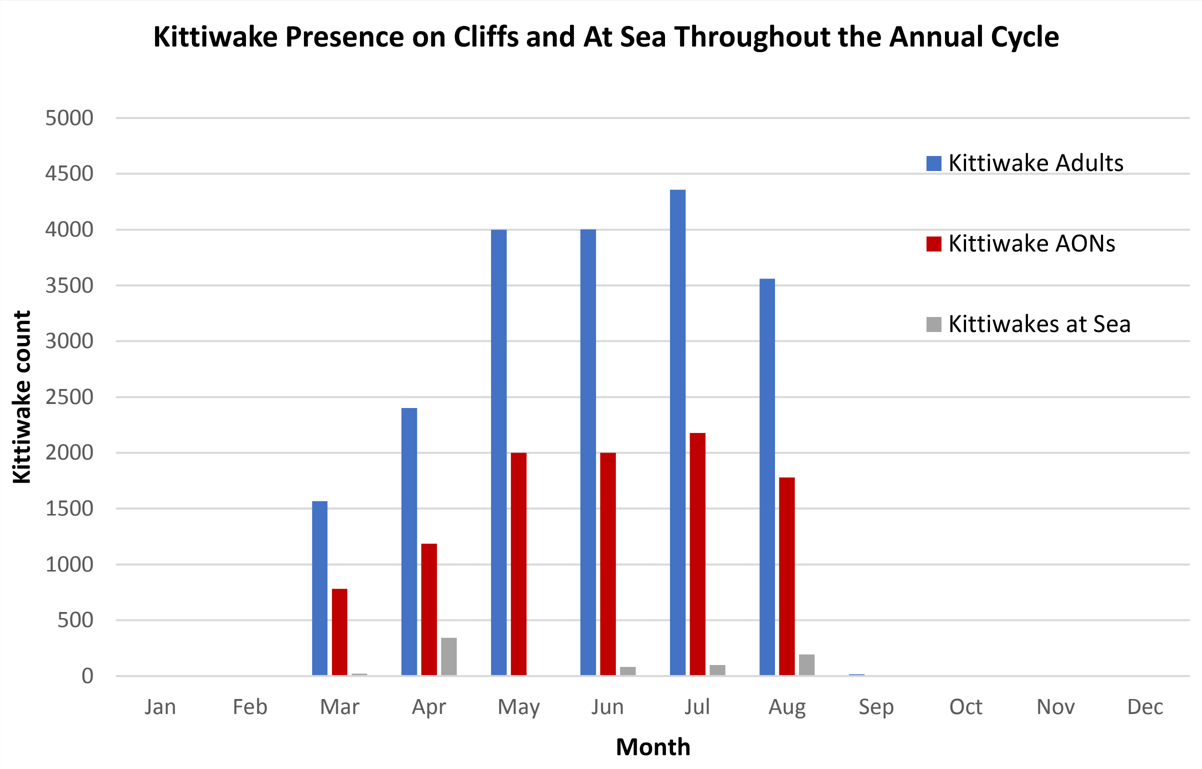

Figure 17.5 Total number of kittiwakes recorded during the year-long survey.

Appendix F.1, Figure 9 shows the spatial distribution of the kittiwakes during the breeding period. The densest areas of breeding kittiwakes within the landfall radii were areas 2N, 2O, 2P and 3F. Kittiwakes are well distributed around the coastline, with very few areas having no kittiwakes recorded. A maximum of 186 kittiwake sites were recorded in the areas within 200m of the landfall site, with the densest patch being 75 sites in area 2X. No kittiwakes were recorded within 100m of the landfall. Kittiwake juveniles were also noted in the area adjacent to the landfall: in area 2W there were 10 recorded and in area 2X there were 59 during August.

For kittiwakes, in the pre-laying period (March and April), numbers of birds recorded were found to be significantly different between different times of the day ($F_{(2,179)} = 7.33$, $p < 0.001$) (Figure 17.6). Further analysis revealed that fewer birds were recorded in the morning compared to both the afternoon (Tukey HSD p=0.02) and the evening (Tukey HSD p<0.001). In the main breeding period (May-July), once again there were significant differences between the times of day the birds were recorded ($F_{(2,265)}=5.63$, $p=0.004$). In contrast to the pre-laying period, more birds were recorded in the morning compared to the afternoon (Tukey HSD p=0.004) or the evening (Tukey HSD p=0.046).

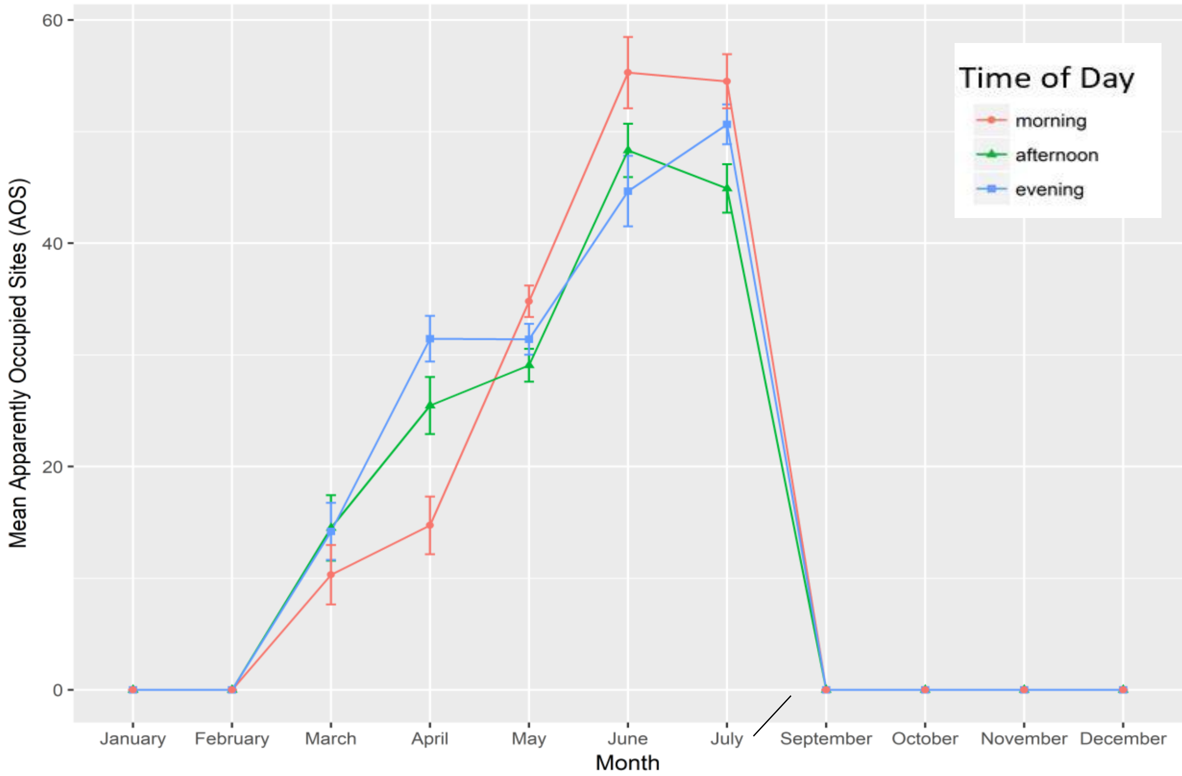

Figure 17.6 Diurnal differences in kittiwake presence from time lapse camera study.

17.5.3.4 Fulmar

Figure 17.7 reveals that fulmars are present throughout the year. Fulmars start to return to the site from November onwards. Fulmar were recorded from the VPs in all months, except October and November. The highest combined counts for fulmar were in December (125 individuals) and January (127 individuals). Only 1 immature fulmar was noted across the whole survey year and 46 juveniles were noted during August (Table 17.12), which is the month when fulmar fledglings leave the breeding site.

Appendix F.1, Figures 3 and 4 show the spatial distribution of the fulmars during both breeding and non-breeding periods. In the breeding period, the densest number of breeding sites was recorded in area 2P, a stack just off the cliffs, with 80 sites noted. From area 2N to 2S there were between 11 and 23 nests recorded in each area. There were a number of sections which had 0-5 nests recorded per area.

During the non-breeding period, the densest patch of fulmars utilising coastline were once again recorded in area 2P, a stack just off the cliffs. Areas 2N and 2R were the next densest parts of the cliff with 33 and 27 sites being recorded respectively.

In the non-breeding period, 3 fulmars were noted in area 2Z. This revealed that the areas adjacent to the landfall site do not hold large numbers of fulmars either during the breeding or non-breeding period.

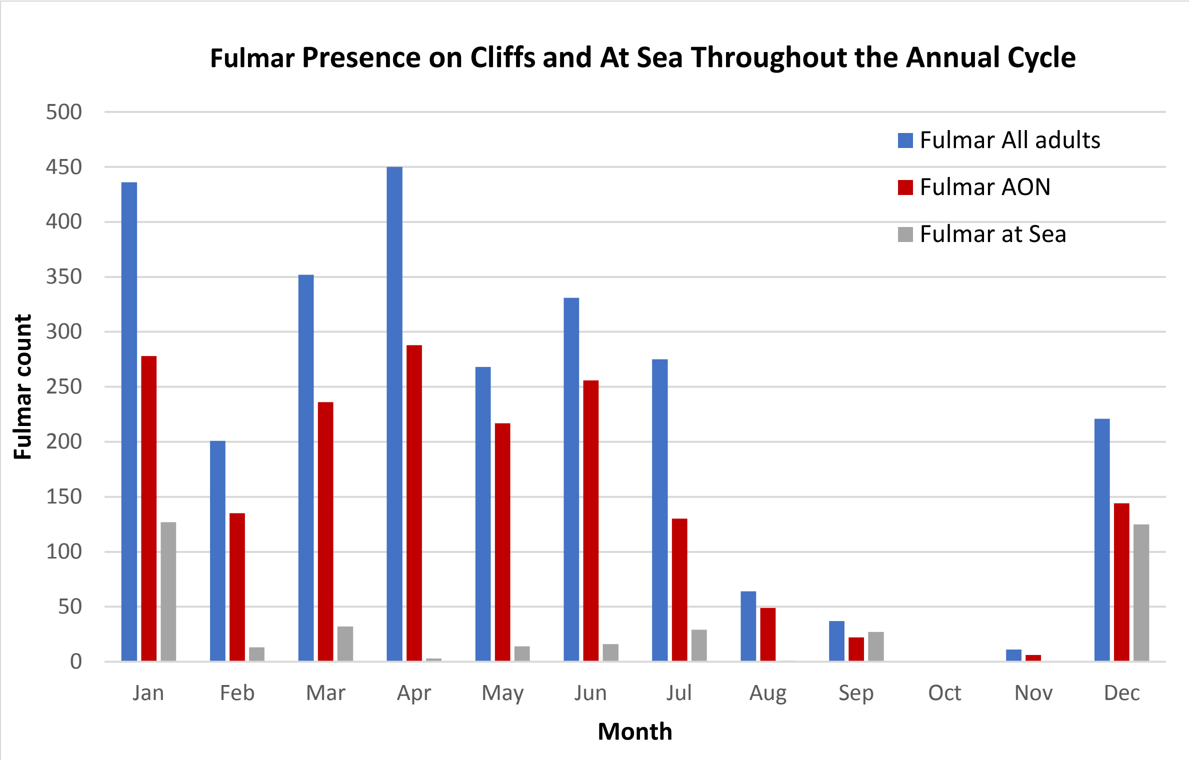

Figure 17.7 Total number of fulmars present through the year from the surveys.

For fulmars, there were significant differences between when birds were recorded during the day, across the whole year ($F_{(2,961)}$=5.48, p=0.004). In every month except June they were recorded in higher numbers during the evening than earlier in the day (Figure 17.8). This difference was significant (Tukey HSD evening-morning: p=0.004; Tukey HSD evening-afternoon: p=0.04). This difference was more pronounced during the non-breeding period (September to February).

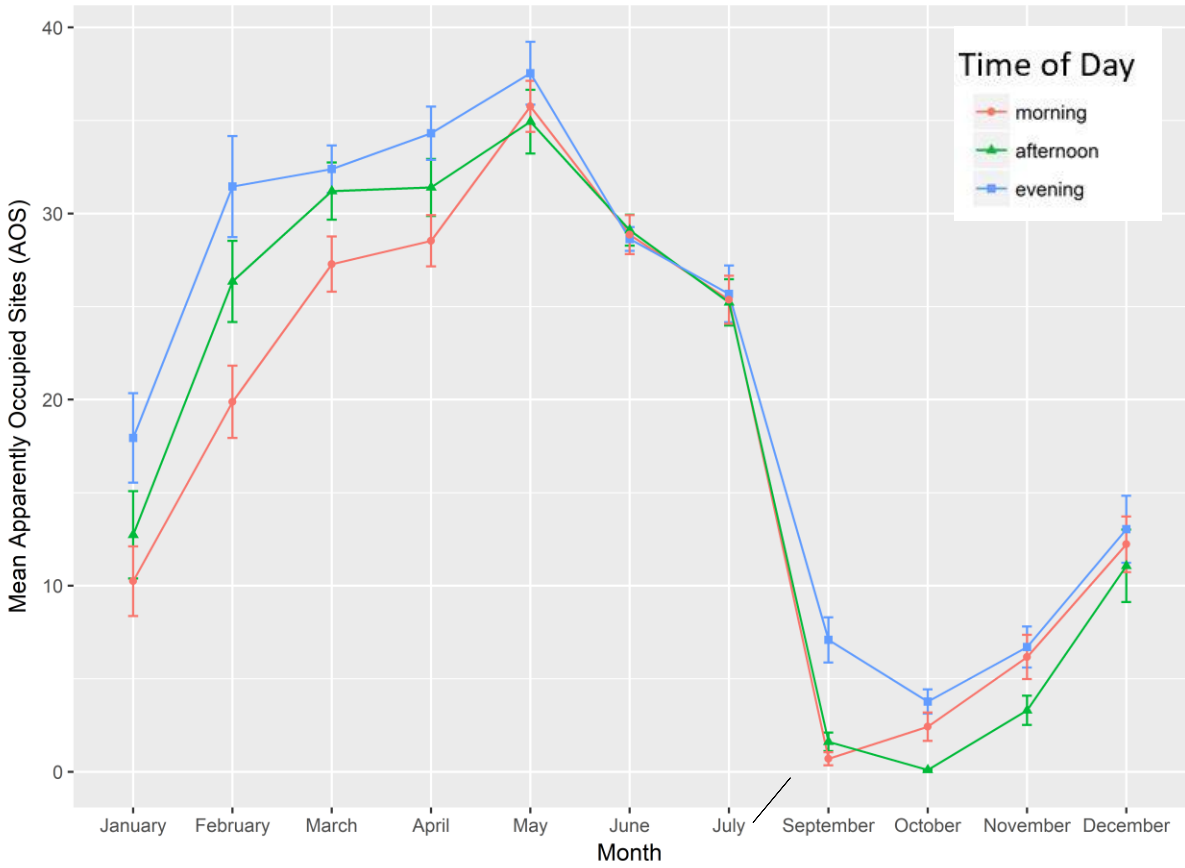

Figure 17.8 Diurnal differences in fulmar presence from time lapse camera study.

17.5.3.5 Razorbill

Razorbills were present on the cliffs from March until July, and not present at all during the non-breeding period. Razorbill was the third most numerous species seen from the vantage point surveys at sea. Most razorbills were seen on the water between April and September, although none were recorded in August. September saw their peak with 200 individuals recorded.

Appendix F.1, Figure 6 shows the spatial distribution of the razorbills during the breeding period. The densest patches of breeding razorbills were recorded in the offshore stack area 2P (132 pairs), 2N (80 pairs), 3B (96 pairs) and 3C (66 pairs). Razorbills were scattered along the coastline, with numbers varying around the coastline. No razorbills were recorded breeding in the area adjacent to the landfall area (within 100m). However, within 200m of the landfall more razorbills were recorded, over half of which within area 3A.

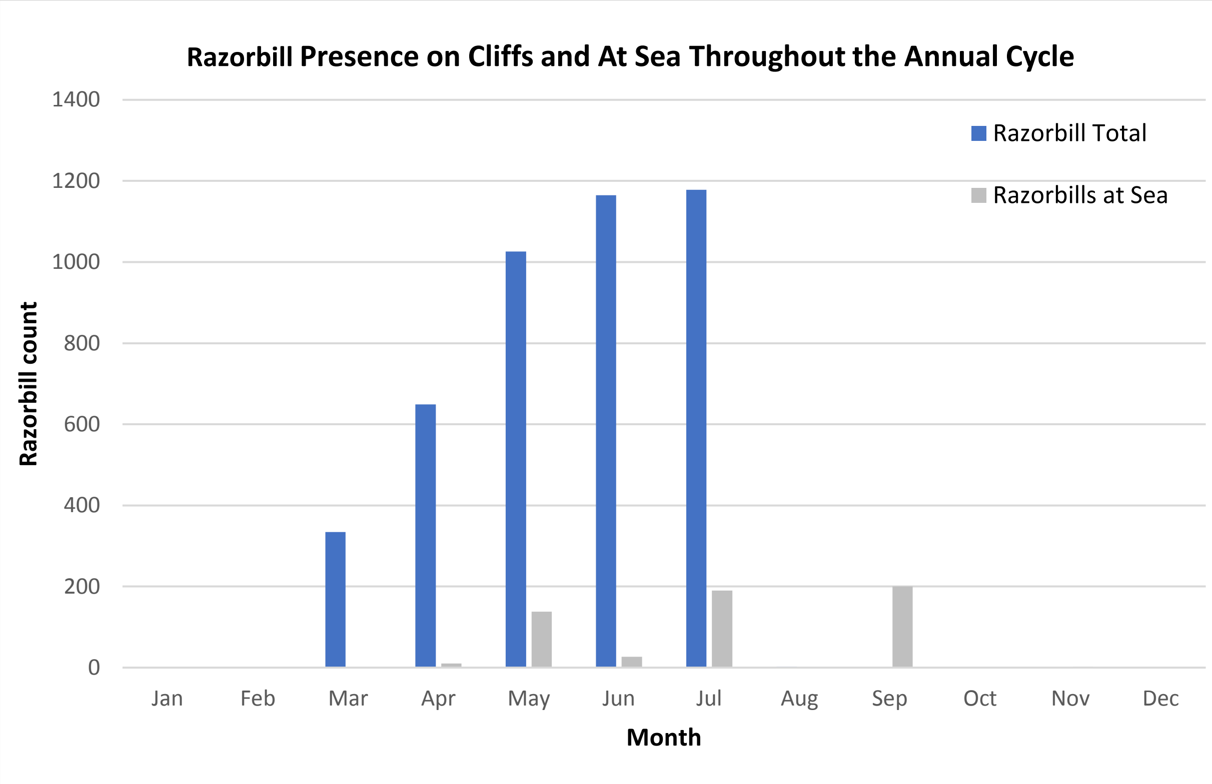

Figure 17.9 Razorbill total numbers throughout the annual cycle.

17.5.3.6 Herring Gull

Herring gull adults were recorded on land and on sea in all months except October. Immature herring gull were also observed in every month except October, with a peak being seen in August. Juvenile herring gulls were recorded most commonly between June and August (Table 17.12). Herring gull was the third most numerous species recorded during the vantage point surveys. They were recorded in eight monthly counts, and consistently between April and July. The largest combined monthly total was in June Figure 17.10.

Appendix F.1, Figures 10 and 11 show the spatial distribution of the herring gulls during both breeding and non-breeding periods. In the breeding period, within the distance radii herring gulls were recorded in greatest numbers on three stacks just off the cliffs: in area 2P (45 nests), area 2V (33 nests) and area 3B (30 nests). During the non-breeding period the two areas with the highest numbers recorded are once again area 2P (29 birds) and 3B (14 birds).

During the breeding period in the areas adjacent to the landfall (within 100m) had a maximum of 4 nests. No herring gulls were recorded as being present in the areas directly adjacent to the landfall site during the non-breeding period. On visits to the landfall site during ground investigations work (January and February 2018), herring gulls were noted using the stack off the cliffs in area 2Y.

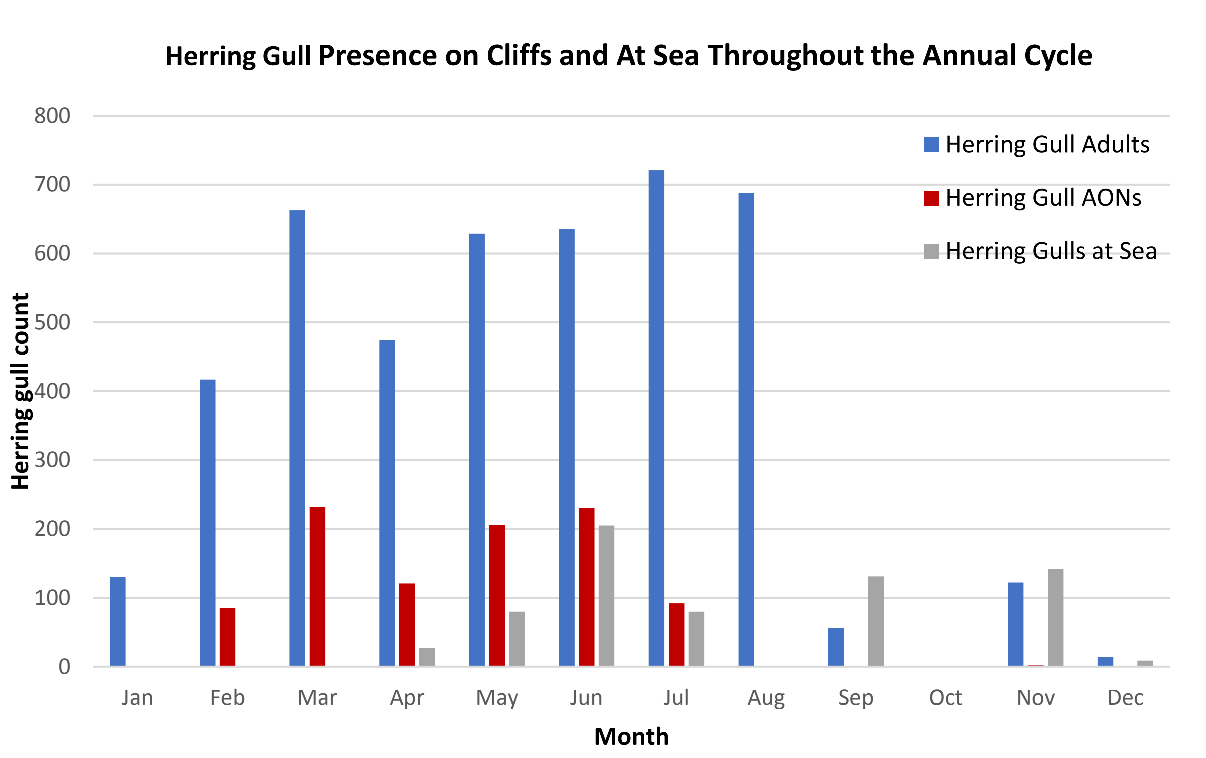

Figure 17.10 Herring gull total numbers throughout the year.

17.5.3.7 Shags

Shags were present on the cliffs in greatest numbers between May and August. They were present over the non-breeding period, though from October to March in very low numbers (Figure 17.11). Juvenile shags were noted between June and August, immature shags from April until October (Table 17.12). Shags were less numerous than the other main target species in the vantage point surveys but were recorded on the sea in all months except May, and in October only 1 individual was recorded. December had the peak number recorded at sea with 22 individuals noted.

During the breeding period low numbers of shags were recorded within proximity to the landfall site. In area 3B there were 14 breeders recorded. Only one other area had more than 5 shags breeding with area 2N being recorded as having 8 breeders. Juvenile shags were also recorded during the breeding period, with the maximum being recorded in area 3B, with 20 juveniles recorded. No breeding or non-breeding shags were recorded in areas adjacent to the landfall site. No juvenile shags were recorded in these areas either.

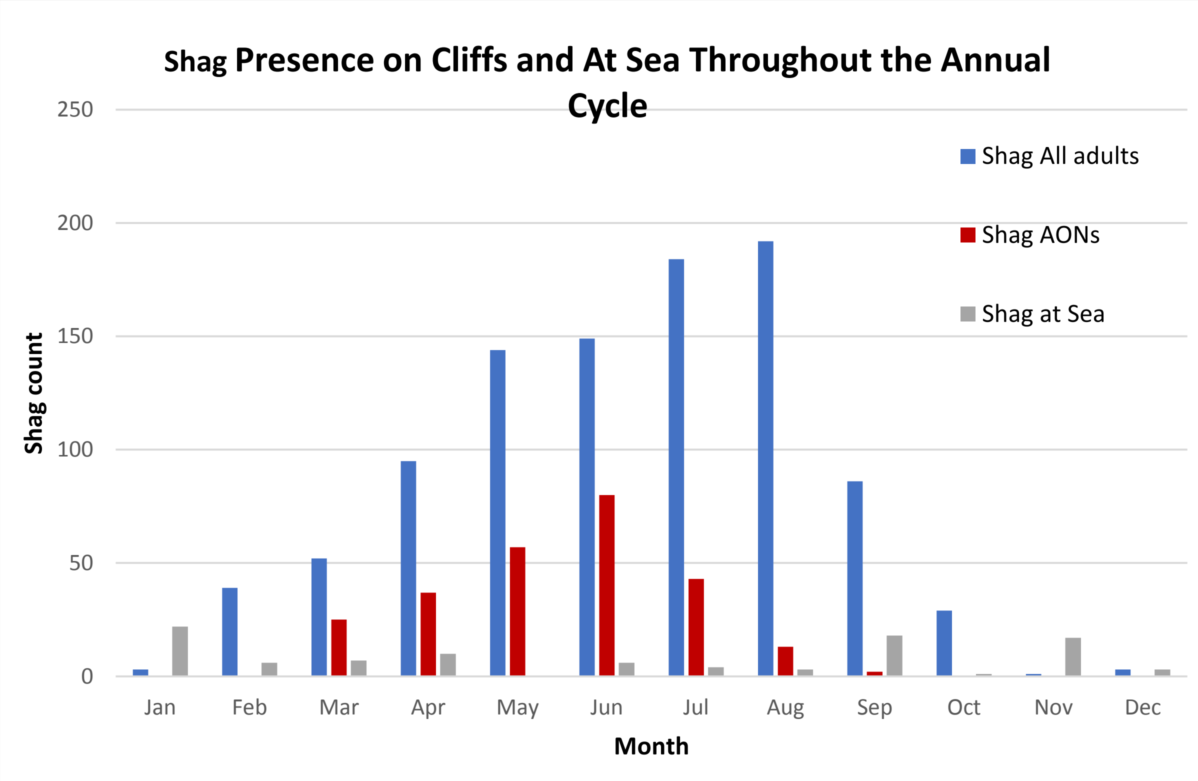

Figure 17.11 Shag presence throughout the year recorded from the surveys.

17.5.3.8 Other Species Recorded

The main target species (fulmar, shag, guillemot, kittiwake, herring gull and razorbill) were the most frequently recorded species. A small number of other species were recorded using the cliffs, including puffins, great black-backed gulls and lesser black-backed gulls.

Other species recorded during the vantage point surveys included: cormorant, eider, red-throated diver, northern gannet, puffin, lesser black-backed full and great black-backed gull. Gannets were recorded in four of the monthly counts; puffin were recorded consistently between April and August; great black-backed gull was recorded in six of the monthly counts. Species' total annual counts were of less than ten individuals for: red-throated diver and lesser-black backed gull. A maximum of 12 eider were recorded during the non-breeding period. Cormorants were recorded in low numbers throughout the year (between 1-7 individuals), and on one survey in October 22 individuals were recorded.

For a full break-down of what species were recorded at sea, see Appendix F.2, Table A3.

17.5.3.9 Summary of Qualifying Features of Designated Sites

Each of the qualifying features of the designated sites related to seabird receptors which are taken forward for assessment are shown in Table 17.15. Buchan Ness to Collieston Coast SPA and Bullers of Buchan Coast SSSI are taken into consideration concurrently as the SSSI sits within the SPA. Similarly, the Scottish Wildlife Trust Longhaven Cliffs Reserve is taken into consideration within the Buchan Ness to Collieston Coast SPA. For Buchan Ness to Collieston Coast SPA, the maximum count of nest sites recorded during the breeding period (defined as March-September) is used for the assessment of the designated sites, as it is breeding seabirds that the qualifying features are designated for. For seabird assemblage (*) assessment the combined maximum totals of each seabirds designated under the assemblage qualification is used and compared against the estimated number of seabirds at the designated site, taken from JNCC count data.

For the designated sites outwith the HVDC corridor, a different approach was taken. SNH provides guidance on apportioning impacts from marine renewable development to breeding seabird populations in special protected areas (SNH, 2016a). The apportioning technique is more relevant for marine developments such as windfarms, which will have potential long-lived operational effects on seabird populations from different SPAs. In the case of the NorthConnect project, the main effects on the seabird will not be during operations but will be during the installation phase. Nevertheless, we have carried out an approximate apportioning for the scoped-in species from the designated sites to obtain an estimated number of birds from other sites which may be in contact with the HVDC cable corridor during installation

The apportioning technique involves weighing by colony size, by distance from the colony, and by sea area available. For our assessment of the Buchan Ness to Collieston Coast SPA we used the most recent data publicly available, which is from 2007 (JNCC, 2018a). For our assessment of the designated sites outwith the cable corridor the species total counts from the most recent Seabird Monitoring Programme (JNCC, 2018a) were used to assess proportions of birds potentially within the development vicinity. The Great Britain and Ireland population totals on the latest JNCC species accounts pages uses totals from Lloyd et al., 1991. Table 17.15 totals uses Seabird 2000 UK census totals instead as these are more up to date values (Mitchell, Newton, Ratcliffe, & Dunn, 2004).

The distance we calculated by measuring the nearest distance from the cable corridor to the designated site centre (Drawing 0005-01). For the weighting by sea area for simplicity purposes it was kept it at 0.50 for all designated sites.

For all the designated sites we calculated the maximum number of nest site counts (or predicted numbers of birds from other sites) as a percentage (%) of the designated site total. The maximum number of nest sites counts were taken from on land data (i.e. no data from sea counts were used), as shown in Table 17.11, and includes all areas of the seabird count sections.

Table 17.15 Designated sites predicted proportion of breeding species' totals.

Site	Species	Max nest site count from surveys (site 1) or predicted proportioning (sites 2-5)	Site total (JNCC counts)	Latest site count year	GB and Ireland population total (Seabird 2000)	% of site total	% GB and Ireland population total
1.	**Buchan Ness to Collieston Coast SPA and Bullers of Buchan Coast SSSI**						
	Fulmar	288	1389	2007	538,000	20.7	0.05
	Guillemot	6219	19,296	2007	1,000,000	32.2	0.62
	Herring Gull	232	3079	2007	150,000	7.5	0.15
	Kittiwake	2179	12,542	2007	416,000	17.4	0.52
	Shag	80	331	2007	32,300	24.2	0.25
	Seabird assemblage*	9000	95,000	-	-	9.5	-
2.	**Troup, Pennan and Lion's Head SPA**						
	Guillemot	73	23,626	2017	1,000,000	0.30	<0.01
	Seabird assemblage*	365	150,000	-	-	0.24	-
3.	**Fowlsheugh SPA**						
	Guillemot	62	55,507	2015	1,000,000	0.11	<0.01
	Kittiwake	71	9655	2015	416,000	0.73	0.02
	Seabird assemblage*	347	170,000	-	-	0.20	-
4.	**Outer Firth of Forth and St Andrews Bay pSPA**						
	Seabird assemblage (breeding)	219	120500		-	0.18	
	Seabird assemblage (non-breeding)	158	87000		-	0.18	
5.	**Firth of Forth Islands SPA (max count from vantage point sea surveys)**						
	Gannet	295	75,259	2014	560,000	0.39	0.05
	Lesser black-backed gull	25	2047	2014	117,000	1.22	0.02
	Puffin	180	46,200	2013	601,000	0.38	0.03
	Seabird assemblage*	122	90,000		-	0.14	-

17.5.4 Summary of Timing Sensitivities of Avian Ecological Receptors

The timing sensitivities of the different avian receptors considered both the guidance documentation (SNH, 2017b) as well as the data gathered from the bird surveys carried out. Figure 17.12 relates the timing sensitives to the indicative timings of when the various cable installation activities will take place. The months during which the works could potentially take place are assigned a blue box. The shaded box during March for the offshore cable pull is when onshore preparation works are likely to take place; the cable pull itself is predicted to be in April or August. The bird colours relate to:

- Red: most sensitive time period and when the largest numbers of the species were present;
- Orange: when the species is still expected to be present but are not in the most sensitive time period; and
- Green: when the species is either not present at all on the site or is present is very low numbers (less than 10% of the maximum number of the species recorded).

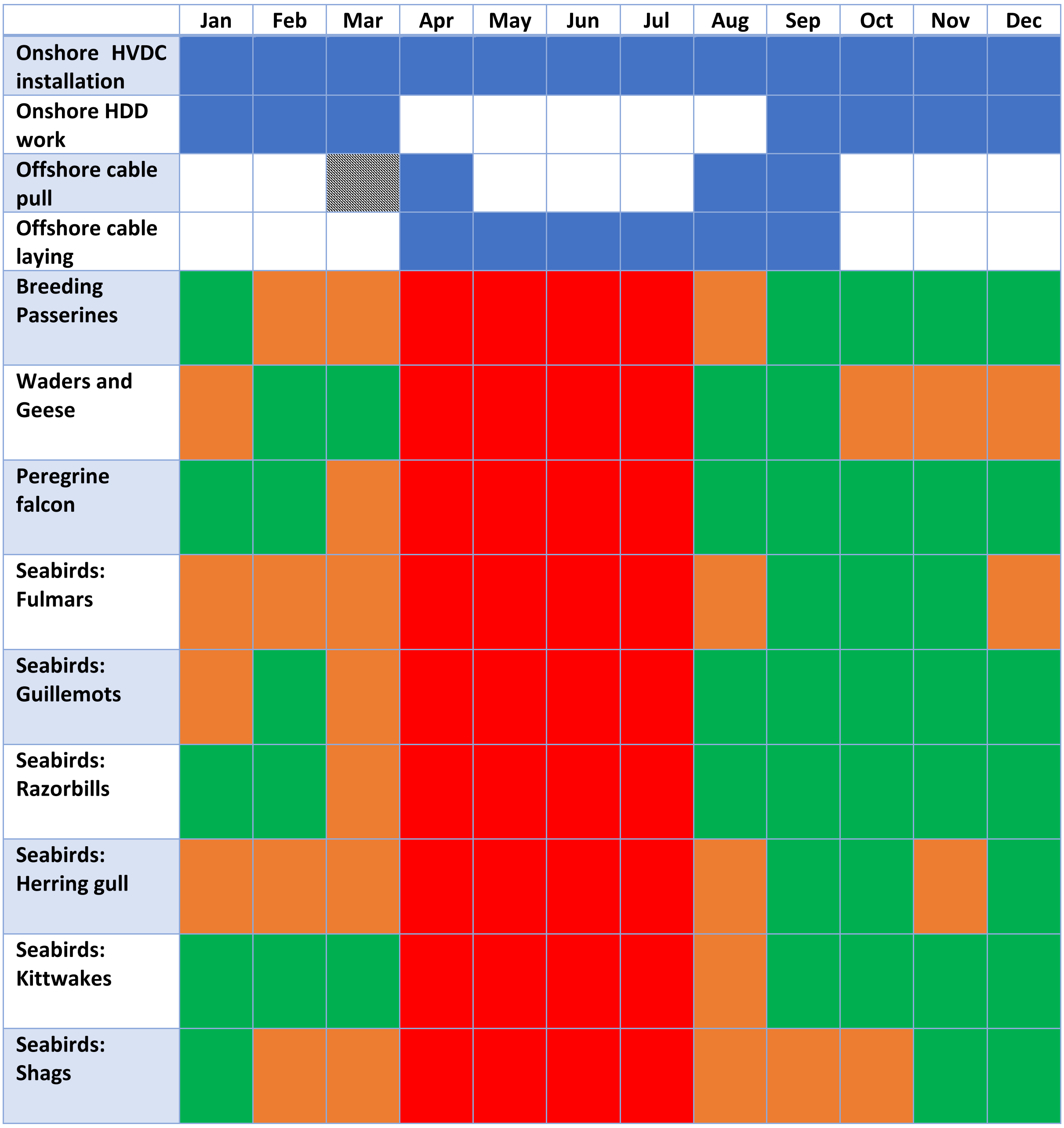

Figure 17.12: Bird Sensitivity and Construction Work Timing

As the cable laying may occur over the peak breeding months, the worst-case scenario will be taken forward for assessment of this activity that birds, both terrestrial and marine, may be disturbed during their breeding period.

17.5.5 Summary of Bird Species Recorded and their Conservation Status

Table 17.16 presents a summary of all the bird species recorded during all of the bird surveys, along with their conservation status. The maximum number recorded for each bird species is given. Their status in Britain relates to RB=Resident Breeder; WM=Winter Migrant; and MB=Migrant Breeder. IUCN codes relate to NT=Near Threatened and V=Vulnerable.

Table 17.16 Summary of birds recorded during all bird surveys.

BTO Code	Common Name	Scientific name	Status in Britain	Maximum number of individuals recorded	IUCN Red List	EU Birds Directive: Annex 1	Schedule 1 Wildlife & Countryside Act 1981	Scottish Biodiversity List	Birds of Conservation Concern (BoCC)
B.	Blackbird	*Turdus merula*	RB,WM	1					
BH	Black-headed gull	*Chroicocephalus ridibundus*	RB,WM	1				X	Amber
BO	Barn owl	*Tyto alba*	RB	1 pellet			X		
BZ	Buzzard	*Buteo buteo*		1					
CA	Cormorant	*Phalacrocorax carbo*	RB,WM	22					
CU	Curlew	*Numenius arquata*	RB,WM	33	NT			X	Red
D.	Dunnock	*Prunella modularis occidentalis*	RB	7				X	Amber
E.	Eider	*Somateria mollissima*	RB,WM	12	NT				Amber
F.	Fulmar	*Fulmarus glacialis*	RB,WM	450					Amber
GB	Great black-backed Gull	*Larus marinus*	RB,WM	7					Amber
GO	Goldfinch	*Carduelis carduelis*	RB	7					
GU	Common Guillemot	*Uria aalge*	RB,WM	6219					Amber
GX	Gannet	*Morus bassanus*	RB,WM	10					Amber
HG	Herring gull	*Larus argentatus argenteus*	RB,WM	721				X	Red
HS	House sparrow	*Passer domesticus*	RB	1				X	Red
K.	Kestrel	*Falco tinnunculus*	RB,WM	3				X	Amber
KI	Kittiwake	*Rissa tridactyla*	RB,WM	4358					Red
L.	Lapwing	*Vanellus vanellus*	RB,WM	4	NT			X	Red
LB	Lesser black-backed gull	*Larus fuscus*	RB,WM	3					Amber
LI	Linnet	*Linaria cannabina*	RB,WM	4				X	Red
LR	Lesser redpoll	*Acanthis cabaret*	RB,WM	2				X	Red
MX	Manx shearwater	*Puffinus puffinus*	MB	1				X	Amber
NX	Great skua	*Stercorarius skua*	MB	1					Amber
OC	Oystercatcher	*Haematopus ostralegus*	RB,WM	5	NT				Amber
PE	Peregrine	*Falco peregrinus*	RB,WM	5		X	X	X	
PG	Pink-footed goose	*Anser brachyrhynchus*	WM	45					Amber
PU	Puffin	*Fratercula arctica*	RB,WM	71	VU				Red
RA	Razorbill	*Alca torda*	RB,WM	1178	NT				Amber
RB	Reed bunting	*Emberiza schoeniclus*	RB,WM	3				X	Amber

BTO Code	Common Name	Scientific name	Status in Britain	Maximum number of individuals recorded	IUCN Red List	EU Birds Directive: Annex 1	Schedule 1 Wildlife & Countryside Act 1981	Scottish Biodiversity List	Birds of Conservation Concern (BoCC)
RH	Red-throated diver	*Gavia stellata*	RB,WM	2		X	X	X	
RK	Redshank	*Tringa totanus*	RB,WM	2					Amber
RN	Raven	*Corvus corax*	RB	3					
S.	Skylark	*Alauda arvensis*	RB,WM	18				X	Red
SA	Shag	*Phalacrocorax aristotelis*	RB	192					Red
SN	Snipe	*Gallinago gallinago*	RB,WM	2					Amber
ST	Song thrush	*Turdus philomelos clarkei*	RB,WM	3				X	Red
SW	Sedge warbler	*Acrocephalus schoenobaenus*	MB	1					
TS	Tree Sparrow	*Passer montanus*	RB	1				X	Red
WR	Wren	*Troglodytes troglodytes*	RB	9					
WW	Willow warbler	*Phylloscopus trochilus*	MB	4					Amber
Y.	Yellowhammer	*Emberiza citrinella*	RB,WM	8				X	Red

17.6 Impact Assessment

17.6.1 Valuation of Key Receptors

This section provides a summary of the evaluation of the nature conservation interests identified from the field surveys and desk top study.

Table 17.17 Summary of Evaluation of Nature Conservation Interests.

Ecological Receptor	Evaluation Rationale	Site Ecological Receptor Value
Designated Sites for Nature Conservation		
Buchan Ness to Collieston Coast SPA (includes marine extension)	The HVDC cables will pass under the cliffs by Buchan Ness to Collieston Coast SPA and the cable exit point offshore will be within the SPA's marine extension zone.	International
Bullers of Buchan Coast SSSI	The HVDC cables will pass under the cliffs by Buchan Ness to Collieston SPA, within which the Bullers of Buchan Coast SSSI sits.	National
Collieston to Whinnyfold Coast SSSI	This SSSI is further down the coast, but is part of the Buchan Ness to Collieston Coast SPA. As such, this SSSI is assessed within the SPA.	National
Ythan Estuary, Sands of Forvie and Meikle Loch SPA/Sands of Forvie and Ythan Estuary SSSI	The HVDC cable corridor and landfall site are approximately 20km from the designated site. No tern species were recorded in any of the seabird surveys, so the proposed development area is not thought to be utlised by these species. They are therefore excluded from further assessment. No non-breeding lapwings were recorded during the migrant surveys and a maximum of two redshanks and 12 eiders were recorded.The designated waders and eiders are therefore excluded from further assessment based on small numbers. Pink-footed geese were recorded once during the surveys in a flock of 45 birds. This species will be taken forward for assessment.	International: All scoped out except pink-footed geese.
Turbot Bank MPA	The Turbot Bank MPA is designated for sandeels; an important food source for many seabird species. This MPA was assessed within Chapter 15: Fish and Shellfish as not being adversely affected by the development, as such can be excluded from further assessment.	International: Scoped out of further assessment.
Troup, Pennan and Lion's Heads SPA	Located 60km northwest of the landfall site. Due to their foraging ranges, seabirds from this SPA could be foraging within waters close to the HVDC marine cable corridor during its installation.	International
Fowlsheugh SPA	Located 75km south of the landfall site. Due to their foraging ranges, certain seabird species from this SPA could be foraging within waters close to the HVDC marine cable corridor during its installation.	International
Outer Firth of Forth and St Andrews Bay pSPA	Located 145km south-west of the landfall site. Due to their foraging ranges, it is possible certain seabird species from the Forth Islands could be foraging within waters close to the HVDC offshore cable corridor during its installation.	International

Ecological Receptor	Evaluation Rationale	Site Ecological Receptor Value
Firth of Forth islands SPA	Located 185km south-west of the landfall site. Due to their foraging ranges, it is possible certain seabird species from the Forth Islands could be foraging within waters close to the HVDC offshore cable corridor during its installation.	International
Moray Firth pSPA	This is located 145km north-west of the landfall site and cable corridor. The breeding shag interest for this proposed SPA is the only relevant designated feature which needs evaluation. As the mean maximum breeding foraging range for shags is 14.5±3.5km this site can therefore be excluded from further assessment.	International: Scoped out of further assessment.
Other Sites		
Longhaven Cliffs Reserve	The cliffside of the Reserve is located within the SPA and as such the avian species recorded within this Reserve are assessed as part of the assessment of the SPA. The inland Reserve area, beside Station Farm and Blackhills, had no bird territories recorded inside and therefore is not considered for further assessment.	High Local: cliffside part of Reserve included.
Terrestrial bird species		
Passerines, Red list species: linnet, yellowhammer, skylark, lesser redpoll, tree sparrow, house sparrow, song thrush	These paserines are listed on the UK BAP listed species and on the red list in the UK for Birds of Conservation Concern.	Regional
Passerines, Amber list species: dunnock, willow warbler	These paserines are on the amber list in the UK for Birds of Conservation Concern.	Moderate Local
Passerines, Green list species: sedge warbler, goldfinch, blackbird, reed bunting, wren.	These species were recorded in low numbers within the bird survey area. As it is not expected that there will be a significant loss of habitat within the local region due to the HVDC cabling, and as these species are in the green list of the BoCC, they will not be considered further.	Low Local: excluded from further assessment.
Corvids: Raven	Ravens are species of least concern in the UK BAP. Therefore, they will not be considered for further assessment.	Low Local: exlucded from further assessment.
Waders, Red list: curlew, lapwing, oystercatcher	These species are on the IUCN Red list and as such should be considered in further assessment. However, the area of the landfall is not known to be an important area for any of these species and it is likely these species may be only occasional visitors to the fields.	High Local

Ecological Receptor	Evaluation Rationale	Site Ecological Receptor Value
Waders, Amber list: snipe	Snipe were recorded breeding and as they are on the Amber list of BoCC will be included for further assessment.	Moderate Local
Wader, Amber list: redshank	Redshank were recorded twice in the non-breeding period, but only 2 individuals were seen as a maximum. It is likely they are only occasional visitors to the fields. They are therefore excluded from further assessment.	Moderate Local: excluded from further assessment.
Migratory birds: geese (pink-footed geese)	Pink-footed geese were recorded only once during the bird survey in a flock of 45 birds. UK wintering population is around 360,000 birds. Small flocks of geese are most likely only occasional visitors to the fields in and close to the HVDC cable corridor. As pink-footed geese are one of the designated features of the Sands of Forvie SPA, they are included for further assessment.	High Local
Birds of prey: Peregrine falcon	Annex 1 listed species in the EU Birds Directive. However, in the UK their conservation status is Green in the BoCC. Due to their conservation status and their breeding presence within the bird survey area, they are included for further assessment.	Regional
Birds of prey: Buzzard	Buzzards are widespread and in the BoCC list are green species. Only one buzzard was recorded during the entire survey period. Therefore, this receptor will be excluded from further assessment.	Low local: excluded from further assessment
Birds of prey: Kestrel	3 Immatures were noted in September and 1 in October. 2 juvenilles were reocrded in October. No kestrel breeding sites were recorded within the survey areas. It is likely the immature birds will be passing through the site and using several fields in the area, kestrels are excluded from further assessment.	Low local: excluded from further assessment
Birds of prey: Barn owl	Schedule 1 species under Wildlife and Countryside Act. However, Barn Owls are currently green-listed in BoCC and with only one pellet being recorded in 2014 this receptor will be excluded from further assessment.	High local: excluded from further assessment.
	Seabird species	
Main seabird species: Guillemot, Kittiwake, Fulmar, Razorbill, Herring gull, Shag	These species are either in the Red or Amber list of BoCC and due to the numbers recorded will be taken forward for further assessment.	Regional
Great-black backed gull	This species is Amber on the BoCC. A maximum of 5 nest sites were recorded across the whole Seabird Survey Site. The UK breeding population is estimated as being 17,000 pairs. Due to such low numbers being recorded in relation to the overall species population size, they are excluded from further assessment.	Low Local: excluded from further assessment.

Ecological Receptor	Evaluation Rationale	Site Ecological Receptor Value
Other gull species: lesser black-backed gull, black-headed gull	Both species are on the Amber list of the BoCC. However, only one non-breeding individual of each species was recorded in the entire year-long period. These species are therefore excluded from further assessment.	Low Local: excluded from further assessment.
Other seabird species recorded breeding, Red list: puffin	A maximum of 19 active burrows were recorded within the Seabird Survey Area. As the puffin is on the IUCN Red list and the BoCC list, it will be considered for further assessment.	High Local
Other seabird species recorded breeding, Green list: cormorant	A single cormorant was noted breeding, and a maximum of of 22 non-breeders were noted within the Seabird Survey Area. As cormorants are in the green list of the BoCC, they will not be considered further.	Low Local: excluded from further assessment.
Other seabird species recorded at sea: gannet, manx shearwater, great skua	1 manx shearwater and 1 great skua were recorded across the entire year-long survey. Due to the low numbers of manx shearwater and great skua, these species will not be considered individually for further assessment.	Low local: excluded from further assessment.
Other seabird species recorded at sea: gannet	A maximum of 10 gannets were recorded at sea. Though they are only of low local value, as gannets are a designated feature of the Firth of Forth SPA, they are included for assessment.	Low Local.
Other Marine-Dependent Bird Species		
Eider	No birds were recorded breeding within the Seabird study area; a maximum of 12 were recorded on the water over the non-breeding period. In the breeding period, 1 female with 7 ducklings was recorded in July. The UK breeding population is estimated at 26,000 pairs and a UK wintering population of 60,000 birds. Due to such low numbers being recorded in relation to the overall species population size, they are excluded from further assessment.	Low local: excluded from further assessment.
Red-throated diver	2 red-throated divers were recorded in December 2016. This was the only occasion across the whole year-long survey when the divers were recorded. Though red-throated divers are an Annex 1 species, they are defined as being green in the BoCC. Their wintering population in 17,000 birds. Due to such low numbers being recorded in relation to the overall population size of this species, they are excluded from further assessment.	Low local: excluded from further assessment.

17.6.2 Installation Phase Impacts

Installation phase impacts are divided between impacts on terrestrial-based species (Section 17.6.2.1) and impacts on marine-reliant species (Section 17.6.2.2). A number of potential impacts (in the absence of secondary mitigation) have been identified in connection with the installation phase of the development, and these may be direct or indirect impacts. Note that for peregrine falcons they are included both in the terrestrial species and within the marine-dependent species under potential impacts on prey species.

Potential effects on terrestrial species:

- Habitat displacement for terrestrial species due to cable installation;
- Accidental nest site destruction during onshore cabling; and
- Disturbance due to noise, light, and human presence.

Potential effects on marine-dependent species:

- Disturbance due to vessel presence, noise, light, and human presence;
- Indirect effects on offshore prey species.
- Water quality effects offshore due to cable installation disturbance onshore: increased sediment loading causing increased turbidity during marine cable installation, and accidental pollution events.

17.6.2.1 Impacts on Terrestrial Species

There are a number of onshore activities which will potentially cause effects on the terrestrial bird species in the vicinity of the installation area. For further information on onshore construction activities, see Chapter 2: Project Description, Section 2.5.1. In summary, the onshore construction activities include: the A90 road junction and access road construction, the Road Crossing HDD site set up and HDD drilling, Joint Pits construction, Landfall HDD site set up and HDD drilling, HVDC cable laying, and the reinstatement of land.

17.6.2.1.1 Habitat Displacement

From the 2016 breeding bird survey, the bird territories most likely to be affected by any habitat displacement will be skylarks, as a total of 6 territories out of a total 18 territories were recorded as being close to the proposed A90 road junction and Access Road (Appendix F.1: Figure 13). The other species potentially affected are linnet, yellowhammer, song thrush, and snipe. For the A90 HDD site set up and drilling, the Joint Pits construction, and the HVDC cable installation, skylarks (18), linnet (4), yellowhammer (8), song thrush (3), snipe (2) and lapwing (4) all have the potential to be affected by these activities. The maximum number of confirmed territories of birds in relation to the species' overall populations in the UK are extremely low (Table 17.7). These activities may lead to a loss of habitat and disturbance of adjacent habitat for potential breeding habitat for these birds.

The cliffside HDD site set up and drilling are due to take place largely outside the breeding season. The HDD drilling work is predicted to take 4-6 months. Taking the worse-case scenario, the assessment assumes that this work is carried out over two winter periods. As the bulk of the work is expected to be carried out from October-February, there are not expected to be any effects on breeding terrestrial birds. There is the chance migratory waders, such as oystercatchers, curlew, lapwing, and pink-footed geese may be present over the winter months. However, the area by the landfall where the HDD site set up will be was not identified as an important area for them over the non-breeding period during the bird surveys. In the autumn of 2016, a flock of 13 curlew was recorded feeding in the southern end of the bird survey area with a second flock of 20 nearby, outside the bird survey area. No oystercatchers or lapwings were recorded during the migratory bird surveys. The November bird survey recorded a flock of 45 pink-footed geese in the far north of the area, but this flock was not recorded as being near the HDD site set up and drilling site.

Any migratory waders or geese are likely only to be occasional visitors to the fields. As the drilling may continue into March, two terrestrial species may have returned to establish territories: song thrush and lapwings. In the BBS only one song thrush territory was recorded and four lapwing territories, though these lapwing territories were further towards Fourfields. The drilling work will have started before the birds return to breed, but if they do return they may be displaced from their usual breeding territory. This effect would be a temporary effect over one or possibly two breeding seasons as a worst-case scenario.

The peregrine falcon pair identified during the survey have their nest more than 500m from the nearest cable installation activity (the location of which is confidential), therefore are not expected to be affected by any breeding site displacement.

For the terrestrial breeding birds of **regional** importance for the passerine species and the peregrine falcon, and of **high local** importance for the breeding wader species, are only expected to experience displacement over two breeding seasons, the magnitude of the effect is defined as being **low**. This leads to a **minor**, **non-significant** effect.

For the migratory birds, the waders and geese of **high local importance**, the effect of displacement may be over two winter periods, which is defined as being of **low** magnitude. This leads to a **negligible**, **non-significant** effect. The same effect is predicted for any pink-footed geese from the Sands of Forvie SPA which could potentially be using the fields as feeding habitat during the day. This **international** receptor is expected to be **negligibly** affected, leading to an overall **minor**, **non-significant** result.

After the HVDC cable installation has been completed the land will be reinstated to its former use of farm land. The exception to this is the Access road which will remain widened from the original access track and the extension of the existing track may remain. This will decrease the field habitat by approximately 0.7 acres, which would mean a direct loss of potential breeding habitat for the passerine and wader species. However, given the area of the remaining existing farmland and the relatively small area of the widened and extended track, this is not likely to have a long-lasting adverse effect on the breeding terrestrial species in the area. The land reinstatement is therefore assigned as being of **low** magnitude, for the **regional** to **high local** species, which leads to a **minor**, **non-significant** effect.

17.6.2.1.2 Accidental Nest Site Destruction or Abandonment

It is highly unlikely, but it is possible that the onshore cabling could lead to an accidental nest site destruction of one of the terrestrial species or the disturbance of a nearby nest site could lead to breeding site abandonment for that season. The context of the existing environment should be taken into consideration in that the fields are currently used a farmland for animals to graze on. Therefore, the birds are unlikely to nest in the middle of the fields where their nest could be destroyed by animals. It is much more likely they are using the hedgerows, nearby walls, and bushes to the side of the fields to nest in. The cable corridor red line boundary is within the fields themselves rather than at the side, so it is unlikely birds will be nesting directly within the corridor. Nevertheless, taking a precautionary approach and in the absence of any secondary mitigation, the effect on the terrestrial species of

regional value with a loss of nest being of **medium** magnitude, would lead to a **moderate**, **significant** impact.

17.6.2.1.1 Disturbance Associated with Onshore Activities

Onshore cable installation activities will give rise to disturbance associated with an increase in noise, an increase in light and the presence of humans in the area may also cause disturbance.

Noise Pollution

Noise pollution can directly cause damage to birds' physiology (Kleist, Guralnick, Cruz, Lowry, & Francis, 2018; Ortega, 2012); or indirectly affect their communication ability, depending on the bird species (Ortega, 2012). Construction noise and traffic noise have been known to have effects on birdsong, particularly on lower frequency birdsongs (Slabbekoorn & Ripmeester, 2007). Noise modelling carried out in in Chapter 22: In-air noise revealed that the existing noise environment, with the busy A90 nearby, is between 53dB by the cliffs and 64dB by the A90 during the day (Chapter 22: Table 22.6). The noisiest activity associated with the onshore works will be the HDD drilling activity (onshore landing), followed by the HDD drilling activity for the A90/disused railway (Chapter 22: Table 22.9). The noise due to these activities will be between 1 and 11dB above background levels for around 400m from the activities. This additional noise coupled with the human presence may deter terrestrial species from nesting in close proximity to the works.

Light Pollution

The working hours are predicted to be 7am-7pm for all activities except the cable pull which will be 24 hours. Therefore, it is likely lighting will be required at least at the start and the end of the day for the HVDC onshore cable installation work. For the HDD site set up and drilling work which will occur over the winter period, light will be needed for longer periods of time. For the onshore aspects of the cable pull activity, light will be required over the night time period. The lighting will be localised to the work areas and will only be required for as long as the construction takes place. Light pollution has been shown to have potential effects on birds in a number of ways: visual impairment (Raine, Borg, Raine, Bairner, & Cardona, 2007), disorientation (Evans, 1996), behavioural changes (Longcore & Rich, 2004), habitat preferences (De Molenaar, DA Jonkers , & Sanders, 2000) and foraging modifications (Santos et al., 2010). However, as the light will be localised in area, none of the terrestrial species are expected to be adversely affected by temporary, additional lighting.

Human Presence

An increase in the number of personnel on the farmland will occur due to the installation activities. This may cause disturbance in birds being put off nesting in the vicinity of activities taking place. This disturbance may be over two breeding seasons and for the HDD site set up and drilling works this will be over two winters.

Due to the temporary nature of the disturbance, and given the context of the existing environment, the disturbance effects on the terrestrial species are assigned as being of **low** magnitude, for the **regional** to **high local** species, which leads to an overall **minor**, **non-significant** effect.

The effect on the Sands of Forvie SPA on the designated terrestrial-based bird species is expected to be of **negligible** magnitude on this **international** receptor, due to the fact the noise, light, and human disturbance will be localised in nature. Therefore, this leads to be **negligible**, **non-significant** effect.

17.6.2.2 Impacts on Marine-dependent Species

There are a number of onshore and offshore activities which will potentially cause effects on the marine-dependent bird species on the cliffs and using the surrounding waters. For further information on installation activities, see Chapter 2: Project Description, Section 2.5.2. and 2.5.3.

In summary, the following activities which could affect the cliff-nesting seabirds are: the Cliffside HDD site set up and HDD drilling, cable pull set up and pull (onshore and offshore), and cable laying and protection activities at sea. Surveys of the laid cable could also cause potential temporary disturbance.

The HDD site set up is predicted to take around 6 weeks. The HDD drilling will take between 4-6months during Year 1: September-March and if required can be completed during Year 2: September-March.

The cable pull activity requires two pulls. Three different time periods over which the cable pull may take place have been identified: Year 2: April 2021, Year 2: August 2021, Year 3: April 2022. The cable pull itself will take a maximum of 7 days and will be carried out for 24 hours during each of these days.

The numbers of vessels expected for each activity is provided in Table 17.18. Cable lay vessels are typically between 120-200m long, and travel around 250-600 metres per hour. The diving support vessel may be around 20-50m and will be largely stationary above the HDD exit, potentially anchored.

Impacts as a result of the above activities will be considered in turn.

17.6.2.2.1 Disturbance Due to Onshore Cable Installation Activities

The onshore activities associated with the HVDC cable laying which may impact upon the marine-dependent bird species include: the HDD site set up activity, the HDD drilling, the cable pull site set up activity. The cable pull itself is considered in its entirety under section 17.6.2.2.2. The disturbance of these activities primarily relates to noise and light pollution, and additional human presence near the clifftop.

Noise Disturbance

Further information on the noise modelling carried out can be found in Chapter 22: Noise and Vibration (In-air). The noise modelling of the HDD onshore activities demonstrated that for the vast majority of the Buchan Ness to Collieston Coast SPA, the noise produced will be the same as background levels recorded (Chapter 22, and drawing NCFFS-NCT-X-XG-0010-07). The background level at the closest noise monitoring location to the HDD onshore activities was 53dB during the daytime, and 54dB at night. For a small section of the cliff in section 2Z, the noise is predicted to increase by approximately 10dB. Images which show the noise dissipation along the cliffs is shown in Appendix H.3, Photo 2. During the ground investigation site visits (in January and February 2018), it was noted that there were frequent helicopter noises passing overhead near to the cliffs. These occasional louder noise events, coupled with the busy A90 close by to the seabird cliffs means that the seabirds are likely to be already accustomed to some anthropogenic noise.

To minimise disturbance on the breeding seabird species, and thus decrease the risk of any breeding site abandonment as a result of disturbance, the HDD activity has been specifically scheduled to avoid the main seabird breeding season (i.e. it is to take place between September to March). As there needs to be three holes drilled in total it is possible this might take two winters to achieve. The HDD site was also designed in such a way as to be as far back from the cliffs as possible and also for the noisiest apparatus (the fluid recycling tank and recycling) to be further back from the cliffs and buffered by water storage tanks and mud pumps at either side to further reduce the noise, Figure 17.13. The distance from the noisiest apparatus to the beginning of the coastal slope is approximately 125m.

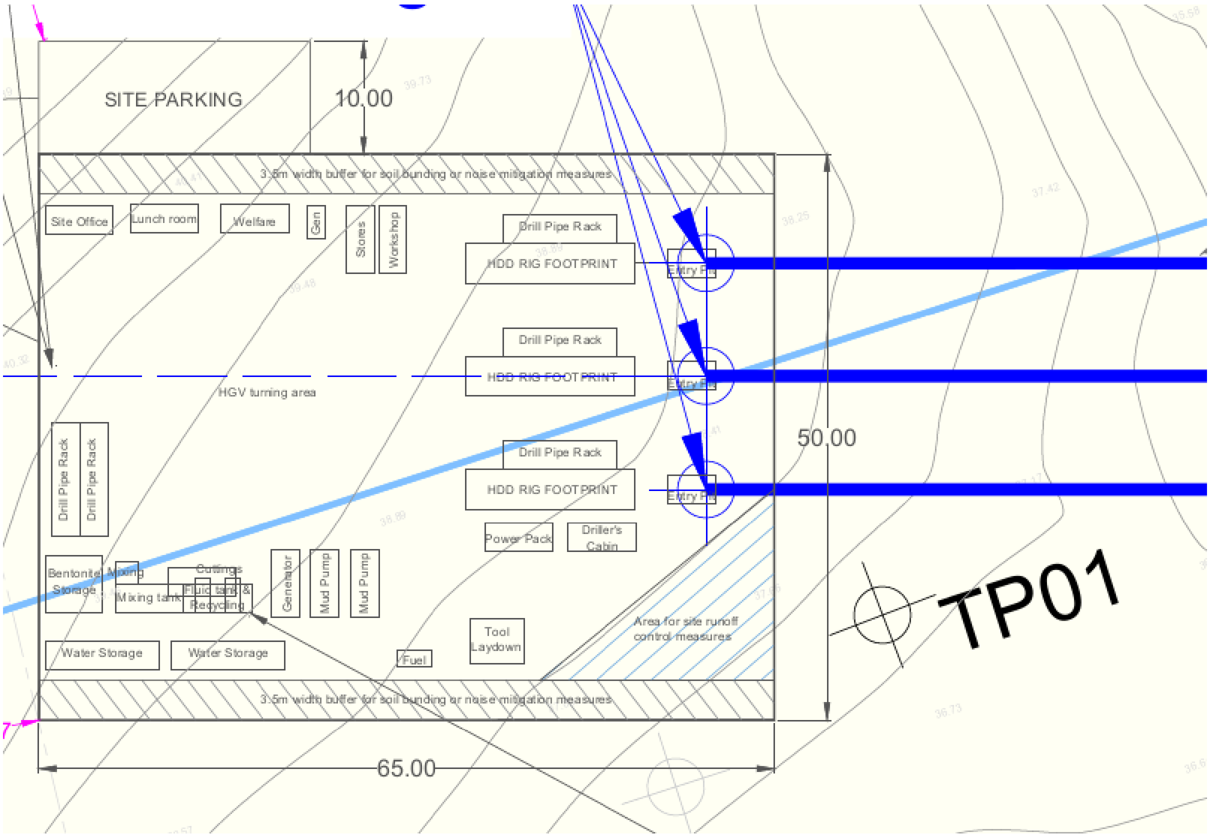

Figure 17.13 Indicative site set-up for the Landfall HDD

From the seabird colony count data, the nearest nests from the HDD site set up area are approximately 150m away. Using Drawing 0006-01 to identify which sections of the cliffs would be affected within the direct vicinity (within 100m) of the HDD land fall work, it was revealed that there are very few seabird species present over the winter months in the relevant sections (see Table 17.13, 100m totals), with only 7 fulmars and 4 herring gulls being noted in this area between September and March, and no other species present within 100m. Note that these fulmars and herring gulls were recorded in Section 2Z, the start of which is within 100m, but their nests are actually more than 150m from the HDD site set up, from field observations. Within 200m, the species most likely to be present are fulmars (21), herring gull (77), guillemot (1166), razorbill (24) and shag (9), as recorded on land during the seabird surveys.

The cable pull site set up is predicted to take 4 days. The set up will take place in March, just before the April cable pull (as assessed in section 17.6.2.2.2) or in August, before the August cable pull. In these months there are 3 fulmars and 4 herring gulls recorded in March, and 1 fulmar recorded in August, within 100m of the cable pull set up. Within 200m of the cable pull site set up there are fulmars (9), kittiwake (81), guillemot (524), razorbill (24), herring gull (61) and shag (9) recorded in March and 1 fulmar recorded and 145 kittiwakes recorded in August. Though there will be inter-annual variations in exact numbers, as seabirds are largely site faithful it is likely these numbers will be indicative of potential number of nests affected during the cable pull. In terms of these species' population numbers as a whole, these are very low numbers of seabirds potentially affected in the context of the whole site, and therefore the cable pull site set up is not anticipated to have any effect on the seabird receptors.

Light Pollution

Light pollution has been shown to have potential effects on birds in a number of ways. The lighting will be localised to the work areas. The HDD landfall work is likely to take place between 7am-7pm. As this will take place over the winter months, it is likely light will be required for safe construction work. As the nearest nest site is over 150m from the HDD onshore site, it is unlikely that any birds loafing at a nest site over the winter period will be adversely affected by temporary lighting, especially considering most of the birds are loafing on or at the bottom of the cliffs themselves, rather than on the same level as the HDD site. From the diurnal study on seabirds using the Longhaven cliffs, it is noted that certain species may be present over the evening, night and early morning periods. Roosting shags, fulmars, and guillemots may all be present at night on the cliffs (Appendix F.2). Birds flying over the site may become disorientated because of the lighting, however measures will be put in place to ensure the lighting is directed in a downward manner to minimise lighting pollution.

Human Presence Disturbance

Disturbance related to the HDD land fall work and the cable pull set up work may also relate to there being additional human presence near to the cliffs. For the winter months, there are so few seabirds adjacent to the landfall area, as identified from the seabird surveys, that it is unlikely to have any effect. For the cable pull set up in March or possibly August, this takes place during the beginning and end of the breeding period months. Two important points need to be made. Firstly, the work area is placed more then 120m back from the beginning of the cliff slope and it is unlikely the work force need to go to the edge of the cliffs as part of their work. Secondly, there is already a public coastal path which runs along the cliffs. Therefore, birds are already used to occasionally seeing people walk past whilst on this coastal path. Furthermore, flushing distances identified from a literature review revealed most bird species flushing at distances less than 100m. It is not anticipated that additional personnel will therefore cause an effect on the seabird species.

Seabird Species

For the seabird species potentially affected by the HDD landfall work over the winter period, fulmars, herring gulls, guillemots, razorbills, kittiwakes and shags are given a **regional** value of importance. There could be noise and light disturbance over two winters in order to drill the holes, but as this will be temporary in nature and as the noise modelling revealed no increase above background levels in the immediate vicinity, the magnitude of impact is defined as being **low**, giving an overall effect of being **minor**, **non-significant**.

For the seabird species potentially affected by the cable pull site set up activity are fulmars herring gulls, guillemots, razorbills, shags, kittiwakes, these species are given a **regional** value of importance. The cable pull site set up is expected to take a short period of time from the and not impact on a large number of individual species in the context of the overall population numbers. Any effects will be temporary in nature and of **low** magnitude, giving an overall effect of being **minor**, **non-significant**.

Designated Sites and Nature Reserves

The sites which contain designated features that may be affected by the onshore activities as described above are:

- Buchan Ness to Collieston Coast SPA/SSSI: this site will potentially be disturbed during the HDD drilling activity and the cable pull site set up activity. The HDD drilling will take place outside the breeding season and therefore the qualifying features will not be affected due to this activity.
  The cable pull site set up activity may take place in March, or during August, therefore will be within the start and end of the seabird breeding period. For fulmars and herring gulls, the proportion of birds of the SPA recorded within 100m of this activity is 0.22% and 0.13% as a maximum. Within 200m fulmars and razorbills were under 1% of the proportion of the SPA total. For kittiwakes, guillemots, herring gulls and shags, the proportions were 1.15, 2.72, 1.98, and 2.72% respectively. No significant effects are expected on any of the receptors. Therefore, no significant effects on any of the qualifying features are expected as a result of disturbance effects during onshore activities.
- A section of the Longhaven cliffs reserve may be subject to noise disturbance as a results of the HDD activities. The seabird species within the Reserve are considered as part of the Buchan Ness to Collieston Coast SPA.
- Designated sites outwith the HVDC cable corridor: any noise, visual and human presence disturbance during the installation will only occur in the direct vicinity of the site. Therefore, given the distance between the other designated sites and the HDD works, effects are expected to have no change on the sites.

Therefore, the effect on the **international** receptors are valued as having a **negligible** magnitude and a **minor**, **non-significant** effect. Effects on Longhaven cliffs as a high local valued receptor are expected to be **negligible** magnitude leading to a **negligible, non-significant** effect.

17.6.2.2.2 Disturbance Due to Marine Cable Installation Activities

During the cable pull, marine surveys, and cable laying activities there will be a number of vessels required which may result in the following disturbance:

- Disturbance due to displacement from foraging habitat; and
- Disturbance due to noise and light pollution from the vessels.

The number of vessels required for each cable installation activity is shown in Table 17.18. The (*) for the guard vessel in the cable pull relates to the fact that this guard vessel is likely to be between 2-4km from the HDD exit, most likely by the Pilot Station, rather than closer to the cliffs as the other vessels are. Guard vessels will be stationary for up to 3 months, until the cable is fully protected. The number of work boats associated with the cable pull activity is assessed as being five as a worse case scenario. More information on the individual activities can be found in Chapter 2: Project Description. Indicative timings for the duration of activities within UK waters (up to the UK EEZ line) as well as an approximate duration of vessel activity inside the Buchan Ness to Collieston Coast SPA are also given. It is likely that the cable pull and cable installation will take place during the spring and summer months (April-September). The site set up for the cable pull is likely to take place at the beginning of the breeding season (March) or at the end (August) but as this is related to an onshore activity has been assessed within Section 17.6.2.2.1.

Table 17.18 Expected number of vessels required for each marine cable installation activity.

Activity	Vessels required	Duration within UK waters	Approximate total duration inside Buchan Ness to Collieston Coast SPA
Cable pull at HDD exit (during summer)	Cable lay vessel (1) Diver support vessel (1) Work boats (up to 5) Guard vessel* (1)	1 week per cable pull. Two cable pulls to take place. Gap of 4-12 months inbetween each pull.	2 weeks
UXO Survey	Survey vessel (1)	3 months	2 days
Marine Route surveys	Survey vessel (1)	3 months	2 days
Route clearance	Clearance vessel (1)	1 month	< 1 day
Pre-lay grapnel run	Clearance vessel (1)	1 month	< 1 day
Cable installation: laying and trenching	Cable lay vessel (1) Cable trenching vessel (1) Guard vessel (1 every 10-15km) Survey vessel (1) Chase vessel (2)	4 cable lay campaigns in UK waters, each taking 1 month and with a gap of at least 4 months inbetween. Survey vessel to follow behind trenching vessel.	2 days
Further cable protection measures	Rock-placement vessel (1) Survey vessel (1) Guard vessel (1)	2 months per cable.	1 day
As-built survey	Survey vessel (1)	1 month	< 1 day

The type of cable laying and trenching vessels employed will depend on the winning Contractor, however cable lay vessels being used currently are between 120m and 200m long. When cable laying the vessels travel at speeds of between 250 and 600 metres per hour. Survey vessels are likely to be between 50-80m long. Guard vessels are normally smaller vessels, between 20-50m. Work boats are likely to be small zodiac boats, or similar, with a small outboard engine.

Vessel disturbance of habitat

Vessels have the potential to cause disturbance to seabirds utilising the waters near the installation activities. Different species have different vulnerabilities associated with disturbance due to vessels, both on sea (as summarised in Furness et al. (2013)) and on land (summarised in Table 17.9). From the field surveys, and from the foraging range information gathered, the species most likely to be potentially affected by vessel presence during the cable installation activities are: fulmars, kittiwakes, herring gull, guillemots, razorbill, and shag. Additionally, from the vantage point surveys, the maximum number of puffins observed in the breeding period was 5 (July) and for gannets was 10 (March) at sea. For the cable laying activity, the seabird species which demonstrate little or minor responses to vessel disturbance (from Table 17.9) are fulmars, kittiwake, herring gulls, puffins, and gannets. Species which may be more prone to vessel disturbance are guillemots, razorbills and shags (Table 17.9). The vessel disturbance will be temporary in nature and will not occur over long periods of time (Table 17.18).

Seabirds tend to raft together in groups on the sea, which means that if a vessel passes through a raft, it has the potential to flush a number of birds all at once. For the marine installation activities, the vessel speeds will be extremely slow and steady due to the nature of the work they are carrying out, with a predicted speed of 250m-600m per hour for the cable laying vessel. It has been previously demonstrated that the slower the vessel speed, the less likely disturbance is to occur for certain seabird species (Ronconi & Clair, 2002). The effect of the vessel's presence would be disturbance of potential foraging or resting habitat on the sea, thus causing the birds to have to move elsewhere, most likely within a few hundred metres away. However, any disturbance is likely to only be in the direct vicinity of the vessel's path and given the ability of the seabirds to forage across large areas, it is unlikely that disturbance of a small section of this habitat will have a large impact on them. The second effect would be that the disturbance may result in birds having less time to forage and cause them to expend additional energy, for example if they are flushed and had to relocate. The effects on energy budgets are extremely unlikely to result in population dynamic effects (i.e. increased adult mortality or impacts on reproduction).

For the cable pull, the species potentially affected by disturbance will be those within close proximity to the HDD exit. From the surveys, no birds were recorded within 100m of this point. Within 200m kittiwakes (41 in March, 66 in August), guillemot (412 in March, 2 in August), razorbill (16 in March), herring gulls (31 in March) and shags (7 in March) were recorded.

As identified in Chapter 19: Navigation and Shipping, and in Chapter 20: Commercial Fisheries, the bay where the HDD exit is situated, as well as the cable corridor itself, is known to be a busy area for shipping activity. From AIS data analysed, the majority of the boats or ships closer in to the cliffs are below 50m in size, however it is not uncommon for vessels of lengths between 80-120m to be within 100m of the cliffs (Appendix J1). Furthermore, the area of Longhaven Bay is a known anchorage for many vessels: 3 oil and gas vessels (between 80-86m in length) have been recorded anchoring close in to the cliffs (Appendix J1; Figure 6.22). The analysis on vessel numbers also revealed that throughout the year the average daily number of vessels using the consenting corridor up to the UK EEZ is consistently over 50 per day, with the busiest month for vessels being August (96 per day). Fewer vessels will be closer to shore, though there is a high density of vessels using the area close by the cliffs; predominantly fishing vessels but also recreational vessels and oil and gas vessels (Appendix J1: Figure 6.11). For the cable pull activity, the vessels will be largely stationary, with the cable laying vessel itself being stationed approximately 280m from the cliff edge. Therefore, the effects on species nesting on the cliffs are not likely to flush from their nests due to the cable lay vessel coming to 280m from the cliffs. The diving support vessel will be directly above the HDD exit, which is 200m from the cliffs. Therefore, for most species sitting on a nest, they are unlikely to be flushed as a result of the vessels required for the cable pull (in accordance with disturbance distances identified in Table 17.9).

The birds will also have some degree of acclimatisation to vessels and recreational boats coming in close to the cliffs. Therefore, any disturbance distances are likely to be reduced even further.

Vessel disturbance due to noise and light

For the cable pull and the cable laying activities, these will require work lights to be on the vessels during any night-time working. The lights will be directed towards the working area only.

The noise assessment revealed that for the majority of the Buchan Ness to Collieston Coast SPA there is no increase above background levels (Chapter 22: Noise and Vibration (In Air) and Drawing NCFFS-NCT-X-XG-010-10). However, for sections 3A, and 3B the noise produced is above background levels by 11dB (from around 54dB up to 65dB) for a concentrated area around the HDD exit and associated vessels. Appendix H.3 demonstrates the noise predicted for the cable pull activity. The 3D images produced clearly show that the noise dissipates to background levels within a short distance from the cable pull activities. The cable pull is likely to take place in April or August. The seabird survey data revealed that in April a total of 1 fulmar, 27 kittiwake, 524 guillemot, 105 razorbill, 12 herring gulls, and 10 shags were recorded on land within 200m of the HDD exit. In August a total of 66 kittiwake (all juvenile) and 2 guillemot were noted on the cliffs. In August much lower numbers are recorded, and therefore fewer birds would potentially be affected by the cable pull activity if it were to be carried out in this month.

In the context of their overall population numbers (Table 17.6), the numbers of birds recorded in the surrounding cliffs to the cable pull activity are low to non-existent numbers of individuals.

The cable pull activity will not cause a significant increase in noise at the seabird cliffs. Given the distance from the HDD exit and the nearest seabird nest sites is over 200m, it is highly unlikely that noise disturbance due to the cable pull activity would be of such a magnitude as to cause nest abandonment.

The cable pull will take place over 24 hours for up to 7 days for each pull, and will therefore require some additional lighting. This lighting will be directed and only used in the vicinity of the work area. The light and noise disturbance at the HDD exit activities (cable pull) will be temporary in nature but may be present across two different breeding seasons.

For cable laying, as the cable laying vessel moves further away from the cliffs, the effect of additional light on the cliff nesting birds will decrease. As identified in Chapter 19: Navigation and Shipping, and from ad hoc sightings recorded whilst visiting the landfall site, it is known that Long Haven Bay is an anchorage due to its sheltered nature. The seabirds along this cliff are therefore likely to be accustomed to large vessels (up to 100m) being close in to the cliffs with lights on and engines running.

The cable laying and trenching will be moving from the HDD exit point out to the UK EEZ line, and beyond. The cable laying vessel does not produce a large amount of noise and the context of the existing environment should be taken into consideration. As demonstrated in Chapter 19: Navigation and Shipping, this part of the North Sea is busy with fishing vessels, cargo vessels and others. It is likely birds are used to both hearing and seeing boats within the same area in which they are foraging.

Seabird Species

For the cable laying activity, the species potentially affected by the vessel noise and light disturbance, and the displacement of foraging habitat are those within foraging range of the cable installation corridor: fulmar, kittiwake, guillemot, razorbill, shag, herring gull, puffin, and gannet. Fulmars, guillemot, kittiwake, razorbill, herring gull, shag are all assessed as being of **regional** importance, puffins as **high local**, and gannets as **low local**. The impact is expected to be **temporary** and of a **low** magnitude given the context of the existing environment, giving an overall **minor**, **non-significant** effect. Of all the species, given their vulnerability to vessel movements, shags are the species which could be temporarily affected whilst at sea, but as the impact is temporary in nature, it remains of minor non-significance.

Designated Sites and Nature Reserve

The sites which contain designated features that may be affected as described above are:

- Buchan Ness to Collieston Coast SPA/SSSI: no significant effects on any of the qualifying features are expected as a result of vessel disturbance effects during construction. The proportion of the qualifying species recorded within 200m of the HDD exit activity, from the whole site population, is less than 3% for all species.

- A section of the Longhaven cliffs reserve may be subject to noise disturbance as a results of the HDD exit activities. The seabird species within the Reserve are considered as part of the Buchan Ness to Collieston Coast SPA assessment.
- Designated sites outwith the HVDC cable corridor: vessels within the cable corridor will be minimal. No significant effects on any of qualifying features are expected as a result of vessel disturbance effects during construction. In the context of the North Sea, an additional 1-3 vessels required for the cable installation at any one time is not expected to impact greatly on any of the other designated sites. No effects due to cable pull HDD exit activities will be present for the sites outwith the HVDC corridor due to the distances involved, and therefore do not need assessed.

Therefore, the effect on these **international** receptors are valued as having a **negligible** magnitude and a **minor**, **non-significant** effect. Effects on Longhaven cliffs as a high local valued receptor are expected to be **negligible** magnitude leading to a **negligible, non-significant** effect.

17.6.2.2.3 Indirect Effects on Prey Species

Chapter 15: Fish and Shellfish identified potential impacts on the fish and shellfish species within the cable installation corridor and surrounding area, which included assessment of potential prey items of seabirds, the most relevant of which are sandeels, but also European sprat, Goby, Saithe and Whiting are relevant. The loss of habitat in relation to these fish species spawning grounds was found to be of no change, negligible, or of minor significance. The introduction of new habitat, due to rock placement along certain sections of the cable installation corridor, was found to have no change for the sandeels, as this is not suitable habitat for their spawning grounds as they require a sandy substrate. For saithe and whiting, the introduction of more rock habitat has been found to have a beneficial effect, thought of minor significance. The increase in sediments due to the cable installation, or changes to water quality, were not found to have any lasting adverse effects on any of the fish species.

Seabird Species

As no effects on fish species are predicted, in turn no effects are expected for the seabird species. Therefore, the **regionally** valued species will experience **negligible** effects as a results of indirect prey effects, leading to a **negligible**, **non-significant** effect.

Peregrine Falcon

Though the peregrine falcon is not a marine-dependent species, it is appropriate to assess it in the context of being associated with the seabirds on the cliffs. If there were to be any adverse effects on the seabird populations at the cliffs this could in turn effect the breeding peregrine falcons. However, as no effects are predicted and given the large area over which peregrines can hunt for seabird eggs and chicks along the cliffs, no effects on peregrines are expected. This **regionally** valued receptor will experience **negligible** effects as a results of indirect prey effects, leading to a **negligible**, **non-significant** effect.

Designated Sites

As no effects on fish species or seabird species are predicted, in turn no effects are expected for any of the designated site species. Therefore, the **internationally** valued sites will experience **negligible** effects as a results of indirect prey effects, leading to a **minor**, **non-significant** effect.

17.6.2.2.4 Water Quality Effects

There are three main activities associated with the cable installation which could have water quality effects relevant to the seabird receptors at the site. Firstly, there could be an effect on water quality as a result of the release of the drilling fluids and solids from the HDD exit holes. Secondly, there could be an effect on water quality as a result of the cable installation techniques employed which can lead to increased sediment loading due to jet-trenching, mechanical trenching, or ploughing activity. Thirdly, there could be an accidental release of contaminants from the cable laying vessel or associated support vessels.

Drilling Fluid Release

As discussed further in Chapter 11: Water Quality (offshore), there will be a total release of drilling fluid solids (17.3m^3 in total) of bentonite for all three HDD holes. Bentonite is a non-toxic material and due to the small volume of solids expected to be released, it is thought this will disperse quickly due to wind and waves. Therefore, from an ornithological perspective, this topic does not require further assessment.

Increased Suspended Solids Loading

As the cable installation techniques have not yet been determined, there could be varying degrees of sediment plumes depending on the technique used and the substrate type. After the cable has been trenched the sediment is likely to settle back down. It should also be noted that the shallowest depth of cable lay occurs at the HDD exit point which is 26m. Thereafter, most of the cable laying occurs at depths of between 35m-150m depths. In assessing what species may be affected by increased sediment loading, those species which dive to depths beyond 35m are most vulnerable, and those species which rely on visual foraging for their prey detection. From Table 17.10, these are: guillemot, razorbill, shag and puffin. Of these species, the most likely species to be foraging close inshore are the shags, therefore it is the shags which are the species potentially affected by the increased sediment loading and hence turbidity due to the HDD exit work and cable laying within the waters closer to the cliffs. From the seabird surveys a total of 33 shags were recorded within 500m of the HDD marine exit point (Table 17.14). Due to the fact the increase in sediment loading will be temporary in nature and the fact that the sediment should redispose itself onto the seabed, it is not likely there will be large effect on the seabird species foraging within the vicinity of the cable installation corridor. The effects will be localised in nature. Furthermore, due to the vessel disturbance during the cable pull and cable laying activity, it is unlikely that the seabirds will be foraging in the direct vicinity of the cable laying activity anyway.

Accidental Release of Pollutants

The accidental release of oil and other marine pollutants is an extremely unlikely event during construction and, provided the mitigation laid out in Chapter 11: Water Quality (offshore), is followed, any potential accidental releases are not likely to have long-lasting effects. Direct effects include:

- Contamination of their feathers leading to a loss of water proofing, and displacing air from between the feathers, affecting the animal's thermoregulation and buoyancy. This can lead to death through hypothermia, and the inability to dive, fly, or forage; and
- Poisoning resulting in sickness or death, through the ingestion or inhalation of the contaminants. Ingestion occurs through preening and foraging in contaminated areas.

Indirect effects include:

- Displacement from foraging areas if species avoid the contaminated area;
- A reduction in prey availability if prey species are affected by the contamination event; and
- Long-term accumulation of contaminants such as poly aromatic hydrocarbons, through foraging on contaminated prey items, leading to illness, reduction in reproductive success, and increased mortality rates.

Any pollution event that did accidentally occur would have potentially larger consequences during the chick fledging period, particularly for the guillemots and razorbills, whose chicks fledge by jumping into the surrounding sea and following their parent out to sea. Their feathers and size would make them more vulnerable to a pollution event effect. This would mean a detrimental effect on the individual could occur if a pollution event occurred during the more sensitive chick fledging time for auk species, i.e. July and August. The periods of time when the vessel is likely to be closest to the seabird cliffs are April and August. Therefore, there could be an effect on chicks if a pollution event was to occur in August, as in April the adults will still be on eggs or will not yet have laid. The numbers of guillemot and razorbill young recorded on the cliff in August was 7 and 1 respectively, but this is likely to be an underestimation of how many young fledged from the cliffs prior to the August survey, so caution is advised in using these values.

Seabird Species

For guillemots, razorbills, shag, and puffins, which are the species most likely to be affected by water quality effects, their value is placed as **regional** for all but puffins which are of **high local** importance. Provided mitigation measures are in place the water quality effects are assessed as being temporary in nature and are therefore low in magnitude, resulting in an overall **minor**, **non-significant** effect.

For all the seabird species identified as being within foraging range of the cable installation corridor: fulmars, guillemot, kittiwake, razorbill, herring gull, shag are all assessed as being of **regional** importance, puffins as **high local**, and gannets as **low local**. The impact of an accidental pollution event is highly unlikely giving the mitigation measures which will be put in place, but if it occurred it would not be expected to have population consequences for any of the species, given the quantities that would be involved. Therefore, for all species expect guillemots and razorbills, the effect is expected to be **temporary** and of a **low** magnitude giving an overall **minor**, **non-significant** effect.

For guillemots and razorbills if a pollution event was to occur in the period of the season when the chicks are on the sea (i.e. July and August), this could have an impact on the individual seabirds, though still not on a population level. The impact is still defined as being low, as it could have an impact in the short-term (1-5 years) but would not be expected to detrimentally affect the baseline character of the site. Therefore, the effect is of **low** magnitude giving an overall **minor**, **non-significant** effect.

Designated Sites

The sites which contain designated features that may be affected as described above are:

- Buchan Ness to Collieston Coast SPA/SSSI: no significant effects on any of the qualifying features are expected as a result of water quality effects during construction. Therefore, it is unlikely that the designated site would be adversely affected by any water quality issues.

- Longhaven Cliffs Nature Reserve could also be affected by accidental pollution events but as for the Buchan Ness to Collieston Coast SPA, no significant effects on the site are expected due to water quality.
- Designated sites outwith the HVDC cable corridor: Any water quality effects are expected to be localised in nature and are not expected to impact on any other designated site. No significant effects on any of qualifying features are expected as a result of water quality effects during construction.

Therefore, the effect on the Buchan Ness to Collieston Coast SPA/SSSI, an **international** receptor, it is valued as having a **negligible** magnitude and a **minor**, **non-significant** effect. Effects on Longhaven cliffs as a high local valued receptor are expected to be **negligible** magnitude leading to a **negligible, non-significant** effect. For all other designated sites outwith the boundary there is expected to be **no change** for these **internationally** designated receptors, therefore having a **non-significant** effect.

17.6.3 Operational Phase Impacts

Once the cable is installed onshore, there are not expected to be any long-lasting or disturbance effects on the onshore terrestrial bird species. Therefore, any effects of the operation on the terrestrial birds are expected to be of **negligible** magnitude and hence of **negligible**, **non-significance**.

For the marine cable installation, similarly, by in large once the cable is installed into the seabed there are not expected to be any long-lasting or disturbance associated with the operation of the HVDC cables. However, there will need to be occasional repairs made over the course of the cables' lifespan (40 years) and there may be effects on the seabird's prey items associated with the cable's operation. The following are potential impacts as a result of the operational phase of the marine installation work:

- Disturbance and displacement due to inspection or required repairs of subsea cable; and
- Indirect effects on offshore prey species.

17.6.3.1.1 Disturbance Due to Repairs

It has been predicted that as a worst-case scenario once every three years one of the cables may need to be repaired. This would involve a vessel to travel to the fault location and there would then be temporary disturbance of the localised area of the sea directly above where the repair needs to take place. It is likely that any repairs would be carried out in a short space of time. Therefore, any effects on the seabird species defined as having **regional**, **high local**, or **low local** sensitivity, would be of **negligible** magnitude, leading to a **negligible**, **non-significant** effect. Similarly, the designated sites defined as being of **international** importance would experience **negligible** magnitude of impact, leading to a **minor**, **non-significant** effect.

17.6.3.1.2 Indirect Effects on Prey Species

Chapter 15: Fish and Shellfish identified potential operational effects on fish and shellfish species as a result of the HVDC cable installation. These included effects such as sediment heating, electro-magnetic fields. No significant impacts were found for any of the fish or shellfish species as a result of these potential impacts. Therefore, any effects on the seabird species defined as having **regional**, **high local**, or **low local** sensitivity, would be of **negligible** magnitude, leading to a **negligible**, **non-significant** effect. Similarly, the designated sites defined as being of **international** importance would experience **negligible** magnitude of impact, leading to a **minor**, **non-significant** effect.

17.7 Mitigation Measures

The Schedule of Mitigation lays out primary and tertiary mitigation in place for ornithological receptors, including a Breeding Bird Protection Plan. All vessels during installation will comply with the International Convention for the Prevention of Pollution from Ships (MARPOL) regulations. It is recognised that mitigation will be put in place to prevent pollution, minimise noise and minimise effects on prey species identified in Chapters 11, 15 and 22 on Water Quality, Fish and Shellfish, and Noise (in-Air) respectively, will assist in the minimisation of impacts on Ornithology.

17.7.1.1 Impacts on Terrestrial Species: Installation

17.7.1.1.1 Pre-works Surveys

Immediately prior to and during the construction phase, surveys will be undertaken to locate nesting birds. Active nest sites will be protected by imposing construction appropriate exclusion zones, which may vary in size depending on the species of bird. This is to ensure that there is not any accidental nest site destruction or no breeding site abandonment due to disturbance. Though the peregrine nest is located 500m from the works, if it is found that this nest site moves to being closer to the cable corridor, then steps will be made to ensure no disturbance of this Schedule 1, legally protected species occurs.

17.7.1.1.2 Sensitive Timing of Activities

Installation activities have the potential to disturb breeding birds. It will not be possible to schedule all works to occur outside the breeding season but where practicable works will be carried out outwith the breeding bird season, or at least started prior to the season. However, if any vegetation clearance is required for the HVDC cable installation, this will occur outside of breeding periods.

17.7.1.1.3 Light Minimisation

Where light is required it will be directional and only within the working area where it is required.

17.7.1.2 Impacts on Terrestrial Species: Operation

No significant effects are expected during the operational of the HVDC cabling, and therefore no mitigation measures need to be put in place.

17.7.1.3 Impacts on Marine-Dependent Species: Installation

No significant effects are predicted on the seabird receptors as a result of the marine installation, therefore no additional mitigation is specifically required. However, certain mitigation measures will be put in place to minimise any potential impacts on the seabirds.

17.7.1.3.1 Sensitive Timing and Location of Activities

Installation activities have the potential to disturb breeding birds. The activity with the most potential for disturbance of the seabird receptors is the HDD drilling. This activity has been specifically programmed to be outwith the bird breeding season and therefore this is embedded mitigation. Furthermore, the location of the HDD site has specifically taken into consideration the seabird receptors from the design of the landfall site (see Chapter 2: Project Description), and the site was placed as far back from the cliffs as possible. The noisiest apparatus (the fluid recycling units) were also placed as far back as possible within the site compound and with further apparatus surrounding them (for example water tanks) to buffer the sound further.

17.7.1.3.2 Seabird Observer Onboard Vessel During Cable Pull Activities

For cable pulling works, where there will be small crafts in the water, a seabird observer will be utilised to ensure that vessels travel at slow speeds around the cliffs and that the vessels do not travel through any substantial rafts of birds.

17.7.1.3.3 Light Minimisation on Vessels

During the cable pull and cable installation activity measures will be put in place to ensure that the vessel lighting is only for the work area required. Where possible, and where safe to do so, light from any windows on the vessel will be covered at night to decrease the light emission of the vessel.

17.7.1.1 Ongoing Assessment and Improvement

The HDD drilling works will be carried out throughout the winter period when fewer birds are present. During the first HDD drilling work there will be observations of birds made, particularly those at the cliffs, and their behaviour noted. This will help identify whether or not they show any signs of disturbance. If they are, then the source of the issue will be investigated. If it is noise or light pollution related, then and where practicable additional steps will be taken to minimise effects for the subsequent drilling activities.

There will be two cable pulling operations, carried out months apart, hence there is an opportunity to observe the first cable pull to understand if any disturbance was caused and to identify areas for improvement if necessary for the second pull. The use of time lapse photography by a suitably qualified ecologist, as utilised in the baseline assessment, coupled with seabird observer recordings during key activities will be utilised.

17.7.1.1 Impacts on Marine-dependent Species: Operation

No significant effects are expected during the operational of the HVDC cabling, and therefore no mitigation measures need to be put in place.

17.8 Residual Effects

17.8.1 Onshore Activities

The only significant effect predicted for the terrestrial bird species is if a nest were to be accidentally destroyed as part of the onshore HVDC cabling, or if a bird was caused to abandon its breeding attempt due to disturbance of its nest site. With pre-construction surveys carried out by a suitably qualified ecologist, this should ensure that any nests present will be detected and suitably protected. Appropriate buffer zones will be put in place if any nests are to be found. Furthermore, any vegetation removal required will take place outside the bird breeding season, which will further reduce the risk of any bird nests being destroyed accidentally.

17.8.2 Marine Installation Activities

No significant effects were predicted for the seabird receptors or designated sites as a result of the marine installation, due to the embedded mitigation already within the project and the temporary nature of the works close in to the cliffs.

17.9 Cumulative Impacts

17.9.1.1 Onshore Impacts

The only onshore project to be considered is the NorthConnect HVDC Converter Station and HVAC cabling. No residual effects were identified as being significant in relation to the bird species

(NorthConnect, 2015). Therefore, no cumulative impacts between the NorthConnect project construction stages are predicted.

17.9.1.2 Marine Installation

Seabirds are wide-ranging in their foraging across the sea and there may be cumulative impacts arising as a result of the construction or operation of other marine developments. Effects are considered in relation to the installation phase of the NorthConnect HVDC cabling, but not for the operation phase as once installed the subsea cables are not expected to have any impact on the seabird receptors.

As identified in Chapter 6: Cumulative Effects and agreed with Marine Scotland, the following marine developments have been considered as part of this assessment:

- **Moray East/West Offshore Windfarm Development (100km)**
- **Inch cape offshore windfarm (110km)**
- **Neart na Gaoithe offshore Windfarm (130km)**
- **Seagreen Phase 1 wind farm (110km)**
- **Beatrice offshore windfarm* (100km)**
- **European offshore wind development centre EOWDC, Aberdeen Bay* (40km)**
- **Hywind Scotland pilot park offshore wind farm* (20km)**
- **Kincardine Offshore Windfarm, 8 6MW floating turbines* (50km)**
- Aberdeen harbour dredge and harbour extension project* (40km)
- Peterhead port authority Harbour masterplan* (3km)
- **North Sea Network Link Interconnector cable (130km)**
- **NorthConnect HVDC subsea cable** (rest of the North Sea: from UK median line-start of Norwegian fjord) (220km)

Those projects which do not overlap in construction phases are marked with an * in the above list. Windfarm projects which would be operational during the time when the NorthConnect project would be under construction are also included as there could be potential effects on seabird species. Those non-wind farm projects which do not overlap in construction periods are in non-bold text, and do not require further consideration.

The potential effects during NorthConnect's installation on the remaining projects (marked in bold in the above list) are then considered in turn for each scoped-in seabird species. As the most sensitive season for seabirds is during the breeding period where they are tied to their breeding site, it is the breeding site foraging distances as identified in Table 17.7 which will help determine whether or not any cumulative effects exist.

Table 17.19 Summary of cumulative projects and seabird species effects from offshore windfarms. Grey indicates where no effect was noted for the species.

Species	Project name							
	Moray East/West offshore wind farm	Inch cape offshore wind farm	Neart na Gaoithe offshore wind farm	Seagreen Phase 1 windfarm	Kincardine windfarm	Beatrice offshore windfarm	Hywind windfarm	EOWDC
Fulmar						Minor effect of displacement.		
Guillemot		Minor displacement predicted during operation of wind farm		Minor effects predicted during impact piling operations due to indirect disturbance of prey items.	Entanglement in mooring lines, non -significant effect predicted.	Minor effect of displacement.		
Razorbill		Minor effects predicted during impact piling operations due to indirect disturbance of prey items. And minor displacement predicted during operation of wind farm	Displacement and barrier effects during breeding period	Minor effects predicted during impact piling operations due to indirect disturbance of prey items.	Entanglement in mooring lines, non -significant effect predicted.	Minor effect of displacement.	Minor effect of disturbance of forgaing habitat.	

Species	Project name							
	Moray East/West offshore wind farm	**Inch cape offshore wind farm**	**Neart na Gaoithe offshore wind farm**	**Seagreen Phase 1 windfarm**	**Kincardine windfarm**	**Beatrice offshore windfarm**	**Hywind windfarm**	**EOWDC**
Herring gull	Collision risk during operation.			Collision risk during operation.		Collision risk during operation.		Collision risk during operation.
Kittiwake		Minor displacement predicted during operation of wind farm		Collision risk during operation.	Collision risk.	Minor effect of displacement.		
Shag								
Gannet	Moderate collision risk identified	Minor displacement predicted during operation of wind farm	Cumulative displacement impact during breeding season with other Firth of Forth windfarms	Collision risk during operation.	Entanglement in mooring lines, non -significant effect predicted. Collision risk.			
Puffin				Minor effects predicted during impact piling operations due to indirect disturbance of prey items.	Entanglement in mooring lines, non -significant effect predicted.			

Table 17.20 Summary of effects identified from non-offshore windfarm projects.

Species	North Sea Link	NorthConnect from UK EEZ line to Norwegian Fjord
Fulmar	Moderate impact predicted for accidental spillage.	Temporary effect of habitat disturbance could take place during cable installation.
Guillemot	Minor impacts of increased sediment loading during cable laying and on prey items during installation. Moderate impact predicted for accidental spillage.	
Razorbill	Minor impacts of increased sediment loading during cable laying and on prey items during installation. Moderate impact predicted for accidental spillage.	
Herring gull	Moderate impact predicted for accidental spillage.	
Kittiwake	Moderate impact predicted for accidental spillage.	
Shag	Minor impacts of increased sediment loading during cable laying and on prey items during installation. Moderate impact predicted for accidental spillage.	
Gannet	Minor impacts of increased sediment loading during cable laying and on prey items during installation. Moderate impact predicted for accidental spillage.	Temporary effect of habitat disturbance could take place during cable installation.
Puffin	Minor impacts of increased sediment loading during cable laying and on prey items during installation. Moderate impact predicted for accidental spillage.	

17.9.1.2.1 Cumulative Impacts of Habitat Displacement

Collision risk modelling revealed that herring gull, gannets, and kittiwakes have been predicted as being vulnerable to collision for some of the offshore wind farms listed above (see Table 17.19). Collision impacts are not relevant for the installation of marine cables, however if any of the seabird species where to be displaced due to the NorthConnect project such that they could come into contact with the offshore wind farms, then cumulative effects could result. However, with no residual effects on habitat displacement predicted for the NorthConnect project and any habitat displacement resulting from vessel presence likely to be extremely limited, unlikely to exceed 1km from the cable installation vessel, no cumulative effects with other projects are expected due to habitat displacement.

Similarly, due to habitat displacement being within a local area, no cumulative effects between the UK NorthConnect cable installation and the Norwegian NorthConnect cable installation are predicted.

17.9.1.2.2 Cumulative Impacts of Disturbance to Prey Items

Some of the offshore wind farms and the North Sea Link cable predicted potential effect on prey items as a result of the installation. The predicted effects on prey from the projects laid out in Table 17.19 were expected to be non-significant. Any effects on prey are predicted to be localised in nature. NorthConnect is not contributing towards an additional effect on prey items as there was no significant effect on prey items found during the impact assessment of prey items. Therefore, there is no cumulative effect between the NorthConnect project and any other project.

17.9.1.2.3 Cumulative Impacts of Increased Sediment loading

The effects of increased sediment loading are very localised in nature. Furthermore, not all the species predicted to be affected by turbidity changes in other projects overlap in foraging range distances. Therefore, no cumulative effects with increased sediment loading are expected.

17.9.1.2.4 Cumulative Impacts of Water Quality Changes

The North Sea link predicted an impact with accidental spillage. As this would be localised in nature, and due to the distances between the two projects (130km), no cumulative impacts would be expected for any of the scoped-in species. The likelihood of either North Sea Link or NorthConnect individually having a loss of contaminant of a magnitude that would lead to potential significant effects on avian receptors is considered extremely unlikely because of stringent mitigation measures put in place. As such the probability of both projects suffering such a loss of containment at the same time is highly improbable. Thus, there are no cumulative impact effects predicted with any of the projects and NorthConnect project.

17.10 Summary

This chapter has considered the potential impacts of construction and operation of the NorthConnect Development on relevant ornithological receptors. The summary of the effects is shown in Table 17.21. The NorthConnect HVDC cable installation is expected to cause temporary, non-significant disturbance during the construction period for any nesting birds in the onshore farmland and along the coastline. Operationally, no effects are predicted on the ornithological receptors once the cable is installed. No cumulative impacts are predicted with any other developments.

Table 17.21 Summary of Ornithological Impacts and Mitigation.

Receptor and Value		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Buchan Ness and Collieston Coast SPA/SSSI and Collieston to Whinnyfold Coast SSSI	International	Installation	Disturbance of marine-based species due to vessel presence, human presence, noise and light pollution.	Negligible Negative Short Term Reversible	Certain	Minor: Non-Significant	Directed lighting for construction area only used.	Negligible Negative Short Term Reversible	Minor Non-Significant
		Installation	Increased sediment loading and water quality effects associated with drilling fluid release.	Negligible Negative Short Term Reversible	Certain	Minor: Non-Significant	No specific mitigation required.	Negligible Negative Short Term Reversible	Minor: Non-Significant
		Installation	Accidental release of pollutants from vessels.	Negligible Negative Short Term Permanent	Unlikely	Minor: Non-Significant	Following procedures laid out for pollution prevention in the SoM.	Negligible Negative Short Term Permanent	Minor: Non-Significant
		Operation	Disturbance to marine-based species during cable repair operations.	Negligible Negative Short-term Reversible	Certain	Minor: Non-Significant	No specific mitigation required.	Negligible Negative Short-term Reversible	Minor Non-Significant
Troup, Pennan and Lion's Head SPA	International	Installation	Disturbance to marine-based species due to vessel disturbance.	Negligible Negative Short Term Reversible	Unlikely	Minor: Non-Significant	No specific mitigation required.	Negligible Negative Short Term Reversible	Minor Non-Significant

Receptor and Value		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Troup, Pennan and Lion's Head SPA	International	Operation	Disturbance to marine-based species during cable repair operations.	Negligible Negative Short-term Reversible	Unlikely	Minor: Non-Significant	No specific mitigation required.	Negligible Negative Short-term Reversible	Minor Non-Significant
Fowlsheugh SPA	International	Installation	Disturbance to marine-based species due to vessel disturbance.	Negligible Negative Short Term Reversible	Unlikely	Minor: Non-Significant	No specific mitigation required.	Negligible Negative Short Term Reversible	Minor Non-Significant
		Operation	Disturbance to marine-based species during cable repair operations.	Negligible Negative Short-term Reversible	Unlikely	Minor: Non-Significant	No specific mitigation required.	Negligible Negative Short-term Reversible	Minor Non-Significant
Outer Firth of Forth and St Andrews Bay pSPA	International	Installation	Disturbance to marine-based species due to vessel disturbance.	Negligible Negative Short Term Reversible	Unlikely	Minor: Non-Significant	No specific mitigation required.	Negligible Negative Short Term Reversible	Minor Non-Significant
		Operation	Disturbance to marine-based species during cable repair operations.	Negligible Negative Short-term Reversible	Unlikely	Minor: Non-Significant	No specific mitigation required.	Negligible Negative Short-term Reversible	Minor Non-Significant
SWT Longhaven Cliffs Reserve	Regional	Installation	Disturbance of marine-based species due to human presence, noise and light pollution.	Negligible Negative Short Term Reversible	Certain	Minor: Non-Significant	Directed lighting for construction area only used.	Negligible Negative Short Term Reversible	Minor Non-Significant

Receptor and Value		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Passerines (red-list species)	Regional	Installation	Disturbance due to habitat displacement, noise, light pollution and human presence.	Low Negative Short Term Reversible	Certain	Minor: Non-Significant	Directed lighting for construction area only used. Breeding Bird Protection Plan put in place.	Low Negative Short Term Reversible	Minor Non-Significant
		Installation	Accidental nest site destruction during construction.	Medium Negative Permanent	Unlikely	**Moderate: Significant**	Pre-construction surveys. Following measures laid out in the SoM.	Low Negative	Minor Non-Significant
Passerines (amber-list species)	Regional	Installation	Disturbance due to habitat displacement, noise, light pollution and human presence.	Low Negative Short Term Reversible	Certain	Minor: Non-Significant	Directed lighting for construction area only used. Breeding Bird Protection Plan put in place.	Low Negative Short Term Reversible	Minor Non-Significant
		Installation	Accidental nest site destruction during construction.	Medium Negative Permanent	Unlikely	**Moderate: Significant**	Pre-construction surveys. Following measures laid out in the SoM.	Low Negative	Minor Non-Significant

Receptor and Value		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Waders (red list species)	High Local	Installation	Disturbance due to habitat displacement, noise, light pollution and human presence.	Low Negative Short Term Reversible	Certain	Minor: Non-Significant	Directed lighting for construction area only used. Breeding Bird Protection Plan put in place.	Low Negative Short Term Reversible	Minor Non-Significant
		Installation	Accidental nest site destruction during construction.	Medium Negative Permanent	Unlikely	**Moderate: Significant**	Pre-construction surveys. Following measures laid out in the SoM.	Low Negative	Minor Non-Significant
Waders: snipe	Moderate Local	Installation	Disturbance due to habitat displacement, noise, light pollution and human presence.	Low Negative Short Term Reversible	Certain	Minor: Non-Significant	Directed lighting for construction area only used. Breeding Bird Protection Plan put in place.	Low Negative Short Term Reversible	Minor Non-Significant
		Installation	Accidental nest site destruction during construction.	Medium Negative Permanent	Unlikely	**Moderate: Significant**	Pre-construction surveys. Following measures laid out in the SoM.	Low Negative	Minor Non-Significant

Receptor and Value		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Peregrine falcon	Regional	Installation	Disturbance due to habitat displacement, noise, light pollution and human presence.	Low Negative Short Term Reversible	Unlikely	Minor: Non-Significant	Directed lighting for construction area only used. Breeding Bird Protection Plan put in place.	Low Negative Short Term Reversible	Minor Non-Significant
		Installation	Indirect effects on prey items	Negligible Negative Short Term Reversible	Unlikely	Negligible: Non-Significant	No specific mitigation required.	Negligible Negative Short Term Reversible	Negligible: Non-Significant
Fulmar	Regional	Installation	Disturbance of marine-based species due to vessel presence, human presence, noise and light pollution.	Low Negative Short Term Reversible	Certain	Minor: Non-Significant	Directed lighting for construction area only used.	Low Negative Short Term Reversible	Minor Non-Significant
		Installation	Increased sediment loading and water quality effects associated with drilling fluid release.	Negligible Negative Short Term Reversible	Unlikely	Minor: Non-Significant	No specific mitigation required.	Negligible Negative Short Term Reversible	Minor: Non-Significant
		Installation	Accidental release of pollutants from vessels.	Low Negative Short Term Permanent	Unlikely	Minor: Non-Significant	Following SoM procedures laid out for pollution prevention.	Low Negative Short Term Permanent	Minor: Non-Significant

Receptor and Value		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Fulmar	Regional	Operation	Disturbance to marine-based species during cable repair operations.	Negligible Negative Short-term Reversible	Certain	Minor: Non-Significant	No specific mitigation required.	Negligible Negative Short-term Reversible	Minor Non-Significant
Guillemot	Regional	Installation	Disturbance of marine-based species due to vessel presence, human presence, noise and light pollution.	Low Negative Short Term Reversible	Certain	Minor: Non-Significant	Directed lighting for construction area only used.	Low Negative Short Term Reversible	Minor Non-Significant
		Installation	Increased sediment loading and water quality effects associated with drilling fluid release.	Negligible Negative Short Term Reversible	Unlikely	Minor: Non-Significant	No specific mitigation required.	Negligible Negative Short Term Reversible	Minor: Non-Significant
		Installation	Accidental release of pollutants from vessels.	Low Negative Short Term Permanent	Unlikely	Minor: Non-Significant	Following SoM procedures laid out for pollution prevention.	Low Negative Short Term Permanent	Minor: Non-Significant
		Operation	Disturbance to marine-based species during cable repair operations.	Negligible Negative Short-term Reversible	Certain	Minor: Non-Significant	No specific mitigation required.	Negligible Negative Short-term Reversible	Minor Non-Significant

Receptor and Value		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Razorbill	Regional	Installation	Disturbance of marine-based species due to vessel presence, human presence, noise and light pollution.	Low Negative Short Term Reversible	Certain	Minor: Non-Significant	Directed lighting for construction area only used.	Low Negative Short Term Reversible	Minor Non-Significant
		Installation	Increased sediment loading and water quality effects associated with drilling fluid release.	Negligible Negative Short Term Reversible	Unlikely	Minor: Non-Significant	No specific mitigation required.	Negligible Negative Short Term Reversible	Minor: Non-Significant
		Installation	Accidental release of pollutants from vessels.	Low Negative Short Term Permanent	Unlikely	Minor: Non-Significant	Following SoM procedures laid out for pollution prevention.	Low Negative Short Term Permanent	Minor: Non-Significant
		Operation	Disturbance to marine-based species during cable repair operations.	Negligible Negative Short-term Reversible	Certain	Minor: Non-Significant	No specific mitigation required.	Negligible Negative Short-term Reversible	Minor Non-Significant
Herring gull	Regional	Installation	Disturbance of marine-based species due to vessel presence, human presence, noise and light pollution.	Low Negative Short Term Reversible	Certain	Minor: Non-Significant	Directed lighting for construction area only used.	Low Negative Short Term Reversible	Minor Non-Significant

Receptor and Value		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Herring gull	Regional	Installation	Increased sediment loading and water quality effects associated with drilling fluid release.	Negligible Negative Short Term Reversible	Unlikely	Minor: Non-Significant	No specific mitigation required.	Negligible Negative Short Term Reversible	Minor: Non-Significant
		Installation	Accidental release of pollutants from vessels.	Low Negative Short Term Permanent	Unlikely	Minor: Non-Significant	Following SoM procedures laid out for pollution prevention.	Low Negative Short Term Permanent	Minor: Non-Significant
		Operation	Disturbance to marine-based species during cable repair operations.	Negligible Negative Short-term Reversible	Certain	Minor: Non-Significant	No specific mitigation required.	Negligible Negative Short-term Reversible	Minor Non-Significant
Shag	Regional	Installation	Disturbance of marine-based species due to vessel presence, human presence, noise and light pollution.	Low Negative Short Term Reversible	Certain	Minor: Non-Significant	Directed lighting for construction area only used.	Low Negative Short Term Reversible	Minor Non-Significant
		Installation	Increased sediment loading and water quality effects associated with drilling fluid release and cable laying activities.	Low Negative Short Term Reversible	Unlikely	Minor: Non-Significant	No specific mitigation required.	Low Negative Short Term Reversible	Minor: Non-Significant

Receptor and Value		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Shag	Regional	Installation	Accidental release of pollutants from vessels.	Low Negative Short Term Permanent	Unlikely	Minor: Non-Significant	Following SoM procedures laid out for pollution prevention.	Low Negative Short Term Permanent	Minor: Non-Significant
		Operation	Disturbance to marine-based species during cable repair operations.	Negligible Negative Short-term Reversible	Certain	Minor: Non-Significant	No specific mitigation required.	Negligible Negative Short-term Reversible	Minor Non-Significant
Puffin	High Local	Installation	Disturbance of marine-based species due to vessel presence, human presence, noise and light pollution.	Low Negative Short Term Reversible	Certain	Minor: Non-Significant	Directed lighting for construction area only used.	Low Negative Short Term Reversible	Minor Non-Significant
		Installation	Increased sediment loading and water quality effects associated with drilling fluid release.	Negligible Negative Short Term Reversible	Unlikely	Minor: Non-Significant	No specific mitigation required.	Negligible Negative Short Term Reversible	Minor: Non-Significant
		Installation	Accidental release of pollutants from vessels.	Low Negative Short Term Permanent	Unlikely	Minor: Non-Significant	Following SoM procedures laid out for pollution prevention.	Low Negative Short Term Permanent	Minor: Non-Significant

Receptor and Value		Phase	Predicted Impact	Impact Magnitude	Likelihood of Impact	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Puffin	High Local	Operation	Disturbance to marine-based species during cable repair operations.	Negligible Negative Short-term Reversible	Certain	Minor: Non-Significant	No specific mitigation required.	Negligible Negative Short-term Reversible	Minor Non-Significant
Gannet	Low Local	Installation	Disturbance of marine-based species due to vessel presence, human presence, noise and light pollution.	Negligible Negative Short Term Reversible	Unlikely	Minor: Non-Significant	Directed lighting for construction area only used.	Negligible Negative Short Term Reversible	Minor Non-Significant
		Installation	Increased sediment loading and water quality effects associated with cable laying activities.	Negligible Negative Short Term Reversible	Unlikely	Minor: Non-Significant	No specific mitigation required.	Negligible Negative Short Term Reversible	Minor: Non-Significant
		Installation	Accidental release of pollutants from vessels.	Negligible Negative Short Term Permanent	Unlikely	Minor: Non-Significant	Following SoM procedures laid out for pollution prevention.	Negligible Negative Short Term Permanent	Minor: Non-Significant
		Operation	Disturbance to marine-based species during cable repair operations.	Negligible Negative Short-term Reversible	Unlikely	Minor: Non-Significant	No specific mitigation required.	Negligible Negative Short-term Reversible	Minor Non-Significant

Key

	Significant Effect

17.11 References

Aberdeenshire Council. (2014). North East Local Biodiversity Action Plan

Affric Limited. (2018). Temporal and spatial variation in seabird attendance at Longhaven cliffs. In L. Quinn (Ed.), *Technical Report*. Affric Limited.

Agroecosystems. (2014). Preliminary breeding bird survey

Atmos Consulting. (2015). North Connect Converter Building, Peterhead – Ornithogy survey 2015: Winter walkovers. (19400-06-Rev1).

Bellefleur, D., Lee, P., & Ronconi, R. A. (2009). The impact of recreational boat traffic on Marbled Murrelets (Brachyramphus marmoratus). *Journal of environmental management, 90*(1), 531-538.

BirdLife International. (2015). *Global International Union for Conservation of Nature (IUCN) Red list for birds*. Retrieved from http://www.birdlife.org/globally-threatened-bird-forums/2015/10/global-iucn-red-list-for-birds-2015-changes/.

BirdLife International. (2018). Seabird Tracking Database: Tracking Ocean Wanderers. Retrieved from http://www.seabirdtracking.org/mapper/index.php

Bustnes, J. O., Moe, B., Helberg, M., & Phillips, R. A. (2013). Rapid long-distance migration in Norwegian Lesser Black-backed Gulls Larus fuscus fuscus along their eastern flyway. *Ibis, 155*(2), 402-406.

Carney, K. M., & Sydeman, W. J. (1999). A review of human disturbance effects on nesting colonial waterbirds. *Waterbirds*, 68-79.

CIEEM. (2016). Guidelines for ecological impact assessment in the UK and Ireland: terrestrial, freshwater and coastal. In (2nd ed.): Chartered Institute of Ecology and Environmental Management.

D., F. G., M., B. S., & C., M. J. (1987). Bioaccumulation of trace organic contaminants from sediment by baltic clams (Macoma balthica) and soft-shell clams (Mya arenaria). *Environmental Toxicology and Chemistry, 6*(12), 969-976. doi:doi:10.1002/etc.5620061209

Daunt, F., Benvenuti, S., Harris, M. P., Dall, x, Antonia, L., . . . Wanless, S. (2002). Foraging strategies of the black-legged kittiwake Rissa tridactyla at a North Sea colony

De Molenaar, J., DA Jonkers , & Sanders, M. (2000). Road illumination and nature. III. Local influence of road lights on a black-tailed godwit (Limosa l. limosa) population. . In *Wageningen, The Netherlands: Alterra.*

Defra. (2017). MAGIC Interactive map. Retrieved from http://www.natureonthemap.naturalengland.org.uk/MagicMap.aspx

Eaton, M. A., Aebischer, N. J., Brown, A. F., Hearn, R. D., Lock, L., Musgrove, A. J., . . . Gregory, R. D. (2015). Birds of Conservation Concern 4: the population status of birds in the United Kingdom, Channel Islands and Isle of Man. . *British Birds, 108*, 708-746.

Edwards, E. W. J., Quinn, L. R., Wakefield, E. D., Miller, P. I., & Thompson, P. M. (2013). Tracking a northern fulmar from a Scottish nesting site to the Charlie-Gibbs Fracture Zone: Evidence of linkage between coastal breeding seabirds and Mid-Atlantic Ridge feeding sites. *Deep-Sea Research Part II, 98*(Part B), 438-444. doi:10.1016/j.dsr2.2013.04.011

Eglington, S. M., & Perrow, M. R. (2014). Literature review of tern (*Stern*a & *Sternula* spp.) foraging ecology. In JNCC. (Ed.). ECON Ecological Consultancy Limited.

European Commission. (2010). *Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (codified version)*.

Evans, O. L. J. (1996). Collision course: the hazards of lighted structures and windows to migrating birds.

Francis, I., & Cook, M. (2011). *The Breeding Birds of North-East Scotland*.

Frederiksen, M., Moe, B., Daunt, F., Phillips, R. A., Barrett, R. T., Bogdanova, M. I., . . . Chivers, L. S. (2012). Multicolony tracking reveals the winter distribution of a pelagic seabird on an ocean basin scale. *Diversity and Distributions, 18*(6), 530-542.

Furness, R. W., Wade, H. M., & Masden, E. A. (2013). Assessing vulnerability of marine bird populations to offshore wind farms. *Journal of environmental management, 119*, 56-66.

Garthe, S., & Hüppop, O. (2004). Scaling possible adverse effects of marine wind farms on seabirds: developing and applying a vulnerability index. *Journal of Applied Ecology, 41*(4), 724-734.

GreenBlue. (2013). Guidance on marine Non-Native Species. In.

Grist, H., Daunt, F., Wanless, S., Nelson, E. J., Harris, M. P., Newell, M., . . . Reid, J. M. (2014). Site fidelity and individual variation in winter location in partially migratory European shags. *PLoS ONE, 9*(6), e98562.

Harris, M. P., Daunt, F., Newell, M., Phillips, R. A., & Wanless, S. (2010). Wintering areas of adult Atlantic puffins Fratercula arctica from a North Sea colony as revealed by geolocation technology. *Marine Biology, 157*(4), 827-836.

JNCC. (2001a). Buchan Ness to Collieston Coast. Retrieved from http://jncc.defra.gov.uk/default.aspx?page=1922

JNCC. (2001b). SPA description: Fowlsheugh. Retrieved from http://jncc.defra.gov.uk/default.aspx?page=1912

JNCC. (2001c). SPA description: Troup, Pennan and Lion's Heads. Retrieved from http://jncc.defra.gov.uk/page-1921

JNCC. (2005). SPA description: Ythan Estuary, Sands of Forvie and Meikle Loch. Retrieved from http://jncc.defra.gov.uk/default.aspx?page=1908

JNCC. (2016a). Northern Gannet *Morus bassanus*. Retrieved from http://jncc.defra.gov.uk/page-2875-theme=default

JNCC. (2016b). UK BAP priority species accounts. In.

JNCC. (2016c). UK BAP priority species and habitats. Retrieved from http://jncc.defra.gov.uk/page-5705

JNCC. (2018a). Seabird Monitoring Programme. Retrieved from http://jncc.defra.gov.uk/smp/sitesBrowser.aspx?siteID=81033

JNCC. (2018b). Turbot bank MPA. Retrieved from http://jncc.defra.gov.uk/page-6490

Klaassen, R. H. G., Ens, B. J., Shamoun-Baranes, J., Exo, K.-M., & Bairlein, F. (2012). Migration strategy of a flight generalist, the Lesser Black-backed Gull Larus fuscus. *Behavioral Ecology, 23*(1), 58-68. doi:10.1093/beheco/arr150

Kleist, N. J., Guralnick, R. P., Cruz, A., Lowry, C. A., & Francis, C. D. (2018). Chronic anthropogenic noise disrupts glucocorticoid signaling and has multiple effects on fitness in an avian community. *Proceedings of the National Academy of Sciences*. doi:10.1073/pnas.1709200115

Kubetzki, U., Garthe, S., Fifield, D., Mendel, B., & Furness, R. W. (2009). Individual migratory schedules and wintering areas of northern gannets. *Mar Ecol Prog Ser, 391*, 257-265.

Lilliendahl, K., & Sólmundsson, J. (2006). *Feeding ecology of sympatric European shags Phalacrocorax aristotelis and great cormorants P. carbo in Iceland* (Vol. 149).

Linnebjerg, J. F., Fort, J., Guilford, T., Reuleaux, A., Mosbech, A., & Frederiksen, M. (2013). Sympatric breeding auks shift between dietary and spatial resource partitioning across the annual cycle. *PLoS ONE, 8*(8), e72987.

Longcore, T., & Rich, C. (2004). Ecological light pollution. *Frontiers in Ecology and the Environment, 2*(4), 191-198.

Mallory, M. L. (2016). Reactions of ground-nesting marine birds to human disturbance in the Canadian Arctic. *Arctic Science, 2*(2), 67-77. doi:10.1139/as-2015-0029

Mitchell, P. I., Newton, S. F., Ratcliffe, N., & Dunn, T. E. (2004). *Seabird Populations of Britain and Ireland: Results of the Searbid 2000 Census (1998-2002)*. London: T & AD Poyser.

Natural Scotland. (2015). The river basin management plan for the Scotland river basin district: 2015-2027. In (pp. 44). Edinburgh: The Scottish Government

NBN. (2017). NBN Atlas: Explore Your Area. Retrieved from https://records.nbnatlas.org/explore/your-area

NESBReC. (2018). Biological records for the North East of Scotland. In *North East Scotland Biological Records Centre*.

NorthConnect. (2015). Interconnector Converter Station and High Voltage Alternating Current Cable Route. In (pp. 433): NorthConnect.

NRP. (2017). NorthConnect technical report on Ornithological surveys

Ortega, C. (2012). *Chapter 2: Effects of noise pollution on birds: A brief review of our knowledge (Efectos de la Polución Sonora en Aves: una Breve Revisión de Nuestro Conocimiento)* (Vol. 74).

Piatt, J., & Nettleship, D. (1985). Diving Depths of Four Alcids. *The Auk, 102*, 293 - 297.

Quinn, L. (2014). *Intra- and inter-specific differences in non-breeding strategies in the northern fulmar, Fulmarus glacialis.* University of Aberdeen, Aberdeen.

Raine, H., Borg, J. J., Raine, A., Bairner, S., & Cardona, M. B. (2007). Light pollution and its effects on Yelkouan Shearwaters in Malta; causes and solutions. *BirdLife International Case Study*.

Ramsar. (1971). The Convension on Wetlands (the Ramsar Convention). In.

Ramsar. (2014). Wetlands of International Importance (Ramsar sites). In.

Rodgers, J. A., & Smith, H. T. (1995). Set-back distances to protect nesting bird colonies from human disturbance in Florida. *Conservation Biology, 9*(1), 89-99.

Rojek, N., A., Parker, M., W., Carter, H., R., & McChesney, G. (2007). *Aircraft and vessel disturbances to Common Murres Uria aalge at breeding colonies in central California, 1997-1999* (Vol. 35).

Ronconi, R. A., & Clair, C. C. S. (2002). Management options to reduce boat disturbance on foraging black guillemots (Cepphus grylle) in the Bay of Fundy. *Biological Conservation, 108*(3), 265-271.

RSPB. (2018a). Curlew: Where and when to see them. Retrieved from https://www.rspb.org.uk/birds-and-wildlife/wildlife-guides/bird-a-z/curlew

RSPB. (2018b). Lapwing breeding and nesting habitats. Retrieved from https://www.rspb.org.uk/birds-and-wildlife/wildlife-guides/bird-a-z/lapwing/breeding-and-nesting-habits/

RSPB. (2018c). Pink-footed goose: Where and when to see them. Retrieved from https://www.rspb.org.uk/birds-and-wildlife/wildlife-guides/bird-a-z/pink-footed-goose

RSPB. (2018d). Skylark: Nesting and breeding habits. Retrieved from https://www.rspb.org.uk/birds-and-wildlife/wildlife-guides/bird-a-z/skylark/nesting-and-breeding-habits/

Santos, C. D., Miranda, A. C., Granadeiro, J. P., Lourenço, P. M., Saraiva, S., & Palmeirim, J. M. (2010). Effects of artificial illumination on the nocturnal foraging of waders. *Acta Oecologica, 36*(2), 166-172.

Scottish Parliament. (2004). *Nature Conservation (Scotland) Act*

SNH. (2016a). Interim guidance on apportioning impacts from marine renewable developments to breeding seabird populations in special protected areas. In.

SNH. (2016b). Moray Firth Proposed Special Protection Area (pSPA) No. UK9020313. .

SNH. (2016c). Outer Firth of Forth and St Andrews Bay Complex Proposed Special Protection (pSPA) NO.UK9020316. In *SPA Site Selection Document: Summary of the scientific case for site selection*.

SNH. (2017a). SiteLink. Retrieved from http://gateway.snh.gov.uk/sitelink/index.jsp

SNH. (2017b). Suggested seasonal definitions for birds in the Scottish Marine Environment. In G. Tyler (Ed.).

SNH. (2018). Site Details for Buchan Ness to Collieston Coast. In Scottish Natural Heritage (Ed.).

Thaxter, C. B., Lascelles, B., Sugar, K., Cook, A. S. C. P., Roos, S., Bolton, M., . . . Burton, N. H. K. (2012). Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas. *Biological Conservation, 156*, 53-61. doi:https://doi.org/10.1016/j.biocon.2011.12.009

Tranquilla, L. A. M., Montevecchi, W. A., Hedd, A., Fifield, D. A., Burke, C. M., Smith, P. A., . . . Phillips, R. A. (2013). Multiple-colony winter habitat use by murres Uria spp. in the Northwest Atlantic Ocean: implications for marine risk assessment. *Marine Ecology Progress Series, 472*, 287-303.

UK Parliament. (1981). The Wildlife and Countryside Act 1981.

Velando, A., & Munilla, I. (2011). Disturbance to a foraging seabird by sea-based tourism: Implications for reserve management in marine protected areas. *Biological Conservation, 144*(3), 1167-1174.

Walsh, P. M., Halley, D. J., Harris, M. P., del Nevo, A., Sim, I. M. W., & Tasker, M. L. (1995). *Seabird monitoring handbook for Britain and Ireland: a comilation of methods for survey and monitoring of breeding seabirds*. Monkstone House, Peterborough.

Wernham, C. (2002). The migration atlas: movements of the birds of Britain and Ireland.

Chapter 18: Electric and Magnetic Fields & Sediment Heating

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Contents

18 Electric and Magnetic Fields & Sediment Heating

18.1 Introduction

This Chapter introduces Electric and Magnetic Fields (EMF), and calculates the levels of magnetic fields expected to arise from the HVDC cables during the Operations phase of the NorthConnect project. The HVDC cables can also give rise to localised temperature increases, hence sediment heating calculations are also presented within this Chapter. Magnetic fields and sediment heating effects on various receptors are discussed further within the following topic-specific Chapters; Chapters 14 to16 (Benthic Ecology; Fish and Shellfish; and Marine Mammals); and Chapter 19 (Navigation and Shipping).

18.1.1 Electric Fields

Electric field strength is an expression of the intensity of an electric field at a particular location. The standard unit is the volt per meter (V/m). A field strength of 1 V/m represents a potential difference of one volt between points separated by one meter. Electric fields are produced by voltage. DC voltages produce static electric fields, and AC voltages produce alternating (fluctuating) electric fields.

For insulated cables, the electric fields are contained inside the cable, hence, there will be no external electric field caused by the NorthConnect HVDC cables and, as such, electric fields will not be considered further.

18.1.2 Magnetic Fields

Magnetic Fields are produced by electric current flow and are measured in Tesla (symbolised as T), being the standard unit for magnetic flux density. Magnetic Fields are not easily screened and can pass through buildings and cable screens. The Earth's core produces a magnetic field, which is oriented in a north-south alignment, and gives rise to varying magnetic field strengths across the globe. The Earth's magnetic field is strongest towards the poles and weakest at the equator, as represented in Figure 18.1.

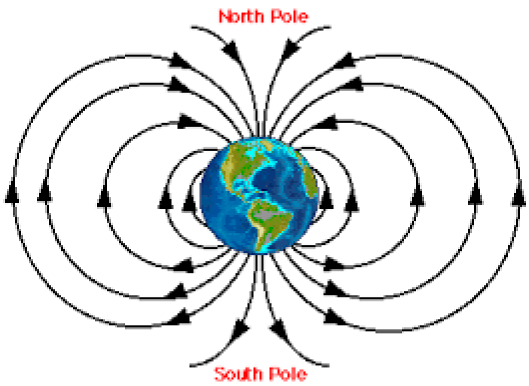

Figure 18.1 Representation of the Earth's Magnetic Field (The University of North Carolina, 2004)

DC cables produce static magnetic fields, which decrease with distance from the cable. The static magnetic fields generated is added or subtracted locally to the earth's natural static magnetic field. Where the outgoing and return paths of a DC circuit (2 cables) are in close proximity, their magnetic fields cancel within relatively short distances from the cables.

High levels of EMF can cause interference with electronic equipment, magnetic equipment and communications such as radio's and compasses. A number of marine species can detect electric and/or magnetic fields and utilise them during feeding, predator detection and navigation. These are considered further in the subject-specific Chapters 14-16.

Magnetic fields can also give rise to compass deviation which are considered with Chapter 19: Shipping and Navigation.

18.2 Sources of Information

18.2.1 Legislative Framework

The Control of Electromagnetic Fields at Work Regulations 2016 implement the European Commission's Directive 213/35/EU on the minimum health and safety requirements regarding the exposure of workers to risk arising from physical agents (electromagnetic fields). The legislation is not directly practicable to the Environmental Impact Assessment (EIA) process; however, it does include action levels which may assist in the interpretation of the numbers provided in this chapter. It should be noted that NorthConnect will ensure compliance with all health and safety legislation to minimise impacts on its workforce.

18.2.2 Guidance

Sources of relevant advice regarding exposure to EMF, although these primarily relate to AC cables, are outlined below:

- Advice on Limiting Exposure to Electromagnetic Fields (0-300 GHz) (National Radiological Protection Board, 2004);
- Guidelines for limiting exposure to static magnetic fields (International Commission on Non-Ionizing Radiation Protection, 2009);
- Power Lines: Demonstrating compliance with EMF public exposure guidelines. A Voluntary Code of Practice(Department of Energy & Climate Change, 2012); and
- Electromagnetic Fields at Work, A guide to the Control of Electromagnetic Fields at Work Regulations 2016 (Health and Safety Executive, 2016).

18.3 Methodology

18.3.1 Magnetic Field Assessment

As there will be two cables laid in close proximity to each other, there will be some degree of cancelling out of the magnetic fields generated by each cable. Magnetic fields strengths have been calculated based on a number of scenarios covering both the onshore and offshore cable configurations. It is assumed that the current will always be in the opposite direction, as this will only cease to be the case as the flow of power on the interconnector is reversed and will last for only an instant.

Magnetic flux density (B) is a measure of magnetic interaction, calculated using the Biot-Savart Law, where I is the current, μ is the magnetic permeability of the medium, and R is the radial distance from the current axis. The equation is expressed as follows:

$$B = \frac{\mu I}{2\pi R}$$

All relevant media have relative permeability constants very close to 1. Only ferromagnetic materials have deviating permeabilities. Hence, a permeability of 1 is assumed for all media.

There are local variations and variations over time of the natural magnetic field. These variations are rather small, but still significantly larger than the impact of different permeabilities of different media.

18.3.1.1 Onshore

For the onshore cables, the magnetic flux associated with the cables has been calculated taking account of the Earth's magnetic field and assuming the worst-case scenario that the cables run in a west-east direction, which is only true for part of the route. The resultant numbers have been compared to the levels identified within the Control of Electromagnetic Fields at Work Regulations 2016 and International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines, to allow their strength to be put into context. Static electric field have a frequency of zero and, as such, the frequency range category of up to 1Hz applies to DC Cables. Table 18.1 details the levels relevant to the DC cables.

Table 18.1: Magnetic Flux Reference Levels

Level Description	Magnetic Flux Density (B) [µT]	Source
Worker Exposure Level Values Sensory Effect – Limb	8,000,000 µT	The Control of Electromagnetic Fields at Work Regulations 2016, and ICNRIP Guidelines on Limits of Exposure to Static Magnetic Fields (International Commission on Non-Ionizing Radiation Protection, 2009)
Worker Exposure Level Values Sensory Effect – Head and Trunk	8,000,000 µT	
Worker Exposure Level Values Health Effect - Any part of the Body	2,000,000 µT	
Interference with active implanted medical devices.	500µT	
General public Exposure of any part of the body.	400,000µT	ICNRIP Guidelines on Limits of Exposure to Static Magnetic Fields (International Commission on Non-Ionizing Radiation Protection, 2009)

18.3.1.2 Offshore

The magnetic fields associated with the offshore cables have been calculated taking account of the local natural magnetic field on the cable route off the coast of Scotland, within the model. The magnetic field from the cables is added (vectorially) to the natural magnetic field. The results have been utilised in the marine ecology Chapters 14-16 and, hence, are not assessed here.

18.3.2 Compass Deviation

Compass deviations have been calculated assuming the compass is 1m above sea level. The effect of the magnetic field on compass deviation have also been calculated for consideration in Chapter 19.

18.3.3 Sediment Heating

Sediment heating modelling has been completed to identify the potential increase in seabed temperature, the effects of which are considered in the relevant ecological Chapters.

18.4 Baseline Information

18.4.1 Onshore Electric and Magnetic Fields

The Earth provides a background static magnetic field ranging between 25 and 65 microtesla (µT) and the intensity tends to decrease from the poles to the equator. In the Peterhead area it is approximately 42µT.

Existing potential onshore sources of Electric fields in the Fourfields and HVDC cable route area include the Peterhead substation and overhead electricity cables, and these will be AC, producing alternating electric fields. The electric fields associated with the substation are likely to be screened by the building structure as metal clad building structures act as a Faraday cage, an earthed metal box, which will effectively screen electric fields within the building.

18.4.2 Offshore Electric and Magnetic Fields

The Earth's background static field is also present offshore. At the landfall it will be in the region of 42µT, but the level will increase across the North Sea as the cable moves into more northern latitudes. The Hywind Export Cable will be the only operational power cable within the NorthConnect cable corridor, and it is an AC cable. There will be a crossing with the Hywind and North Connect cables, which is addressed in Section 18.8: Cumulative Assessment.

18.5 Impact Assessment

18.5.1 Operation

18.5.1.1 Onshore Magnetic Field

The onshore HVDC cables' radii will be approximately 0.1m. The two cables will be laid in a single trench as shown in Drawing NCGEN-NCT-Z-XE-0003-01, approximately 1m apart and, 1m below ground and, from the exit of the Road Crossing HDD to Joint Pit 2, a distance of 610m. A similar arrangement will be used for the parts of the route from Joint Pit 2 to Fourfields which aren't ducted. The current in the cable, I = 1400 Amps and the magnetic permeability, µ is assumed to be 1.

Figure 18.2 shows the magnetic flux values in µT for distances perpendicular to the onshore HVDC cables in a single trench, with 0 being the mid-point between the two cables, where the magnetic fields cancel out.

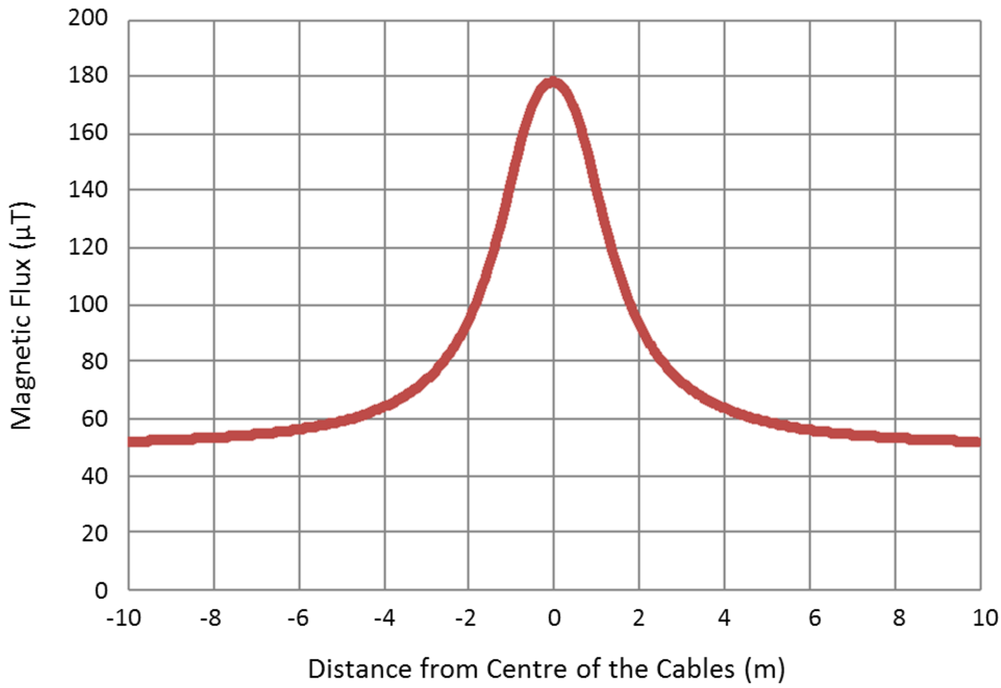

Figure 18.2: Magnetic Field when Crossing Perpendicular to the Onshore HVDC Cables in a Single Trench

The marine HVDC cables will be in separate trenches from the Landfall HDD to Joint Pit 1 and, as indicated in Figure 2.7 of Chapter 2, the cables will be 7m apart, and the cables radii is are assumed to be 0.13m. Figure 18.3 shows the magnetic flux values in µT for distances perpendicular to the marine HVDC cables in two trenches, with 0 being the mid-point between the two cables, where the magnetic fields cancel out.

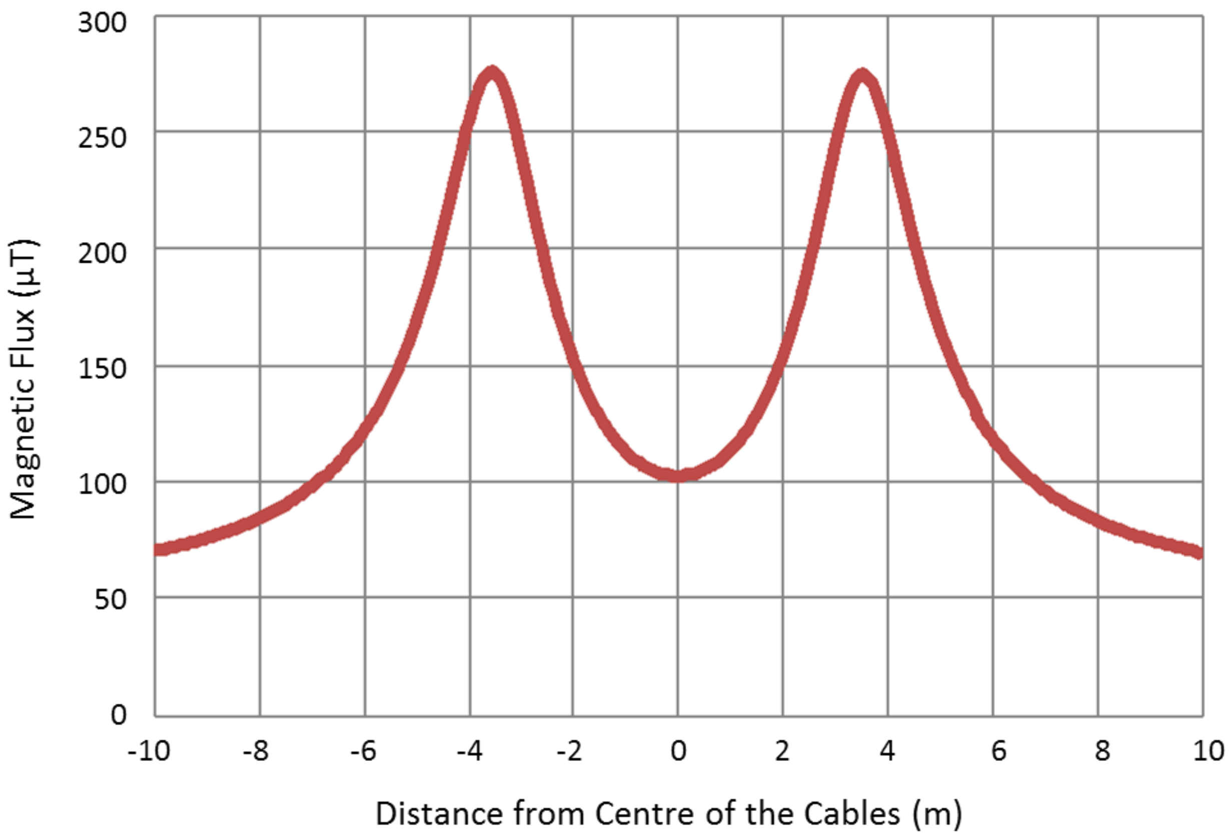

Figure 18.3: Magnetic Flux when Crossing Perpendicular to the Marine HVDC Cables in Two Trenches

The Road Crossing HDD and ducted cables will be deeper and afforded insulation by the ducts and, as such, the associated magnetic flux levels will be lower than those shown in Figures 18.2 and 18.3.

The maximum magnetic flux values are experienced at ground level directly above one of the cables in the two-trench design (270µT) as shown in Figure 18.3, and between the two cables in the single trench design (180µT). The peak magnetic flux for the two-trench design is 270µT including the Earth's magnetic field. This is 230µT below the level that causes interference with active implanted medical devices and 1000 times lower than general public exposure levels (see Table 18.1). The peak levels dissipate rapidly with distance, halving in both scenarios within 2 meters.

It should however be noted that implanted medical devices are likely to be in the torso not the feet, so for people standing above the cables, magnetic field at the torso >1m above ground level will be less than 150µT for the two trench design and 100µT for the single trench.

Considering the cables are located in grazing fields, then there are unlikely to be human receptors in the immediate vicinity of the cables for more than a few moments at a time. The cables will be ducted under the core paths and planned Fourfields paths and, as such, will be deeper and hence give rise to even lower magnetic flux levels. The effect of onshore cable magnetic fields on human receptors are considered to be **negligible** and **non-significant** due to their low levels.

18.5.1.2 Offshore Magnetic Fields

As discussed in Chapter 2, there is a possibility that the offshore cables could be bundled together, installed in close proximity to one another. If this is the case, then the fields between the two cables will cancel each other out and, therefore, the external magnetic field will be negligible as shown in Figure 18.4. However, for the purposes of the EIA we are considering the worst-case scenario that the cables will be laid in separate trenches.

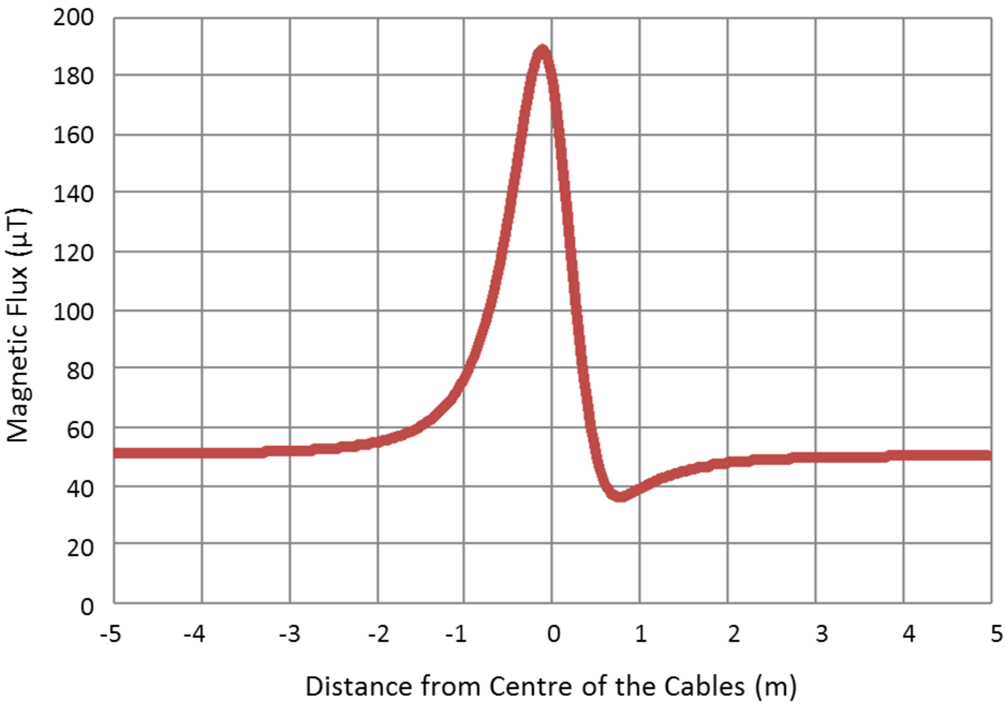

Figure 18.4: Bundled Cable Depth of Burial 0.4m – Magnetic Flux on seabed When Crossing Perpendicular

The worst-case depth of burial (DOB) is 0.4 m in hard substrates and 0.5 m in soft substrates. Cable separation will likely be between 20m and 100m as discussed in Chapter 2 and the Construction Method Statement (NorthConnect, 2018). The current in the cable, I = 1400 Amps and the magnetic permeability µ, is assumed to be 1. Figures 18.5, 18.6 and 18.7 assume a DOB of 0.4m and a cable separation of 20m, 40m and 100m respectively. In all three instances the peak magnetic flux is 640µT, with levels reducing to <300 µT within 2 m of the seabed in all cases.

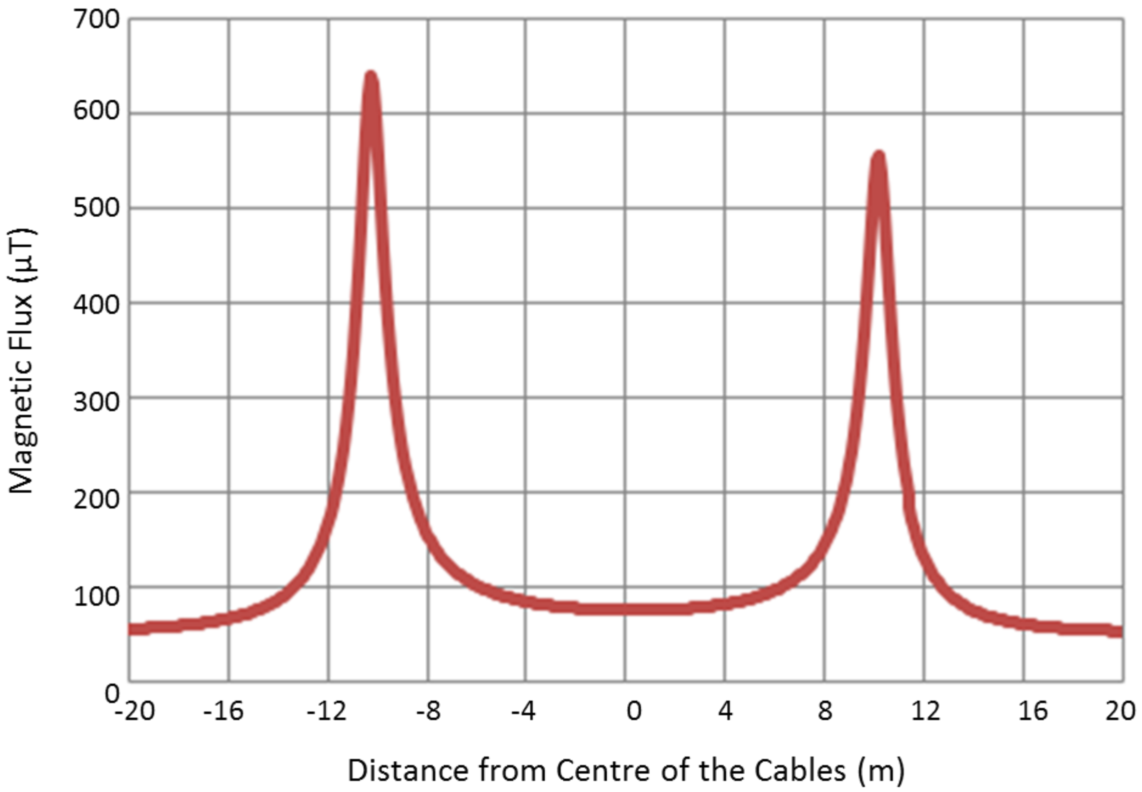

Figure 18.5: Magnetic Flux on seabed When Crossing Perpendicular - 20m Separation, 0.4m DOL

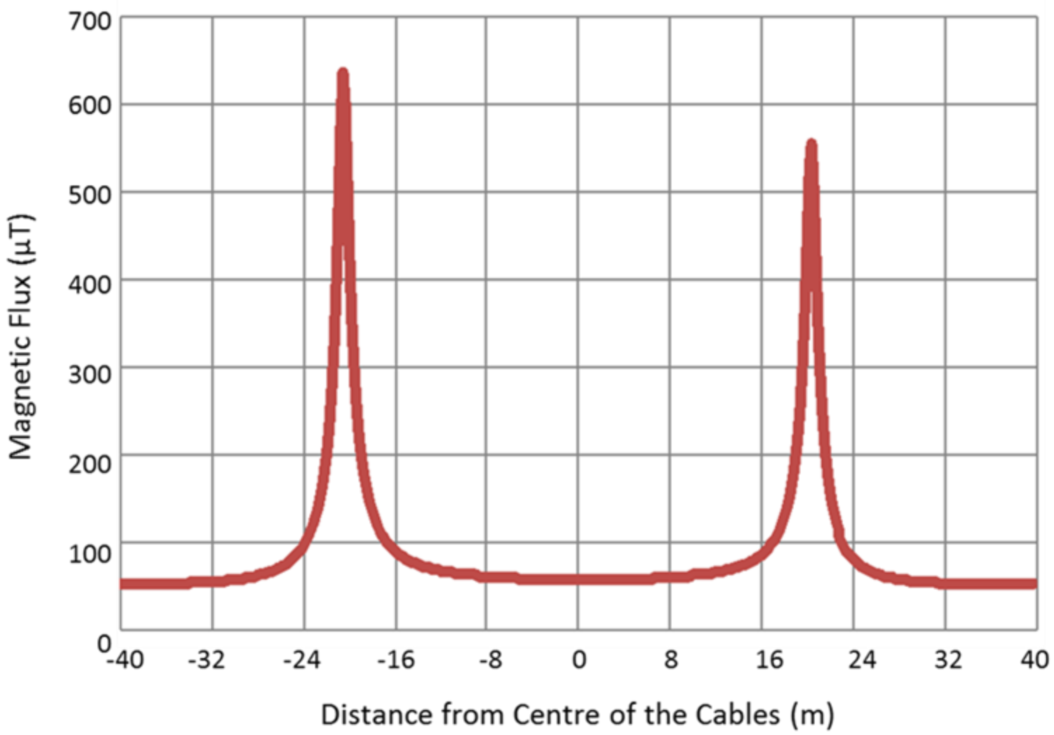

Figure 18.6: Magnetic Flux on seabed When Crossing Perpendicular - 40m Separation, 0.4m DOL

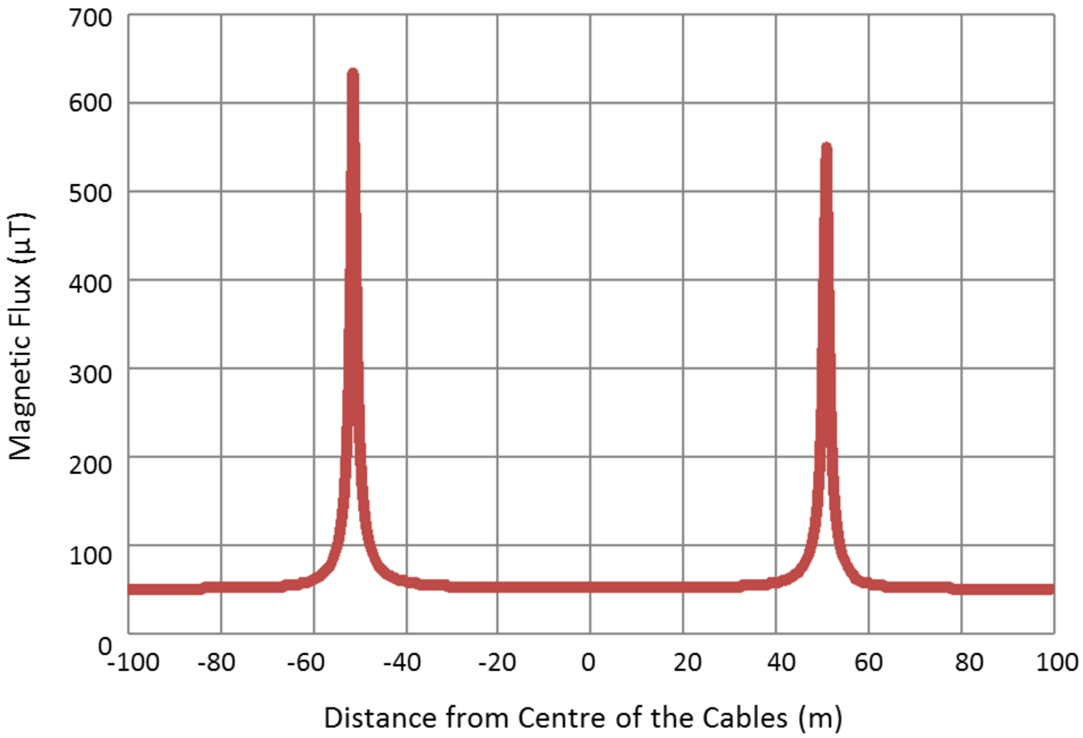

Figure 18.7: Magnetic Flux on seabed When Crossing Perpendicular - 100m Separation, 0.4m DOB

The majority of the cable will, however, have a DOB of over 0.8m and, Figure 18.8 assumes a cable separation of 40m and a DOB of 1m. The peak DOB is 310µT for a cable with a DOB of 1m.

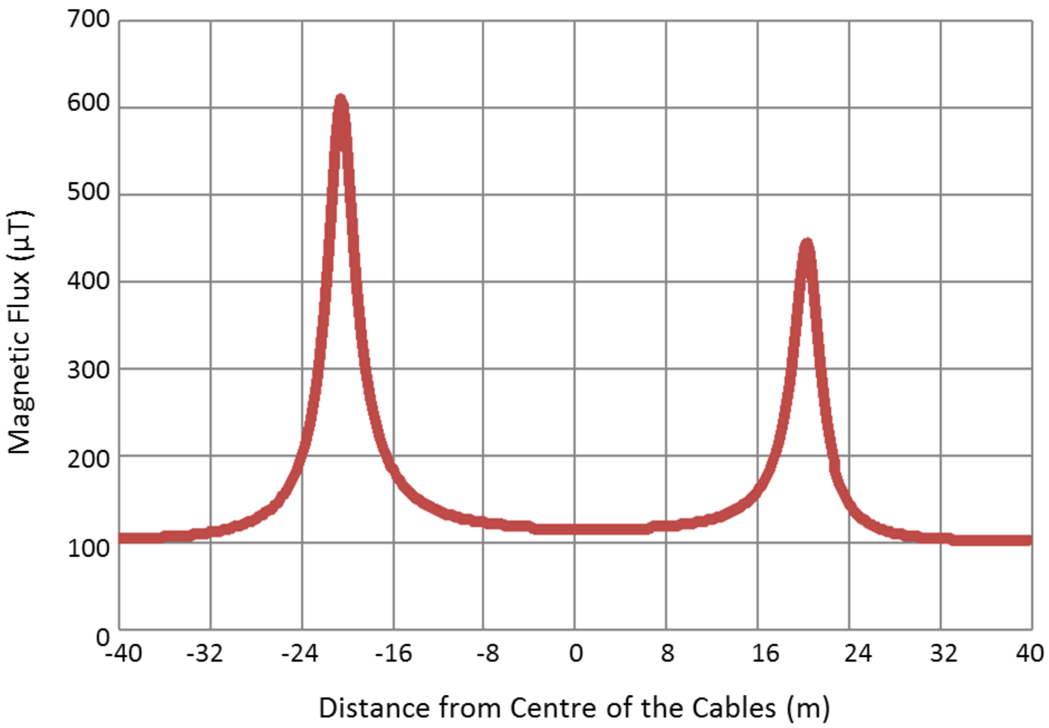

Figure 18.8: Magnetic Flux on seabed When Crossing Perpendicular - 40m Separation, 1m D

18.5.1.3 Compass Deviation

The magnetic fields associated with the cables could cause compass deviation. As discussed above magnetic fields reduce with distance, hence, the deeper the water the lower the compass deviation effect. Similarly, the closer cables are to each other, the greater the cancelling effect between the two cables. Hence, compass deviation in shallow waters can be reduced by installing the cables closer together. Figure 18.9 shows the maximum cable separation that can be employed while achieving compass deviations of less than 5 degrees at various water depths.

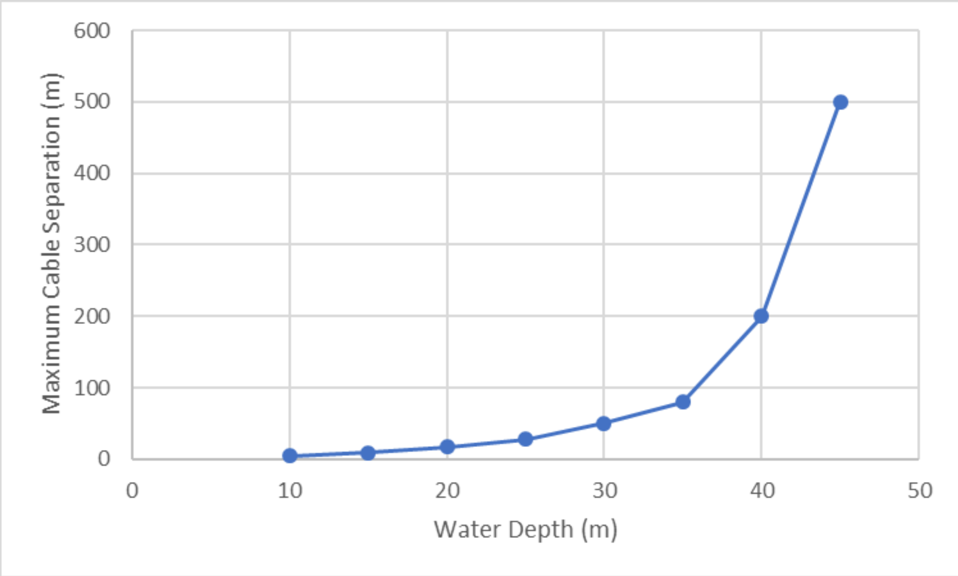

Figure 18.9: Maximum Cable Separation by Water Depth to Achieve <5-degree Compass Deviation

At 25m water depth a cable separation of <28m will give rise to a compass deviation of less than 5 degrees, whereas at 30m water depth a separation of <50m is required. The exit point is in the region of 26.5m water depth, so a separation of <35m would be sufficient to keep compass deviation below 5 degrees. Within Scottish Territorial Waters (STW), cable separation is likely to be between 20 and 40m. Beyond STW, water depths are greater than 45m and, as such, cables anywhere within the consenting corridor will not increase compass deviation by more than 5 degrees.

18.5.1.4 Sediment Heating

The cables will generate heat and in theory could increase the temperature of the surrounding sediments, which could have knock-on ecological impacts primarily to benthic species, as discussed in Chapter 14: Benthic Ecology. The heating associated with the cables has therefore been modelled. Figure 18.10 shows the predicted sediment heating assuming a 20m cable separation, a Depth of Lowering (DOL) of 0.5m and an ambient seabed temperature of 9°C for the North Sea. Figure 18.11 provides a closer view of the temperatures around one of the cables.

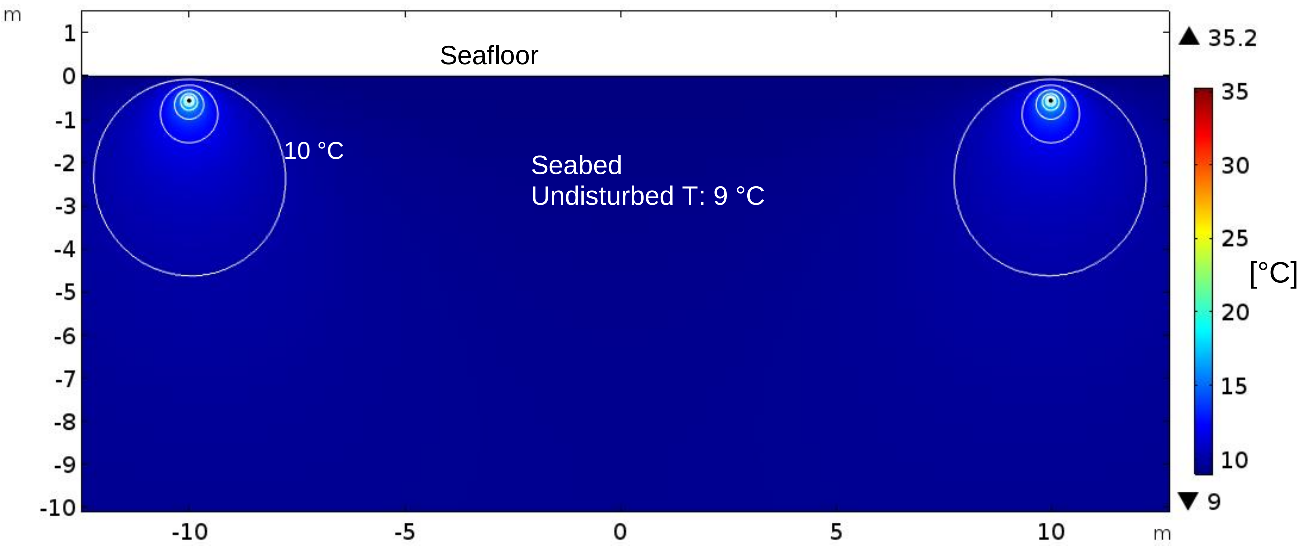

Figure 18.10: Sediment Temperatures for Cables 20m Separation and DOL 0.5m

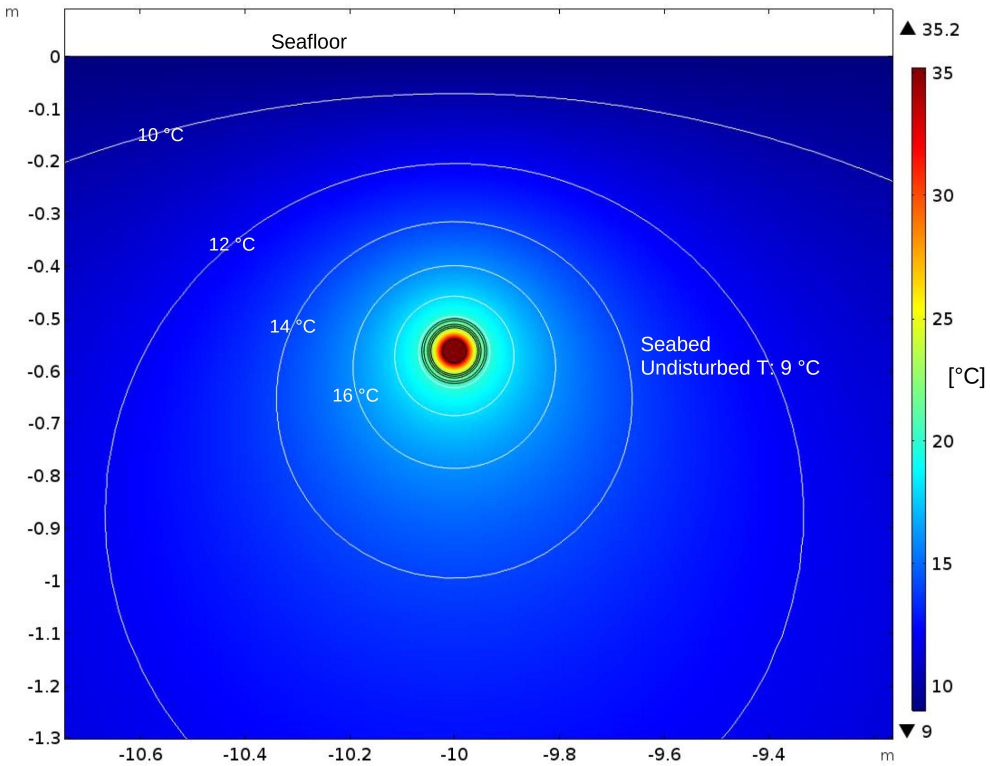

Figure 18.11: Sediment Temperatures for Cables 20m Separation DOL 0.5m (Close Up)

The model output demonstrates that sediment heating effects are extremely localised and, as such, there are no interaction effects between the two cables at a 20m separation. Increases above 1 degree are localised to an area with a radius of less than 2.5m, with the centre point being below the cable. This is due to heat dissipation nearer the top of the seabed, and probably due to the increased heat dissipation facilitate by seawater. Seafloor temperatures are not predicted to increase. Temperature increases of up to 7 degrees occur for an area within a radius of 0.2m, so significant temperature increases are very localised.

Bundled cables give rise to higher temperatures as they interact with each other. Figures 18.12 and 18.13 assume a 0.5m depth of lowering for a bundled cable.

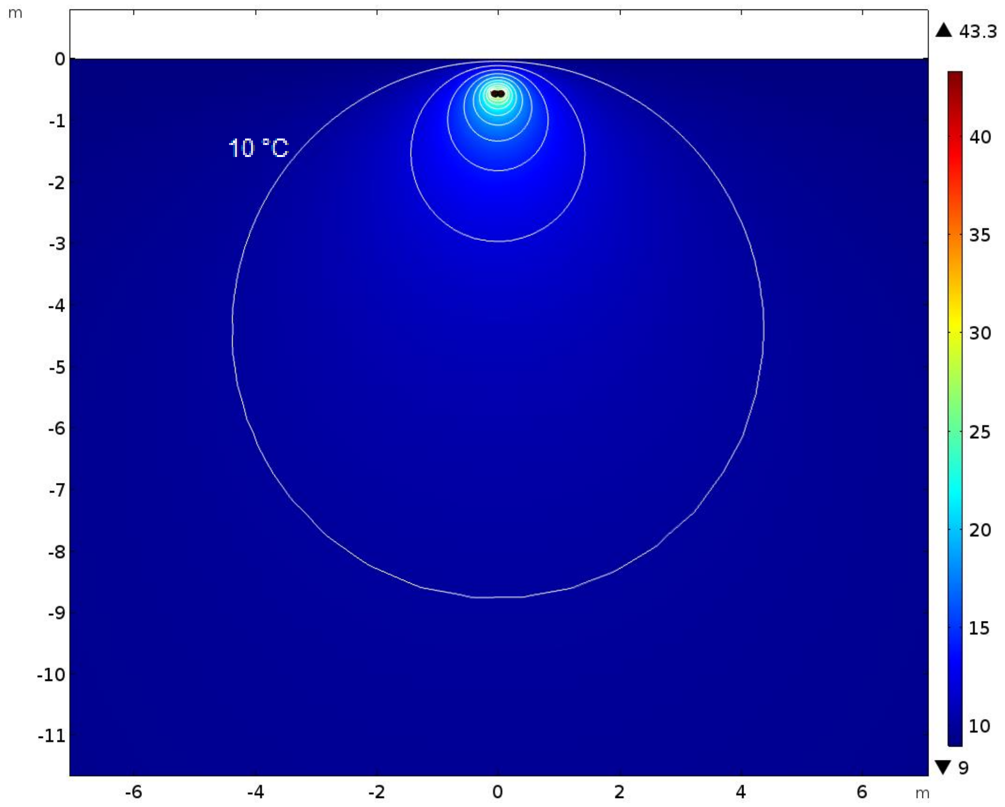

Figure 18.12: Sediment Temperatures for Bundled Cables DOL 0.5m

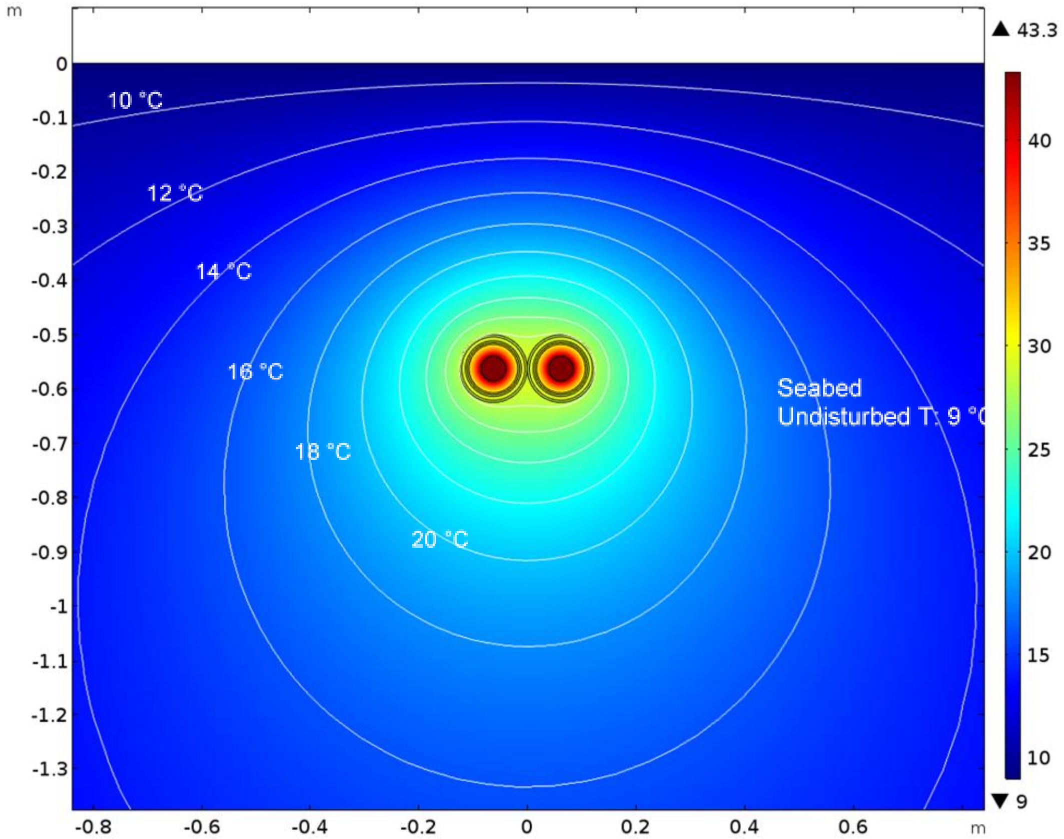

Figure 18.13: Sediment Temperatures for Bundled Cables DOL 0.5m – Close Up

With bundled cables, the 1-degree increase area is also localised to a radius of less than 2.5m, however, the increase of up to 7 degrees covers a wider area with a radius of 0.5m.

18.6 Mitigation Measures

No secondary mitigation is required to minimise impacts, as the need to minimise magnetic field, compass deviation and sediment heating effects has been considered throughout the project design process and is included as primary mitigation.

18.7 Residual Effects

18.8 Cumulative Assessment

18.8.1 Onshore Magnetic Field

An assessment of magnetic fields associated with the NorthConnect Converter Station and HVAC Cable Route, was included within the Environmental Statement (NorthConnect, 2015). The HVAC cables and AC components of the converter station were calculated, to give rise to, a 18µT magnetic fields. For the cable this is at ground level (assuming a 1.5m burial depth), for the converter station it was at the boundary fence. Some of the DC components could give rise to 57µT at 5m, the public will be a minimum of 5m from these components.

Due to the low levels of magnetic fields associated with the HVAC cables, and the fact that they will only be close to the HVDC cables near the converter station; and they will be in ducts at depth; no significant cumulative effects are expected, between the HVAC and HVDC cables.

Similarly, the HVDC cables will be in ducts much deeper than 1m (as used in the calculations in section 18.5.1.1), near the site boundary, and as such, no significant cumulative effects are expected with the DC components of the Converter Station.

NorthConnect have committed to carrying out, pre and post-energisation magnetic field measurements at the Fourfield site, to show that magnetic fields generated will not have a detrimental effect on the public. The HVDC cables need to be energised to allow this to happen, hence, the measurement will be of the cumulative effects.

18.8.2 Offshore

EMF and sediment heating effects are very localised and, as such, the only project with which there could be cumulative effects is the Hywind Scotland Pilot Park Offshore Windfarm. Statoil have calculated that the magnetic field surrounding their cables would be 6µT reducing to 2 µT within 2m and having negligible effects on the environment (Statoil, 2015). At the crossings the magnetic fields could, in theory, interact, however, there will be rock protection between the cables reducing the interaction between the cables. The interactions will be extremely localised to within 2m and the Hywind levels of magnetic flux are so low that the overall effect would be **negligible, non-significant**.

18.9 Summary

The only impact assessed within this Chapter was the effect of onshore magnetic flux on human receptors, this was deemed to be negligible, non-significant. The magnetic flux levels and sediment heating effects on ecological receptors are considered in topic-specific Chapters 14-16 (Benthic Ecology; Fish and Shellfish; and Marine Mammals); and compass deviation is discussed in Chapter 19 (Navigation and Shipping).

The potential for cumulative effects with the Hywind Scotland Pilot Park Offshore Wind Farm has identified that their magnetic flux levels were extremely low and hence cumulative effects are negligible, non-significant.

18.10 References

Department of Energy & Climate Change. (2012). Powerlines: Demonstrating compliance with EMF public exposure guidelines. A voluntary Code of Practice., 1-7.

Health and Safety Executive. (2016). Electromagnetic Fields at Work, A guide to the Control of Electromagnetic Fields at Work Regulations 2016

International Commission on Non-Ionizing Radiation Protection. (2009). Guidelines on the Limits of Exposure to Static Magnetic Fields. *Health Physics*(96(4)), 504-514.

National Radiological Protection Board. (2004). Advice on Limiting Exposure to Electromagnetic Fields (0-300 GHz).

NorthConnect. (2015). NorthConnect Interconnecter Convertor Station and High Voltage Alternative Current Cable Route Environmental Statement. *2*.

NorthConnect. (2018). HVDC Cable Infrastructure - UK Construction Method Statement. In F. Henderson (Ed.).

Statoil. (2015). Hywind Scotland Pilot Park Project - Environmental Statement.

Chapter 19: Navigation and Shipping

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Contents

19 Navigation and Shipping

19.1 Introduction

This chapter assesses the potential impacts related to shipping and navigation associated with the installation and operational phases of the proposed NorthConnect HVDC marine cabling between Long Haven Bay (south of Peterhead), UK and the UK-Norway median line. A baseline assessment (Appendix G.1) was used to identify the impacts, the significance of which were determined using the Formal Safety Assessment Process (IMO, 2002).

19.2 Sources of Information

The key sources of information used to inform this chapter are listed below:

- One year of Automatic Identification System (AIS) data (January-December 2017);
- Four years of Vessel Monitoring System (VMS) data (2014-2017);
- Ten years of Royal National Lifeboat Institution (RNLI) incident data (2005-2014);
- Ten years of Marine Accident Investigation Branch (MAIB) data (2005-2014);
- UK Admiralty Charts;
- Admiralty Sailing Directions, North Sea (West) Pilot, 2016; and
- Marine Scotland Data.

The primary data source on vessel activity used in this assessment was the AIS data. IMO regulation requires AIS to be fitted aboard all ships of 300 gross tonnage (GT) and upward engaged on international voyages, cargo ships of 500 GT and upwards not engaged on international voyages and passenger ships irrespective of size. Ships fitted with AIS shall maintain AIS in operation at all times except where international agreements, rules or standards provide for the protection of navigational information.

As of 31 May 2014, all EU fishing vessels of length 15m and above are required to carry AIS equipment. A proportion of smaller fishing vessels carry AIS voluntarily but may not broadcast continuously. The VMS data covers fishing vessels of 12m length and above.

Recreational craft are not required to carry AIS, but a minority do, estimated at around one-fifth for this area by RYA Scotland in their Scoping Opinion response. Similarly, military vessels may not broadcast on AIS.

19.2.1 Planning Framework

The United Nations Convention on the Law of the Sea (UNCLOS, 1982) provides principles relating to all submarine cables and pipelines. In line with UNCLOS and UK legislation, the consenting process will involve relevant navigation stakeholders via the Department for Business, Energy and Industrial Strategy (BEIS) and Crown Estate Scotland (CES).

19.2.2 Legislative Framework

In the UK, developers are required to comply with the following:

- International Regulations for Preventing Collisions at Sea (COLREGS 1972/78), as implemented in the UK through Marine Shipping Notices (IMO, 1972/78); and
- International Association for Lighthouse Authorities Guidance on Aids to Navigation and Buoyage (IALA, 2001).

19.2.3 Relevant Guidance

The following guidance has been used in preparation of this assessment:

- International Maritime Organisation (IMO) Guidelines for Formal Safety Assessment (FSA) – MSC/Circ. 1023 (IMO, 2002). The impact assessment methodology used in this chapter is in line with the FSA method; and
- MCA MGN 543 (MCA, 2016) Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response Issues. Although this guidance is focused on offshore renewables, it highlights issues to be taken into consideration when assessing the effects of offshore developments on navigational safety and includes guidance on cable protection and burial within UK waters.

19.2.4 Other Sources

19.2.4.1 Consultation

Meetings specific to navigation and shipping were held with the following organisations:

- Maritime and Coastguard Agency (MCA);
- Northern Lighthouse Board (NLB); and
- Peterhead Harbour.

As part of the wider project stakeholder engagement, consultation was also carried out with recreational vessel representatives (RYA Scotland, Peterhead Sailing Club, Misty Angling Trips), fisheries representatives (as part of the commercial fisheries assessment as well as in planning survey work) and the Ministry of Defence. Correspondence about the project was also sent to the Marine Safety Forum but no technical feedback was received.

19.2.4.2 Cable Protection Analysis Report

Cathie Associates has undertaken a Cable Protection Analysis Report (CPAR) for the subsea cable survey corridor of the NorthConnect project. This has drawn upon many of the findings from the separate CBRA (Cable Burial Risk Assessment) report which included an assessment of hazards from ship anchors and fishing gear. The CPAR and CBRA are provided as Appendixes to the Construction Method Statement (NorthConnect 2018). It also incorporates information gathered from the final geophysical and geotechnical reports.

The main body of the CPAR summarises the seabed conditions and installation risks identified along the cable route. A Risk Register, analysing the main cable installation and protection risks and mitigation measures to reduce these risks is presented as Appendix A. Other appendices provide a comprehensive assessment of the route, encompassing a preliminary burial tool assessment, Alignment Charts, information on cable burial techniques and tools and examples of specific equipment and rock placement volume estimates to account for possible sections of reduced burial, trench backfill and crossing designs.

Implementation of the CPAR findings provides key mitigation against navigation and shipping hazards.

19.3 Assessment Methodology

An overview of the NRA methodology used in this study is presented in this section.

19.3.1 Overview

The IMO Formal Safety Assessment process (IMO, 2002) approved by the IMO in 2002 under SC/Circ.1023/MEPC/Circ392 has been applied within this study. This is a structured and systematic methodology based on risk analysis and cost benefit analysis (if applicable). There are five basic steps within this process:

- Identification of hazards (a list of all relevant accident scenarios with potential causes and outcomes);
- Assessment of risks (evaluation of risk factors);
- Risk control options (devising regulatory measures to control and reduce the identified risks);
- Cost benefit analysis (determining cost effectiveness of risk control measures); and
- Recommendations for decision making (information about the hazards, their associated risks and the cost effectiveness of alternative risk control measures).

Figure 19.1 is a flow diagram of the FSA methodology applied. The focus of this assessment has been on Steps 1-3.

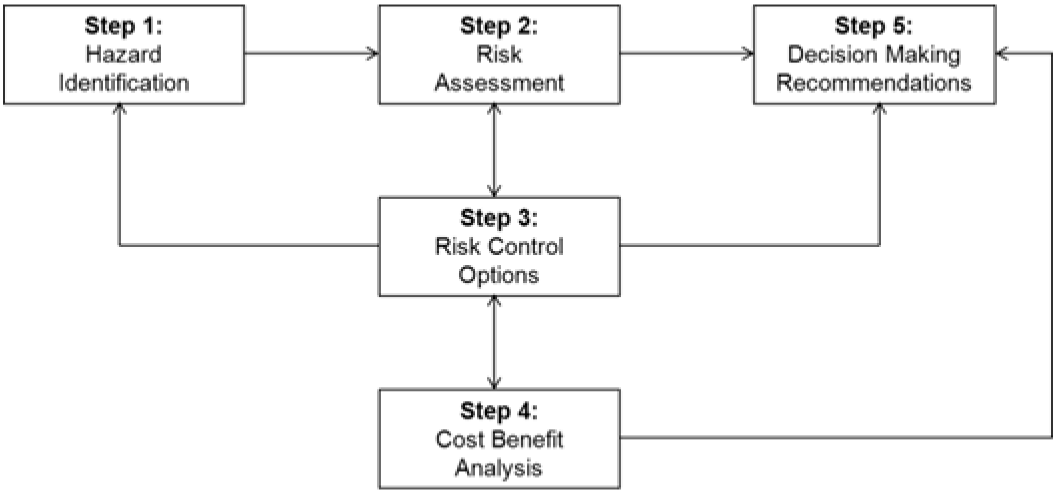

Figure 19.1. Formal Safety Assessment Process.

19.3.2 Desk Study

A detailed assessment of the vessel activity in the vicinity of the NorthConnect HVDC consenting cable corridor was undertaken using a variety of data sources including twelve months of AIS data. A 5NM buffer of the HVDC offshore cable corridor was used to encapsulate all relevant shipping and fishing activity, and this was therefore chosen as the study area in which to perform the detailed shipping assessment. To ensure the anchoring activity analysis was comprehensive, the study area was extended to 10NM around the cable corridor for the section within UK territorial limits.

As fishing activity can vary by season, long term Vessel Monitoring System (VMS) was used in addition to the AIS data in the fishing assessment. The long-term data covered the four-year period from 1st January 2014 to 31st December 2017 (inclusive). Other fisheries data sets covering smaller vessels are presented in Chapter 20: Commercial Fisheries.

Admiralty Navigational Charts and Sailing Directions (UKHO, 2016) covering the North Sea were used to identify the navigational features relevant to the consenting cable corridor. This high-level assessment carried out by Anatec, was undertaken over a wider area than that used in the shipping and anchoring assessment as significant features existed outside the 5 and 10NM study areas.

The shipping and navigation baseline assessment was then used to identify potential impacts that have been considered within the impact assessment.

19.3.3 Consultation

Consultations were carried out with a number of organisations to gain information to inform the baseline and impact assessment of shipping and navigation (see Section 19.2.4). A summary of the key points raised during face-to-face meetings is provided in Table 19.1.

Table 19.1. Stakeholder Consultation Meetings on Navigation and Shipping.

Organisation	Summary of Key Points
Maritime and Coastguard Agency	• Overview presented of NorthConnect project and baseline shipping and navigation assessment. • MCA are interested to review the Cable Burial Risk Assessment and evidence of navigational stakeholder consultation. • Where protection measures other than trenching / burial are being proposed, the MCA will require details. Any reduction in the existing chart datum should not exceed 5%. • MCA do not want to see compass deviation greater than 5 degrees. Actual deviation should be confirmed post-installation. • Other issues discussed included military activity, UXO, wrecks, guard vessels and Marine Conservation Zone.
Northern Lighthouse Board	• Overview presented of NorthConnect project and baseline shipping and navigation assessment. • Restriction on AIS range of coverage as well as vessel carriage requirements were discussed. Recreational vessels and fishing vessels below 15m length are known to be under-represented. • Cumulative projects were reviewed, the nearest being redevelopment of Peterhead Port and Hywind Scotland floating wind farm. No significant adverse cumulative effects were considered likely. • Potential impacts and planned mitigation measures were reviewed and considered appropriate. • A shore-based marker would not be required given the impracticality of establishing a mark in the area above the HDD route. The cable will be suitably protected against anchor and fishing gear impact from the exit point onwards, informed by a Cable Burial Risk Assessment.

Organisation	Summary of Key Points
Peterhead Port Authoirty	• Review of vessels involved in installation work and timescales. • Review of vessel activity – shipping, fishing anfd recreation • Review of anchoring activity outside Peterhead Harbour Limits and methodology used to separate anchored vessels from vessels holding posiiton using DP. • Port VTS control movements inside Harbour Lmits but does not offer advice to vessels on where to anchor. • There is good holding ground outside the port to north and south. Rare for vessels to drag anchor. • Discussion of Pilot station which overlaps consenting corridor. Harbour Master stated this can be temporarily relocated to the west to avoid the cable laying when in this vicinity. • Cumulative issues including Peterhead Port Redevelopment were discussed. No significant changes to baseline traffic (from 2017) are expected. • Further meetings planned as the offshore installation work approaches.

Scoping Opinion responses were also considered as part of the assessment. Each of the scoping opinions have been considered and are summarised in Chapter 4: Consultations.

19.3.4 Impact Assessment Methodology

The impact assessment process has been evaluated using the IMO Formal Safety Assessment Methodology (IMO, 2002). The FSA assigns each impact a "severity of consequence" and a "frequency of occurrence" to evaluate the significance of each impact. The definitions used in the FSA to evaluate the consequence and frequency of impacts are presented in Table 19.2 and Table 19.3, respectively.

Table 19.2. Severity of Consequence.

Severity	Definition
Catastrophic	• Total loss of a vessel or crew • Extensive environmental damage
Serious	• Loss of a crew member, or multiple serious injuries • Major environmental damage • Major damage to infrastructure or vessel • Major national business, operation or reputation impacts
Moderate	• Serious injury to person • Notable damage to infrastructure or vessel • Significant environmental damage • Considerable business, operation, or reputation impact
Minor	• Slight injury(s) to person • Minor damage to infrastructure of vessel • Minor environmental damage • Minor business, operation, or reputation impact
Negligible	• No injury to persons • No significant damage to infrastructure of vessel • No environmental damage • No significant operational impacts

Table 19.3. Frequency of Occurrence.

Frequency	Definition
Frequent	Will occur on a regular basis during the project
Reasonably Probable	Extremely likely to happen during the project span
Remote	Likely to happen during the project span
Extremely Unlikely	Unlikely to happen but not exceptional
Negligible	Only likely to happen in exceptional cicrumstances

Once impacts have been assigned significance based on their severity of consequence and frequency of occurrence, their significance has been assessed as "Unacceptable", "Tolerable", or "Broadly Acceptable". The definitions of these are given in Table 19.5. The risk matrix used to assign significance is presented below.

Table 19.4. Risk Matrix.

Frequency	Frequent	Tolerable	Tolerable	Unacceptable	Unacceptable	Unacceptable
	Reasonably Probable	Broadly Acceptable	Tolerable	Tolerable	Unacceptable	Unacceptable
	Remote	Broadly Acceptable	Broadly Acceptable	Tolerable	Tolerable	Unacceptable
	Extremely Unlikely	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable	Tolerable	Tolerable
	Negligible	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable	Tolerable
		Negligible	Minor	Moderate	Serious	Catastrophic
		Severity				

Table 19.5. Significance Definitions.

Significance	Definition
Unacceptable (High Risk)	Generally regarded as unacceptable whatever the level of benefit associated with the activity. Significant risk mitigation or design modification required to reduce to tolerable (ALARP).
Tolerable (Moderate Risk)	Typical of the risks from activities which people are prepared to tolerate to secure benefits. There is however an expectation that such risks are properly assessed, appropriate control measures are in place, residual risks are as low as reasonably practicable (ALARP) and that risks are periodically reviewed to monitor if further controls are appropriate.
Broadly Acceptable (Low Risk)	Generally regarded as acceptable and adequately controlled. At these risk levels the opportunity for further reduction is limited.

19.4 Baseline Information

19.4.1 Introduction

This section summarises baseline vessel activity and navigational features in the vicinity of the proposed NorthConnect offshore consenting cable corridor. The full analysis is provided in Appendix G.1.

19.4.2 Navigational Features

The closest major port to the consenting corridor is Peterhead Port, located approximately 3NM north of the corridor landfall. This port provides deep-water berthing facilities at depths of up to 14m to a broad range of industries including oil & gas, renewables and fishing. Peterhead Port is the UK's largest white and pelagic fish port; it also accommodates tankers, general cargo ships, cruise ships as well as recreational craft in Peterhead Bay Marina. Further south (approximately 21NM south of the landfall) is Aberdeen Harbour. This port is of commercial significance and the most important base for the offshore oil and gas industry in NW Europe. There are various small harbours located within 10NM of the landfall including Buchanhaven, Boddam, Port Errol, Collieston and Newburgh. Boddam is closest to the landfall (approx. 1.3NM) and is the base for inshore creel boats as well as the Misty Angling sea angling/boat trips in the summer.

Two general anchorages area were identified in literature: Peterhead Bay; and Cruden Bay. The Pilot Book states that Peterhead Bay offers anchorages in depths exceeding 11m with the best holding ground found SE of the South Breakwater. It also notes that vessels have been known to drag anchor in bad weather. Cruden Bay also offers anchorage, primarily for small vessels.

There are no military practice areas (PEXA) that intersect the consenting cable corridor. The closest firing practice area lies approximately 10NM south of the corridor. There are no restrictions on vessels' rights to transit the area.

There are three wind farms in the vicinity of the consenting corridor with the closest (Hywind Scotland Pilot Park) lying approximately 5-6NM to the south of the corridor (at its closest point). This is comprised of five floating wind turbines. The European Offshore Wind Development Centre (EOWDC), located 14NM south of the corridor landfall in Aberdeen Bay, is currently under construction. Finally, the Kincardine Offshore Wind Farm is located approximately 22NM south of the cable landfall and has been granted consent for the installation of seven turbines.

19.4.3 Metocean Data

A description of the tidal streams in the general area off the east coast of Scotland is provided below (extracted from Admiralty Sailing Directions (UKHO, 2016)):

> *The offshore stream runs generally N and S from Rattray Head to Bell Rock. The E-going stream out of the S part of the Moray Firth sets in the direction of the coast, that is gradually SE and S round Rattray Head before joining the S-going offshore stream. The N-going offshore stream divides N of Rattray Head, part of it sets NW and W into Moray Firth and part of it continues N.*
>
> *The change from the S-going to the N-going stream is through W and from the N-going to the S-going stream through the E.*

In the vicinity of the consenting corridor east of Peterhead, the peak spring and neap tidal rates are 2.1 knots and 1.0 knots (north), and 1.7 knots and 0.8 knots (south), respectively.

Mean tidal levels as presented on Admiralty Chart 213 for Peterhead are presented (heights in metres above chart datum):

- MHWS – 4.0m
- MHWN – 3.2m
- MLWN – 1.6m
- MLWS – 0.7m

Fog occasionally affects the east coast, particularly in the north, however it is not especially frequent over the open sea.

19.4.4 Maritime Incidents

Based on a recent ten years of data (2005-14), there were 97 maritime incidents recorded in the study area by the RNLI and 56 incidents recorded by the MAIB. Machinery failure was the most prominent cause of incidents although other frequent causes included “ill crewman” and “accidents to person.” The majority of incidents recorded were in Peterhead Port and in coastal waters off Peterhead with relatively few recorded further offshore.

19.4.5 Maritime Traffic Survey

A shipping analysis was performed using 12 months of Automatic Identification System (AIS) data from 2017 to account for seasonal variations. Analysis was undertaken in a study area covering 5NM around the consenting cable corridor. Figure 19.2 presents the AIS tracks recorded in the study area, colour-coded by vessel type.

It is noted that tracks associated with temporary (non-routine) operations such as those from vessels carrying out surveys, cable work, or fishing vessels carrying out guard duties (e.g., at Hywind during installation works) have been removed from the remaining analysis.

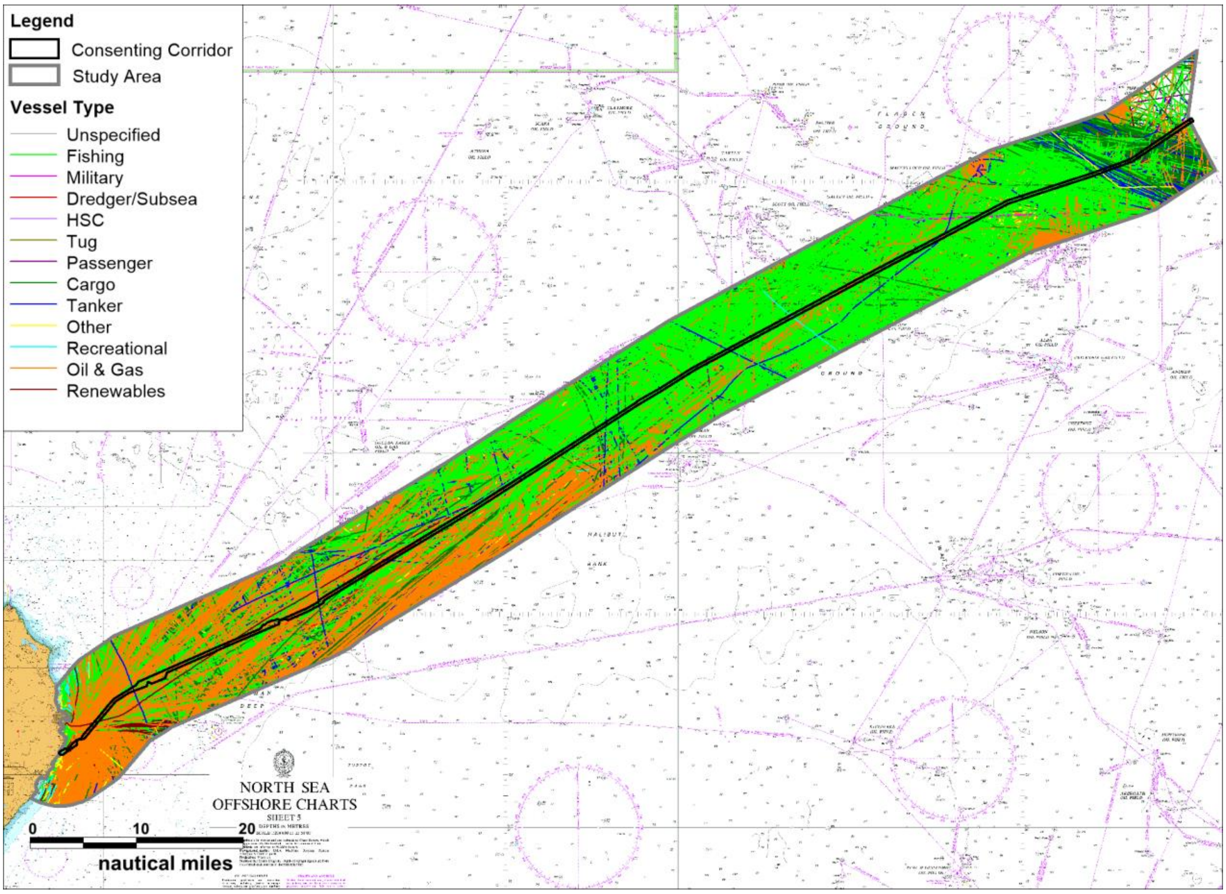

Figure 19.2. AIS Tracks by Vessel Type (2017).

Excluding temporary vessel activity, there was an average of 79 unique vessels per day recorded in the study area over the 12-month study period. August was the busiest month with an average of 96 unique vessels per day whilst January was the quietest with 58 unique vessels recorded per day.

The most frequently recorded vessel types in the area were associated with the oil and gas industry (contributing approximately 37%), followed by fishing vessels (34%). Commercial vessels accounted for approximately 21% of the total. It is again noted that fishing vessels below 15m in length and recreational vessels are not required to broadcast on AIS. The main vessel type distribution based on unique vessels per day is presented in Figure 19.3.

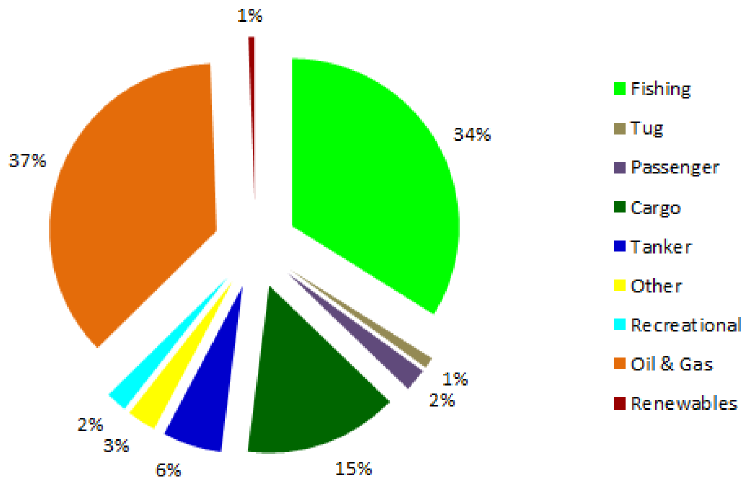

Figure 19.3. AIS Main Vessel Type Distribution (2017).

The average vessel length and deadweight tonnage (DWT) recorded in the study area was 73m and 7,125 DWT, respectively. The largest vessel recorded in the study area was the crane vessel Pioneering Spirit, with a DWT of 499,125.

The highest density area for all vessel types recorded was the coastal waters off Peterhead. Relatively low densities were seen farther offshore particularly at the far NE of the study area.

Vessels at anchor within 10NM of the consenting cable corridor during the twelve-month study period were identified using a combination of the information broadcast on AIS (navigation status) as well as a review of vessels' speeds versus headings over time, since it is known that anchored vessels do not always change their status on AIS which requires a manual update by the Officer of the Watch (OOW). Tracks were also manually checked to filter out low speed vessels that were holding position using DP (fixed heading) rather than anchor (swing circle) (Refer to Appendix G.1 for more details).

All anchoring activity was recorded within 6NM of the coast with over half (approximately 53%) from oil & gas related vessels. Other frequently recorded vessel types were cargo vessels (23%) and tankers (10%).

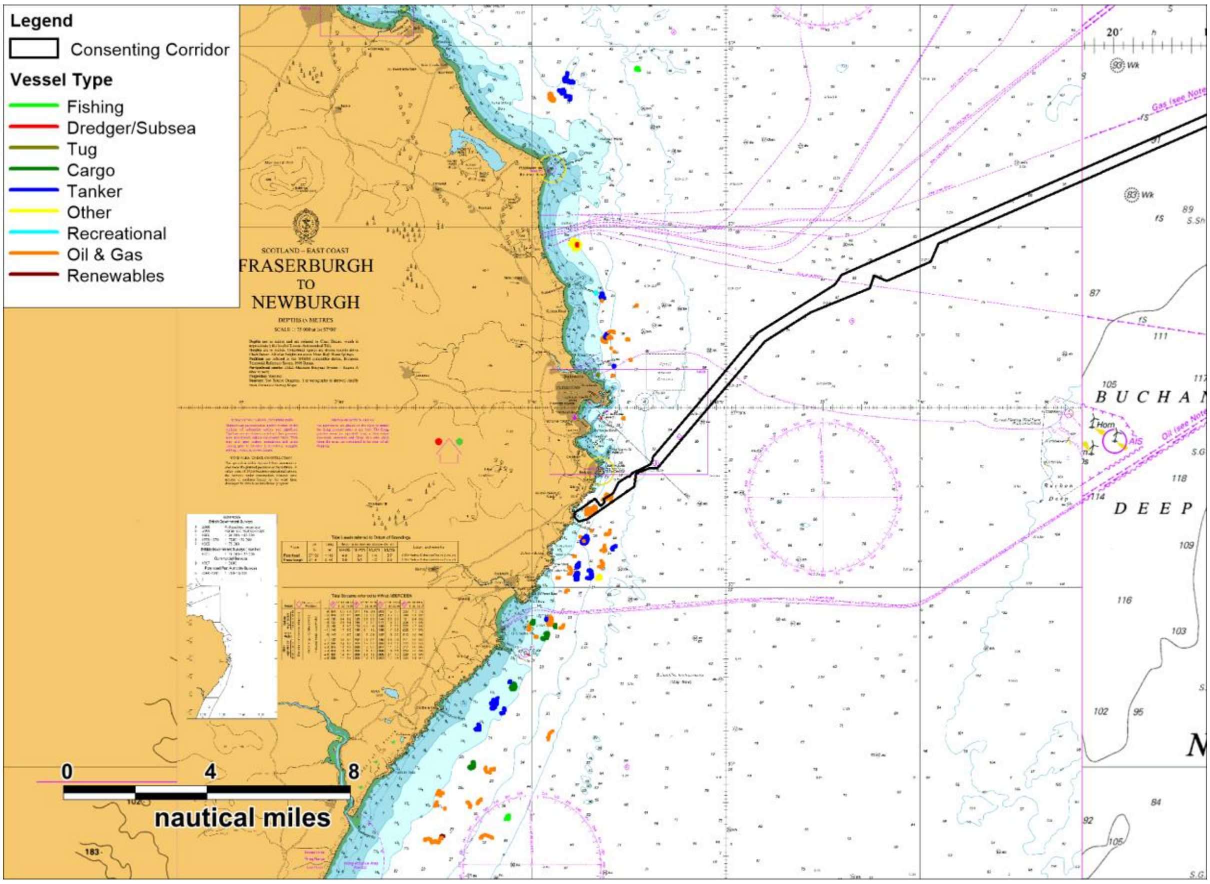

Figure 19.4. General View of Anchored Vessels near the Consenting Corridor (2017).

The majority of vessels recorded at anchor were in the 2,500 – 5,000 DWT category. The largest vessel recorded at anchor was the 145m oil & gas supply vessel Seven Atlantic, with a DWT of 11,885.

Three unique oil & gas related vessels were recorded at anchor within the consenting corridor on five separate occasions. Their details are given below in Table 19.6. One other anchored vessel was also recorded within 100m of the cable corridor in December 2017, a 3,100 DWT offshore support vessel.

Table 19.6. Vessels recorded at Anchor within the Consenting Corridor.

Vessel Name	Type	Length (m)	DWT	Date(s) at Anchor
Grampian Sovereign	Offshore Supply	83	2,515	11th – 12th January 2017
Olympus	Offshore Supply	80	4,000	26th July 2017
Vestland Cetus	Offshore Supply	86	4,260	11th January 2017 12th-13th January 2017 8th-9th December 2017

A detailed view of the vessels recorded at anchor within the consenting corridor is presented in Figure 19.5.

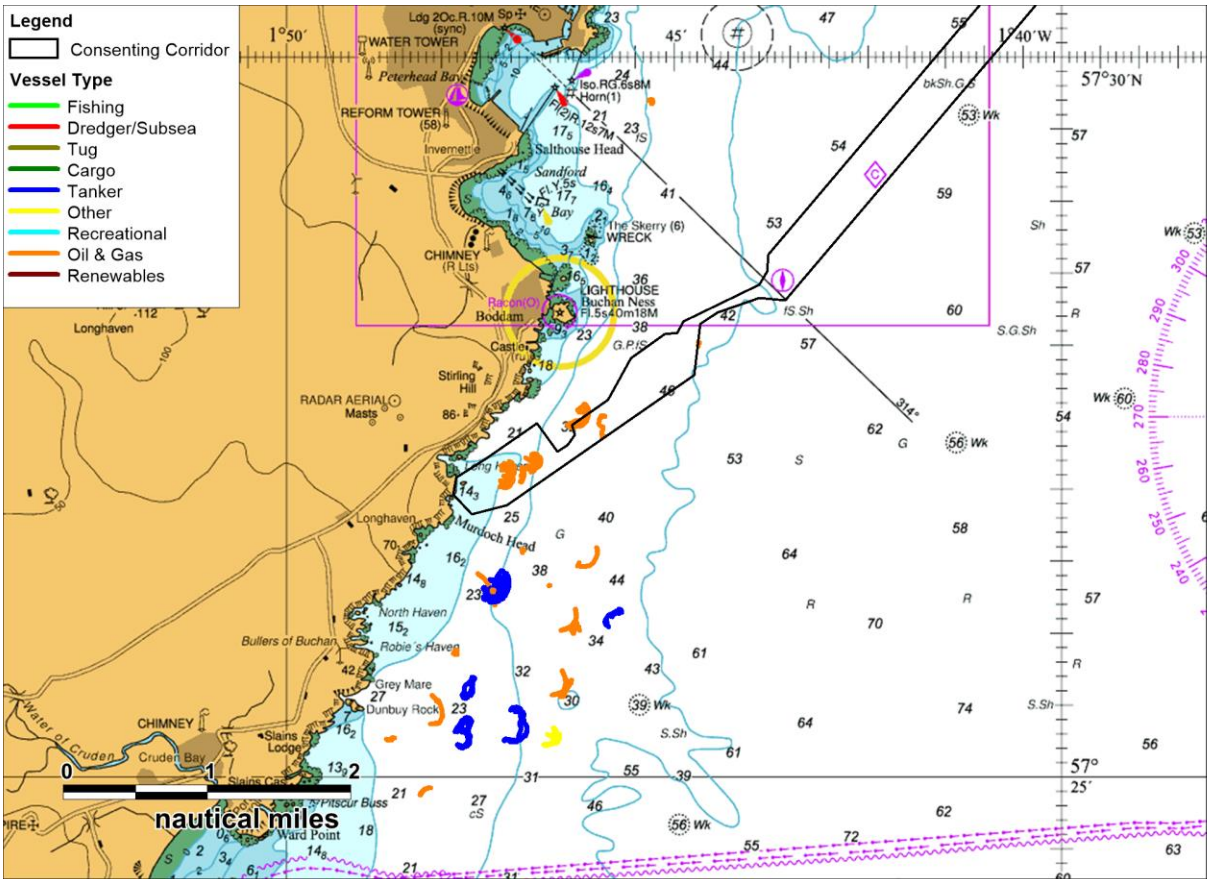

Figure 19.5. Detailed View of Anchored Vessels within and near the Consenting Corridor (2017).

19.4.6 Recreational Activity

Figure 19.6 presents the tracks of recreational vessels recorded on AIS within the study area during 2017. Density was highest in coastal waters off Peterhead, with fewer crossings of the cable corridor farther offshore. This agrees well with the recreational AIS intensity grid available on the National Marine Plan Interactive (NMPi) (Marine Scotland, 2018), which showed the highest density of recreational vessels in the approaches to Peterhead harbour based on AIS analysis provided by Anatec to the RYA for summer periods from 2011 to 2013.

It is noted that the consenting corridor is outside of indicative areas of general recreational boating identified by the RYA, which mainly relate to club training and racing areas.

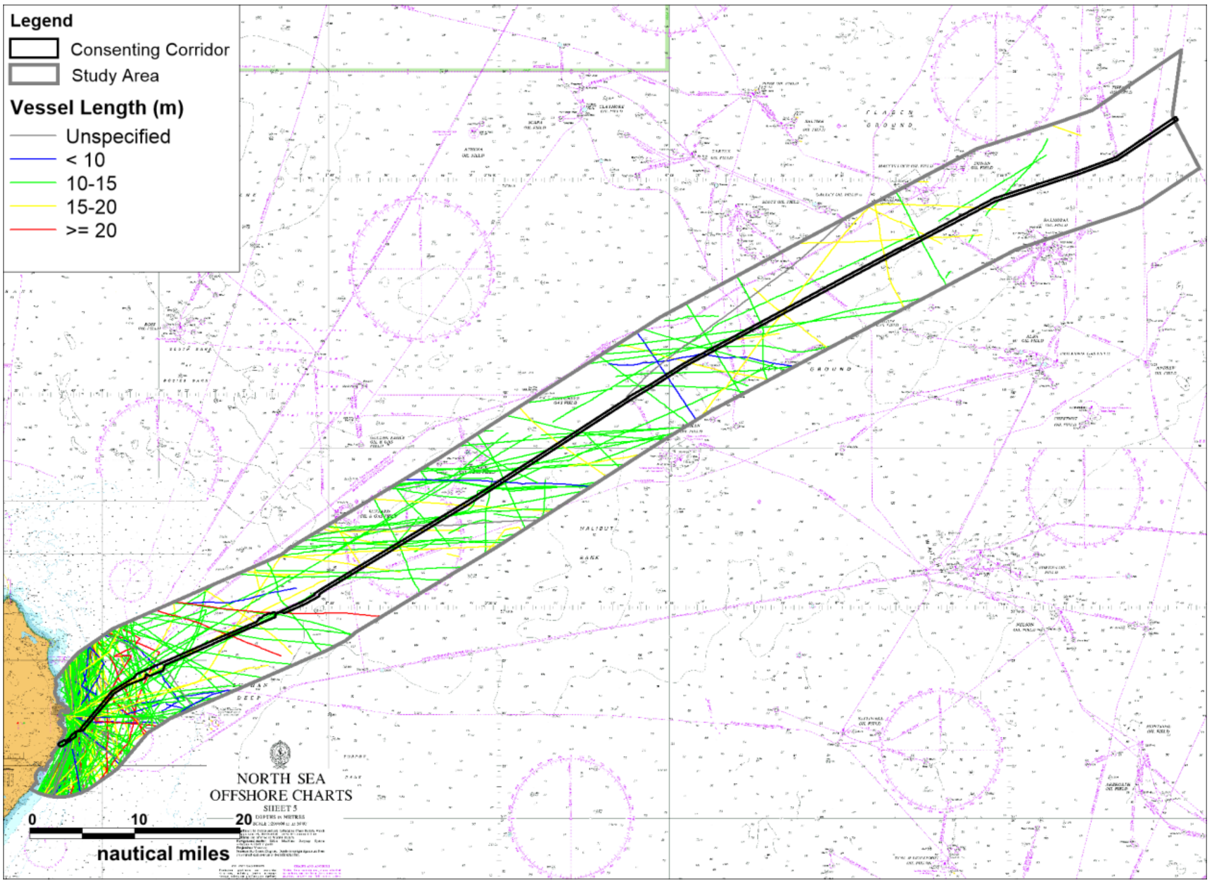

Figure 19.6. AIS Recreational Activity (2017).

In terms of nearby shore-based facilities, Peterhead harbour offers excellent shelter for recreational vessels in all weather. Peterhead Bay Marina accommodates visiting yachts up to 22m in length with 150 fully serviced berths, and ample berths for visiting yachts. It is also home to a sailing club (Peterhead Sailing Club) which carries out dinghy cruising, dinghy racing and yacht cruising. There are also three RYA training centres located in Peterhead:

- Sea Cadets;
- North East Scotland College; and
- Falck Safety Services.

19.4.7 Fishing Vessel Activity

Significant fishing activity was recorded in the study area along the entire length of the consenting corridor with a peak in the approaches to Peterhead Port, and in coastal waters due to creeling and scallop dredging. The most frequently recorded gear type in the study area overall was demersal trawlers (54%) followed by twin (13%) and pair (10%) trawlers.

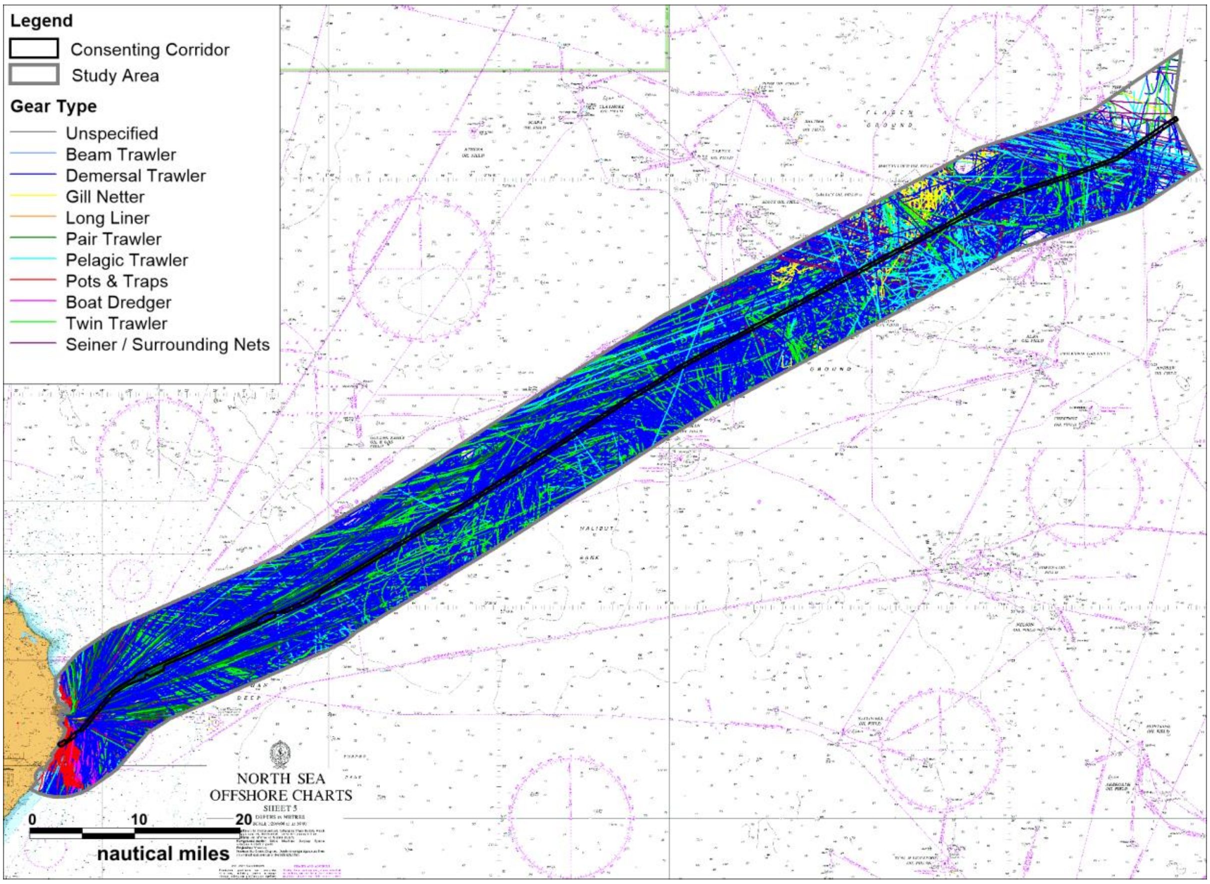

Figure 19.7. AIS Fishing Tracks by Gear Type (2017).

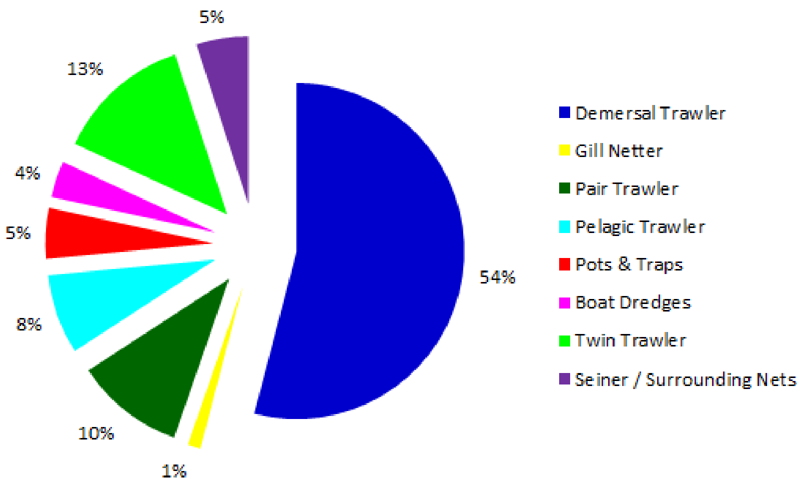

Figure 19.8. AIS Fishing Main Gear Type Distribution.

Demersal gear-types which include demersal trawls (single otter and paired) and scallop dredges are at most risk of snagging on subsea cables as they drag their gear along the seabed. It is estimated that vessels recorded with speeds less than 6 knots (approximately 79%) may be actively engaged in fishing. Detailed analysis was carried out to filter out any demersal vessels with slow speeds, e.g., vessels transiting in/out of Peterhead port, from those potentially fishing. A density plot revealed KP67-KP118 (approximately) was the busiest section of the cable corridor with active demersal fishing activity.

19.4.8 Data Gaps

The main data set used in this analysis was AIS data. The limitations of AIS data are as follows:

- AIS equipment carriage is not mandatory for all vessels. Recreational craft and smaller fishing vessels are not obliged to carry it, and are therefore will be under-represented in the AIS data;
- Coverage may temporarily be lost especially further offshore due to the range from receivers. However, vessels are normally on consistent courses when steaming at sea, so this was not found to be a significant limitation; and
- Navigational status broadcast on AIS is reliant on update by the OOW on the vessel. Where this was not done in a timely manner, interpretation of the vessel speed and heading was necessary to identify whether a vessel was anchored versus holding station using DP.

Appendix G.1 provides details on the other data sources that were used to supplement AIS, especially for smaller vessels.

19.4.9 Identification of Key Receptors

The following key receptors have been carried forward to the impact assessment:

- Passing traffic (encompasses all passing vessel types e.g., commercial, oil & gas, fishing and recreation);
- Vessels engaged in fishing (steaming fishing vessels on passage included in preceding point);
- Vessels at anchor; and
- Military exercises.

19.5 Impact Assessment

This section identifies aspects of the proposed development which have the potential to affect shipping and navigation. The methodology used to assess them is presented in Section 19.3.4.

19.5.1 Impact Overview

The impacts identified based on the shipping and navigation baseline assessment and stakeholder consultation are summarised and listed below in Table 19.7. The impacts are grouped by phase.

Table 19.7. Assessed Impacts.

Phase	Impact
Installation	Collision of a passing (third party) vessel with a vessel associated with the cable installation
	Cable installation causing disruption to passing vessel routeing
	Snag risk to fishing vessel while cable is exposed
	A vessel drags anchor across the cable while it is exposed
	A vessel drops anchor in an emergency over the cable while it is exposed
	Cable installation causing disruption to military exercises
Operation and Maintenance	A vessel drags anchor over the cable
	A vessel drops anchor in an emergency over the cable
	A vessel founders (sinks) onto the cable
	A vessel drops an object e.g., container, onto the cable
	A vessel grounds due to reduced under keel clearance
	A vessel engaged in fishing snags its gear on the cable or associated cable protection
	Collision of a passing vessel with a vessel associated with maintenance works/monitoring of the cable
	Interference with magnetic compass onboard passing vessels

Decommissioning is assumed to have similar (or lesser) impacts than installation. The decommissioning of the cables may be subject to a separate assessment nearer the time, as advised by Marine Scotland, and therefore has not been assessed in detail.

19.5.2 Primary and Tertiary Mitigation

This section details the primary and tertiary mitigation measures that are assumed to be in place prior to the installation phase as part of the Formal Safety Assessment process. The primary and tertiary mitigation are also laid out in Chapter 25: Schedule of Mitigation.

Installation Phase

- Circulation of information via Notices to Mariners, Radio Navigational Warnings, NAVTEX, and/or broadcast warnings in advance of and during the offshore works. The notices will include a description of the work being carried out.
- Cable vessels will display appropriate marks and lights, and broadcast their status on AIS at all times, to indicate the nature of the work in progress, and highlight their restricted manoeuvrability.
- Temporary aids to navigation will be deployed (if required) to guide vessels around any areas of installation activity.
- Guard vessels will be used to monitor and advise vessels in the vicinity of the installation works as appropriate.
- Compliance with International Regulations for the Prevention of Collision at Sea (IMO, 1972) and the International Regulations for the Safety of Life at Sea (SOLAS).
- Temporary (advisory) protection zones will be created around the installation works during the installation phase, and monitored by the guard vessel(s).
- Liaison with local ports and harbours, notably Peterhead.
- Fisheries Liaison Officer (FLO) will be employed to facilitate communications between the project and the fishing sector.
- The programming is such that the cables will not remain uncovered for longer than a 3-month period.

Operation & Maintenance Phase

- As built information will be provided to the UKHO for inclusion in admiralty charts, and the Kingfisher Cable awareness charts, with appropriate notes.
- Cable to be installed with appropriate protection as per the Construction Method Statement.
- Any protection measures used (e.g. rock placement) will not reduce the existing water depths by greater than 5%.
- Routine surveys will be carried out to verify that the cable protection status is adequate.
- Compass deviation effects will be minimised by keeping cable separation distance as short as practicable.

19.5.3 Installation Stage Impacts

This subsection describes the impacts that have been considered during the installation phase as part of the Formal Safety Assessment process. All are direct, short term, temporary, adverse impacts.

Increased Collision Risk (Passing Vessel with Installation Vessel)

There is an increased collision risk created during the installation phase for all passing traffic (including commercial, oil & gas, fishing and recreational) due to the presence of vessels associated with the installation of the offshore cabling. The nature of cable installation requires large, slow moving vessels which will be restricted in their ability to manoeuvre. Therefore, these vessels may have limited capability in taking avoidance action from a passing vessel on a collision course, should such a situation arise. Due to their size and mobility in comparison, smaller vessels associated with the installation phase, e.g., guard vessels, are considered to pose a lesser risk of collision than that of the cable installation vessels.

The collision risk is likely to be greater in higher density shipping areas. From the baseline assessment, the highest collision risk area will be in territorial waters near the landfall. However, there is third-party vessel traffic all along the consenting corridor, so encounters are also possible further offshore up to the UK/Norway median line.

It is expected that the majority of vessels in the area will be aware of the installation work before encountering the project vessels through tertiary mitigation measures (circulation of information such as Radio Navigation Warnings and NAVTEX). This will assist vessels in reviewing their passages prior to embarking, and revising their passage plans if necessary. During a voyage any passing vessels in the vicinity will become aware of the installation work via AIS broadcasts from work vessel(s), assuming the passing vessel has an AIS unit fitted. The installation and guard vessels will maintain visual, RADAR, and AIS watches. If a passing vessel is projected to be on a collision course, or their projected closest point of approach is within the safety zone, the guard vessel will have procedures in place to contact the vessel and request a safe clearance.

The frequency of this impact is considered to be **Extremely Unlikely**, and the severity **Serious**, resulting in a ranking of **Tolerable**.

Disruption to Vessel Routeing

Installation of the cables may also cause disruption to vessel routeing/timetables. This will most likely affect busier areas of shipping where vessels are transiting on regular routes with a time schedule, such as oil & gas vessels and passenger ferries. The risk of a collision between two third-party vessels may also be increased as a result of route deviation.

However, the additional vessel activity due to the installation work, in the context of the existing baseline traffic using the area, is low, and there will normally be room for vessels to re-route a safe distance from the installation work, assuming a rolling (advisory) safety zone around the cable installation activity. Through circulation of information, the vast majority of vessels should be aware of the installation work in advance, allowing alternate routes to be planned with minimal impact on schedules.

It is noted the consenting corridor overlaps the Pilot Station for Peterhead Port. Liaison with the Peterhead Harbour Master has taken place on this issue to ensure any disruption can be managed by temporarily relocating the station. Further liaison is planned as per the list of tertiary mitigation measures in Section 19.5.2.

The frequency of this impact is considered to be **Reasonably Probable**, and the severity **Minor**, resulting in a ranking of **Tolerable**.

Snagging Risk to Fishing Vessel on Exposed Cable

From the baseline fishing analysis, activity was observed along the consenting corridor, including in the vicinity of the landfall which is close to the busy fishing port of Peterhead.

During installation, there may be a period of time of between 7 days to 3 months after laying when the cable is exposed and not protected through burial or other means such as rock placement. This short period represents a potentially higher risk of snagging should a fishing gear interact with the exposed cable. Consequences of snagging to the fishing vessel could range from damage to gear (and cable), loss of vessel stability due to lines being put under strain and in the worst case, capsize of vessel, men overboard and risk of injury or fatality. For example, a risk of capsize could occur if the vessel attempted to free its gear by raising the cable rather than slipping the gear.

The impact is likely to be greatest in higher density active fishing areas such as the coastal waters off Peterhead and certain sections further offshore. Further detail is provided in Chapter 20: Commercial Fisheries and Appendix G.1.

It is expected that tertiary mitigation measures including having the FLO in place, circulation of information (via Kingfisher and local communications) as well as the presence of guard vessels at no more than 15km intervals along any sections of exposed cable, will help ensure fishermen are aware of the hazard and avoid fishing over the exposed cable.

The frequency of this impact is considered to be **Extremely Unlikely**, and the severity **Serious**, resulting in a ranking of **Tolerable**.

Anchor Dragging onto Exposed Cable

All anchoring activity recorded in the baseline shipping analysis was within 6NM of the coast. Two anchorages (Peterhead and Cruden Bay) were identified in literature, but vessels were found to anchor at various locations off the coast within 10NM of the cable consenting corridor.

There were three unique oil and gas industry vessels that were recorded at anchor within the cable consenting corridor on five separate occasions. After the installation and charting of the offshore cabling, it is expected that vessels will not plan to anchor in its immediate proximity. However, immediately following laying it is possible vessels will not be aware of the cable.

While exposed any vessel anchor could interact with the cable. If an anchor becomes snagged on the cable, there could be a risk of injury in trying to free it. If the anchor cannot be freed the safest action is to slip it, and not attempt to raise or cut the cable. Smaller vessels may be at risk of losing stability and capsizing in the worst case.

Mitigation will include circulation of information including chart depiction (ideally pre-installation), guard vessels, and minimising the duration the cable is exposed (maximum of three months).

The frequency of this temporary impact is considered to be **Extremely Unlikely** and the severity is ranked as **Serious**, taking into account mitigation. This results in an assigned ranking of **Tolerable**.

Emergency Anchoring onto Exposed Cable

If a vessel suffers engine failure, there is a chance it may drop anchor to avoid drifting into an emergency situation such as a collision or grounding. Should this happen in the vicinity of the HVDC marine cables, the anchor may come into contact with the cable.

A vessel suffering engine failure is only likely to drop anchor if there is immediate danger nearby. This is more likely to occur in the shallower, coastal waters near the landfall where there is a higher risk of grounding. In open waters further offshore, the vessel may attempt to fix the problem first or await assistance, particularly in deeper waters where anchoring may not be feasible.

In general, the highest risk areas of emergency anchoring are where traffic levels are high and water depths are shallow. The coastal waters off Peterhead were identified as a busy area of shipping and fishing, and have experienced a number of machinery failures on vessels in recent years based on the review of recent maritime incidents (MAIB and RNLI), thus are likely to be highest risk.

During the short period when the cable may be exposed, any anchor could interact with the cable. If the anchor fouls the cable, there could be a risk in trying to free it. Smaller vessels may be at risk of losing stability and capsizing in the worst case. If the anchor cannot be freed it should be slipped, and no attempt made to raise or cut the cable.

During the installation period, mariners may not be as aware of the newly laid cable although this can be mitigated through circulation of information including chart depiction (ideally pre-installation), guard vessels, and minimising the duration the cable is exposed (maximum of three months).

The frequency of this temporary impact was considered to be **Extremely Unlikely**, the consequences are estimated to be **Moderate**, resulting in an overall ranking of **Broadly Acceptable**.

Disruption to Military Exercises

The corridor landfall and approach lie approximately within 10NM of two designated firing practice areas. These areas are operated under a clear range procedure, that is, no firing will take place unless the area is considered to be clear of all shipping.

Assuming embedded mitigation measures (e.g. circulation of information including UKHO) are in place preceding any installation works, there is not expected to be significant disruption to military exercises, due to the distance between the areas, and because the installation work timetable will be taken into consideration by the Ministry of Defence (MoD).

The frequency of this impact was considered to be **Remote**, and the severity **Minor**, resulting in a ranking of **Broadly Acceptable**.

19.5.4 Operation and Maintenance

This subsection describes the impacts that have been considered for the operation and maintenance phases as part of the Formal Safety Assessment process. All are direct, long-term, permanent, adverse impacts.

Anchor Dragging

Anchoring activity in the vicinity of the consenting corridor has been described previously under the description of this hazard during the Installation Phase. Once protected, only larger vessels are likely to threaten the buried cable as their anchors are able to penetrate deeper. If the anchor is snagged on the cable, there could be a risk of electrocution or other injury in trying to free it, with the worst case being capsize of the vessel and loss of life. However, this is less likely for larger vessels such as oil & gas support vessels, with the cable being more likely to be damaged / severed.

Based on experience and consultation with the Peterhead Harbour Master, the frequency of an anchor drag over the cable is considered to be **Remote**, i.e., likely to occur during the span of the project. The severity is ranked as **Moderate**, taking into account mitigation including cable protection informed by the Cable Burial Risk Assessment (CBRA), which includes a review of anchoring risks based on vessels identified to be anchoring in the area. Protection will be designed, where possible, to bury the cable below the depth that an anchor can penetrate. Where sufficient protection is not provided by burial, additional external protection such as rock berms will be utilised. This is especially important in the first few KP where oil & gas vessels were seen to be anchoring in proximity to (or inside) the corridor. This results in an assigned ranking of **Tolerable**.

Emergency Anchoring

This scenario has already been described under the Installation Phase.

As with anchor dragging, larger anchors pose the biggest threat to the protected cable, as they are capable of penetrating deeper into the seabed, and can cause greater damage than smaller anchors if contact is made. If the anchor fouls the cable, there could be a risk of electrocution or other injury in trying to free it. If the anchor cannot be freed it is safest to slip it, and not attempt made to raise or cut the cable.

The frequency of this effect was considered to be **Extremely Unlikely**, as even in an emergency Masters should consult charts before dropping anchor, and therefore avoid anchoring directly over the cable. The consequences are estimated to be **Moderate**, taking into account the planned cable protection informed by the CBRA which is designed to bury the cable below the depth that an anchor can penetrate. This results in an overall ranking of **Broadly Acceptable**.

Vessel Foundering

Foundering refers to a vessel losing its structural integrity, and subsequently sinking over the offshore cabling. Areas along the cable where traffic levels are higher generally correspond to areas of higher foundering risk.

Historically, fishing vessels have been seen to have the greatest risk of foundering, particularly in bad weather. From the baseline analysis, fishing vessels accounted for approximately 34% of vessel traffic recorded in the study area. It is noted that other small vessels such as recreational craft also have a higher risk of foundering compared to larger vessels, especially in bad weather.

Should a vessel founder over the offshore cabling, the consequence would be potential damage to the cable. Burial of the cable (and/or alternative protections) may provide a degree of protection against damage from smaller vessels.

The frequency of this impact is considered to be **Extremely Unlikely**, and the severity **Moderate**, resulting in a ranking of **Broadly Acceptable**.

Dropped Object from Vessel

This hazard refers to a vessel dropping an object when over the marine cabling. Areas along the cable where traffic levels are higher generally correspond to areas of higher dropped object risk. There is also higher risk from vessels that carry containers on deck, which includes oil and gas supply vessels, as well as container ships.

An incident is most likely to occur in heavy seas, due to cargo being shifted. There is also the possibility of smaller objects being dropped, e.g., from a fishing vessel operating in the area, but this is unlikely to threaten the cable.

The frequency of this impact is considered to be **Extremely Unlikely**, and the severity **Minor**, resulting in a ranking of **Broadly Acceptable**.

Vessel Grounding due to Reduced Under Keel Clearance

This hazard refers to a vessel grounding due to reduced under keel clearance associated with cable crossing points and protection methods, which could lead to subsequent capsize, injury, loss of life, oil spill, etc. In general, the higher risk areas are coastal waters where water depths are shallower.

The minimum water depth along the HVDC offshore cabling is at the HDD exit point where depths are 26.5m. In line with MCA guidance, it is not planned to reduce the existing water depth by more than 5% along any section of the cabling, which would correspond to approximately 1.3m at the HDD exit point. The cable protection level put in place directly at the HDD exit point will not be more than 1.3m, and thereafter is expected to be 0.8-1m within the first 12NM. The water depth increases to over 40m within 1NM of the shore. The small fishing and recreational vessels which were generally seen in the AIS survey data to be transiting this close to shore would be at no risk of grounding (less than 5m draught).

Further offshore (in over 40m depths), the maximum vessel draught recorded within 6 miles of the coast was approximately 14m from a bulk carrier transiting to Rotterdam. The maximum draught vessel that Peterhead Port can accommodate is c. 14m. Vessels such as these would not be at risk of grounding based on the planned cable protection and the existing water depths over the parts of the corridor they cross. The deepest draught vessel overall in the 2017 survey was 24m, however this was recorded transiting at water depths between 80m and 120m outside UK territorial waters (approximately 50nm NE of the Scottish coastline).

The frequency of this impact is considered to be **Extremely Unlikely**, and the severity **Moderate**, resulting in a ranking of **Broadly Acceptable**.

Fishing Gear Snagging

Fishing vessels carrying demersal gear that interacts with the seabed when deployed are at risk of snagging on subsea cables. Demersal trawling was the most frequent activity observed however, dredging activity was also recorded near the coast off Peterhead, as well as creeling using static gear. A detailed analysis revealed that high density areas of demersal activity occurred close to the coast as well as between KP67 and KP118 (approximately). The depiction of the cable on nautical and Kingfisher charts (embedded mitigation measures) may discourage fishing in the cable's vicinity, however, evidence shows that this is not always the case with laid cables.

If a fishing vessel snags its gear on a cable, the crew should attempt to make contact with the Coastguard, and if possible the cable operator. However, as it is extremely likely that the crew will be advised to abandon the gear, attempts will sometimes be made to free the gear without consulting the Authorities. This can cause further damage to the cable and gear, pose a risk of injury including electrocution if the cable is raised or cut, can threaten the stability of the vessel due to lines being put under strain, and in the worst-case lead to capsize and loss of life. Cable protection such as trenching and burial, rock placement with suitable profiling (as detailed in Chapter 2: Project Description), etc., is assumed to provide effective mitigation. Further detail is provided in Chapter 20: Commercial Fisheries.

The frequency of this impact is considered to be **Remote**, and the severity **Serious**, resulting in a ranking of **Tolerable**.

Increased Collision Risk (Passing Vessel with Maintenance/Survey Vessel)

It is planned that two years after completion of the installation period and every fifth year, the Inspection, Maintenance and Repair (IMR) Contractor shall conduct a survey of the entire cable route. The findings from the survey shall be documented and compared with as-built documentation and latest route information. Based on discrepancies, the IMR Contractor shall propose which sections to survey on a more frequent basis, where applicable. IMR Contractor shall perform Time Based Maintenance (TBM) activities on the critical areas identified, typically every 12 months, if not agreed otherwise.

Whilst this provides important mitigation against cable interaction, it will require vessel(s) working over the cable, resulting in a potential collision risk with passing traffic.

As the IMR work will be relatively infrequent during the operational phase, and assuming circulation of information of the intended works is undertaken in advance, the risk is not considered to be significant. It is noted that the IMR work is expected to be much less disruptive and span a much shorter period than for cable installation.

The frequency of this impact is considered to be **Extremely Unlikely**, and the severity **Moderate**, resulting in a ranking of **Broadly Acceptable**.

Magnetic Compass Interference

The static magnetic fields created by HVDC cables can interact with the earth's natural magnetic field, which can result in interference with magnetic navigational equipment, particularly in shallow waters. A high-level review of this potential impact has been conducted.

The vast majority of commercial vessel traffic uses GPS and non-magnetic gyrocompasses as the primary means of navigation, which are unaffected by EMF. Therefore, it is considered unlikely that any created interference will have a significant impact on vessel navigation. However, magnetic compasses still serve as an essential means of navigation in the event of power loss or a secondary source, and some smaller craft (fishing or leisure) may rely on it as their sole means of navigation, especially in bad visibility or at night. The important factors that affect the resultant deviation are:

- Water depth;
- Burial depth;
- Spacing or separation of the two cables in a pair; and/or
- Cable route alignment relative to the earth's magnetic field.

The highest risk area is waters up to 12NM from the HDD exit point where water depths are as shallow as 26.5m. In this nearshore area, there will be an indicative 60m construction corridor with a likely cable separation distance of 20m which will not cause a compass deviation of more than five degrees. However, if the worst-case scenario (e.g. cable separation distance of 40m) is applied, there will be a compass deviation of six degrees for approximately 500m from the HDD exit point, at nominal DC current. Following this, no compass deviation greater or equal to 5 degrees is anticipated as cable separation is expected to reduce to 20m.

If for some reason the cable separation was 28m or above until a water depth of 30m, a compass deviation of more than five degrees would be detected for approximately 1km north east from the HDD exit point.

There is not expected to be compass deviation in waters from the 12-mile limit to the UK-Norway median line as water depths are greater than 45m and thus cables could be separated from anything between 20m and 450m without causing significant deviation.

Although the potential maximum deviation slightly exceeds the five degrees recommended by the MCA, this would be worst-case, and also transitory as a vessel would pass over the cables. Only a small number of vessels when operating close to shore directly over the cable would potentially be affected. If not equipped with GPS, such vessels will normally be able to identify their position using landmarks onshore by day or lights by night.

Assuming the worst-case cable separation and hence magnetic compass deviation, this impact is considered to be **Frequent**, with **Minor** severity, resulting in a ranking of **Tolerable**.

19.5.5 Decommissioning

It is noted that the decommissioning of this project will most likely require a separate environmental assessment at the time due to the scale of the removal of the cables from the seabed. With regard to impacts on shipping and navigation, if the marine cabling were to be removed, the installation operation would be reversed and thus all temporary impacts assessed in the installation phase will apply.

Elsewhere if the cable is left in situ, for example at crossings, the future risk to fishing vessels will require to be assessed using updated baseline data.

19.6 Mitigation Measures

This section provides additional mitigation measures to be implemented to bring impacts assessed as tolerable to ALARP. Impacts assessed as broadly acceptable have not been included in this part of the assessment, although they may also benefit from the additional mitigation. It is noted that no hazards were assessed to be unacceptable.

- Consultation and circulation of information to the Marine Safety Forum (MSF) whose members represent the oil & gas vessels anchoring in proximity to the cable landfall; and
- Circulation of information to marinas located along the east coast of the UK (including Peterhead and others north and south) to increase the likelihood of non-local sailors being made aware of the temporary installation work.

19.7 Residual effects

The additional mitigation measures presented above will benefit the anchor drag and recreational activity however the overall rankings remain as **Tolerable** (with mitigation).

19.8 Cumulative effects

This section describes cumulative and in-combination developments potentially relevant to the NorthConnect HVDC marine cabling, including the expected cumulative impacts. This is based on a review of all developments listed in Chapter 6: Cumulative Assessment. Specific discussion of key developments is provided below.

Moray East/West Offshore Windfarm Development

The Moray East and West Offshore windfarm developments are considered as one effect and are located approximately 47NM NNE of the consenting corridor landfall. The Moray East project was granted consent in 2014 with a Contract for Difference (CfD) awarded in 2017. The Moray West however, is still in the early planning stage.

Due to the distance between the projects, there is not expected to be a significant cumulative impact resulting from either of the Moray Wind Farm developments.

Inch Cape Offshore Windfarm

The Inch Cape Offshore Wind Farm (OWF) is located around 8 miles off the Angus coastline (approximately 53NM south of the cable corridor landfall). It is currently under development and expected to enter construction in 2020.

Despite the predicted overlap of construction periods, the distance between the two projects means there are no significant cumulative impacts anticipated.

Neart na Gaoithe Offshore Windfarm

The Neart na Gaoithe (NnG) Wind Farm is located approximately 25km off the coast of Fife. The wind farm was granted consent in October 2014 and is the second Scottish wind farm to be awarded a contract for difference (CfD).

Due to the distance between the projects, there is not expected to be a significant cumulative impact resulting from the NnG Wind Farm.

Seagreen Phase 1 Windfarm

The Seagreen Phase 1 comprises two sites (Alpha and Bravo) and is awaiting consent for a new proposal. The sites are located approximately 25km off the east coast of Fife (i.e. approximately 47NM south of the NorthConnect consenting corridor landfall).

Due to the distance between the projects, there is not expected to be a significant cumulative impact resulting from the Seagreen Phase 1 Wind Farm.

Beatrice Offshore Windfarm

Beatrice Offshore Wind Farm is located in the Moray Firth, approximately 13km from the Caithness coast. Onshore construction of this wind farm began in May 2016 whilst offshore construction began later in April 2017. The aim is to energise the wind farm in phases with the expectation of being fully operational in 2019.

The construction and marshalling harbour for the Beatrice OWF is located in Nigg, thus should not increase the collision risk/disruption risk of passing vessels. Additionally, once fully operational, the operations and maintenance base will be located in Wick, meaning any maintenance traffic will be expected to travel between Wick and the wind farm site.

Overall, it is concluded that there should be no significant cumulative impact with this wind farm.

EOWDC (European Offshore Wind Development Centre), Aberdeen Bay

The EOWDC is currently under construction (beginning October 2016), with the first power generated expected in summer of 2018. The site is located in Aberdeen Bay approximately 12NM (from its closest point) to the NorthConnect corridor landfall. The installation base for this project is located in Denmark and the operations and maintenance base is located in Aberdeen.

The construction periods for the projects are unlikely to overlap however maintenance works may be required at the EOWDC. It is anticipated the routine maintenance vessels will be travelling from Aberdeen to the site however a small rise in collision/disruption risk in the area may occur. If both operators follow best practise guidelines, then the cumulative impact is expected to be minimal.

Hywind Scotland Pilot Park Offshore Windfarm

The Hywind Scotland Pilot Park Offshore Wind Farm is the closest site to the HVDC offshore cabling (approximately 5.4NM south of corridor). This floating wind farm was fully commissioned in Q4 2017. The onshore maintenance and operation base is located in Peterhead; however, resources are also obtained from existing offices in Aberdeen.

Due to the location of the maintenance and operation base, any vessel carrying out operations on the wind farm may overlap with the installation period of the NorthConnect HVDC offshore cabling. This could cause an increase in collision risk and/or disruption due to the close proximity of the two developments.

If both operators follow best practise guidelines during construction and/or maintenance operations, then the cumulative impact is likely to be minimal.

The risk of one of the five floating turbines at Hywind losing station and dragging anchor across the NorthConnect cable is also considered to be minimal due to the third-party verification of the Hywind moorings and the redundancy in the mooring system.

Kincardine Offshore Windfarm

The authorised Kincardine Offshore Wind Farm began its installation works in November 2017, and is expected to continue until 2020. The site is located SE of Aberdeen, approximately 22NM south of the consenting corridor landfall.

If there is an overlap between the construction periods, there may be a slight increase in collision and/or disruption risk in the area. However, if this were to occur, the cumulative impact is not anticipated to be significant due to the distance between the projects.

Aberdeen Harbour Development

Aberdeen Harbour have commenced construction of new facilities in the South Harbour (Nigg Bay) to expand the port's capacity and ability to accommodate larger vessels (e.g. commercial vessels and cruise vessels). This development is expected to finish in 2020 however there may be a slight overlap in construction works if any delays occur.

Following these developments, there is potential for future traffic within the area to change. The number of larger vessels transiting over the offshore cabling to/from Aberdeen may increase in the future due to the new facilities. A slight increase in traffic may also occur if construction periods overlap however the large distance between the projects means that cumulative impacts are assessed to be minimal.

Peterhead Harbour Developments

Peterhead Port Authority are currently developing the harbour by widening the harbour entrance through improved realignment of existing quay walls as well as strengthening and deepening the port to accommodate larger vessels. These works are scheduled for completion in September 2018 and thus there will be no overlap of construction periods.

The port of Peterhead lies within the 5NM study area surrounding the consenting corridor. In addition to being a busy fishing port, Peterhead also services offshore traffic associated with oil fields in the North Sea. The completion of the harbour development could lead to changes in future traffic to that identified using the 2017 AIS data, for example, the number and/or size of vessels visiting or anchoring outside the harbour may increase in future, but any changes are not expected to be significant.

Peterhead port has been kept updated on the NorthConnect project and this will be continued to help manage potential cumulative issues.

North Sea Link Interconnector

The North Sea Link (NSL) is an interconnector project, the offshore component of which runs between Blyth (UK) and Kvilldal (Norway). This project is jointly being undertaken by the National Grid and Statnett.

The installation of the subsea cable is due to start in 2018 and continue on until 2021 therefore, there is potential for overlap of construction periods. A possible increase in collision risk due to the presence of multiple installation vessels may occur. However, it is noted the projects are sufficiently far apart (approximately 70NM) that no significant cumulative impacts are anticipated.

NorthConnect HVDC Subsea Cable (from UK median line-start of Norwegian Fjord)

The installation of the Norwegian section of the NorthConnect HVDC marine cabling is likely to have similar impacts to those identified in this study, affecting vessels operating in Norwegian waters. Whilst a proportion of vessels may operate on both sides of the median line, and hence encounter the project in UK and Norwegian waters, no significant cumulative impacts are anticipated on the basis suitable mitigation measures, including protection, will be applied over the entire length of the cable.

19.9 Summary

This chapter has used baseline shipping and navigation conditions to identify the significant effects that may arise as a result of the NorthConnect HVDC offshore cabling. This was based on the IMO Formal Safety Assessment Process (IMO, 2002).

The baseline summary comprised a review of relevant navigational features, and an analysis of passing shipping, fishing and anchoring based on real time AIS data. The fishing analysis also used longer term data.

Of the effects considered, seven were considered to be tolerable. These included four from the installation phase (increased collision risk, potential disruption to vessel routeing/timetables and fishing / anchor dragging interaction with exposed cable) and three from the operation phase (anchor dragging, snagging from fishing gear and EMF interference).

Additional mitigation measures identified were liaison with the Marine Safety Forum (MSF) whose members represent the oil & gas vessels anchoring in proximity to the landfall, and further communication with the MCA regarding potential magnetic compass deviations, including test results proving the extent of deviation following the cable-laying operation.

The impacts considered within the preceding assessment are summarised in Table 19.8. The assessment takes into account the planned mitigation.

Table 19.8. Summary Table of Impacts.

Receptor	Phase	Impact Description	Frequency of Occurrence	Severity of Consequence	Impact Significance	Key Mitigation (Sample)
Passing Traffic	Installation	Increased collision risk	Extremely Unlikely	Serious	**Tolerable**	Guard vessels, Circulation of Information, Compliance with COLREGS, Advisory Safety Zone
Passing Traffic	Installation	Disruption to vessel routeing/timetables	Reasonably Probable	Minor	**Tolerable**	Circulation of Information, Marks and Lights, Guard vessels
Fishing Vessels	Installation	Snag risk to fishing vessels from exposed cable	Extremely Unlikely	Serious	**Tolerable**	Circulation of Information, FLO, FLMAP, Guard Vessels
Anchoring Vessels	Installation	Vessel dragging anchor over exposed cable	Extremely Unlikely	Serious	**Tolerable**	Circulation of Information, Guard Vessels
Passing Traffic	Installation	Emergency anchoring over exposed cable	Extremely Unlikely	Moderate	**Broadly acceptable**	Circulation of Information, Guard Vessels
Military Vessels	Installation	Disruption to military exercises	Remote	Minor	**Broadly acceptable**	Circulation of Information, Guard Vessels
Anchoring Vessels	Operation	Vessel dragging anchor over cable	Remote	Moderate	**Tolerable**	Chart depiction, Cable Protection
Passing Traffic	Operation	Vessel anchoring over cable in an emergency	Extremely Unlikely	Moderate	**Broadly acceptable**	Chart depiction, Cable Protection
Cable Route	Operation	Vessel foundering onto cable	Extremely Unlikely	Minor	**Broadly acceptable**	Cable Protection, Routine Surveys
Cable Route	Operation	Vessel dropping object onto cable	Extremely Unlikely	Minor	**Broadly acceptable**	Cable Protection, Routine Surveys
Passing Traffic	Operation	Vessel grounding due to reduced under keel clearance	Extremely Unlikely	Moderate	**Broadly acceptable**	Chart depiction, < 5% reduction in existing depth
Fishing Vessels	Operation	Fishing gear snagging on cable	Remote	Serious	**Tolerable**	Chart depiction, FLO, FLMAP, Cable Protection, Routine Surveys
Passing Traffic	Operation	Increased collision risk with maintenance/repair vessels	Extremely Unlikely	Moderate	**Broadly acceptable**	Guard vessels, Circulation of Information, Advisory Safety Zone
Passing Traffic	Operation	Interference with magnetic compass	Frequent	Minor	**Tolerable**	Minimising cable separation, Cable Protection Plan, Post-Lay Test of Deviation

19.10 References

Anatec Ltd (2018). NorthConnect HVDC Cable, Shipping and Navigation, Appendix G.1: Baseline Conditions.

International Maritime Organisation (IMO) (1972/78). International Regulations for Preventing Collisions at Sea 1972 (COLREGS) IMO, London.

International Maritime Organisation (IMO) (2002). Guidelines for Formal Safety Assessment, MSC/Circ. 1023. IMO, London.

International Association for Lighthouse Authorities (IALA) 2001, Guidance on Aids to Navigation and Buoyage (Paris, 2001).

MarineScotland (2018). Marine Scotland Maps NMPi – Leisure and Recreation: Recreational AIS intensity. [online] Available at: <https://marinescotland.atkinsgeospatial.com/nmpi/> [Accessed 30 April 2018].

Maritime and Coastguard Agency (2016). Marine Guidance Note 543 – MGN 543 Offshore renewable energy installations (OREIs). Guidance on UK navigational practice, safety and emergency response issues. MCA, Southampton.

NorthConnect (2017). Offshore Cumulative Project List.

NorthConnect (2018). HVDC Cable Infrastructure – UK Construction Method Statement

UKHO (2016). Admiralty Sailing Directions – North Sea (West) Pilot, NP54, 10th Edition. Taunton: UKHO.

United Nations (1982). The United Nations Convention on the Law of the Sea (UNCLOS).

NORTHCONNECT
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Chapter 20: Commercial Fisheries

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Contents

20 Commercial Fisheries

20.1 Introduction

This chapter assesses the potential impacts of the NorthConnect interconnector project on commercial fisheries. This draws upon available data and consultation undertaken with fisheries organisations to provide information on the following:

- The types of and value of fisheries active along the Consenting Corridor;
- Seasonal variation in commercial fishing activity;
- Species targeted along the Consenting Corridor; and
- Potential restrictions on fishing activity in the vicinity of the Consenting Corridor.

The commercial fishing activities fall into two categories: effort expended by smaller, inshore vessels; and larger vessels which operate further offshore.

20.2 Sources of Information

The fisheries baseline description is based upon a comprehensive desk-based study supported by consultation. Key data sources used to inform the baseline included:

- Vessel Monitoring System (VMS) datasets for UK vessels over 15 m for the period 2011 – 2015;
- Marine Scotland landings value (£) liveweight (tonnes) data for the period 2011-2016 for UK vessels (all sizes);
- Marine Scotland seasonal fishing effort by UK vessels (all sizes);
- Marine Scotland fishing effort (days at sea) and gear type;
- ScotMap spatial data for inshore fishing activity; and
- Marine Scotland salmon and sea trout catch statistics.

In addition to these datasets, the following information sources were also used:

- UK-Norway HVDC Interconnector Cable Burial Risk Assessment (CA Report No.: C831R01 - 02) (Cathie Associates Ltd, 2018) (Appended to the Construction Method Statement (NorthConnect, 2018);
- NorthConnect Cable Protection Analysis Report (CA Report No.: C831R02 – 02) (Cathie Associates Ltd, 2018) (Appended to the Construction Method Statement (NorthConnect, 2018);
- Chapter 2: Project Description;
- Chapter 15: Fish and Shellfish;
- Chapter 19: Navigation and Shipping; and
- Appendix G.1: Navigation and Shipping Baseline.

20.3 Legislation, Policy and Guidance

The following legislation, policy and guidance is relevant to the assessment of potential effects on commercial fisheries and salmon and sea trout fisheries.

20.3.1 Legislative Framework

- EC Directive 2000/60/EC known as the ‘Water Framework Directive’ (or WFD) has the aim of preventing deterioration in ecological quality and where necessary improving the quality of our rivers, lochs, estuaries, coastal waters and groundwater.

- EC Regulation 1100/2007 the Eel Recovery Plan, aims to ensure recovery of European eel stocks. Scotland developed its own Eel Management Plan in 2010.
- Aquaculture & Fisheries (Scotland) Act 2013. Came into force in 2013 to ensure that farmed and wild fisheries, and their interactions with each other, continue to be managed effectively, maximising their combined contribution to supporting sustainable economic growth with due regard to the wider marine environment.
- The Marine (Scotland) Act 2010 provides a legal mechanism to help ensure clean, healthy, safe, productive and biologically diverse marine and coastal environments, managed to meet the long-term needs of both nature and people, by putting in place a new system for improved management and protection of the marine and coastal environment. The Act applies to Scottish territorial waters (up to 12 NM).
- Marine and Coastal Act 2009. Came into force in 2009 and provides the legal mechanism to help ensure clean, healthy, safe, productive and biologically diverse oceans and seas by putting in place a new system for improved management and protection of the marine and coastal environment. The Act applies to the offshore environment from 12 NM to the UK EEZ.
- The Conservation of Salmon (Amendment) Scotland Regulations 2018. The regulations outline a system whereby the killing of Atlantic salmon in inland waters is managed on an annual basis by categorising the conservation status of their stocks.

20.3.2 Policy

- Common Fisheries Policy. The CFP is a set of rules for managing European fishing fleets and for conserving fish stocks. Designed to manage a common resource, it gives all European fishing fleets equal access to EU waters and fishing grounds and allows fishermen to compete fairly.
- UK Marine Policy Statement (MPS) which aims to contribute to attaining sustainable development in marine UK waters and is the main policy in determining marine licence applications.

20.3.3 Guidance

- Best Practice Guidance for Fishing Industry Financial and Economic Impact Assessments - guidelines based on outputs from a technical workshop organised by the UK Fisheries Economics Network (UFEN and Seafish, 2012);
- FLOWW Best Practice Guidance for Offshore Renewables Developments: Recommendations for Fisheries Liaison (January 2014);
- Guidance on Licensing and Environmental Impact Assessment (EIA) requirements for offshore wind farms (Centre for Environment, Fisheries and Aquaculture Science (CEFAS), 2004); and
- Guidance on Commercial Fisheries Mitigation and Opportunities from Offshore Wind commissioned by Collaborative Offshore Wind Research into the Environment (COWRIE), (Blyth-Skyrme, 2010).

20.4 Assessment Methodology

20.4.1 Scoping and Consultation

Consultation has been on-going throughout the Project and played an important part in ensuring the scope of the commercial fisheries baseline and impact assessment is appropriate to the project and the requirements of the regulators and their advisors.

Responses to comments made in the Marine Scotland Scoping Opinion (July, 2016) and Aberdeenshire Council Scoping Opinion (May, 2016) are presented in Chapter 4: Consultation.

Table 20.1 summarises fisheries related consultation activities carried out to date. The fisheries stakeholders with whom consultation has been carried out are listed below:

- Maritime and Coastguard Agency (MCA);
- Northern Lighthouse Board (NLB);
- Peterhead Harbour;
- Marine Safety Forum:
    - No technical feedback has been received;
- Fisheries representatives, namely:
    - Buchan Inshore Fisheries Association;
    - Scottish Fishermen's Federation (SFF); and
    - The Scottish White Fish Producer's Association (SWFPA).

Table 20.1. Summary of Consultation Relating to Commercial Fisheries.

Organisation	Description	Date
Various	Two-day pre-consultation drop in session at Peterhead Fishermen's Mission. Participants were asked to fill out questionnaires following discussions.	18th and 19th January 2018
SFF	Meeting with SFF, they were requested to direct members to the charts and questionnaires on the North Connect website.	9th February 2018
SWFPA	Request to SWFPA to direct members to charts and questionnaires on the NorthConnect website.	9th February 2018
SWFPA	Meeting with SWFPA members at Fraserburgh Leisure Centre	22nd May 2018
Various	Fisheries specific pre-application consultation event at Peterhead Fishermen's Mission.	24th May 2018
SFF and SWFPA	SFF and SWFPA were provided with GIS shapefiles and coordinates for the Consenting Corridor in advance of the official consultation period.	17th May 2018
Various	Attendance and liaison at Skipper Expo International.	25th May 2018
Various	Numerous one to one meetings conducted between NorthConnect Fisheries Liaison Officer (FLO) and Communications Manager and skippers of commercial fishing vessels and vessel owners.	Various dates between October 2016 and June 2018.

20.4.2 Desk study

A desk study was undertaken to inform the characterisation of the existing baseline conditions. The study included the interpretation of fishing data, including fishing effort and value of landings. The baseline was also informed by a fishing questionnaire which was distributed to local fishermen and collected information on gear types, target species, fishing locations and seasonality. The key data sources used to inform the baseline description are detailed in Table 20.2.

Table 20.2. Summary of Relevant Data Sources.

Dataset	Date	Description
MMO Landings value and effort (time)	2011 - 2015	Vessel Monitoring System (VMS) datasets for UK vessels over 15 m were provided in GIS format. This included details at the International Council for the Exploration of the Sea (ICES) statistical sub-rectangle level.
Marine Scotland landings value (£) and liveweight (tonnes)	2012 - 2016	Landings and effort data for UK vessels landing from relevant ICES rectangles for the period 2012 – 2016 were provided in spreadsheet format by Marine Scotland. This data included details on effort by month, vessel size and gear type.
Marine Scotland Vessel Landing data	2012 - 2016	UK fleet landings and foreign fleet landings into the UK by port.
Marine Scotland salmon and sea trout catch statistics by Salmon Fishery District	2016	Salmon and sea trout catch data for rivers in the north east region including rod and line, fixed engine and net and coble fisheries.
ScotMap spatial data	2013	Spatial information on fishing activity of Scottish fishing vessels under 15 m in overall length. Includes data on creel activity, Langoustine trawls, other trawls, dredges and mackerel line fishing.
Marine Scotland seasonal landings of primary target species	2012 - 2016	Data on the landings of most targeted species in relevant ICES rectangles including value (£) and liveweight (tonnes).

In addition to these datasets, relevant sources of information were consulted to inform the background and baseline commercial fishing conditions in the Consenting Corridor, including:

- Scottish Sea Fisheries Statistics 2016 (Scottish Government, 2017);
- 2016 vessel and employment statistical tables (Marine Scotland, 2018); and
- Individual fishermen and their representatives during consultation (as detailed in Section 20.4.1).

20.4.3 Impact Assessment Methodology

The method presented here has been developed by reference to the Institute of Ecology and Environmental Management (IEEM) guidelines for marine impact assessment (IEEM, 2010), the Marine Life Information Network (MarLIN) species and ecosystem sensitivities guidelines (Tyler-Walters *et al*., 2001) and guidance provided by Scottish Natural Heritage (SNH) (SNH, 2018) and by The Institute of Environmental Management and Assessment (IEMA) (IEMA, 2016).

For each effect, the assessment identifies receptors sensitive to that effect and implements a systematic approach to understand the level of impact. The process considers the following:

- Sensitivity/value of a receptor;
- Magnitude of effect; and
- Determination and qualification of the level of impact of and effect or change on a receptor, considering the probability that it will occur, the spatial and temporal extent and the

importance of the impact. If the level of impact is determined as moderate, major or severe, it is considered a significant impact.

Once the level of potential impact has been assessed it is possible to identify measures that can be taken to mitigate impacts through design or operational measures. This process also identifies aspects of the proposed project that may require monitoring.

20.4.3.1 Sensitivity / Value

The sensitivity of a receptor is a function of its capacity to accommodate change and reflects its ability to recover if it is affected. Sensitivity of the receptor is quantified via the following factors:

- Tolerance to change: the ability of a receptor to accommodate temporary or permanent change;
- Recoverability: the ability of a receptor to return to a normal state following cessation of an effect;
- Adaptability: the ability of a receptor to avoid or adapt to an effect; and
- Value: a measure of the receptors importance, rarity and worth.

The sensitivity criteria relevant to commercial fisheries are presented in Table 20.3. Sensitivity categories used include very high, high, medium, low and negligible. The sensitive receptors are summarised in Section 20.5.3.

Table 20.3. Criteria for Sensitivity of Commercial Fisheries.

Sensitivity	Definition
Very high	No spatial adaptability due to operational range and ability to deploy only one gear type. No recoverability due to inability to mitigate loss of fishing area by operating in alternative areas.
High	Low spatial adaptability due to limited operational range and ability to deploy only one gear type. Dependence mostly on one area but with some fishing activity occurring in other areas. Low recoverability due to inability to mitigate loss of fishing area by operating in alternative areas.
Medium	Some spatial adaptability due to extent of operational range and/or ability to deploy an alternative gear type. Dependence on a limited number of fishing grounds. Limited recoverability with some ability to mitigate loss of fishing area by operating in alternative areas.
Low	High spatial adaptability due to extensive operational range and/or ability to deploy a number of gear types. Ability to fish a moderate number of fishing grounds. High recoverability due to ability to mitigate loss of fishing area by operating in range of alternative areas.
Negligible	Fisheries are not sensitive to change.

20.4.3.2 Magnitude of Effects

The magnitude or size of an effect can be characterised by considering the following:

- Duration over which the effect is likely to occur i.e. days, weeks;
- Timing: when the effect is likely to occur;
- Size and scale: geographical area; and
- Frequency: how often the effect is predicted to occur.

The magnitude criteria relevant to commercial fisheries are presented in Table 20.4. Magnitude categories used include severe, major, moderate, minor and negligible. Magnitude of effect is presented as a variety of parameters including duration, timing, size and scale, and frequency.

Table 20.4. Criteria for Magnitude of Effect.

Magnitude of effect	Definition
Severe	Effect is widespread, or occurs over a prolonged duration, or at a high frequency (e.g. repeated or continuous effect), resulting in extensive permanent changes to baseline fishing areas and their condition.
Major	Effect is over a large scale or spatial extent, or occurs long term, or at a medium-high frequency, resulting in extensive temporary change or some permanent change to baseline fishing areas and their condition.
Moderate	Effect is localised, or occurs for a short duration, or at a medium frequency, resulting in temporary changes or limited permanent changes to baseline fishing areas and their condition.
Minor	Detectable disturbance or change to baseline fishing areas and their condition and no long term noticeable effects above the level of natural variation experienced for commercial fisheries.
Negligible	No change or an imperceptible change to the baseline fishing areas and their condition.

Definitions in Table 20.4 may not be appropriate for all effects, for example there may be an effect which is over a very small area (minor or moderate) but is repeated a large number of times during a particular phase of the project (major or severe). In such cases expert judgement is used to determine the most appropriate magnitude ranking and this is explained through the narrative of the assessment.

20.4.3.1 Level of Impact

The level of impact, be it beneficial or adverse, is determined using a combination of sensitivity of the receptor and magnitude of effect as illustrated in Table 20.5.

The likelihood of an impact occurring is another factor that should be considered in the assessment of potential impacts. This captures the probability that the effect will occur and also the probability that the receptor will be present and is generally based on knowledge of the receptor and experienced professional judgement. Consideration of likelihood is described in the impact characterisation text and used to provide context to the specific impact being assessed. Likelihood of impact is described as certain, likely, unlikely or very unlikely.

Table 20.5. Level of Impact.

Magnitude of Effect	**Sensitivity/Value**				
	Very high	High	Medium	Low	Negligible
Severe	Severe	Severe	Major	Moderate	Minor
Major	Severe	Major	Major	Moderate	Minor
Moderate	Major	Major	Moderate	Minor	Negligible
Minor	Moderate	Moderate	Minor	Minor	Negligible
Negligible	Minor	Minor	Negligible	Negligible	Negligible

As required by the EIA Regulations, the significance of impacts is determined based on the level of impact as shown in Table 20.5.

Key:	
Severe	Significant impact under EIA Regulations
Major	
Moderate	
Minor	Non-significant impact under EIA Regulations
Negligible	

20.4.3.1 Mitigation

Where potentially significant impacts (i.e. those ranked as being of moderate impact level or higher) are identified, mitigation measures have been considered. The intention is that such measures should remove, reduce or manage the impacts to a point where the resulting residual significance is at an acceptable or insignificant level. Mitigation is also proposed in some instances to ensure impacts that are predicted to be insignificant remain so.

20.5 Baseline Information

20.5.1 Data Gaps

Analysis of the data and information sources used for the commercial fisheries assessment are subject to various qualifications, limitations, sensitivities and gaps as discussed below. Despite these minor limitations the published data supported by consultation is considered to have generated a robust baseline against which impacts can be assessed.

20.5.1.1 VMS Based Statistics

Vessel monitoring systems (VMS) provides commercial catch statistics (landings value, tonnage and effort) for vessels > 15m length. The MMO present these data in an ICES sub-rectangle grid system (3 x 1.75 NM) to provide a geographical context for interpretation. It is noted that fishing will not occur in a uniform fashion throughout the area of an ICES rectangle. Effort distribution is a continuum between those squares which contain little effort and those which are actively exploited. Fishing activity also varies both seasonally and annually. In order to take account of this fact, data is averaged over a five-year period (2012-2016). Due to the processing required for these data there is a lag before the data is available for use therefore the most recent VMS data used in this study is from 2016.

Some effort is being made to introduce VMS to the 12-15 m fleet and these data have been included in this assessment, however, there is as of yet, no way of currently addressing the lack of GPS information on where the < 12 m vessels fish.

20.5.1.2 Marine Scotland Fisheries Statistics

Fisheries data for Scotland is collected and collated by Marine Scotland. The data is presented by length category and for each category, statistics available include gear types utilised, species caught and effort. Statistics are reported at the scale of ICES statistical rectangles (30 x 30 NM). The area of ICES rectangles is very large with the Consenting Corridor intersecting with only a small region of each of the ICES rectangles that the corridor crosses. Analysis of these fisheries statistics by ICES rectangle should therefore be treated with caution as it may lead to an overestimation of the value of the fishery that the proposed Project covers.

20.5.1.3 ScotMap

Like VMS, ScotMap data has also been presented as a grid system. These data are based on interviews with the inshore fleet (representing < 15 m vessel length). ScotMap provides the best available data for the inshore area but notable gaps include:

- Not all vessels have been interviewed;
- Earnings information was not always available;
- The way some fishermen have defined their fishing areas affected the output resolution of the maps, dispersing value and giving a false impression of where some types of fishing are taking place; and
- The study took place in 2013 therefore some of the information presented may be out of date.

20.5.1.4 Catch Statistics for Salmon and Trout Fisheries

The catch data used for the purposes of this assessment are as reported to Marine Scotland Science (MSS) and refer to both commercial and recreational fisheries. It is recognised that there may be a degree of error within the catch dataset due to misclassification of fish between the grilse and salmon categories.

20.5.2 Fishing Activity

In 2016, 453,000 tonnes of fish were landed in Scotland, worth £557 million. In terms of weight, this is dominated by pelagic species which comprise 65% of landings, followed by demersal species comprising 21% of weight and shellfish species accounting for 14% of landings by weight. Pelagic species also dominate in terms of value, accounting for 40% of landings. Demersal species and shellfish species each comprise 30% for the value of landings (Scottish Government, 2017). Mackerel and herring are the main pelagic species landed in Scotland, accounting for 96% of the value of pelagic landings in 2016 in Scotland. Numerous demersal species are targeted in Scotland, but they are dominated by haddock, cod, monkfish, hake, saithe and whiting. Shellfish landings are dominated by langoustine, scallops, edible crab and lobster (Scottish Government, 2017).

The available fishing effort and landings data for vessels > 15 m in length with mobile gear for the Consenting Corridor is summarised in Figure 20.1 and Figure 20.2. These averaged data cover the period 2012 - 2016. No vessels over 15 m utilising passive gear were active along the Consenting Corridor during this time period. The data in Figure 20.1 and Figure 20.2 indicates that there is a small area of fishing activity approximately 10 km from the coastline in ICES rectangles 44E8 and 43E8 which the Consenting Corridor passes through. The Consenting Corridor passes through more significant areas of mobile fishing (vessels over 15 m) further offshore in ICES rectangles 44E9 and 45F0 (MMO, 2017). This is in line with the information provided during consultation.

ScotMap data (Figure 20.3) indicates that there is a considerable amount of fishing activity within approximately 5 km of the cable landfall site, with the highest concentration west of the 1˚40" line, which was also highlighted during consultation with fishermen. This is supported by the information received during consultation, as discussed on a fishery by fishery basis.

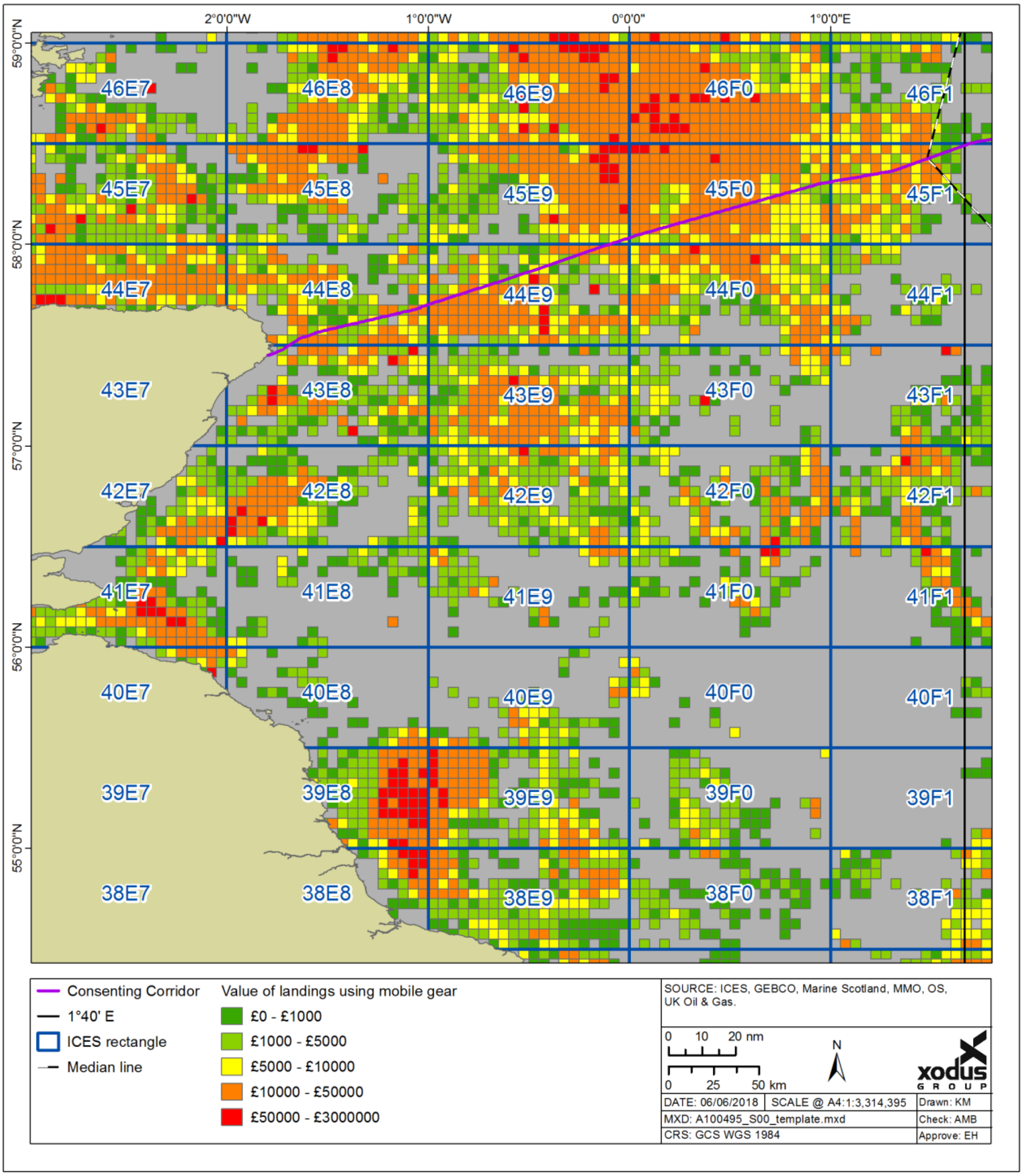


Figure 20.1. Distribution of Value of Landings (£) of Vessels >15 m Using Mobile Gear (MMO, 2017).

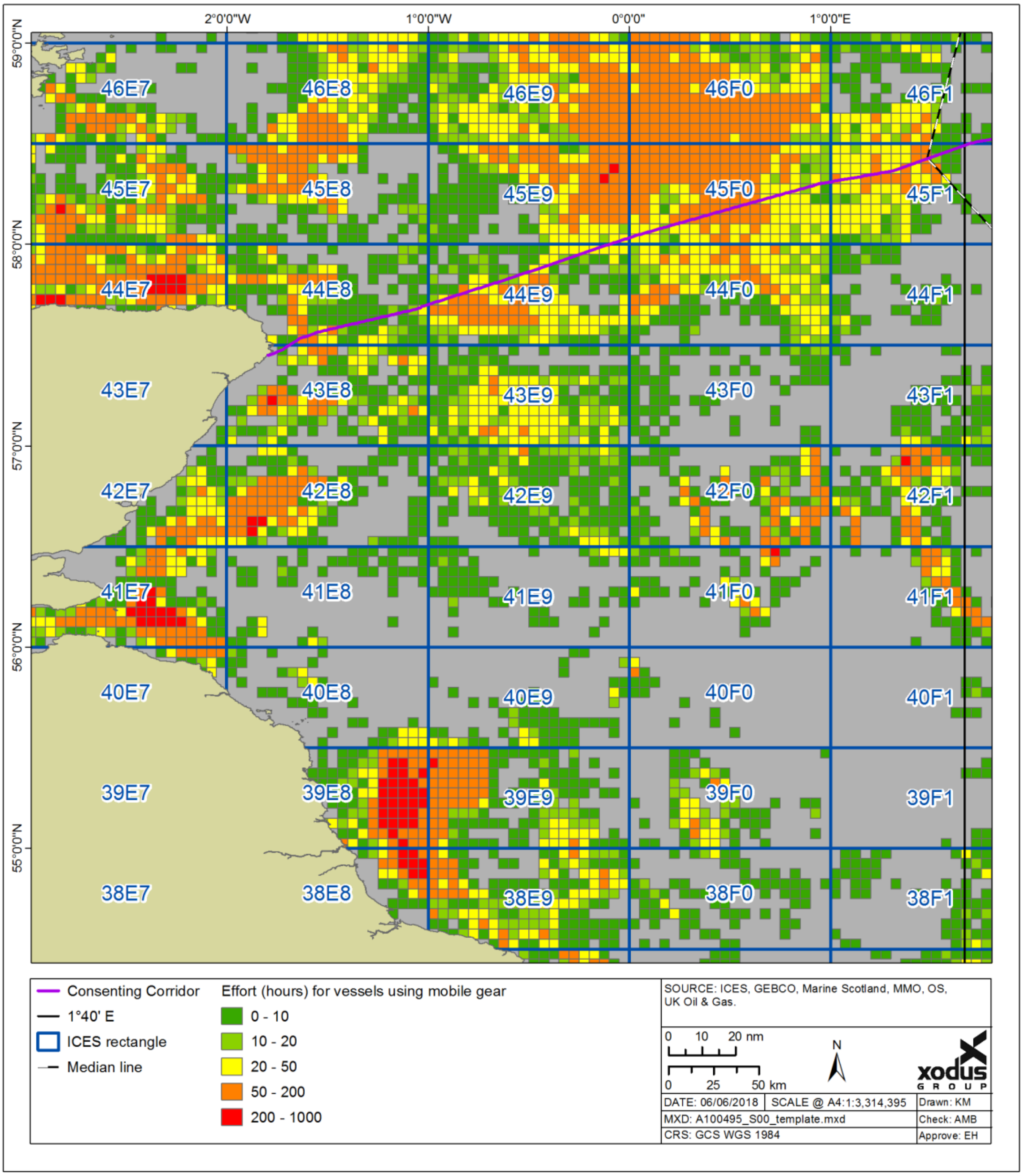


Figure 20.2. Distribution of Effort (Time) by Vessels >15 m Using Mobile Gear (MMO, 2017).

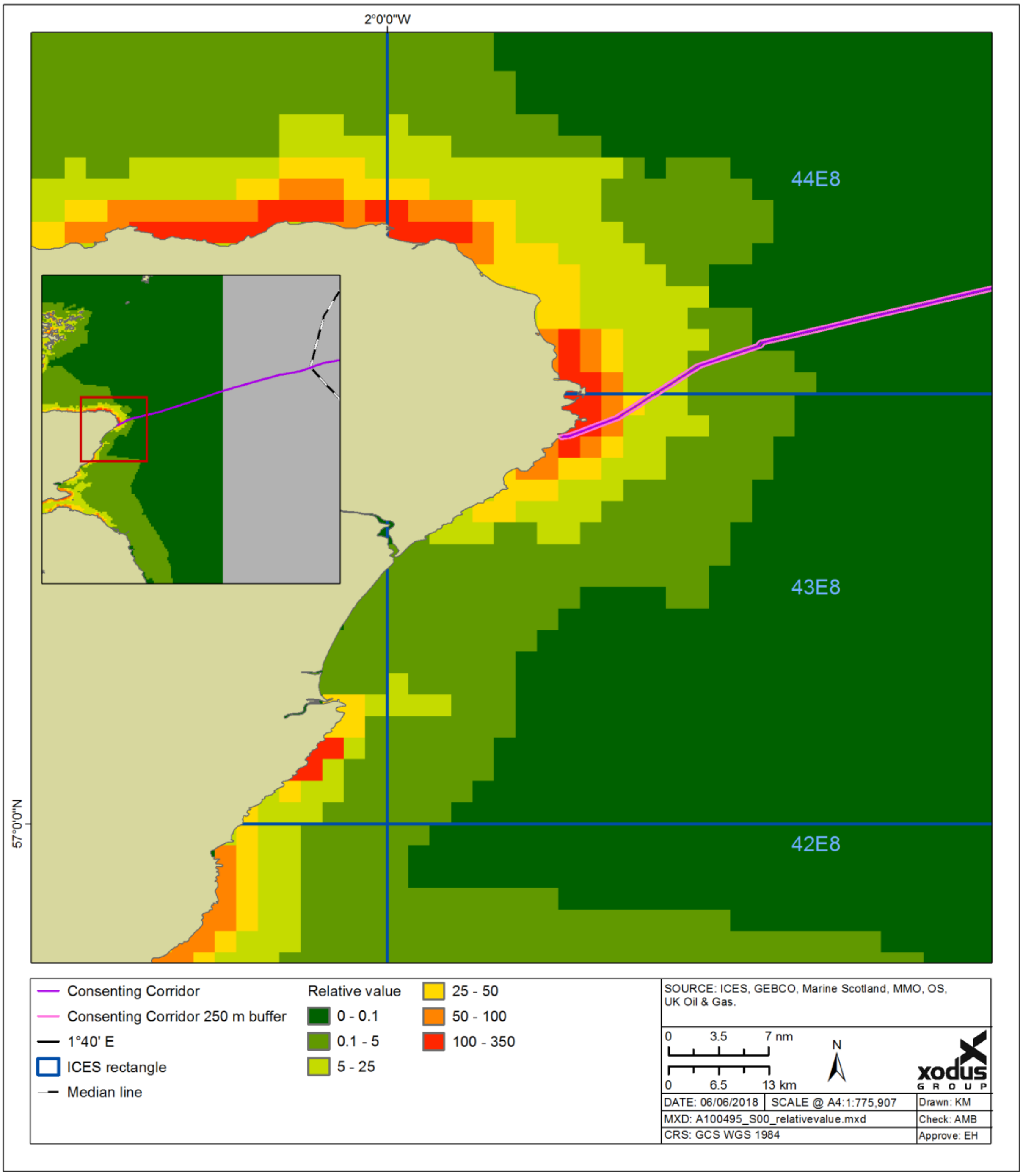


Figure 20.3. Relative Value of Inshore Fisheries (ScotMap, 2014).

The Consenting Corridor runs across seven ICES rectangles in the UK: 43E8, 44E8, 44E9, 44F0, 45E9, 45F0 and 45F1. Vessels under 10 m operate in ICES rectangles 43E8 and 44E8, typically extending approximately 14 km from shore, as shown in Figure 20.3. Landings by these vessels are dominated by shellfish and pelagic species, whilst the value and tonnage of demersal species comprises less than 1% of landings, as shown in Figure 20.4. Demersal, shellfish and pelagic species are targeted in all of these ICES rectangles by vessels over 10 m in length as shown in Figure 20.5. In terms of value, shellfish dominate landings in all ICES rectangles, except 44E9 which is dominated by demersal landings. In terms of landed weight, pelagic landings dominate all rectangles except 44E9 and 45E9 which are dominated by demersal landings.

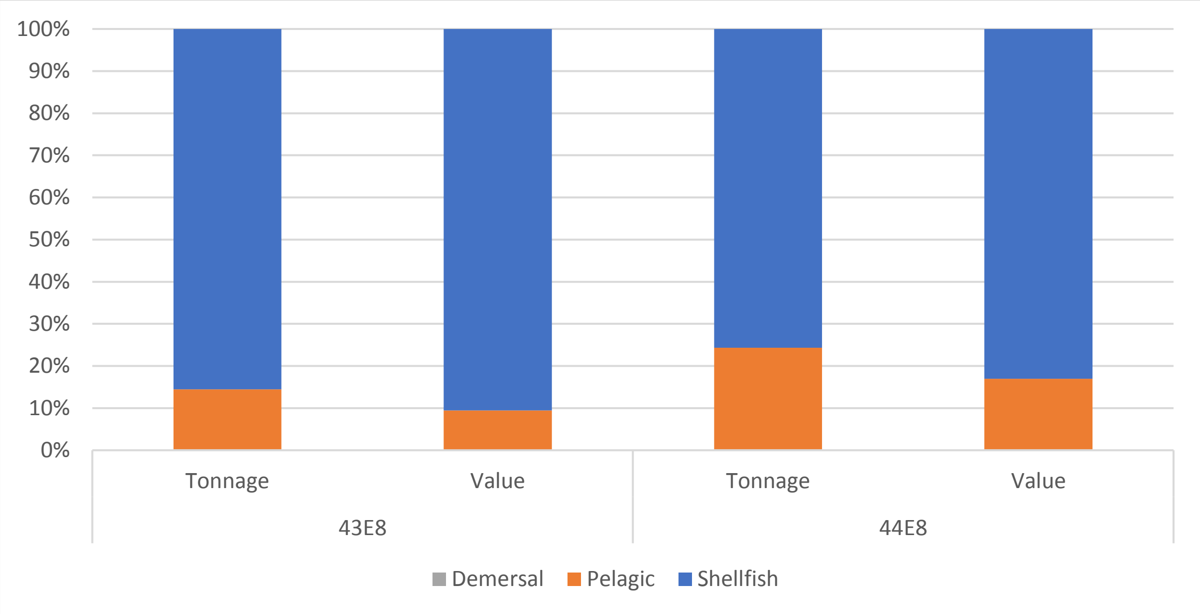


Figure 20.4. Proportional Landings by Species Type – Vessels under 10 m (average 2012-2016) (Scottish Government, 2018).

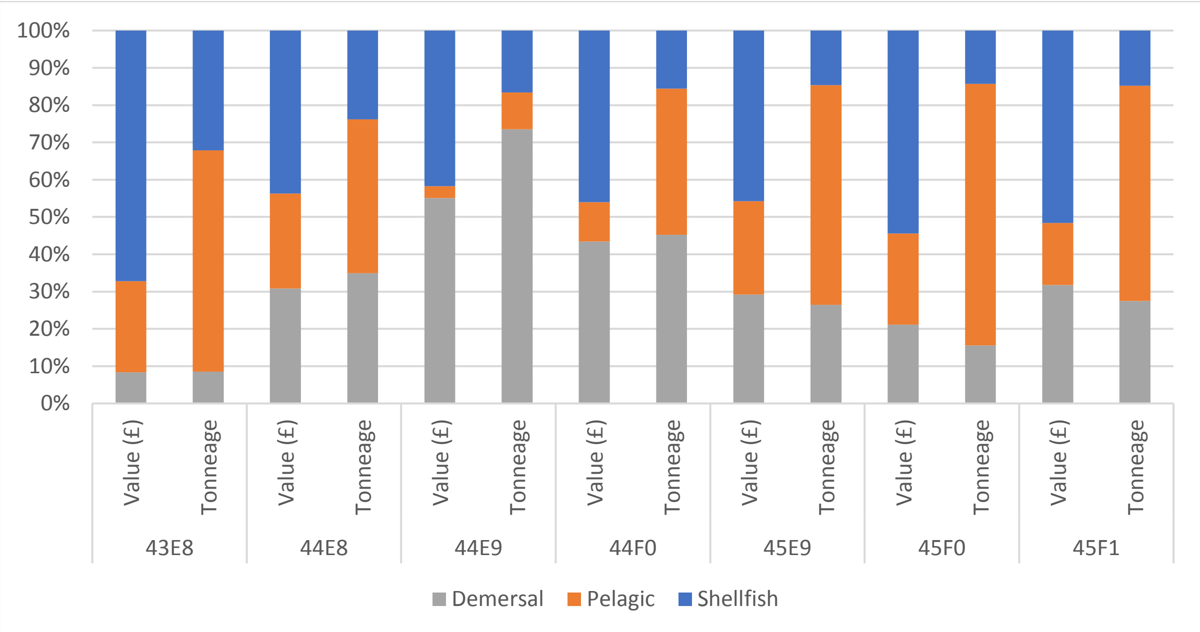


Figure 20.5. Proportional Landings by Species Type – Vessels over 10 m (average 2012-2016) (Scottish Government, 2018).

20.5.2.1 Target species

Vessels under 10 m in length operate primarily in the coastal ICES rectangles 43E8 and 44E8. Vessels under 10 m have also operated in ICES rectangle 44E9 and 45F1 in 2012 and 2014 respectively. As landings from this vessel size group this far offshore is atypical in terms of location and are sporadic in terms of time, these landings have not been included in the analysis.

Figure 20.6 details the value of the top landed species in ICES Rectangles 43E8 and 44E8 for vessels under 10 m in length. The top five species are the same in both rectangles with the value of landings consistently dominated by brown crab from 2012 to 2016. Lobsters, mackerel, velvet crab and langoustine comprise the remaining top five landed species in terms of value and liveweight of landings, as shown in Table 20.6.

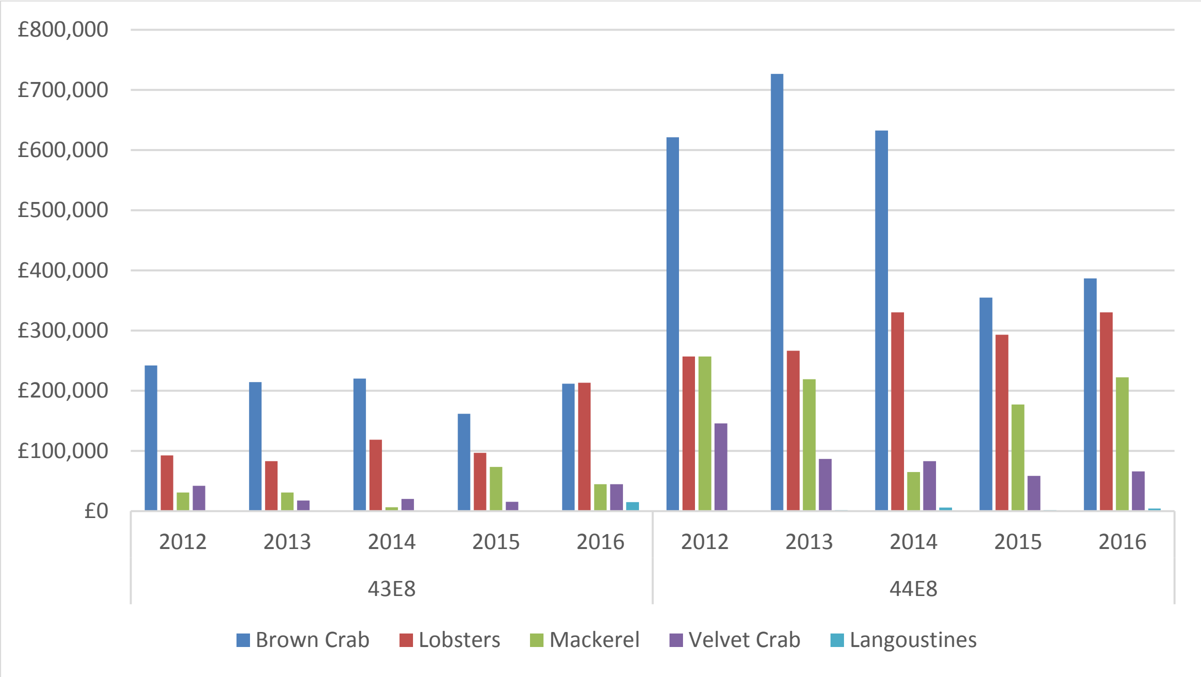


Figure 20.6. Top Five Target Species by Vessels under 10 m (Scottish Government, 2018).

Table 20.6. Value and Liveweight of Species by Vessels under 10 m in ICES Rectangles 43E8 and 44E8 (Average 2012-2016) (Scottish Government, 2018).

Species	**43E8**				**44E8**			
	Value		Liveweight		Value		Liveweight	
	£	%	Tonnes	%	£	%	Tonnes	%
Brown crab	210,050	52	172.05	74	544,470	48	399.73	63
Lobsters	120,942	30	10.93	5	295,537	26	153.49	24
Mackerel	37,353	9	32.95	14	188,211	17	49.98	8
Velvet crab	28,122	7	13.30	6	88,050	8	28.41	4
Langoustines	3,171	1	1.00	0	2,732	<1	1.03	<1
Other Species	The remaining <1% of value and liveweight is made up from catches of the following species: green crab, plaice, squat lobster, haddock, brown shrimps, squid, cod and whelks.				The remaining <1% of value and liveweight is made up from catches of the following species: squid, pollack, cod, green crab, monkfish, scallops, haddock, whelks, redfishes, squat lobster, oysters, saithe, crawfish, lemon sole, brill, hake, octopus, plaice, whiting and cuckoo ray.			

Figure 20.7 details the value of the top five landed species by vessels over 10 m in length in ICES rectangles 43E8 and 44E8. As shown the dominant species are different to those targeted by vessels under 10 m in length, with scallops shown to be the highest value species landed in both ICES rectangles. Pelagic species are also important with herring and mackerel as the second most landed species in ICES rectangle 43E8 and 44E8 respectively. Langoustine and haddock are also important target species in these ICES rectangles (Figure 20.7 and Table 20.7).

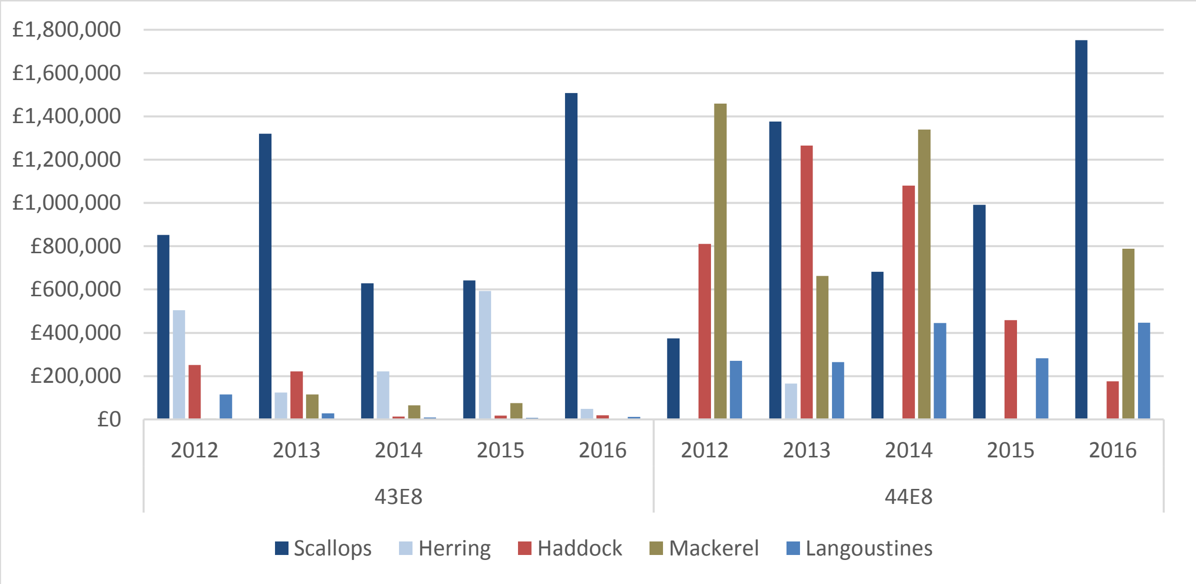


Figure 20.7. Top Five Target Species by Vessels over 10 m from 2012 to 2016 (Scottish Government, 2018).

Table 20.7. Value and Liveweight of Species by Vessels over 10 m in ICES rectangles 43E8 and 44E8 (Average 2012-2016) (Scottish Government, 2018).

Species	43E8				44E8			
	Value		Liveweight		Value		Liveweight	
	£	%	Tonnes	%	£	%	Tonnes	%
Scallops	990,354	64	493.33	31	1,035,280	30	528.50	19
Herring	298,490	19	830.72	53	33,117	1	96.04	3
Haddock	104,878	7	116.85	7	757,749	22	774.08	27
Mackerel	52,602	3	72.40	5	850,276	24	1071.92	38
Langoustines	34,243	2	9.83	1	341,902	10	91.54	3
Horse mackerel	27,400	2	33.83	2	58	<1	0.15	<1
Squid	11,368	1	2.86	<1	81,632	2	19.84	1
Whiting	7,598	<1	8.70	1	80,508	2	83.54	3
Monkfish	5,911	<1	2.22	<1	123,111	4	49.24	2
Cod	3,088	<1	1.46	<1	37,625	1	19.51	1
Brown crab	1,238	<1	0.92	<1	41,902	1	32.84	1
Other Species	The remaining <1% of value and liveweight is made up from catches of the following species: lemon sole, saithe, plaice, hake, halibut, lobsters, common skate, witch, megrim, turbot, catfish, pollack, gurnard and latchet, tusk, red and grey gurnards, brill, ling, thornback ray, velvet crab, red mullet, octopus, cuckoo ray, northern prawn, sole, dabs, squat lobster, spotted ray, john dory and whelks.				The remaining ~3% of value and liveweight is made up from catches of the following species: lobsters, lemon sole, hake, saithe, plaice, witch, halibut, megrim, turbot, ling, grey and red gurnards, velvet crabs, cuckoo ray, catfish, brill, dogfish, skates and rays, thornback ray, pollack, lesser spotted dogfish, octopus, john dory, red mullet, horse mackerel, dabs, tusk, conger eels, spotted ray, sole, eels, cuttlefish, greater forked beard, redfishes, albacore.			

Haddock and langoustine are the most valuable species landed in ICES rectangle 44E9 from 2012 to 2016, comprising and average of 40% and 34% respectively of the value of landings (Table 20.8). The species comprising 'other whitefish' are species landed in this rectangle include monkfish, cod and whiting (Figure 20.8).

Langoustine is consistently the most valuable species landed from ICES rectangles 44F0, 45E9, 45F0 and 45F1 except during 2015 and 2016 in ICES rectangle 45F0 and 2013 in rectangle 45F1 when herring landings dominated in terms of value (Figure 20.8). Other key species in these ICES rectangles include other demersal whitefish species such as monkfish, whiting and cod (Table 20.6, Table 20.7, Table 20.8, Table 20.9, and Table 20.10).

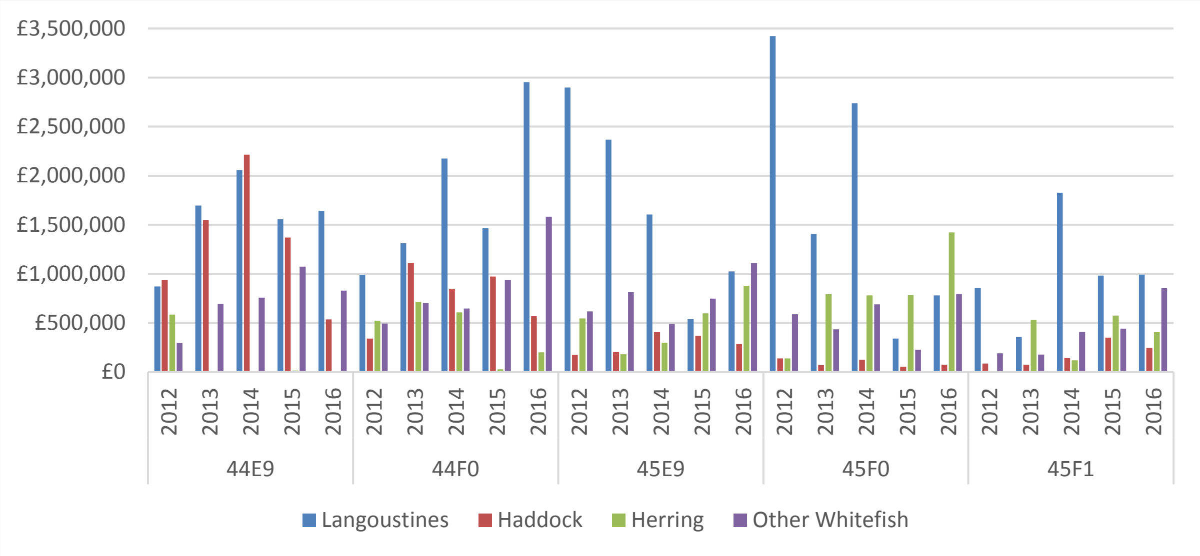


Figure 20.8. Top Six Target Species by Vessels over 10 m from 2012 to 2016 (Scottish Government, 2018).

Table 20.8. Value and Liveweight of Species by Vessels over 10 m (average 2012-2016) in ICES Rectangles 44E9 and 44F0 (Scottish Government, 2018).

Species	44E9				44F0			
	Value		Liveweight		Value		Liveweight	
	£	%	Tonnes	%	£	%	Tonnes	%
Langoustines	1,564,396	40	412.24	16	1,779,740	45	442.93	15
Haddock	1,321,900	34	1,320.58	51	769,616	19	703.24	24
Monkfish	315,105	8	134.07	5	305,119	8	116.11	4
Whiting	194,119	5	214.39	8	158,542	4	173.63	6
Herring	120,307	3	251.83	10	414,686	10	1137.68	39
Cod	86,375	2	44.01	2	169,708	4	85.93	3
Lemon sole	58,619	2	28.74	1	86,016	2	36.40	1
Squid	52,357	1	15.19	1	39,443	1	12.49	<1
Saithe	32,197	1	35.78	1	61,930	2	66.65	2
Hake	26,743	1	20.19	1	69,606	2	55.86	2
Other Species	The remaining ~3% of value and ~4% liveweight is made up from catches of the following species: witch, halibut, turbot, plaice, ling, grey and red gurnards, scallops, pollack, megrim, mackerel, catfish, cuckoo ray, thornback ray, octopus, red mullet, lesser spotted dogfish, brill, lobsters, sole, tusk, conger eels, john dory, cuttlefish, spotted ray, brown crab, tope, redfishes, common skate, greater forked beard, white skate, sandy ray, spider crabs and black dogfish.				The remaining ~3% of value and ~4% liveweight is made up from catches of the following species: witch, halibut, ling, plaice, turbot, pollack, grey and red gurnards, catfish, mackerel, cuckoo ray, megrim, octopus, thornback ray, red mullet, lesser spotted dogfish, cuttlefish, spotted ray, brill, blonde ray, mullet, skates and rays, brown crab, common skate, blue whiting, tusk, john dory, sandy ray, greater forked beard, redfishes, sole, spider crabs, flounder, lobsters and white skate.			

Table 20.9. Value and Liveweight of Species by Vessels over 10 m in ICES Rectangles 45E9 and 45F0 (Average 2012-2016) (Scottish Government, 2018).

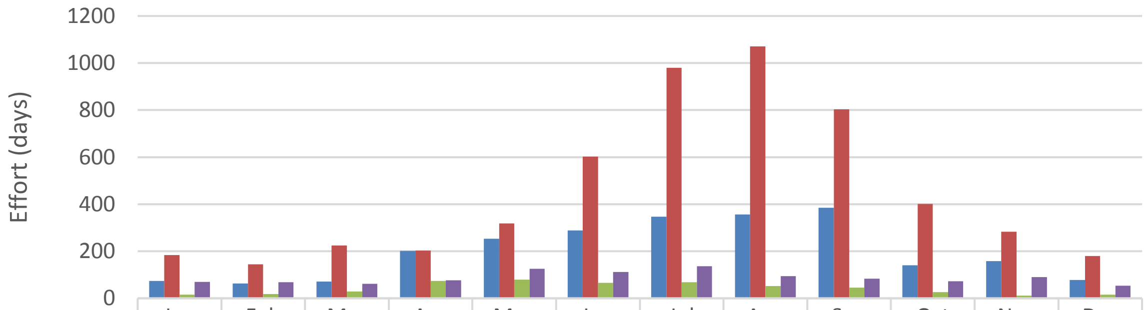
Species	45E9				45F0			
	Value		Liveweight		Value		Liveweight	
	£	%	Tonnes	%	£	%	Tonnes	%
Langoustines	1,687,344	45	435.33	14	1,737,654	54	440.16	14
Herring	499,958	13	1,349.79	44	783,895	24	2179.63	70
Mackerel	441,995	12	451.03	15	1,712	<1	4.56	<1
Monkfish	369,620	10	134.61	4	206,274	6	72.88	2
Haddock	287,766	8	282.50	9	92,659	3	95.45	3
Whiting	180,841	5	214.26	7	104,846	3	125.00	4
Cod	100,536	3	51.81	2	112,635	3	54.50	2
Saithe	34,426	1	38.89	1	62,866	2	68.32	2
Lemon sole	32,483	1	14.31	0	22,527	1	8.34	<1
Squid	31,412	1	10.29	0	15,387	<1	5.48	<1
Witch	24213	1	25.75	1	29,670	1	29.26	1
Other Species	The remaining ~2% of value and ~2% liveweight is made up from catches of the following species: witch, hake, halibut, ling, megrim, plaice, turbot, pollack, grey and red gurnards, catfish, cuckoo ray, lesser spotted dogfish, octopus, red mullet, thornback rays, brill, redfishes, tusk, spotted ray, brown crab, conger eel, wrasses, john dory, tope, cuttlefish, greater forked beard, bass, dabs, sandy ray, spider crabs.				The remaining ~2% of value and ~2% liveweight is made up from catches of the following species: ling, halibut, hake, plaice, pollack, catfish, mackerel, turbot, megrim, grey and red gurnards, octopus, cuckoo ray, tusk, red mullet, cuttlefish, thornback ray, brill, bluemouth, lesser spotted dogfish, mullet dabs, john dory, bass, conger eels, greater forked beard, northern shrimp and blue whiting.			

Table 20.10. Value and Liveweight of Species by Vessels over 10 m in ICES Rectangle 45F1 (average 2012-2016) (Scottish Government, 2018).

Species	45F1			
	Value		Liveweight	
	£	%	Tonnes	%
Langoustines	1,004,375	51	232.69	14
Herring	326,508	17	927.18	57
Haddock	179,673	9	167.30	10
Monkfish	166,656	8	56.11	3
Cod	85,136	4	41.39	3
Whiting	53,304	3	65.85	4
Witch	35,862	2	34.63	2
Lemon sole	35,650	2	12.55	1
Saithe	27,408	1	27.03	2
Squid	15,300	1	5.64	0
Other species	The remaining ~3% of value and ~3% liveweight is made up from catches of the following species: hake, ling, plaice, halibut, pollack, grey and red gurnards, catfish, mackerel, turbot, megrim, cuckoo ray, octopus, cuttlefish, thornback ray, tusk, red mullet, skates and rays, lesser spotted dogfish, brill, dabs, blue whiting, sole, greater forked beard, spotted ray, lobster, long rough dabs and John Dory.			

20.5.2.2 Seasonal Variation

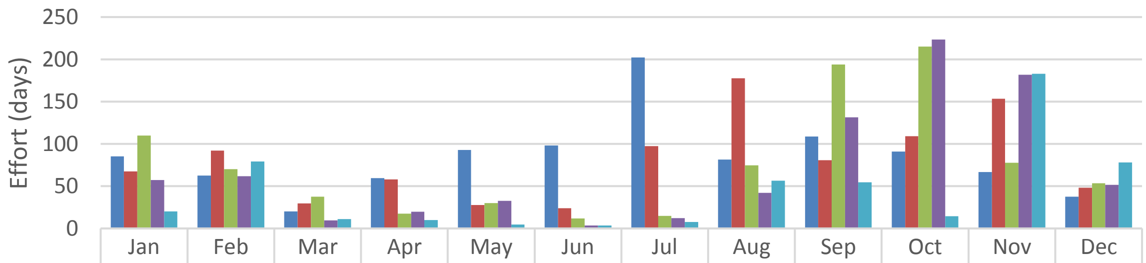
Fishing activity takes place all year round in all ICES rectangles that intersect with the Consenting Corridor. Figure 20.9 shows the average number of days spent fishing by vessels under and over 10 m in length from 2012 to 2016. As shown, effort is consistently higher in ICES rectangle 4E8, which also shows the most dramatic seasonal variation in activity by vessels under 10 m in length with activity peaking in summer and early autumn. Activity by vessels under 10 m in ICES rectangle 43E8 is also higher from May to September compared with the rest of the year. Effort by vessels over 10 m is much lower than less than 10 m vessels in these ICES rectangles.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
43E8 <10	73	63	72	202	254	288	348	357	384	140	158	78
44E8 <10	184	145	225	203	319	602	981	1070	804	401	284	180
43E8 >10	16	18	29	74	80	66	69	52	46	27	12	15
44E8 >10	70	69	62	77	125	112	136	95	84	73	91	54

Figure 20.9. Monthly Effort in ICES Rectangles 43E8 and 44E8 by Vessels under 10 m (average 2012 to 2016).

Figure 20.10 shows the average number of days spent fishing in ICES rectangles 44E9, 44F0, 45E9, 45F0 and 45F1 by vessels over 10 m in length.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
44E9	85	62	20	59	93	98	202	82	109	91	67	38
44F0	67	92	29	58	28	24	97	178	81	109	153	48
45E9	110	70	38	17	30	12	15	75	194	215	78	53
45F0	57	62	10	20	33	3	12	42	131	223	182	51
45F1	20	79	11	10	5	4	8	57	55	14	183	78

Figure 20.10. Monthly effort in ICES Rectangles 43E8 and 44E8 by vessels over 10 m (average 2012 to 2016).

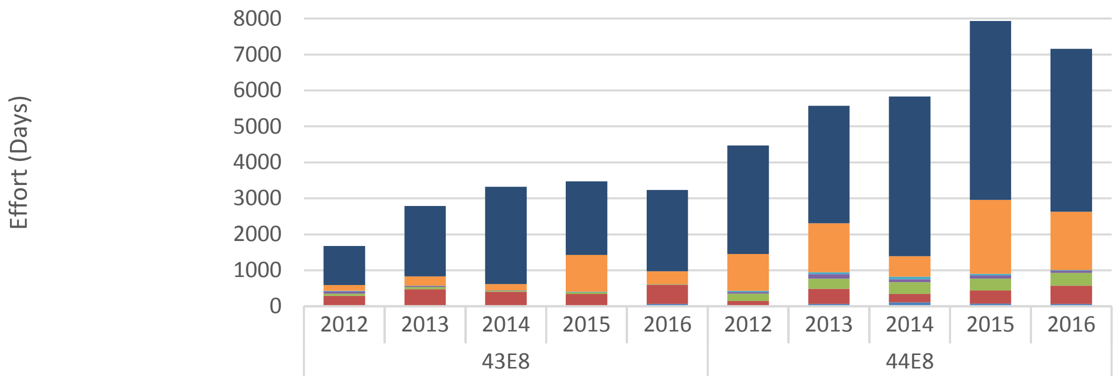
20.5.2.3 Gear Types

As the Consenting Corridor extends across a range of depths and habitat types, numerous gear types are in use across the Consenting Corridor, targeting a variety of different species, and these are detailed in Table 20.11. Demersal gear, including dredging, has the potential to interact with cables on the seabed, and associated cable protection. Pelagic gear has the potential to interact with vessels during marine cable installation.

Table 20.11. Summary of Fishing Gear Likely to be Operating in Consenting Corridor.

Gear type	Number of vessels required	Number of nets required	Towing speed (knots)	Tow duration (hours)	Additional information	Target species
Single bottom trawl	One	One	2-4	Up to 6	Nets used are chosen to be compatible with seabed conditions in the area being fished	Mixed whitefish, Langoustine and squid
Twin-rig trawl	One	Two	2-3	4-7	Sometime associated with heavy rock hopper ground gear	Mixed whitefish, Langoustine and squid
Demersal pair trawl	Two	One	3-3.5	4-5	Vessels 370 m apart; will close during hauling and pairing up	Mixed whitefish
Pelagic pair seining	Two	One	2	4	Nets follow ~2,200 m behind vessels; vessels between one quarter and one third of 1 NM from each other	Herring and mackerel
Seine net	One	One	1-2	2	At greatest distance net is over 1 NM from vessel	Demersal species
Dredge	One	n/a	3-5	4-5	Dredges are towed up to 1 NM from the vessels	King scallop, queen scallop
Creels	One	n/a	n/a	n/a	Baited creels are left in place for a period of time before being hauled (up to two weeks)	Lobster, brown crab, velvet crab, green crab
Lines	One	n/a	n/a	n/a	Hand lines or jigging machines	Mackerel

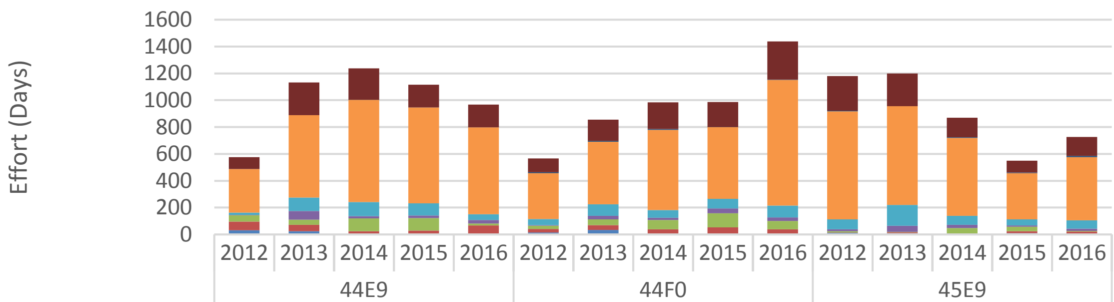
In the under 10 m fleet, pots, or creels, are the most utilised gear as shown in Figure 20.11 'Other' gear types utilised in these rectangles comprise mechanical handlines (jiggers), bottom otter trawls, hand fishing, trolling lines, boat dredges, otter twin trawls (all under 10 m fleet), bottom trawls, midwater trawls, langoustine trawls, midwater and unspecified otter trawls, pair trawls seine nets and mechanized dredges. Hand lines (jiggers), used to target mackerel, are the second most utilised gear by the under 10 m fleet in the ICES rectangles 43E8 and 44E8. Boat dredges, used to target scallops, dominate the gear utilised by the over 10 m fleet in ICES rectangles 43E8 and 44E8. The use of bottom otter trawls by the over 10 m fleet is also apparent in ICES rectangle 44E8.



	43E8 2012	43E8 2013	43E8 2014	43E8 2015	43E8 2016	44E8 2012	44E8 2013	44E8 2014	44E8 2015	44E8 2016
Pots <10	1089	1955	2708	2042	2265	3019	3273	4448	4980	4526
Hand Lines <10	157	257	176	1028	351	1018	1360	562	2055	1618
Pair Trawls (bottom) >10	17	8	5	10	0	35	53	73	44	17
Otter Twin Trawls >10	59	26	1	3	6	49	119	82	89	66
Otter Trawls (bottom) >10	67	61	30	44	15	207	285	328	327	358
Boat Dredges >10	283	459	392	330	534	122	425	232	365	499
Other (all vesssles)	4	17	11	13	67	20	62	111	73	70

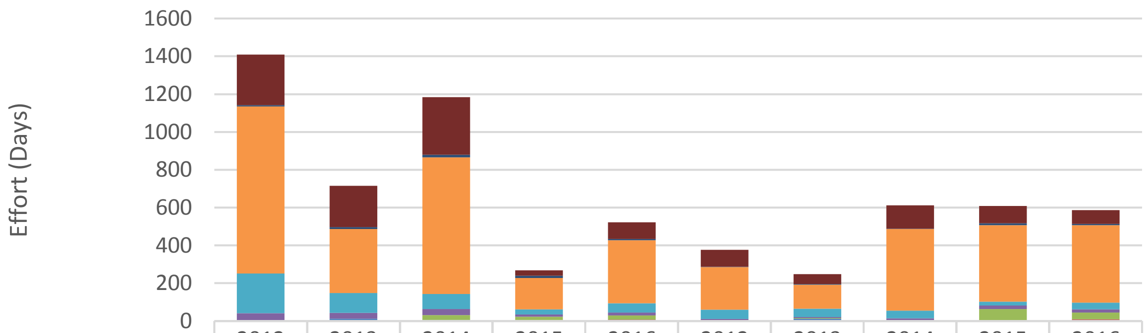
Figure 20.11. Effort by Gear Type in ICES rectangles 43E8 and 44E8 (all vessel sizes) (Scottish Government, 2018).

The over 10 m fleet is dominated by bottom otter trawling gear in all other ICES rectangles, as shown in Figure 20.12 and Figure 20.13 'Other' gear types adopted by the over 10 m fleet in ICES rectangles 44E9, 44F0, 45E9, 45F0 and 45F1 comprise boat dredges, midwater trawls, unspecified otter trawls, midwater and unspecified pair trawls, pots, seine nets and mechanized dredges. Otter twin trawls are the second most utilised gear adopted in these ICES rectangles, followed by langoustine trawls (Figure 20.12 and Figure 20.13).



	44E9 2012	44E9 2013	44E9 2014	44E9 2015	44E9 2016	44F0 2012	44F0 2013	44F0 2014	44F0 2015	44F0 2016	45E9 2012	45E9 2013	45E9 2014	45E9 2015	45E9 2016
Otter (Twin)	87	245	233	171	171	101	159	198	185	284	257	244	147	89	141
Otter (midwater)	0	0	1	0	0	9	6	6	1	3	6	0	5	6	10
Otter (bottom)	327	613	763	714	646	341	468	598	534	937	804	736	580	343	470
Nephrops Trawl	15	101	104	91	44	45	85	56	72	88	75	155	65	45	64
Bottom Trawls	3	63	16	18	25	5	26	17	35	27	14	46	25	10	16
Pair (bottom)	47	39	95	94	16	23	43	68	105	62	8	3	46	34	3
Scottish Seines	65	47	23	21	62	26	37	34	51	33	2	6	1	15	20
Other	31	25	2	7	5	15	33	5	3	5	13	11	0	10	3

Figure 20.12. Effort by Gear Type in ICES Rectangles 44E9, 44F0 and 45E9 (vessels >10 m) (Scottish Government, 2018).



	45F0					45F1				
	2012	2013	2014	2015	2016	2012	2013	2014	2015	2016
Otter (Twin)	267	219	305	29	88	89	52	124	92	74
Otter (midwater)	7	10	13	12	8	3	3	2	10	7
Otter (bottom)	883	339	723	167	334	226	128	432	405	409
Nephrops Trawl	210	104	80	26	49	49	43	40	20	36
Bottom Trawls	39	31	32	12	15	10	6	10	19	16
Pair (bottom)	1	0	26	17	22	1	3	5	59	36
Scottish Seines	0	0	0	2	1	0	0	0	5	7
Other	1	12	6	3	7	0	12	0	0	3

Figure 20.13. Effort by Gear Type in ICES Rectangles 45F0 and 45F1 (Vessels >10 m) (Scottish Government, 2018).

20.5.2.4 Crab and Lobster Fishery

Brown crab is targeted on a variety of substrate whilst lobsters are targeted on rocky, uneven ground and around wreck sites. Velvet crab is a swimming crab most commonly found on rocky substrates to depths up to 25 m. Crab and lobster are not currently quota restricted, although all vessels landing over a particular weight (200 kg of lobster, 750 kg of crab) must be licensed.

Brown and velvet crab and lobster are principally targeted by static gear vessels setting creels (pots). The Peterhead inshore fleet is largely comprised of vessels up to 10 m in length which operate from the harbour on a daily basis. A creel fleet is also known to operate from Boddam harbour located approximately 3 km south of Peterhead. The fleet is active over the summer months but less so over the winter as the harbour is vulnerable to large swells particularly from the north and east. ScotMap data (2014) indicates that the majority of creeling activity occurs within 3 NM, although some vessels operate as far out as 6 NM and very few operate beyond that. ScotMap suggests that no creeling activity occurs beyond 12 NM. Although the ScotMap data was collected several years ago, feedback during consultation suggests that this pattern is still in place. In particular, fishermen operating creel boats noted that they typically remain within the 1° 40' longitude line as part of an agreement with scallop fishermen who utilise waters further offshore. The creel fishery is therefore operational at the Long Haven Bay landfall site and up to 6 NM from the coast.

The majority of brown crab in Scotland is landed from June to December and velvet crab between July and November. As a result of the limited size of vessels in the area, weather conditions are a significant factor in determining levels of activity in the winter months. In addition to full time vessels, there are also a number of part time vessels that will set a small number of creels in inshore areas during the summer months.

The crab and lobster fishery is the highest value fishing activity by the inshore fleet of <10 m length vessels (Scottish Government, 2018). Brown crab is the most landed species in terms of value and liveweight in ICES rectangles 43E8 and 44E8 by the under 10 m fleet, comprising 52% and 48% of the value of landings respectively and 74% and 63% of landed weight respectively (Table 20.6). Average landings from 2012-2016 are worth £210,050 and £544,470 in 43E8 and 44E8 respectively. Brown crab landings by the over 10 m fleet in these rectangles is worth £1,238 and £41,902 (average 2012-2016). Lobsters are the second most landed species by the under 10 m fleet, worth £120,942 (30%) and £295,537 (26%) of value in 43E8 and 44E8 and weighing 10.93 tonnes (5%) and 153.49 tonnes (24%) respectively (average 2012-2016) (Table 20.6).

20.5.2.5 Herring and Mackerel Fishery

Pelagic species, mainly herring, mackerel, and sprat, are habitually mid-water shoaling fish, but during full daylight conditions they will congregate in dense shoals near the sea-bed. Normally they are caught while they are nearer the surface but it is possible to trawl for them near the bottom. In normal circumstances these nets would not come into hard contact with the seabed, having no protective ground-line.

20.5.2.5.1 Vessels Under 10m

There is a significant hand-line fishery for mackerel in the summer months between May and November. An estimated 45 vessels are understood to target the fishery from Peterhead, with a declining number of vessels further from the coast (based on ScotMap data as shown in Figure 20.14). Hand lining also includes the automated lines used to target mackerel known as jigging machines. Consultation with fishermen highlighted that mackerel grounds are variable from year to year and vessels will operate wherever the mackerel are.

Mackerel is the third most important species targeted by vessels under 10 m in ICES rectangles 43E8 and 44E8, worth £37,353 (9%) and £188,050 (17%) and weighing 32.95 tonnes (14%) and 49.98 tonnes (8%) respectively (Table 20.6). In the same ICES rectangles mackerel worth £52,602 (3%) and £850,276 (24%) is landed by the over 10 m fleet respectively. ICES Rectangle 44E8 has therefore been more productive for mackerel than 43E8 based on the average landings from 2012-2016.

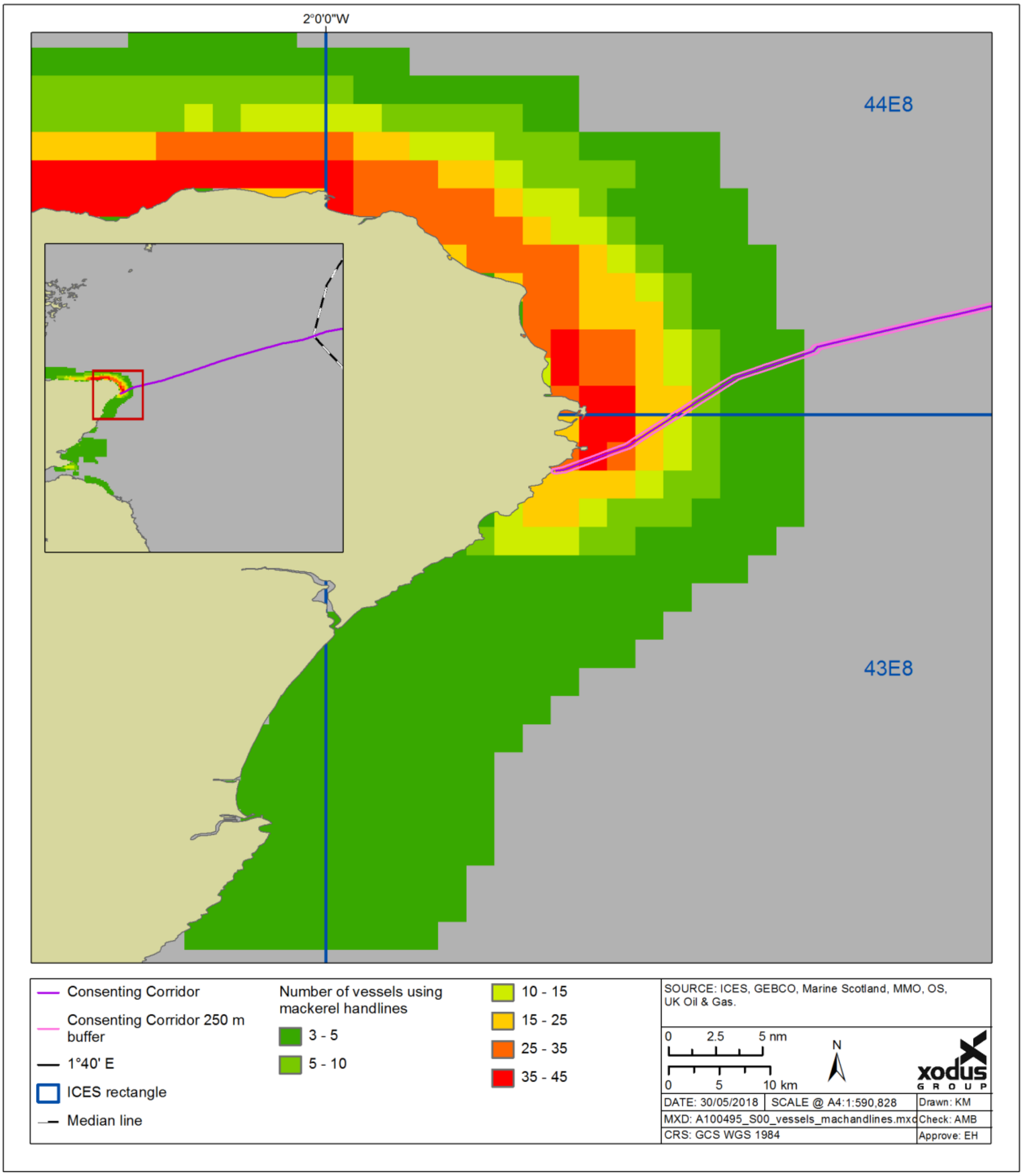


Figure 20.14. Number of Mackerel Handlining Vessels (ScotMap, 2014).

20.5.2.5.1 Vessels Over 10m

Pelagic species (herring and mackerel) further offshore are targeting by vessels > 10 m using seines and mid water trawls. Mid-water trawls are towed at the appropriate level in the water column to intercept shoaling fish such as herring. Seining depends on long lengths of rope up to three kilometres per side which herd fish into the path of the net as the gear is hauled. Pelagic fishing methods tend to be highly efficient by targeting shoals, large catches are possible over short time periods which leads to sporadic effort where periods of intense fishing are followed by periods of vessels not working for prolonged periods of time. The relative value of landings from vessels using pelagic gear (Figure 20.15) is low for the entirety of the Consenting Corridor. A small area of high value occurs directly adjacent to the Consenting Corridor in rectangle 44E9. The effort of vessels using this gear mirrors the value, with low effort along the Consenting Corridor apart from a small area of higher effort in rectangle 44E9. For ICES rectangles 45E9, 44E9 and 44F0, seine nets accounted for approximately 1% of the fishing effort in 2016, mid water trawls accounted for less than 1 % of the fishing effort in 2016 (Figure 20.11). For ICES rectangles 45F0 and 45F1 seine nets and mid water trawls each accounted for less than 1% of the effort for 2016 (Figure 20.12).

In the ICES rectangles further offshore, herring is a key species. For ICES rectangles 45E9, 45F0 and 45F1 herring was the second most valuable species accounting for 13%, 24% and 17% of the landings value respectively. Mackerel was also important in rectangles 45E9 being the third most valuable species and accounting for 12% of the landings value. The high value of these species in comparison to the low value placed on pelagic gear methods indicates that these species are also likely to be targeted using other gear types too.

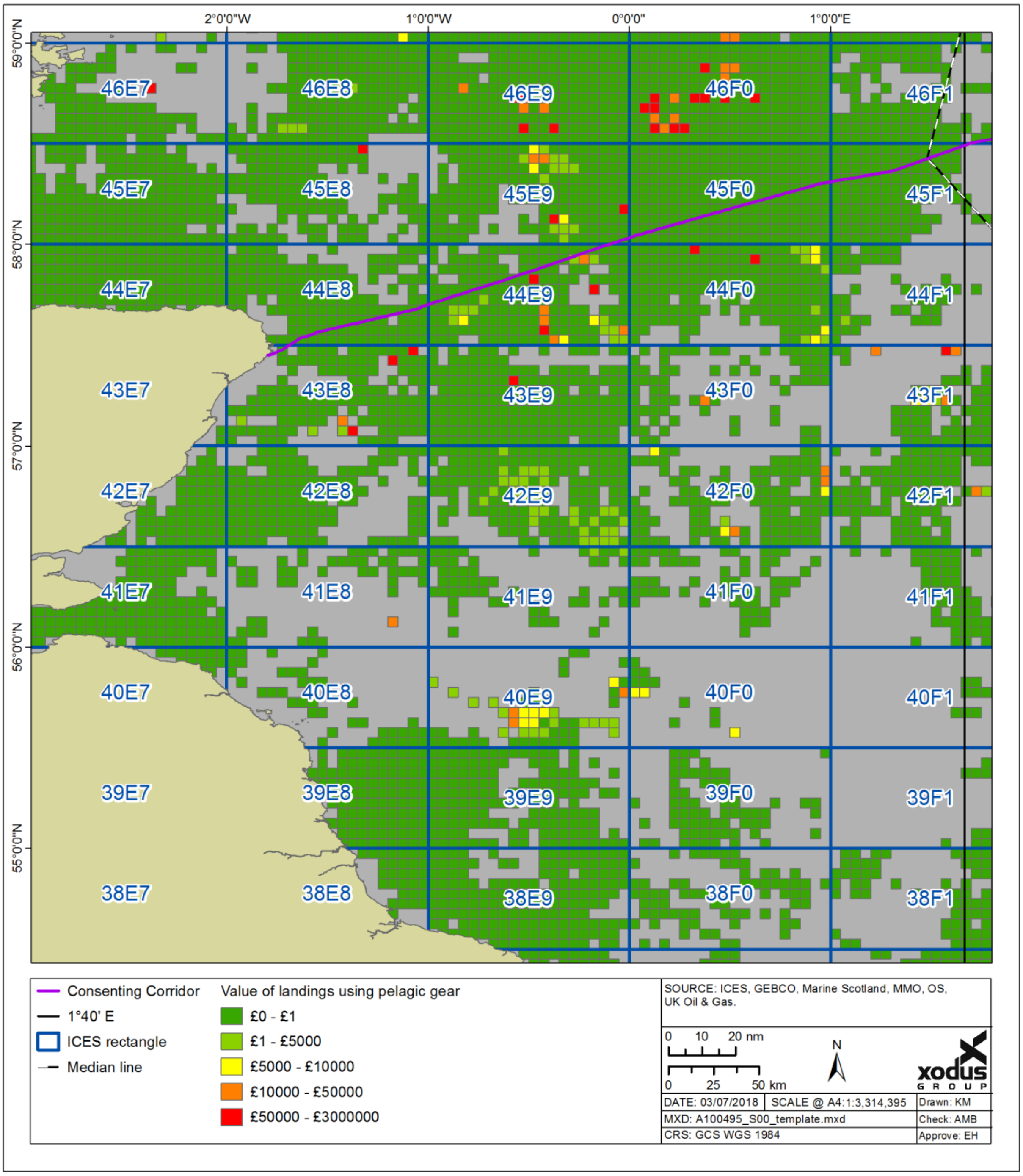


Figure 20.15. Relative Distribution of Landings (£) of Vessels >10 m Targeting the Pelagic Fishery (MMO, 2018).

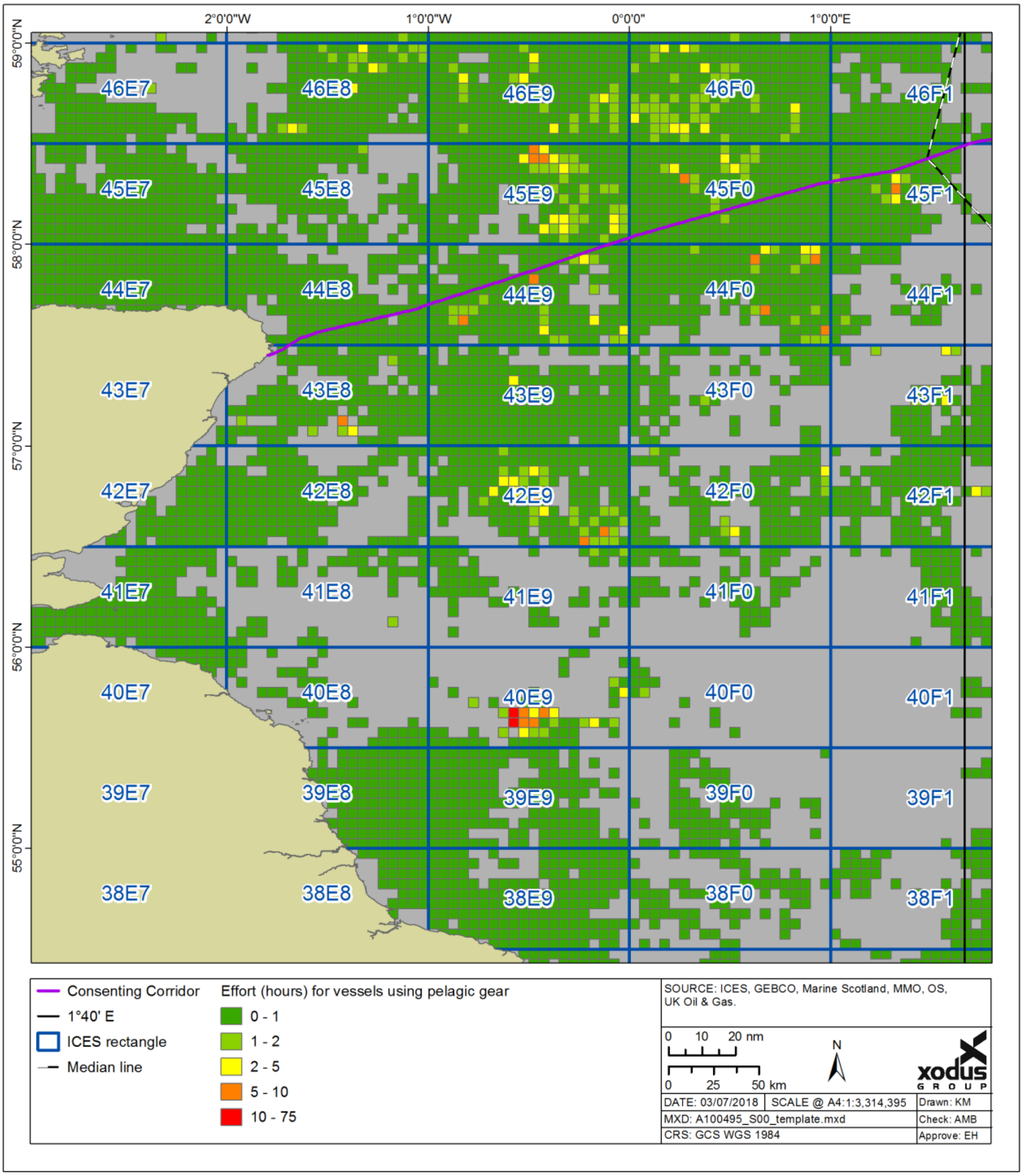


Figure 20.16. Relative Distribution of Effort (Hours) of Vessels >10 m Targeting the Pelagic Fishery (MMO, 2018).

20.5.2.6 Scallop Fishery

Scallops occur on the seabed primarily on sediments comprising sand, gravel and mud and possibly interspersed with stones, rocks or boulders. Scallops lie disguised in the sediments and are generally considered sedentary, however, they are able to swim short distances propelled by jets of water.

Scallop vessels tow one (astern) or two (either side) beams onto which a number of dredges are attached. The number of dredges used depends on vessel size, engine power and winch capacity. In Scottish waters vessels are restricted to eight dredges per side inside 6 NM from shore and up to ten dredges per side between 6 and 12 NM from shore. Scallops are "raked" from the seabed by a row of sprung steel teeth up to 11 cm in length. Mesh bags are situated behind the teeth to retain the catch. The maximum penetration depth of this gear is up to 20 cm, although this will vary depending on substrate composition. Scallops are not targeted by vessels under 10 m in length (.

Table 20.6). They are however the most valuable landed species in ICES rectangles 43E8 and 44E8 by vessels over 10 m in length, worth an average of £990,354 (64%) and £1,035,280 (30%) respectively (Table 20.7). Scallops do not comprise a significant proportion of landings from any of the other ICES rectangles which intersect with the Consenting Corridor (Figure 20.17 and Figure 20.18).

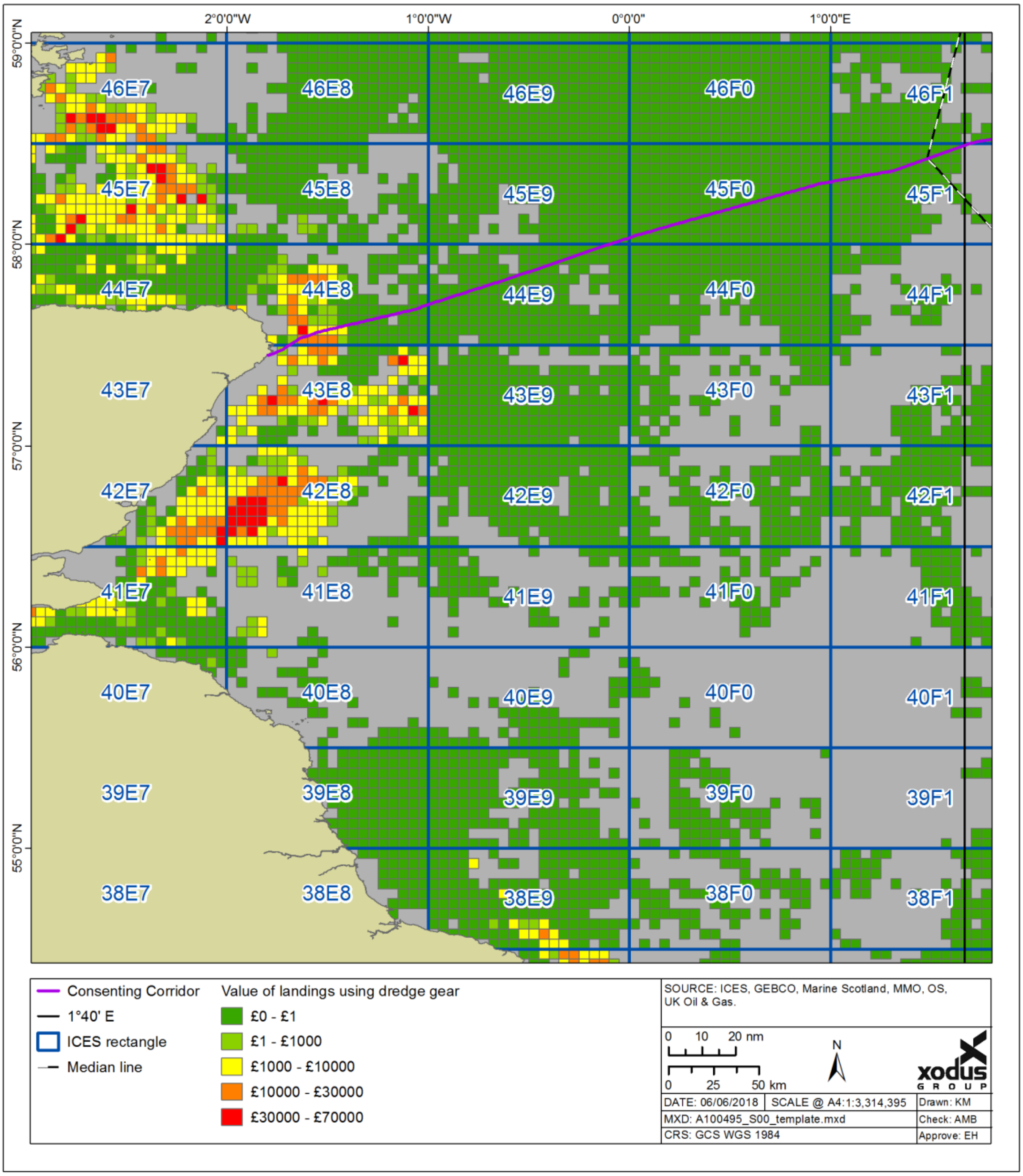


Figure 20.17. Relative Distribution of Landings (£) of Vessels >15 m Using Dredge Gear (MMO, 2018).

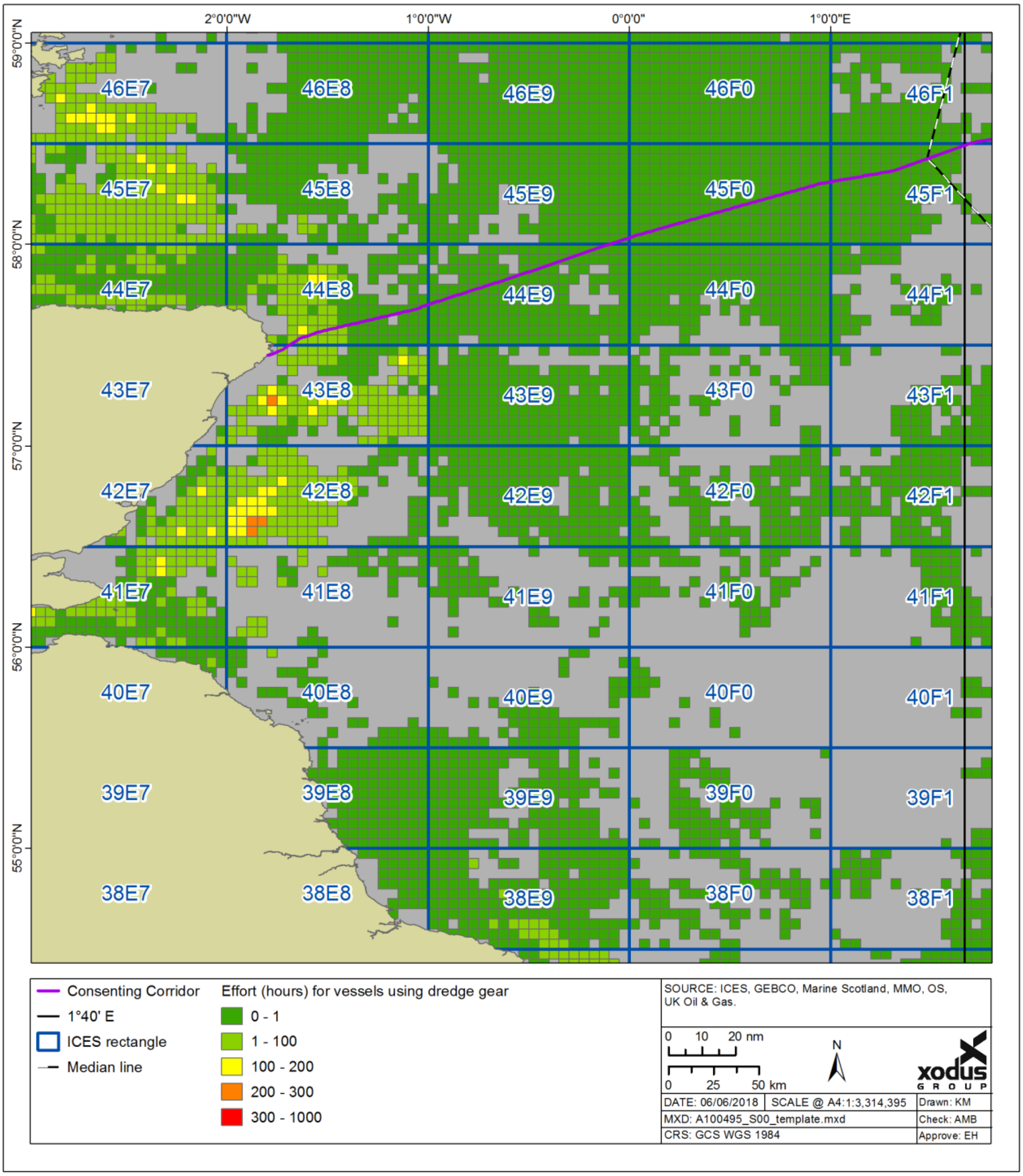


Figure 20.18. Relative Distribution of Effort (Days) of Vessels >15 m using Dredge Gear (MMO, 2018).

20.5.2.7 Demersal Trawl Fishery

The demersal trawl fishery is for the most part a mixed fishery whereby multiple demersal species are simultaneously caught. EU quota restrictions and upon the landing of cod have reduced the fleet's ability to fish alternative species. As a result of a lack of available quota, demersal trawlers have diversified into the langoustine fishery, where quota levels are not so restrictive.

There is a historic whitefish fishery in the region, targeting species such as haddock, cod and whiting using demersal otter trawl and Scottish seine netting fleets. Demersal trawling is the most common fishing method in Scottish waters in terms of vessel numbers.

Haddock and monkfish are the most valuable whitefish species landed along the cable corridor, with the average value of haddock (2012-2016) landed from any of the intersecting ICES rectangles peaking at £1,321,900 (34%) in ICES rectangle 44E9, a liveweight of 1,320.58 tonnes, or 51% of the average landed weight (Table 20.8). As shown in Figure 20.8 haddock and other whitefish are an important species landed in all ICES rectangles which intersect with the Consenting Corridor.

Langoustine gear is configured in the same way as that used to target whitefish, but with modified nets. Langoustine inhabit burrows in the seabed and favour muddy and soft substrates. Vessels tow one or more trawl nets (single or twin rig) along the seabed.

Along the Consenting Corridor demersal trawling is most important in terms of effort and value in ICES rectangle 44E9, with the cable corridor passing through the area considered the most valuable within the rectangle (Figure 20.19 and Figure 20.20). Demersal trawls are also of some importance to ICES rectangles 45F0, 44F0, 45E9 and 45F1 with the cable corridor passing through areas of moderate value and effort in comparison to the surrounding rectangles. Demersal trawling is not considered important in the more coastal ICES rectangles (44F8 and 43E8) that the cable corridor passes through (Figure 20.19 and Figure 20.20). AIS data for 2017 confirms that demersal trawls are the most utilised gear type along the Consenting Corridor (Figure 20.23).

Langoustine is frequently the most valuable species landed from ICES rectangles 44E9, 44F0, 45E9, 45F0 and 45F1 as shown in Figure 20.8.

As part of the Navigational and Shipping Baseline (Appendix G.1), an analysis was undertaken to identify tracks of demersal vessels actively engaged in fishing, as opposed to transiting through the area. Within the AIS data, vessels can change their navigation status to “engaged in fishing” where appropriate, although it is noted that fishing vessels do not always keep this reliably updated. The analysis was therefore based on a combination of navigation status, destination, speed and course (e.g. consistent course or several turns). The results are presented in Figure 20.24 and correlate with the effort and value results presented in Figure 20.19 and Figure 20.20 in that ICES rectangle 44F9 shows the greatest level of activity, with the highest level occurring in a concentrated area to the north of the Consenting Corridor.

Anecdotal information from consultation with fishermen indicates that the langoustine fishery reportedly travels from a west to east direction as the species migrate during the season.

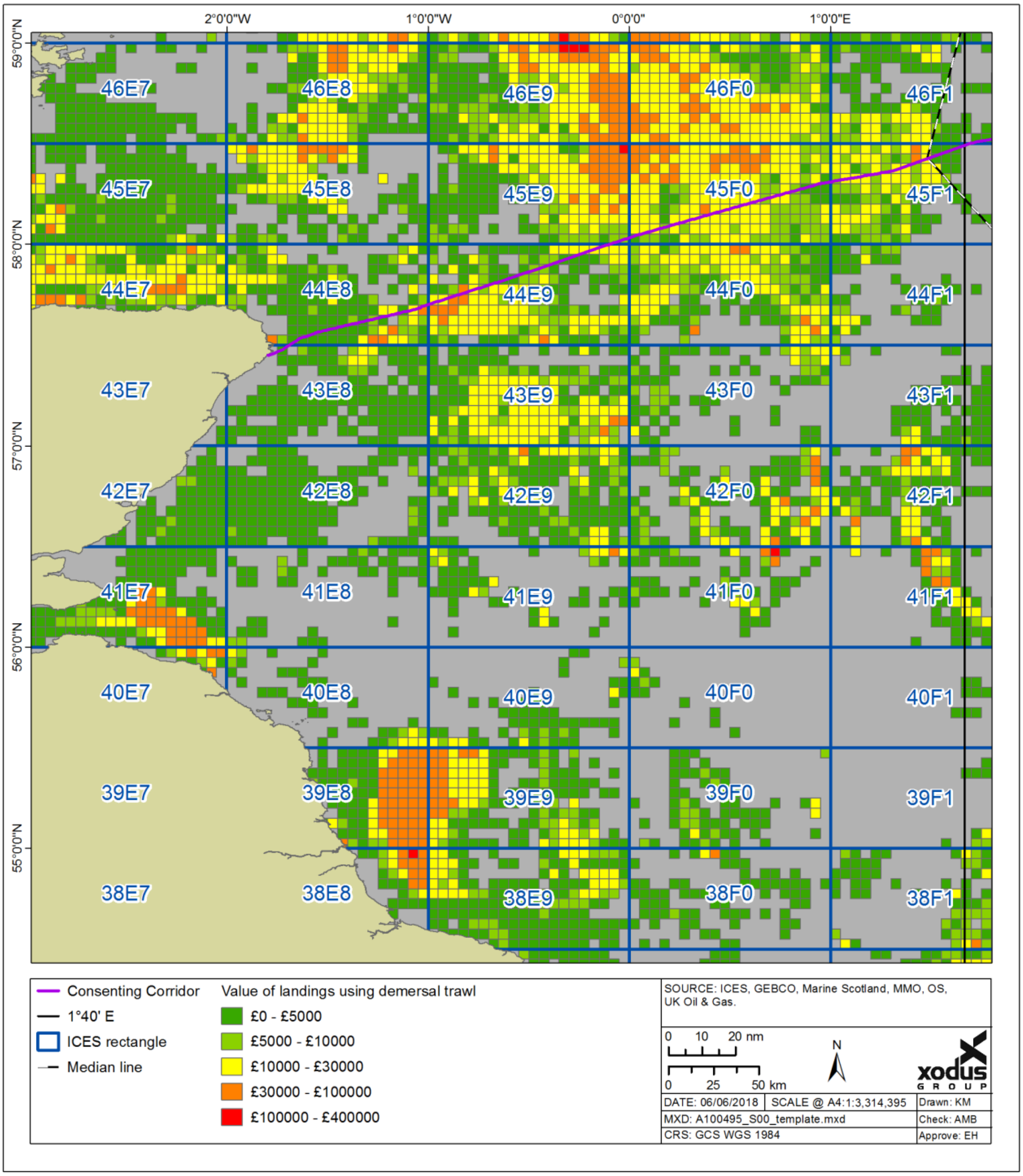


Figure 20.19. Relative Distribution of Landings (£) of Vessels >15 m using Demersal Trawling (MMO, 2018).

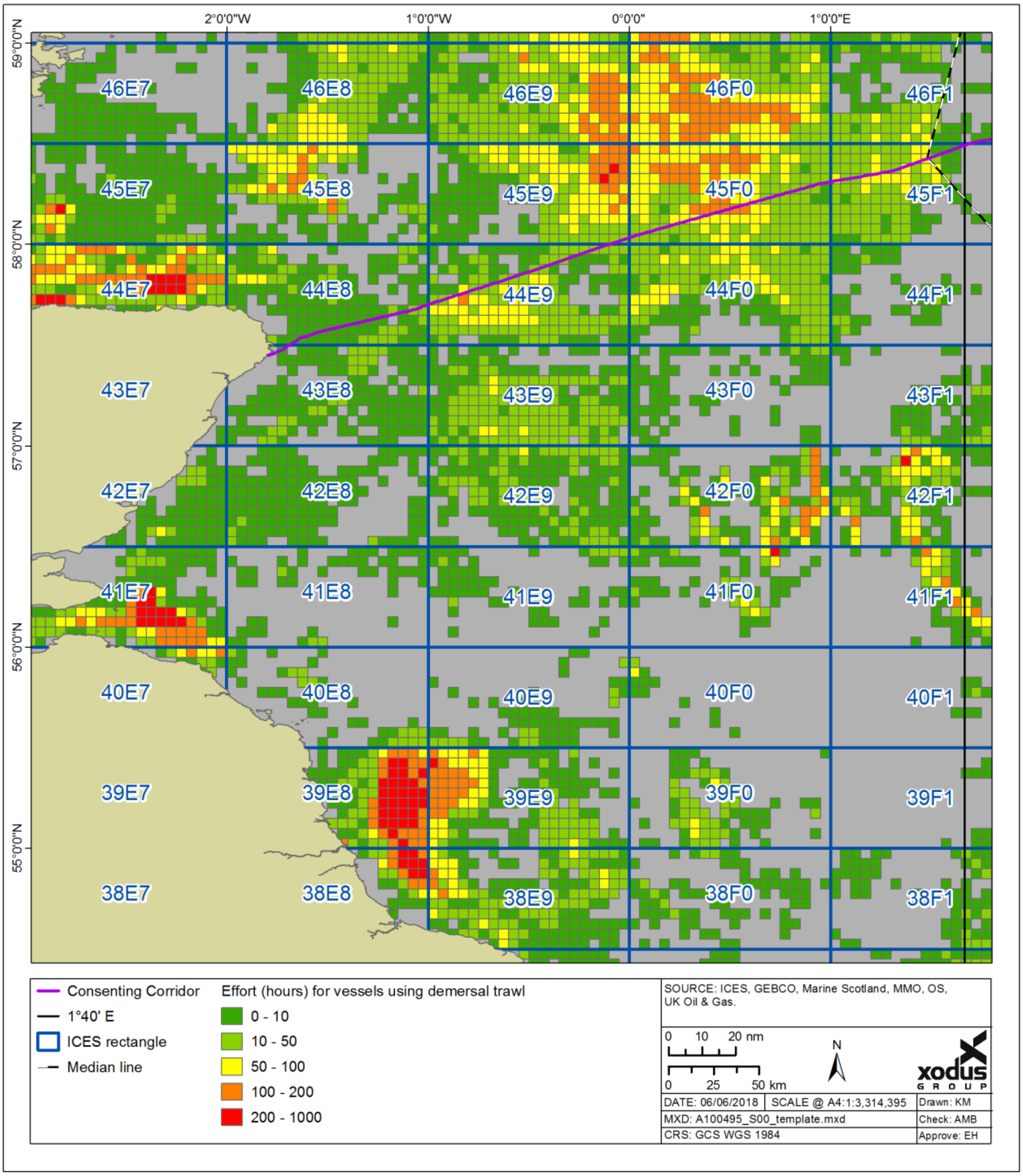


Figure 20.20. Relative Distribution of Effort (Days) of Vessels >15 m using Demersal Trawling (MMO, 2018).

20.5.2.8 AIS data

In support of the Chapter 19: Navigation and Shipping Chapter, a Navigation and Shipping Baseline has been prepared (Appendix G.1). The baseline utilised AIS information to present gear types used both in the coastal area and the offshore Consenting Corridor for the year 2017 (Figure 20.21 and Figure 20.22).

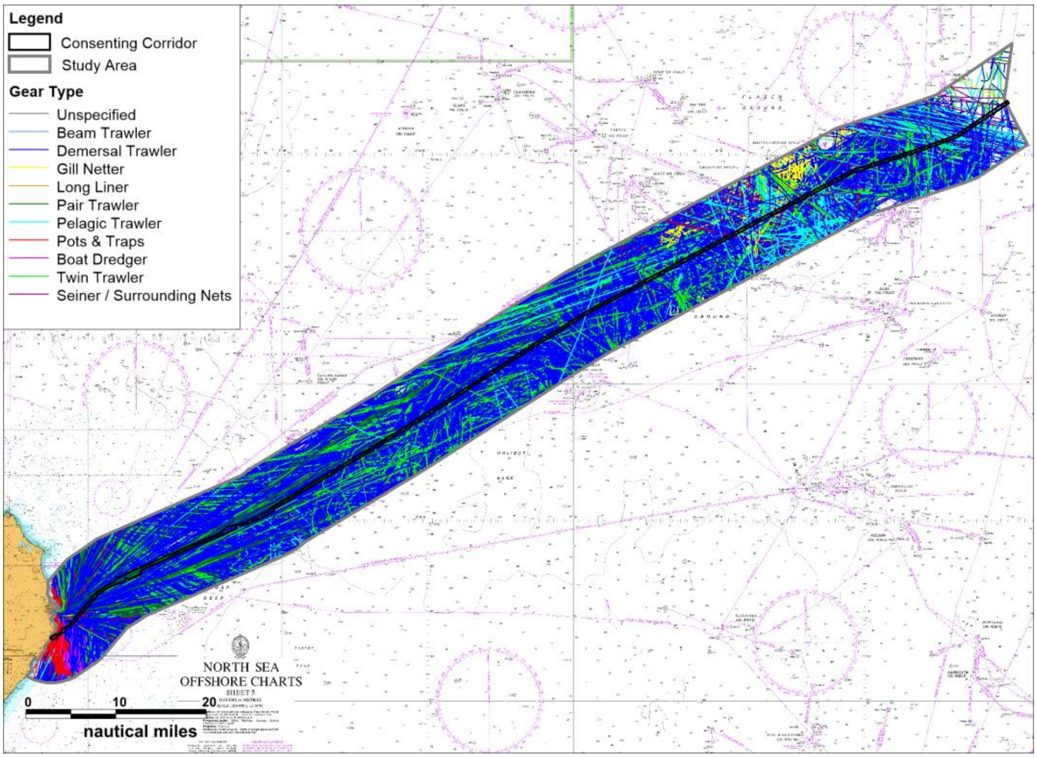


Figure 20.21. AIS Fishing Tracks by Gear Type for the year 2017 along the Consenting Corridor (Taken from Navigation and Shipping Baseline Appendix G.1).

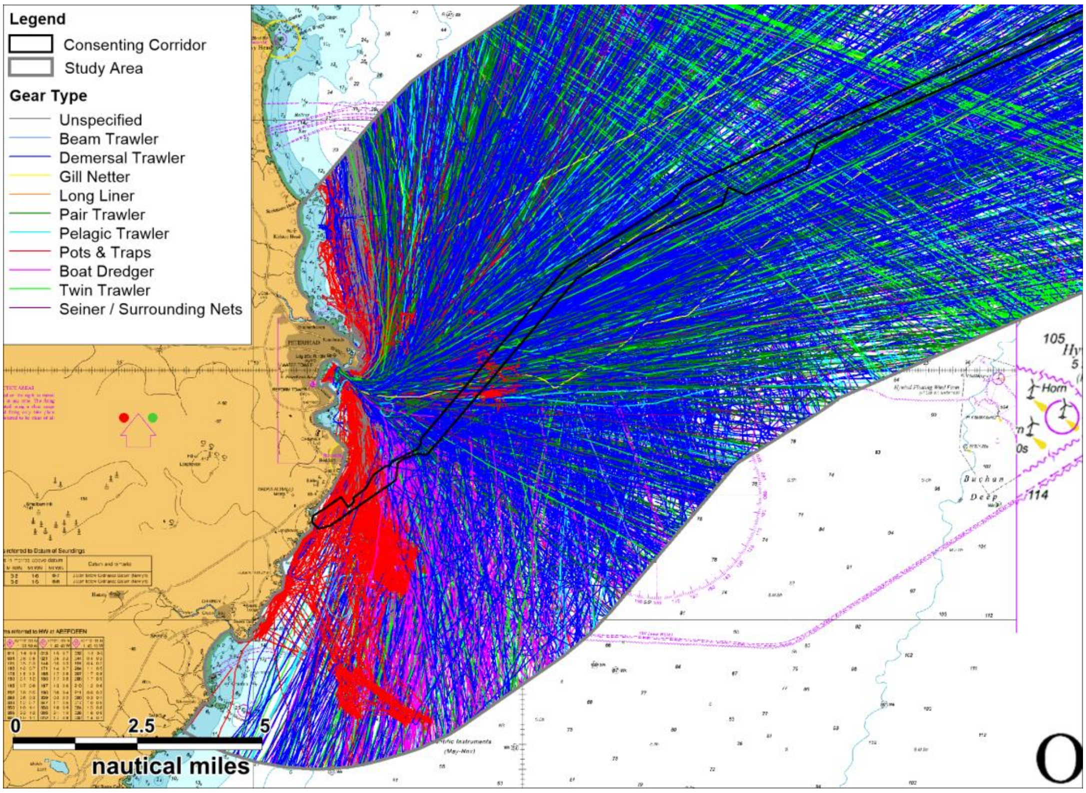


Figure 20.22. AIS Fishing Tracks by Gear Type for the Year 2017 in the Coastal Area of the Consenting Corridor (Taken from Navigation and Shipping Baseline Appendix G.1).

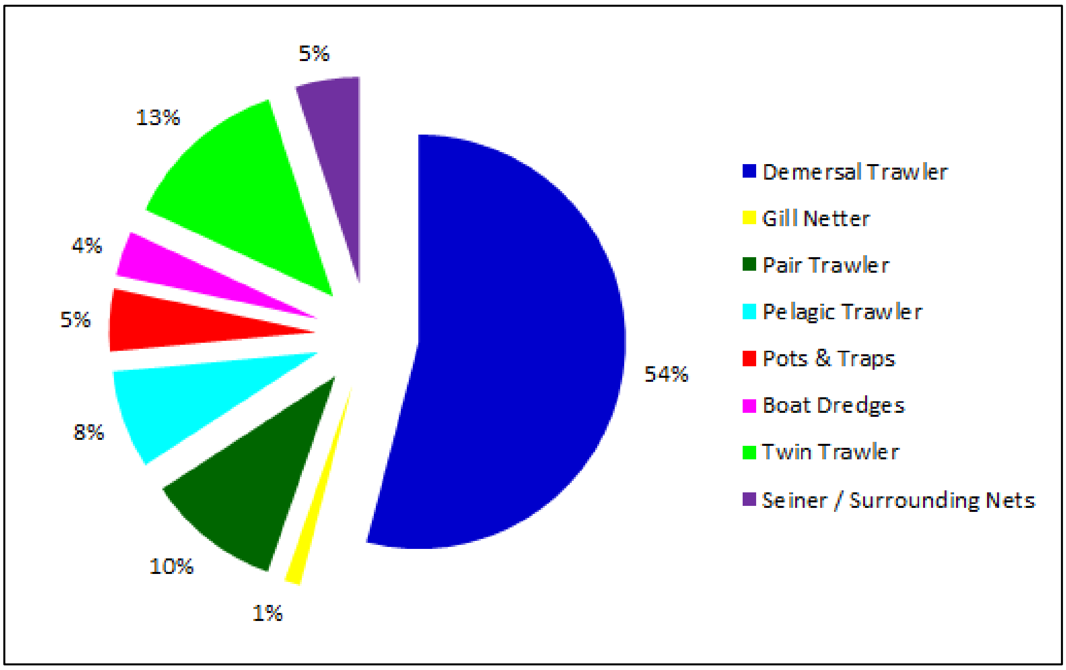


Figure 20.23. AIS Fishing Main Gear Type Distribution (Taken from Navigation and Shipping Baseline Appendix G.1).

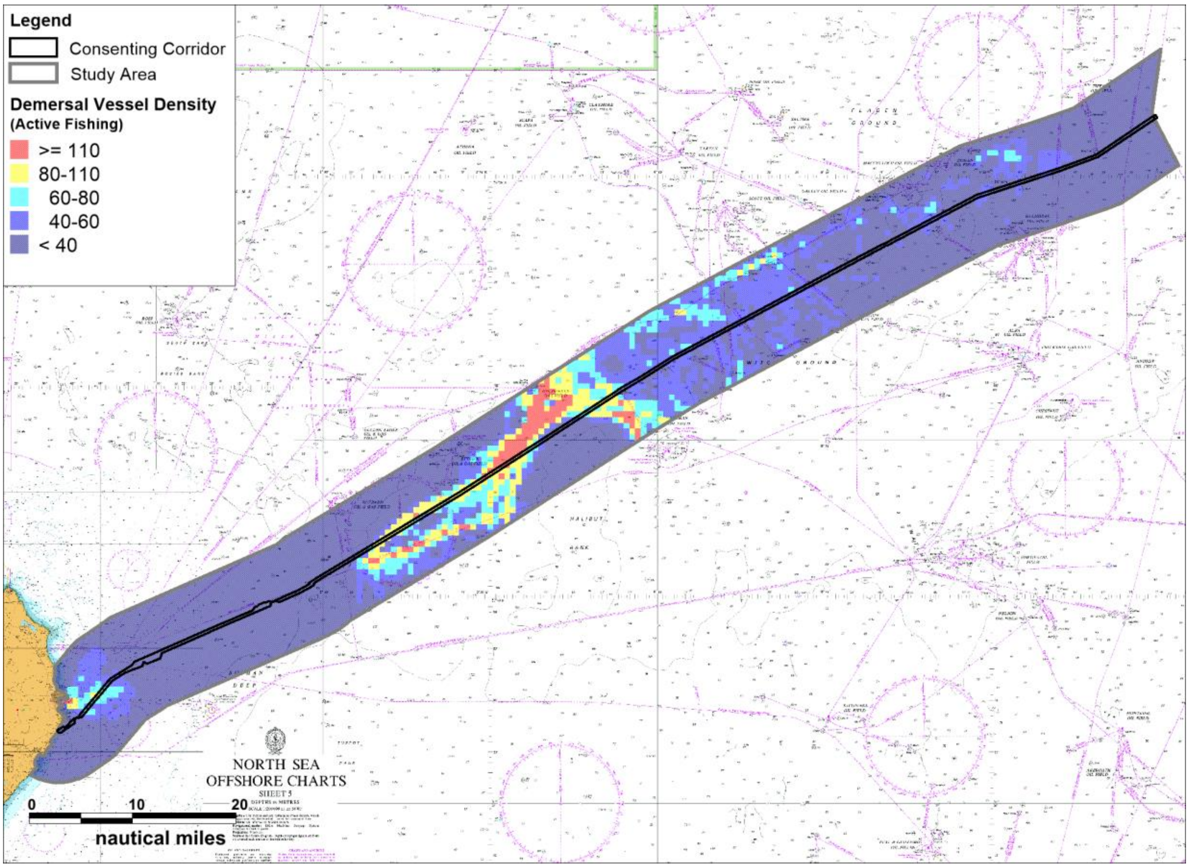


Figure 20.24. Demersal Trawls Actively Fishing along the Consenting Corridor from January to December 2017 (Taken from Navigation and Shipping Baseline Appendix G.1).

20.5.2.9 Salmon and Sea Trout Fishery

Atlantic salmon and sea trout are diadromous or migratory species of fish, with a lifecycle that includes time in freshwater river environments and at sea. After a period spent in a riverine environment, the individuals undertake a marine migration to offshore feeding grounds, returning after a varying number of years to their natal river to spawn (see Chapter 15: Fish and Shellfish Ecology for further information). It is probable that they will transit the Consenting Corridor, therefore, migration and catch levels could potentially be disrupted.

Each fishery in Scotland is required to provide the number and total weight of salmon and grilse and sea trout caught and retained each month of the fishing season. The principal salmon and sea trout fisheries are rod and line (including catch and release), fixed engine (bag netting) and net and coble.

The fishery is managed through fishery districts, each of which has a District Salmon Fishery Board (DSFB). Salmon and sea trout catches are recorded under the following categories:

- Sea trout (sea trout that have spent multiple winters at sea);
- Finnock (sea trout that have only spent one winter at sea);
- Salmon (salmon that have spent multiple winters at sea); and
- Grilse (salmon that have only spent one winter at sea).

The cable landfall is located in the North-East region which covers seven DSFBs: South Esk, North Esk, Bervie, Dee, Don, Ythan and Ugie. The cable landfall is in the River Ugie DSFB. Salmon and sea trout catch methods are shown in Table 20.12. Rod and line gears dominate with the greatest proportion of caught fish subsequently being released. There were no fixed engine salmon or sea trout landings in 2016, however, this appears to be an anomaly rather than typical for the region, therefore, 2015 data has been used for this catch method (Scottish Government, 2018).

Table 20.12. Salmon and Sea Trout Catches by Fishery in 2016[1] in North East Region and the East Region (Scottish Government, 2018).

Catch Method	Salmon	Grilse	Sea Trout	Finnock	Total
North East Region					
Rod and line (released)	4195	1470	1857	2600	10,122
Rod and line (retained)	276	170	956	103	1,505
Net and Coble	1094	1207	1288	0	3,589
Fixed Engine	1433	1380	396	0	3,209
Total	6,998	4,227	4,497	2,703	18,425
East Region[2]					
Rod and line (released)	10,640	1,693	1,398	531	14,262
Rod and line (retained)	1,186	592	586	7	2,371
Net and Coble	274	201	193	0	668
Fixed Engine	0	0	170	0	170
Total	12,100	2,486	2,347	538	17,471

The rod and line salmon fishery can be subdivided into 'catch and release' and 'catch and retain' activities. As shown in Table 20.12 catch and release activities dominate salmon and sea trout fishing activities, comprising 55% of all fish caught in the north-east region and 82% of fish caught in the River Tweed and River Tay in the east region. Fish which are retained comprise 8% and 14% in the north east and east regions respectively.

The net and coble fisheries typically operate between May and August and the rod and line (retained) fishery operate between April and October. The rod and line (released) fishery has the longest operational period, occurring from February to October in 2016. No salmon or sea trout were caught between November and January (Scottish Government, 2018).

20.5.2.10 Aquaculture

There are currently no aquaculture sites registered with Marine Scotland Science located in the close vicinity of the Consenting Corridor (NMPi, 2018). No aquaculture sites are anticipated to be affected by this development and are therefore not considered further.

20.5.3 Valuation of Key Receptors

The key commercial fishery receptors of the NorthConnect Consenting Corridor are:

- Inshore creel fishery targeting brown crab, lobster and velvet crab all year round and mackerel from May to November;

[1] Fixed engine fisheries did not operate in the North East in 2016 therefore 2015 data has been used instead.
[2] Specifically, the Tay and Tweed Rivers as specified in the Scoping Opinion (there are no catches in the River Teith to include).

- Scallop fishery, which operates in a similar area to the creel fishery but extends further offshore;
- The offshore pelagic fleet (vessels > 10 m) targeting pelagic species such as herring and mackerel;
- The demersal fishery operating between 12 nautical miles and the UK Norway median line, primarily targeting Langoustine; and
- Salmon fishery associated with the east and north east regions.

The inshore creel fishery, scallop fishery and demersal fishery could be affected during the cable installation and decommissioning activities. The latter two and the salmon fishery may also be affected during the operational phase of the project.

20.6 Impact Assessment

Following establishment of the baseline conditions of the project and surrounding area, and an understanding of the project activities, it is possible to assess the potential impacts from the project on commercial fishery interests in the vicinity of the project. The range of impacts that have been considered is based on impacts identified during EIA scoping and any further potential impacts that have been identified as the EIA has progressed. The impacts assessed are summarised in Table 20.13.

For each potential impact, the implications for fisheries during the installation and operation / maintenance phase of the project are assessed separately where appropriate. Decommissioning is considered under Section 20.5.5. The assessment is based on the information that has been provided to date in relation to methods of installation, operation and decommissioning, as presented in Chapter 2 (Project Description).

Table 20.13. Impact Summary.

Project Activity	Potential impact	Considered in this impact assessment	Relevant phase of Project			Zone of influence
			I	O	D	
Presence of vessels	Loss of access to fishing grounds.	Yes, see Sections 20.6.2.1 and 20.6.3.1	✓	✓	✓	Immediate vicinity of the installation vessels.
Presence of vessels	Change of distribution of species.	Yes, see Sections 20.6.2.1 and 20.6.3.1	✓	✓	✓	Immediate vicinity of the installation vessels.
	Collision risk.	No, this is covered in Chapter 19: Navigation and Shipping				
Sections of exposed cable between laying and burial.	Loss of access to fishing grounds.	Yes, see Section 20.6.2.1	✓	×	×	Indicative 500m protection zone along any unprotected sections of cable.
Cable burial (jet trenching, ploughing and mechanical trenching)	Potential for fouling of fishing equipment on fishing grounds.	The potential for fouling of fishing equipment on fishing grounds is anticipated to be limited to the immediate area surrounding the installation vessels and the risk of fouling will be removed through by having protection zones around unprotected cables therefore, this impact is not considered further. Once the protection zone is removed there is not considered a risk of fouling.				Immediate vicinity of Consenting Corridor.
	Change in Distribution of Target Species.	Yes, see Sections 20.6.2.2 and 20.6.3.2.	✓	×	✓	

<table>
<tr><th rowspan="2">Project Activity</th><th rowspan="2">Potential impact</th><th rowspan="2">Considered in this impact assessment</th><th colspan="3">Relevant phase of Project</th><th rowspan="2">Zone of influence</th></tr>
<tr><th>I</th><th>O</th><th>D</th></tr>
<tr><td rowspan="2">Rock placement used for cable protection</td><td>Snagging risk as a result of obstruction on the seabed.</td><td>Yes, see Section 20.6.3.3</td><td>✓</td><td>✓</td><td>✓</td><td>• Pipeline Crossings: 70 m of rock either side.
• Cable crossings, 25 m either side.
• The slope used is assumed to be 1:2.5. The rock berm height will vary from 1 m for buried cables to 2 m for surface laid pipelines.
• Remedial rock berms may be required in areas were the cable is not sufficiently protected by trenching. Remedial berm heights will be a maximum of 1.5m, with slope angles no greater than 1:2.5.
  ○ Within the 12NM limit is predicted that remedial berms may be required for between 5-10% of each cable.
  ○ From 12NM to the limit of the UK EEZ, remedial berms may be required for approximately 1% of each cable.
• Rock placement backfill may be required in areas where the trenching tool does not provide a sufficient depth of burial. Rock placement backfill will be finished level with the existing seabed, and hence presents no snagging risk and is not considered further.</td></tr>
<tr><td>Loss of access to fishing grounds if rock berms are not overtrawlable.</td><td>Yes, see Section 20.6.3.1</td><td>×</td><td>✓</td><td>×</td><td>Immediate vicinity of rock berms.</td></tr>
<tr><td rowspan="2">Cable operation</td><td>Emission of EMF – compass deviation effect</td><td colspan="5">No, this is covered in Chapter 19: Navigation and Shipping</td></tr>
<tr><td>Emission of EMF – change in distribution of species</td><td>Yes, see Section 20.6.3.2</td><td>×</td><td>✓</td><td>×</td><td>Close to seabed, in immediate vicinity of cables.</td></tr>
</table>

Project Activity	Potential impact	Considered in this impact assessment	Relevant phase of Project			Zone of influence
			I	O	D	
Cable operation	Sediment redistribution, sediment heating	No, this is covered in Chapter 15: Fish and Shellfish				
Cable installation and operation	Ghost fishing	No, this is covered in Chapter: 24 Resource Usage and Waste				

20.6.1 Primary and Tertiary Mitigation

All mitigation described in the following sections is, unless stated otherwise, considered to be embedded mitigation, i.e. primary or tertiary mitigation. These are measures that are assumed to be in place prior to the cable installation phase, identified during the concept design phase or as per industry best practice. Relevant primary and tertiary mitigation will be identified in specific impact assessments and will also be included in the Schedule of Mitigation (Chapter 25).

20.6.2 Installation stage

20.6.2.1 Loss of access to fishing grounds

Some fishermen will experience a temporary loss of access to traditional fishing grounds in the immediate vicinity of the cable route due to the presence of installation vessels. A detailed installation schedule is yet to be developed, however, it is anticipated there will be four separate installation campaigns in UK waters and cable installation will occur in approximately 150 km sections. Campaigns will be separated by periods of several months and, as a worst case, it is assumed that cable installation activity could be conducted at any time of year, apart from the HDD drilling operations, which will occur between September-March, and the cable laying, which will be between April-September. The HVDC cables will be installed using one of the techniques described in Chapter 2 (Project Description). The cable trenches will either be infilled during the laying process or left to infill naturally, as the sediment will naturally fill back into the trench. Where trenching does not provide sufficient protection, remedial rock berms will be installed. Rock berms will also be used to protect the cables at subsea asset crossings where trenching is not possible. Cable laying will begin with the operation of landfall cable pulling, with the trenching vessel starting approximately seven days following the commencement of laying activities. Throughout installation there will be an indicative 500 m protection zone in place around installation spread and areas of exposed cable between the laying and cable protection. This area will be enforced by guard vessels. Surveys will identify when the cable has been adequately protected to allow the protection zone to be removed. NorthConnect is committed to ensuring all protection works (including rock placement) are completed within three months of laying, in order to open up the areas to fishermen again.

20.6.2.1.1 Mobile vessels

During installation there will be an indicative 500 m protection zone around the cable laying spread. All fishing vessels will be prohibited from operating within the protection zone in order to prevent collisions and interference between fishing vessels and cable installation vessels.

The nature of towed gear such as trawls and dredges requires that vessels operating such demersal gear will be excluded from the unprotected or unburied sections of the cable. It is estimated that such areas will be restricted to small areas of the cable route. This temporary 500 m protection zone will occur behind the cable lay vessel in area of exposed cable prior to burial. Protection zones will last for periods of up to three months per 150 km section until the cable has reached an adequate level of protection. It is expected that fishermen will be able to exploit alternative fishing grounds during the cable installation works but it is acknowledged that some disruption is inevitable. Fishing industry representatives including SFF and SWFPA will be kept informed of NorthConnect's activities. Additionally, Notices to Mariners, and notices in the Kingfisher Bulletin, will be issued in good time to advise fishermen of where and when the installation activities will be operating. Further details are provided in the Fisheries Liaison Mitigation Action Plan (FLMAP).

The sensitivity of fisheries is considered **medium** on the basis that, although some fishing activity is located within the Consenting Corridor, there are alternative fishing areas in the vicinity. The magnitude of the impact is considered **minor** as the area of protection zones where certain activities will be restricted will be short term and confined to a small area of fishing grounds. The overall level of effect is therefore **minor**, **non-significant.** This effect is **certain** to occur.

20.6.2.1.2 Static gear

The dominant gear types for vessels < 10 m are static (pots and creels). These vessels are recorded predominantly in the coastal rectangles (43E8 and 44E8), with which the Consenting Corridor intersects (Section 20.5.2.2). Fishing vessels using static gear will need to avoid the temporary protection zone during installation. Any static gear lying within the Consenting Corridor, or the 500m protection zone, would need to be removed by the fishing vessel operators immediately prior to and during the installation period. On completion of cable laying and burial, static gear can be redeployed in the area. The disruption period is therefore temporary. It is however recognised that the area of cable lay operations is important for static gear operators, especially over the summer months and, at any time, a significant amount of static gear can be deployed in the area. This means that options for relocating static gear are quite limited. Additionally, it is acknowledged that removal of static gear takes time and effort away from fishing and temporarily reduces grounds for fishing. This will predominantly impact vessels < 10 m fishing in coastal areas of the Consenting Corridor. Notices to Mariners, and notices in the Kingfisher Bulletin will be issued in good time to advise fishermen of where and when the installation activities will be operating. Further detail is provided in the FLMAP.

The sensitivity of static gear fisheries is considered **medium to high** on the basis that some of the Consenting Corridor is known to be important for static gear and that movement to alternative grounds may be difficult. Taking into account the proposed mitigation and the fact that area of protection zones where certain activities will be restricted will be short term and confined to a relatively small area of fishing grounds, the magnitude of the impact is considered **minor**. The overall level of effect is therefore **moderate**, and this therefore considered a **significant** impact under the EIA regulations**.** This impact is **certain** to occur. As this impact is considered significant, secondary mitigation measures are described in Section 20.8.

20.6.2.2 Change in Distribution of Target Species

Chapter 15 (Fish and shellfish) has been used to inform the descriptions on behaviour and sensitivity of commercial fish species in the vicinity of the Project in the following assessment.

During installation there is the potential for indirect impacts on commercial fisheries due to impacts on the distribution of fish and shellfish species as a result of installation activities. During cable installation benthic habitat may be removed or disturbed which could affect the spawning success of commercial species.

Langoustine are one of the most valuable species landed in the area of the Consenting Corridor (Section 20.5.2.1). The corridor passes through Fladen Ground, which is indicated by OSPAR as a langoustine spawning area. Langoustine spawn all year round (Coull *et al*., 1998) across extensive areas of seas around Scotland and Ireland. Although they could be adversely affected by the installation activities, it is unlikely that there will be population level effects. Additionally, langoustine are noted as having a degree of tolerance to smothering (OSPAR, 2010), so any temporary impact to the population as a result of changes in sediment concentration will be short-term and localised in nature. Indirect effects on the langoustine fishery in the area are therefore not anticipated.

In relation to other crustacean species in the Consenting Corridor, such as scallops which contribute significantly to the landings value in the area, it is considered there is limited possibility of impact as a result of installation, as the habitat loss resulting from trenching is minimal and species have the ability to move away from the impact. Once the trench has refilled, crustacean species are likely to move back into the area. Rock placement will lead to a change in habitat which can be considered long term, and this change may lead to some species seeking alternate habitat. However, this is estimated to apply to only 0.04% of the Consenting Corridor which represents an insignificant proportion of habitat available, both within the Consenting Corridor and the wider North Sea. It is therefore considered that there will be no significant impact to the commercial interest for crustacean species in the Consenting Corridor.

Haddock and monkfish are the most valuable whitefish species caught along the Consenting Corridor. The corridor is known to be a nursery area for both species (Coull *et al*., 1998 and Ellis, 2012). The fish and shellfish impact assessment (Chapter 15) reported that no significant impact would occur to these species during any stage of the Project. It can therefore be concluded that there will be no indirect impact to the commercial fisheries which target these species.

Herring is a notable species landed from the Consenting Corridor (Section 20.5.2.1). Herring are reported to spawn along the Consenting Corridor (Coull *et al*., 1998 and Ellis, 2012). Herring spawn on the seabed in specific habitat types and their eggs are demersal, which means they are particularly vulnerable to benthic impacts occurring as a result of installation operations. As reported in Chapter 15 (Fish and Shellfish), section 15.1.2.1.4, the Project will result in the temporary disturbance to 7.2ha of suitable herring spawning habitat due to trenching, along the 3.6 km length of suitable habitat within the Consenting Corridor identified by MMT (2017). This equates to 0.0006% of the local herring spawning ground as designated by Coull *et al*. (1998) and Ellis *et al*. (2012). This is considered a very small area in relation to the extensive spawning habitat in the wider environment. Sediment redistribution is not expected to have a significant impact on herring spawning as the impact will be locally confined and temporary. The installation activities associated with the Project are therefore not anticipated to have any significant impact on herring distribution.

The sensitivity of fisheries is considered **low** on the basis that, although some commercially targeted species occur within the Consenting Corridor, this comprises a small fraction of the spawning grounds within Scotland and recoverability is assessed as high. The magnitude of the impact is considered **minor** as the majority of effects are considered to be short and long-term effects (rock placement) will impact a very small area. Variation will be within the range of experience for the fishery. The overall level of effect is therefore **minor** and **non-significant**. This impact is **certain** to occur.

20.6.3 Operation and Maintenance

20.6.3.1 Loss of access to fishing grounds

The cables will be trenched, and the trenches allowed to backfill for the majority of the route. The designed protection levels and associated trench depths have taken demersal fishing gear into consideration and trenching will occur to a depth which will not be penetrated by fishing gear. At existing subsea asset crossings, and in areas where adequate cable protection is not provided by trenching, the cables will be protected by rock berms. All rock berms will be designed to have a smooth over trawlable profile, with the rock grade utilised suitable for the nature of fishing activity typically undertaken in the area. As such, mobile fishing vessels will not be excluded from the Consenting Corridor during the operational phase. Static gear such as pots are also not anticipated to be affected during the operational phase, since the cable protection design accounts for the placement of static gear over the cable. There is therefore not considered to be a significant impact to commercial fishing vessels through loss of access to fishing grounds as a result of the operation of the cable.

There will be periods of repair and maintenance during the operational life of the cable. These will cause disruption similar to that experienced during the installation phase, however, on a smaller scale and for a shorter duration, it is predicted that a repair may be required once every three years which over the 40-year lifespan of the cable would equate to approximately 13 repair events.

Surveys of the cable will be conducted during the lifetime of the cable, and protection zones will be required around the survey spread which may disrupt fishing activities. Approximately two years after completion of installation and every fifth year, a survey of the entire route shall be carried out. Certain critical areas will be inspected approximately every 12 months. Protection zones for survey operations will be short in duration, and transient, so will not have a significant effect on fishing activities.

Prior to conducting survey or maintenance operations, NorthConnect will issue Notice to Mariners, notices in the Kingfisher bulletin and liaise with fishing industry representative bodies, or directly with fishermen. This will ensure the commercial fishing fleets are aware of any possible disruption, and allow any necessary arrangements to be made.

The sensitivity of fisheries is considered **low** on the basis that, although some fishing activity is located within the consenting corridor, most effort is outside the area. The magnitude of the impact is considered **minor** as the area of protection zones where certain activities will be restricted will be short term, localised, and transient. Fishermen will have the ability to utilise the wider environment for fishing. The overall level of effect is therefore **minor** and **non-significant**. This impact is **certain** to occur.

20.6.3.2 Change in Distribution of Target Species

There will be minimal disturbance to fish species during operation of the cable. Repairs and maintenance will occur as described in Section 20.6.3.1. These events will be short in duration and impact a very limited area. It is not anticipated there will be any impact to fish or shellfish as a result of these repair activities and therefore no indirect impacts on commercial fishing in the vicinity of the Consenting Corridor.

When operational, the HVDC will emit a magnetic field. An assessment of the EMFs created by the project is provided in Chapter 18 (EMF and Sediment Heating) and the impacts of this EMF on fish species is considered in Chapter 15 (Fish and Shellfish). Either no change or negligible impacts are predicted for all species groups found in the vicinity of the Consenting Corridor, including species of commercial value. Additionally, no significant impact is predicted to spawning or nursery areas in the Consenting Corridor as a result of EMF. It is therefore considered there will be no indirect impact on commercial fisheries in the area as a result of EMF.

The sensitivity of fisheries is considered **low** on the basis that although some commercially targeted species occur within the cable route this comprises a small fraction of the spawning grounds within Scotland and recoverability is assessed as high. The magnitude of the impact is considered **negligible** as effects will be intermittent, short term and limited in duration with no change or an imperceptible change to the baseline fishing areas and their condition. Variation will be within the range of experience for the fishery. The overall level of effect is therefore **minor** and **non-significant**. This impact is **certain** to occur.

20.6.3.3 Exposed Cable and Degradation of Rock Berms

If any section of cable was to become exposed during the operational phase, this could present a snagging risk to fishing vessels. This could cause a significant hazard to fishing vessels and, in turn, a loss of earnings to fishermen as a result of lost or damaged gear. The likelihood of this occurring is considered very low. However, the sensitivity of fishermen to this and other snagging hazards is recognised. The safety aspect of this impact is considered in Chapter 19 (Navigation and Shipping).

A further potential impact would be that external cable protection measures (rock berms) become eroded or degraded causing them not to be over trawlable by fishermen. If a rock berm degrades to the point where it is no long over trawlable, it could present a snagging risk to demersal trawlers and inshore creel vessels. This could result in loss of earnings, expenses due to the loss of, or damage to gear, and displacement from the area.

The Construction Method Statement (CMS) (NorthConnect, 2018) has been produced which details the cable protection requirements. Following the installation of the cables, as built survey information will be provided to the UKHO for inclusion in admiralty charts, and the Kingfisher Cable awareness charts will be updated to advise fishermen on their location. Post installation inspection surveys and any necessary maintenance will be conducted along the length of the cable on a regular basis, which will ensure cables remain buried and protected, and rock berms remain over trawlable.

The sensitivity of commercial fisheries to a snagging incident is considered **medium to high**, as the Consenting Corridor is known for importance for dredging and demersal trawls which are at risk from snagging incidents. The **likelihood of the impact is considered low** due to the relevant mitigation measures and regular surveys which will ensure the seabed is in an over trawlable condition. The magnitude of the impact is considered **negligible** as, if a snagging incident did occur, it would not cause long term effects to commercial fisheries in the area of the Consenting Corridor, although the financial implications from time lost due to replacement of fishing gear is recognised. Variation will be within the range of experience for the fishery. The overall level of effect is therefore **minor**, **non-significant.**

20.6.4 Decommissioning

The exact methodology for decommissioning will not be known until closer to the end of the cable lifespan.

Impacts during the decommissioning phase associated with the removal of the cable are expected to be of a similar or lesser magnitude than for cable installation. On a precautionary basis for the following decommissioning phase impacts, the magnitude of impact is assessed to be the same as for the installation phase:

- Loss of habitat; and
- Displacement from fishing areas.

No other impacts are anticipated during decommissioning.

20.7 Mitigation Measures

The only aspect of the NorthConnect Interconnector project identified as having the potential to cause a significant impact on the commercial fishing fleets is the displacement of inshore creel fishing vessels and gear during the installation phase.

In order to mitigate this risk, NorthConnect along with their FLO will work with local fishing organisations to identify all vessels which will be affected. NorthConnect will then work directly with the vessel owners and operators on an individual basis well in advance of operations commencing, in order to make arrangements to ensure all gear is removed from a protection zone within a required time period prior to work commencing. Ensuring early communications with the fishing owners and operators will allow all parties to plan and prepare for the potential disruption, and thus allowing impacts to be minimised. During installation, the FLO will maintain a dialogue with the affected fishing vessels in order to keep them up to date with progress, and allowing them to renter the protection zone as soon as it is safe to do so.

20.8 Residual Effects

For the majority of impacts assessed, the primary and tertiary mitigation applied means that no significant impact is predicted and therefore there is no requirement for any further (secondary) mitigation. However, as discussed in Section 20.6.2.1, there is predicted to be a significant impact to static gear operators as a result of loss of access to fishing grounds as a result of installation activities. For this reason, secondary impact specific mitigation is required. It is proposed that NorthConnect with their FLO will consult with individual static gear operators who will be impacted. They will ensure that these operators are fully aware of the Project including timescales, operations and protection zones. The sensitivity of static gear fisheries is considered **medium to high** on the basis that some of the Consenting Corridor is known to be important for static gear and that movement to alternative grounds may be difficult. Taking into account the proposed primary and tertiary mitigation, in addition to the secondary impact specific mitigation and, considering areas of protection zones during installation will be short term and confined to a relatively small area of fishing grounds, the magnitude of the impact is considered **negligible**. The overall level of effect is therefore reduced to **minor, non-significant.** This impact is **certain** to occur.

20.9 Cumulative Effects

The consideration of potential cumulative impacts is an important stage in the impact assessment process, as combined incremental impacts may pose a threat to sensitive receptors. The fish species in the area of the Consenting Corridor which are targeted commercially are largely mobile species and/or occur widely throughout the region. Cumulative impacts impacting commercial fish species and directly on the fishing fleets may arise from impacts originating from the installation, operation or decommissioning of the project as assessed in Sections 20.6, with impacts from other planned or consented projects upon the same receptor populations.

A list of cumulative projects requiring assessment within the EIAR has been agreed with Marine Scotland and further detail is provided in Chapter 6: Cumulative Effects. The potential for cumulative impacts is considered in relation to these projects in Table 20.14.

Table 20.14. Potential for Cumulative Impacts.

Project	Potential for cumulative impacts			Rationale
	Project Phase			
	I	O and M	D	
Moray East/West Offshore Windfarm Development **Seagreen Alpha and Bravo Windfarms** **Inch cape offshore windfarm** **Neartna Gaoithe offshore Windfarm** **Beatrice offshore windfarm** **Kincardine Offshore Windfarm**	✓	×	×	It is possible that installation activities associated with the Project and any of the offshore wind projects listed, may have a schedule overlap for installation activities. This could lead to fishermen in the region being excluded from more than one area at the same time. However, given the wide geographic range of these projects it is likely that not all fishing vessels will face exclusion from all of the projects, with some exclusion areas being out with the range fished by certain vessels. Additionally, given the short-term duration and rolling nature of protection zones associated with the installation of the Project and the likelihood that any overlap with the installation phase of any of the mentioned projects will be minimal if at all, it is not anticipated that there is the potential for a significant cumulative impact. Any impact to commercial fisheries as a result of the operation and maintenance of the Project was concluded to be insignificant. It is expected that any impact to commercial fisheries as a result of the offshore windfarm projects listed will be as a result of repair and maintenance activity causing temporary exclusion and possibly EMF impacting on fish species. Given the minimal nature of NorthConnect's impacts, the likelihood that maintenance work will not occur at the same time, and taking into account that the EMF from the project will have negligible impact on commercial fish species, it is considered there will be no cumulative impact. Decommissioning is anticipated to have the same or lesser impact than installation activities. No cumulative impact predicted.
European offshore wind development centre EOWDC, Aberdeen Bay	×	×	×	This project is currently being constructed and therefore no installation overlap is predicted. Any impact to commercial fisheries as a result of the operation and maintenance of the Project was concluded to be insignificant. It is expected that any impact to commercial fisheries as a result of the offshore windfarm projects listed will be as a result of repair and maintenance activity causing temporary exclusion and possibly EMF impacting on fish species. Given the minimal nature of NorthConnect's impacts, the likelihood that maintenance work will not occur at the same time, and taking into account that the EMF

				from the project will have negligible impact on commercial fish species, it is considered there will be no cumulative impact. Decommissioning is anticipated to have the same or lesser impact than installation activities. No cumulative impact predicted.
Hywind Scotland pilot park offshore wind farm	×	×	×	This project is currently operational so has been considered as part of the baseline against which the project has been assessed.
Aberdeen harbour dredge and harbour extension project	×	×	×	This project is currently being constructed and therefore no installation overlap is predicted. Impacts are not predicted as a result of the operation of the harbour extension and the NorthConnect installation activities. Given the localised coastal nature of the Aberdeen harbour project, it is not considered there will be any cumulative impacts as a result of the NorthConnect operation and maintenance activities and its own. Decommissioning is anticipated to have the same or lesser impact than installation activities. No cumulative impact predicted.
Peterhead port authority Harbour masterplan	×	×	×	The Peterhead Harbour Masterplan is limited in geographical context to within the existing breakwaters and existing harbours of Peterhead Port. The masterplan serves to assist in the development of current fishing markets, renewables and decommissioning sectors. Installation activities are currently underway and will be completed prior to installation of the Project, therefore, there is no chance of cumulative impact as a result of installation activities occurring simultaneously Once in place the plan and associated harbour improvements will serve to be beneficial to local fishing fleets. The operation and maintenance of the Project will not impact on this and liaison with Peterhead Port authority will ensure that any possible disruption during installation as a result of increased vessel activity is kept to a minimum and local fishing fleets are kept informed of activities. Decommissioning is anticipated to have the same or lesser impact than installation activities. No cumulative impact predicted.
North Sea Network Link Interconnector cable	✓	×	×	Installation of the North Sea Network Link Interconnector is underway with commissioning expected in 2021. It is therefore possible there will be an overlap with the installation phase of the Project however this is anticipated to be minimal. This could lead to fishermen in the region being excluded from both areas at the same time. However, given the wide geographic range of these projects it is likely that not all fishing vessels will rely on both of these areas and will therefore not be simultaneously impacted by the exclusion from two areas. Additionally, given the short-term duration and rolling nature of protection zones associated with the NorthConnect installation, and the likelihood that any overlap with the installation phases of interconnector projects, will be minimal if at all, it is not anticipated that there is the potential for a significant cumulative impact.

				Any impact to commercial fisheries as a result of the operation and maintenance of the Project was concluded to be insignificant. It is expected that any impact to commercial fisheries as a result of the Interconnector project will be as a result of repair and maintenance activity causing temporary exclusion and possibly EMF impacting on fish species. Given the minimal nature of NorthConnect's impacts, the likelihood that maintenance will not occur at the same time, taking into account that the EMF from the Project will have negligible impact on commercial fish species, it is considered there will be no cumulative impact. Decommissioning is anticipated to have the same or lesser impact than installation activities. No cumulative impact predicted.
NorthConnect HVDC subsea cable (from UK median line-start of Norwegian fjord)	✓	×	×	It is anticipated that the installation of the NorthConnect HVDC cables in Norwegian waters will have similar effects to those predicted in Scottish waters, given that installation will occur utilising similar methodologies and equipment. Similar impacts are also anticipated in Norwegian water during the operational and maintenance phase. During installation there is the potential for UK vessels which fish in both UK and Norwegian waters to be excluded from fishing grounds in both areas simultaneously. However, if this did occur it would be for a limited duration of time during cable lay installation. It is therefore considered that if the same mitigation and management is applied which will include rolling protection zones, notices to mariners, and FLO's there is no likelihood of a significant cumulative impact at any Project stage.

20.10 Summary

The area surrounding the Consenting Corridor is important for the < 10 m and > 10 m fishing fleets. Shellfish species dominate landings by all vessel sizes with Langoustine being the most valuable species landed in all three of the ICES rectangles which intersect the Consenting Corridor. Demersal trawlers over 15 m in length, which target langoustine, operate along the Consenting Corridor although peak effort is greatest in the eastern section of the cable route in rectangle 45F0 approximately 40 NM from the UK-Norway median line. Value of landings for vessels over 15 m using demersal gear is greatest in ICES rectangle 45F0. Whitefish and pelagic species are also targeted along the cable route, collectively comprising less than 10 % of the average value of fish landed in ICES rectangles 44E4, 45E3 and 45E4 from 2012-2016.

Fishing activity will be displaced during the installation activities, which will most likely take place between April and October. Due to the localised nature and short duration of activities, no significant impact is anticipated on vessels using mobile gear. Fishing will be able to resume in the Consenting Corridor when it becomes operational. Changes in the distribution of commercially important species is not anticipated therefore commercial fisheries are not anticipated to be indirectly affected by effects on fish species.

The only potential significant effect identified during this assessment is the displacement of inshore creel fishermen during the installation phase. However, appropriate mitigation has been identified which reduces the impact to non-significant. Therefore, this assessment finds that no residual significant adverse impacts on commercial fisheries are anticipated as a result of the installation, operation and decommissioning of the NorthConnect HVDC cables. Mitigation measures will be adopted to ensure that fishermen are aware of the location of the cable and the timing and duration of all installation and maintenance operations. Additionally, it will be ensured that the cable is left in a condition which minimises potential impacts to commercial fisheries and periodic surveys will confirm that this remains the case. A summary of the predicted impacts and associated significance and mitigation is presented in Table 20.15.

Table 20.15. Summary of predicted impacts for commercial fisheries in the vicinity of the Project.

Impact	Receptor	Phase	Frequency Likelihood	Severity of Consequence	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of residual Effect
Loss of access to fishing ground	Mobile gear operators	Installation	Certain	Minor	Non-significant	Cable protection works to be completed within three months of cable laying. Fisheries Liaison Officer (FLO) will be employed to facilitate communications between the project and the fishing sector. Guard vessels will be used to monitor and advise vessels in the vicinity of the installation works as appropriate. Circulation of information via Notices to Mariners, Radio Navigational Warnings, NAVTEX, and/or broadcast warnings in advance of and during the offshore works. Early communications with the fishing sector, to allow preparations to be made for the potential disruption. Ongoing dialogue to update on progress and when re-entry to protection zone for fishing activities is possible.	Non-significant impact following primary and tertiary mitigation so residual impact remains non-significant.	Non-significant
	Static gear operators	Installation	Certain	Moderate	Significant	As per mobile gear mitigation above. Fisheries Liaison Officer will work with local fishing organisations to identify static gear vessels that will be affected. Arrangements will be made with individual vessel owners.	Negligible	Non-significant

Impact	Receptor	Phase	Frequency Likelihood	Severity of Consequence	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of residual Effect
Change in distribution of target species	Commercial fish species	Installation	Certain	Minor	Non-significant	No specific mitigation as impact non-significant.	Non-significant impact following primary and tertiary mitigation so residual impact remains non-significant.	Non-significant
		Operations and maintenance	Possible	Negligible	Non-signficant	No specific mitigation as impact non-significant.	Non-significant impact following primary and tertiary mitigation so residual impact remains non-significant.	Non-significant
Snagging risk – damage to fishing gear	Mobile gear operators	Operation	Low likelihood	Minor	Non-significant	Rock berm and mattresses will be designed to have a smooth over trawlable profile, utilising appropriate rock grades. Cable to be installed with appropriate protection as per the Construction Method Statement. Routine surveys will be carried out to verify that the cable protection status is adequate. As built information will be provided to the UKHO for inclusion in admiralty charts, and the Kingfisher Cable awareness charts, with appropriate notes.	Non-significant impact following primary and tertiary mitigation so residual impact remains non-significant.	Non-significant

20.11 References

NorthConnect, 2018. HVDC Cable Infrastructure – UK Construction Method Statement, NCGEB-NCT-X-RA-0002

IEEM, 2010. Guidelines for Ecological Impact Assessment in Britain and Ireland. Marine and Coastal. August 2010. Final Version 5. Available online at https://www.cieem.net/data/files/Resource_Library/Technical_Guidance_Series/EcIA_Guidelines/Final_EcIA_Marine_01_Dec_2010.pdf [Accessed 28/03/2018].

IEMA, 2016. Environmental Impact Assessment Guide to: Delivering Quality Development. Available online at https://www.iema.net/assets/newbuild/documents/Delivering%20Quality%20Development.pdf [Accessed 28/03/2018].

MMO, 2018. VMS data

Scottish Government, 2017. Scottish Sea Fisheries Statistics 2016 available online at http://www.gov.scot/Resource/0052/00524991.pdf [Accessed 07/02/2018]

Scottish Government, 2018. Salmon and Sea Trout Fishery Statistics available online at http://www.gov.scot/Topics/marine/Publications/stats/SalmonSeaTroutCatches/Data [Accessed 08/01/2017]

SNH, 2018. Environmental Impact Assessment Handbook. Guidance for competent authorities, consultation bodies, and others involved in the Environmental Impact Assessment process in Scotland. 5th Edition. Available online at https://www.nature.scot/sites/default/files/2018-05/Publication%202018%20-%20Environmental%20Impact%20Assessment%20Handbook%20V5.pdf [Accessed 05/06/2018].

Chapter 21: Local Community and Economy

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21.1 Introduction

This chapter describes the baseline of the socioeconomic conditions, identifies potential impacts, and assesses the significance of effects which may arise from the construction, and operation of the NorthConnect HVDC Cable Infrastructure. Where required, mitigation measures to avoid, reduce or offset potential adverse effects or further enhance potential beneficial effects are identified.

It is noted that the decommissioning phase was scoped out of the assessment, in agreement with Marine Scotland, as detailed in Chapter 3: Methodology.

21.2 Sources of Information

This assessment has been undertaken based on standard EIA guidance and practices. The primary resources for the data within this chapter are the Scottish Neighbourhood Statistics (Scottish Goverment, 2018) and National Records of Scotland Scottish Government' (Scottish Goverment, 2018) websites, along with Aberdeenshire Council population statistics (Aberdeenshire Council, 2016a) and Marine Management Organisation fishery statistics.

Relevant policy and guidance includes:

- GEN 2 Economic benefits: Sustainable development and use which provides economic benefit to Scottish communities is encouraged when consistent with the objectives and policies of this Plan;
- GEN 3 Social benefits: Sustainable development and use which provides social benefits is encouraged when consistent with the objectives and policies of this (Scottish Goverment, 2015);
- Aberdeenshire Economic Development Strategy (Aberdeenshire Council, 2012); and
- Aberdeenshire Local Development Plan Supplementary Guidance 3 – Energetica (Aberdeenshire Council, 2017).

21.3 Regulatory Framework

The regulatory framework relevant to access which has informed this document is The Land Reform (Scotland) Act 2016 (as amended), and associated Scottish Outdoor Access Code, which provides a practical guide to access users.

21.4 Assessment Methodology

21.4.1 Valuation of Receptor

Standard EIA methodology has been applied in terms of assessing the value of receptors, the magnitude of any potential impact and the resulting significance of effect. Terminology and approach has followed the process as set out within Chapter 3: Methodology. Table 21.1 shows the criteria applied within this chapter to determine the value of receptors.

Table 21.1 Definitions of the receptor values.

Value	Definition
International	International effects.
National	Effects on Scotland or Great Britain (GB)
Regional	Effects on the Aberdeenshire region.
High Local	Effects on the Buchan area.
Moderate Local	Effects on neighbouring villages e.g. Boddam, Longhaven.
Low Local	Effects in the immediate vicinity and on rural residences.

21.4.2 Magnitude of Impact

Table 21. provides definitions with regard to the magnitude of impacts for socioeconomic receptors. Note those associated with employment, marked with an asterisk(*), will be taken to be the effect level and hence Tables 21.1 and 21.3 do not apply to them.

Table 21.2 Definition of the magnitude of impacts used in the assessment

Magnitude of Impact	Definition
High	A permanent or long-term measurable effect on the economy. A short-term large effect on the economy. Permanent substantial increase/decrease in recreational facilities. Permanent large effect on the community. *A permanent increase/decrease in employment by ≥20 Full Time (FTE). *A short term increase/decrease in employment by ≥150 FTE.
Medium	A permanent or long-term effect on the economy. A short-term moderate effect on the economy. Permanent increase/decrease in recreational facilities. Permanent effect on the community. Short term large effect on the community. *A permanent increase/decrease in employment by >5 FTE. *A short-term increase/decrease in employment by ≥ 50 FTE.
Low	A short term low effect on the economy. Short-term increase/decrease in recreational facilities. Short-term effect on the community. *A permanent increase/decrease in employment by 1-5 FTE. *A short-term increase/decrease in employment by ≥ 5 FTE.
Negligible	A short-term but reversible effect on socioeconomics, that is within standard levels of variation.

21.4.3 Assessment of Effects

The value of receptor and magnitude of impact are combined to determine the significance of the effect using a matrix, as shown in Table 21.2.

Table 21.2 Matrix used to determine significance of effects

Magnitude of Impact	Value				
	International	National	Regional	Moderate Local/ High Local	Low Local
High	Major	Major	Moderate	Moderate	Minor/ Negligible
Medium	Major	Moderate	Moderate	Minor	Minor / Negligible
Low	Moderate	Minor	Minor	Minor	Minor / Negligible
Negligible	Minor	Negligible	Negligible	Negligible	Negligible

Key

	Significant Effect
	Non-Significant Effect

In order to assess the significance of the potential effects derived from the proposed development, professional judgement has been applied. Effects considered to be moderate and major must be regarded as significant and, therefore, further attention and specific mitigation measures are to be applied to ensure appropriate minimisation of the significance.

21.5 Baseline Information

21.5.1 Socio-Economics

The population of Aberdeenshire in 2017 was 261,800, an increase of 2% from 2013, which represents 4.8% of the Scottish population when compared to the 2017 Mid-Year Population Estimates for Scotland (National Statistics, 2018). It is projected that by 2037 the population will be 299,000, an increase of 12.3% (National Statistics, 2018). The median age for Aberdeenshire is 42, although a higher proportion of people aged 0-17 and 36-68 live in Aberdeenshire. Aberdeenshire holds a significantly lower population aged 18-35 compared to the Scottish average (Aberdeenshire Council, 2016a).

The employment levels in Scotland in 2017 were 74.3%, while in Aberdeenshire they were 78.6%, the fourth highest rate in the country (Scottish Government, 2017. When analysed by gender, Aberdeenshire has the highest male employment rate at 82.3% (the overall level for Scotland is 74.3%), whereas the area was not in the top three for female employment rates, with a level of 72.3%, but still higher than the Scottish average of 66.5%. By the end of 2017, the unemployment rate in Buchan was 0.9%, compared to a Scottish rate of 2.8% (Aberdeenshire Council, 2016a).

Table 21.3 21.4 provides an overview of the basic socioeconomic baseline for the Aberdeenshire Local Authority (Aberdeenshire Council, 2016a).

Table 21.3: Statistical Overview of the Aberdeenshire Area Demography in 2013

Socioeconomic parameter	**Value**	
	Aberdeenshire*	**Scotland**
Total population	257,740	5,327,700
Percentage of population between 0-15 year of age	18.7%	17.1%
Percentage of population between 16-59 year of age	57.7%	59.1%
Percentage of population between 60-+75 year of age	23.6%	23.8%

*not including Aberdeen City

The settlement of Boddam is the closest to the proposed development. Its population by 2016 was 1,270 people. Peterhead is the nearest major town with a population of 19,270 (Aberdeenshire Council, 2016b). Peterhead relies heavily on fishing and the oil and gas sector for local employment, while the harbour facilities are also now starting to provide support to the rapidly expanding renewable energy industry. Peterhead has been identified as a potential location for development to support renewables within Scotland, building on its experience in supporting the oil and gas industry of the North Sea.

As discussed in Chapter 2: Project Description, Section 2.3: Needs Case, the Scottish Government has set a challenging target to reduce carbon emissions. To facilitate the increase in renewables into the energy mix to meet the targets, it is anticipated that a total investment of £46 billion is required in both electricity generation and the transmission network (Scottish Government, 2011).

In 2016, UK vessels landed 701 thousand tonnes of sea fish (including shellfish) into the UK and abroad with a value of £936 million. This represents a 1 per cent decrease in quantity, but a 21 per cent increase in value, compared with 2015. Landings by Scottish vessels were well over 400 thousand tonnes in each of the last three years, a result of increased mackerel landings. In 2016, the Scottish fleet's share of total landings was 65 per cent, compared with 29 per cent for the English fleet. Peterhead remained the port with the highest landings – 145.4 thousand tonnes with a value of £157.6 million (Marine Management Organisation, 2017).

The largest education facility in the region (and in Scotland, in terms of area, at 22,920m^2) is the Peterhead Academy, run by Aberdeenshire Council, and catering for around 1,400 students from 11 to 18 years of age (Personal Communications, 2018).

Longhaven is the closest residential community to the HVDC cable corridor, approximately 16km south of Peterhead with no more than 10 residential properties and a local shop. The residential community previously sustained a school (Longhaven School) which is currently closed.

At a local level, Boddam is one of the larger communities close to the HVDC cable corridor, and is just under 5km south of Peterhead. As with Peterhead, Boddam grew during the 18th century due to the local fishing industry, however, in the 1800s, the local fleet outgrew the harbour and many vessels moved to use the expanding Peterhead harbour instead. Quarrying was also an important local industry, with 'Peterhead granite' being exported both around the UK and overseas. The town was also the location of a former RAF base, and a railway branch, both now closed, although the RAF Buchan Ness radar station still maintains a small operations staff of around 30 people made up of military and civilian personnel.

In the present day, Boddam is a commuter settlement for workers in Aberdeen or Peterhead, with some inshore fishing still based here, primarily fishing for crab, lobster and mackerel.

21.5.2 Recreation

21.5.2.1 Paths

The rights of way within the vicinity of the onshore HVDC cable corridor are shown in Figure 21.1. As shown, there is a right of way immediately to the west of Fourfields and part of the cable corridor; this route has been in use since the 17th Century.

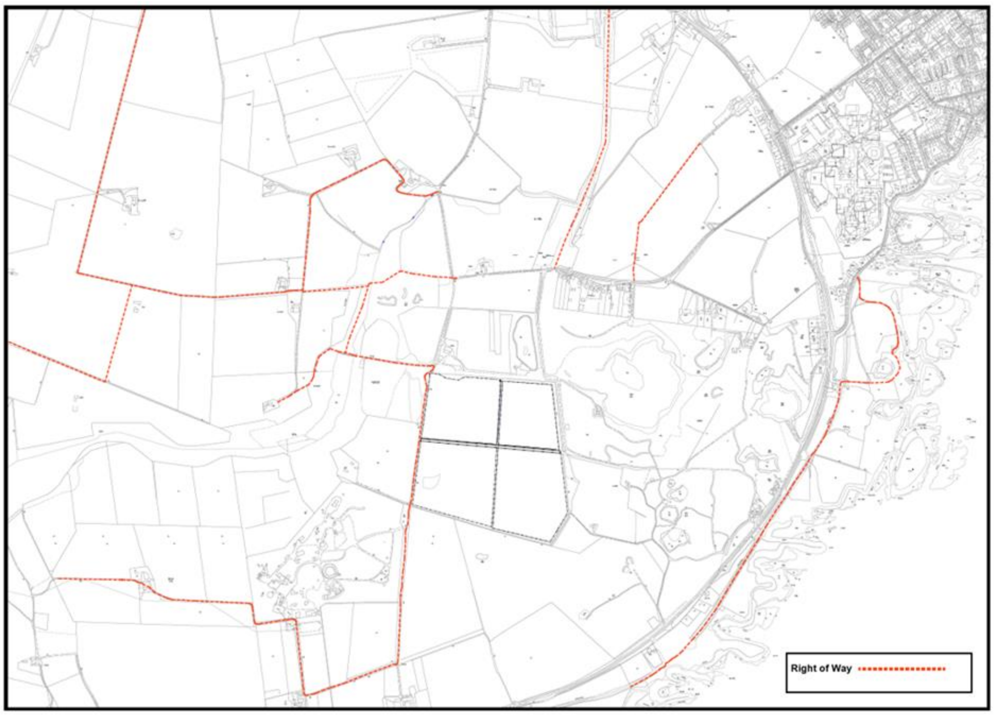

Figure 21.1 Rights of Way in the Vicinity of the HVDC

In addition to the rights of way, there are core paths around the east, west and south sides of the Fourfields site and along the cliff top at Long Haven Bay, as shown in Figure 21.2.

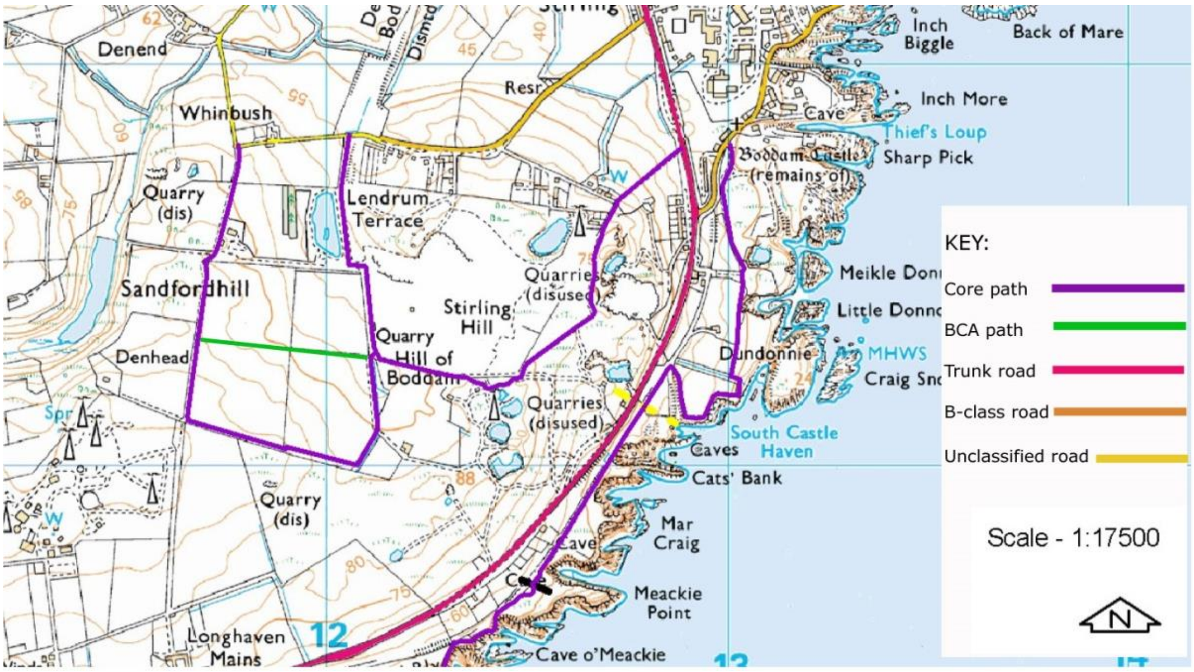

Figure 21.2 Core Paths (after Aberdeenshire Council, 2014)

The Boddam & District Community Association completed construction of an additional path in 2012, bisecting the Fourfields site west to east (as shown in green on Figure 21.2). The area around Fourfields is utilised for recreational purposes, primarily walking/jogging and exercising dogs. The NorthConnect Converter Station plans include the realignment of the path which bisects Fourfields around the converter station, and the addition of new paths in the north east field as shown in Drawing 3022. The new paths will not be available until the Converter Station construction is suitably advanced.

The coastal path in this area is part of the network of Core Paths in Aberdeenshire and links Whinnyfold just south of Cruden Bay with Boddam, Peterhead and further north to Rattray Head. The terrain is rough coast path, muddy in places with unprotected cliff edges. The section at Long Haven Bay runs through the Long Haven Scottish Wildlife Trust reserve. The Trust provides parking for a small number of cars at Longhaven on the A90, which gives easy access to the coastal path.

21.5.2.2 Tourism

The nearest hotels and Bed & Breakfasts are in Boddam, however, the area is not known as a tourist destination. Most visitors to the area are there for business purposes.

21.5.2.3 Climbing Crags

There are a number of climbing crags along this section of the North East coast, with one particularly close (c.120m) to the landing point at Long Haven Bay, called Hare Craig. It is a concave off-vertical wall of granite, bird free and south east facing, which are positives from a climber's perspective. The deep pool at the base may make it less attractive to novice climbers. The records accessible from www.ukclimbing.com do not show any recently logged ascents at this site (UK Climbing, 2018).

21.5.2.4 Sub-aqua diving

Aberdeen Divers, a small collective of recreational cold-water divers based on the north east coast use Boddam harbour as a base for diving in this area, as well as the Den Dam inland near the Fourfields site. However, they do not tend to venture as far south as the Long Haven Bay area and usually concentrate dives around the Buchan Ness lighthouse at Boddam, although a small number dive on a wreck to the north of Long Haven Bay directly from boats (Personal Communications, 2018). This recreational activity is therefore not considered further.

21.5.2.5 Recreational vessels

This activity is assessed within Chapter 19: Navigation and Shipping, Section: 19.4.6 Recreational Activity. Density of recreational vessels was found to be highest in coastal waters off Peterhead, with fewer crossings of the cable corridor farther offshore. The consenting corridor is outside of indicative areas of general recreational boating identified by the RYA, which mainly relate to club training and racing areas. Peterhead harbour offers excellent shelter for recreational vessels in all weather. It is also home to a sailing club (Peterhead Sailing Club), a Sea Cadet Unit and three RYA training centres.

21.5.3 Local Residencies

The small settlement of Longhaven lies just to the south of the cable route, spread for a short distance along the A90 trunk road. The village of Boddam lies approximately 1km to the northeast of the northerly section of the HVDC cable corridor. There are a number of rural properties closer to the HVDC cable corridor: Longhaven Mains (125m from nearest corridor point); Station House (270m from nearest corridor point); Ivy Cottage (345m from nearest corridor point); and Four Winds Croft (390m from nearest corridor point). Highfield is located to the north of the cable corridor, immediately adjacent to the Fourfields site.

21.6 Impact Assessment

21.6.1 Construction

21.6.1.1 Direct Employment

During preparation and installation of the onshore HVDC cable route there will be the potential for a range of jobs to be created. It is NorthConnect's intention to encourage and support the local workforce to tender for work packages where possible and in compliance with procurement law. However, given the technical and specialist nature of some elements of the work and the high employment levels in the area, some imported labour may be required.

The estimated value of the whole project is c. £1.5billion and while a significant proportion of that value cannot be allocated in the UK (because it takes place in Norway or offshore, or due to manufacturing / supply capability of specialist equipment) a large amount of value could be added to Scotland and directly to Aberdeenshire. For example, the full UK enabling works package value is c. £40m. All of the activities required under this package are available through the supply chain in the UK and many are local to the area, having been directly involved in current major infrastructure projects such as the AWPR near Aberdeen. Even with the main converter station contract involving specialist supply of the large electrical components from outside of the UK, many of the lower tiers of that supply chain will involve services, materials and equipment associated with the buildings construction, building services and small electrical power which will provide opportunities for local supply.

An estimation of the potential number of workers required for both onshore and marine HVDC cable installation is provided in One-year FTE are calculated, based on workforce numbers and duration of works.

Table 21.4. This is in addition to the previously estimated 40-200 people for the previously consented Converter Station and HVAC cable route (NorthConnect Converter Station and HVAC Cable ES, Chapter 17). This will be direct labour employed by the main contractors and their 1st, 2nd or lower tier sub-contractors for the construction works. One-year FTE are calculated, based on workforce numbers and duration of works.

Table 21.4 Estimates of the Number of Workers Required

Construction task.	Estimated number of workforce required	FTE	Duration
Enabling works	8-15 people	3.75	3 months
HDD operation	10-20 people	8.33	5 months
HVDC onshore cabling	1. 25 – 30 people 2. 20 people	2.5 3.33	1. pull-in operation - 1 month 2. preparation of trenches 2 months
Guard vessels for marine HVDC cable installation	Up to 16 guard vessels required, assumes a 4-5 person crew.	40-80	Up to 12 months
Marine cable installation	100-200 UK marine & cable vessel crews. In addition, Route	300	Up to 18 months

	Clearance, Survey Work, MMO's, etc. required		
Total		**398**	

In addition to the construction work force, during the proposed construction period for onshore and offshore cable routes, there will be a requirement for non-construction personnel, for example security guards and administrative staff.

The magnitude of impact associated with construction jobs relating to this element of the project will be **high**, so the resulting beneficial effect is assessed as **major: significant**.

21.6.1.2 Indirect Employment

As well as those individuals and businesses directly employed by NorthConnect during the phases of the interconnector's development, there is also the potential for indirect benefits for local businesses. Due to the nature of the works involved in the laying of the HVDC cables, there may be the need for specialist teams to be brought into the area. Furthermore, there will be the need for members of the project management team to be present during specific periods to oversee particular activities.

These individuals will require accommodation, food and drink and other services, therefore local hotels, restaurants and entertainment venues are likely to benefit from the influx of people and additional revenue generated. As indicated in Section 21.5.2.2, levels of tourism to Boddam are relatively low, therefore these additional visitors may prove beneficial, specifically to local businesses in the area.

It is also possible that the vessels required in the cable laying process will use Peterhead Port to mobilise/demobilise, and berth when not required at sea. Again, this would have an indirect benefit for the local economy through the payment of port, berthing, bunkering and pilotage fees.

Some raw materials associated with the construction process will be sourced locally to avoid transport expenses. This is likely to include construction materials such as concrete. In addition, consumable items are likely to be procured locally.

The impact magnitude of indirect construction impacts is **low** within the Buchan, so the resulting impact is assessed as **minor/negligible: non-significant.**

21.6.1.3 Local Residents

Impacts on local residents during construction have been assessed in topic specific chapters. Chapter 6: Noise and Vibration have identified potential significant effects on a small number of local receptors during the period of construction. The impacts are not reassessed here, however, it is recognised that this element of the project as a whole could have a short-term negligible effect on amenity for a small number of local residents, giving rise to a **low** magnitude effect on a **moderate local** value receptor. The resulting impact assessed as **minor: non-significant.**

21.6.1.4 Navigation and Shipping, and Commercial Fisheries

Whilst there is the potential risk of disruption to fishing activities as well as to shipping and navigation as assessed in Chapters 19: Shipping and Navigation, and 20: Commercial Fisheries, no significant residual effects were identified. As such, with regard to the socioeconomic impacts, the effect magnitude is **low**, on a receptor of **national** value, giving rise to a **minor**: **non-significant** impact.

21.6.1.5 Recreation

NorthConnect and the construction contractor will ensure that during all phases of the Proposed Development, the requirements of both the Land Reform Act (Scotland) 2016 (as amended) and the Scottish Outdoor Access Code are met in full.

The HVDC cable is buried or ducted along the entire length of the route from the Converter Station to the exit point, some 200m offshore. Work to bury the cable at Long Haven Bay will take place away from the Coastal Path and so will cause minimal disruption to the coastal footpath users and potential climbers. As with local residents, impacts will relate to noise and sense of place, giving rise to a **low** magnitude of impact, on a receptor of **high loca**l value, so the resulting impact is assessed as **minor: non-significant.**

Work to install ducting at the entry to the Fourfields site will see one section of the core path closed temporarily with diversions in place via the bisecting path. Appropriate notification will be put in place to advise users of this activity. Subsequently, this portion of the path will have vehicular access controlled via a gate system, manned when required. The amenity value of the core paths will be reduced temporarily during the construction phase, which will give rise to a **low** magnitude of impact, on a **moderate local** value receptor, resulting in a **minor: non-significant** impact.

Offshore, recreational sailors may be required to re-route their journeys, however only by a small degree, and therefore the potential impacts are considered to be **low** magnitude on a receptor of **regional** value, resulting in a **minor: non-significant effect.**

21.6.2 Operation

21.6.2.1 Energy Market

The qualitative discussion of the benefits from NorthConnect and interconnector has been described in Chapter 2: Project Description, Section 2.3 Needs Case. One of the quantified benefits, CO_2 reduction, has also been covered in Chapter 12: Air Quality.

As energy is not a devolved policy and Regulation is applied at a GB level, most of the economic analyses referred to in this section are carried out from a GB-wide perspective, and therefore describe socio-economic impacts on the UK as a whole, including Scotland. Some exceptions to this interpretation occur when describing grid impacts, where there are features highlighted which specifically affect Scotland.

The NorthConnect project has been named on the first, second and now third European Union wide lists of Projects of Common Interest, meaning that it has been identified as one of the projects crucial to achieving the goals of Europe's 'Energy Union' initiative [Regulation (EC) No.714/2009 and amending Regulation (EU) No.347/2013]. Furthermore, in 2017 it was chosen as part of a smaller subset of the PCI projects for E-Highways 2050 status, essentially seen as a vital part of long-term plans for a European 'SuperGrid'.

In a UK context, the project has received a positive decision from the UK Regulator Ofgem on the Initial Project Assessment (IPA) stage of its suitability for 'Cap & Floor' regulation of GB interconnectors. As a result of that decision, NorthConnect KS have been granted an Operating Licence by Ofgem under the UK Electricity Act, 1989. It is noted that the Licence Conditions are still to be modified or determined by later stages of the Cap & Floor approval process, at contract close and construction completion.

The need for interconnectors is also clearly established within Scotland's national policy, falling within the category of "national development" in terms of the National Planning Framework 3. The Scottish Energy strategy published in Dec-17 referred to the project directly stating:

> *"….the NorthConnect cable [that] would enable renewable electricity to be traded directly between Scotland and Norway. Ofgem's initial assessment of this project has concluded that it is likely to benefit consumers, and that it could also improve our security of supply by providing access to a vast alternative source of renewable generation when required"* (Scottish Ministers, 2014).

In addition, the project will provide opportunity for jobs, supply chain and economic benefits to Scotland from the construction and operation of the asset itself, as well as similar secondary economic benefits from interconnection with Norway, facilitating the development of further cost-effective renewable generation in Scotland. To support this, the supply chain opportunities initiatives described above are currently being commenced in Scotland, alongside the project's procurement processes.

Many studies have been carried out with regard to the socio-economic benefit of interconnection, and the most pertinent are referenced here. As they are based on economic models looking into the future, they all differ slightly in their methodologies and assumptions, and often quote their findings in ranges of values, or across a spread of different stated scenarios.

The Project will provide a link between the electricity grids of Scotland and Norway, connecting two countries with high volumes of renewables; wind and hydro respectively, and will support the achievement of Scottish, Scandinavian and European renewable energy targets.

The socio-economic benefits of interconnection between countries derive from connecting areas of surplus generating capacity with areas of high demand (or storage capacity) at every point in time. These differences fluctuate between regions on an hourly, daily, weekly, or seasonal basis dependent upon many variables on both the supply side and the demand side. A greater proportion of renewables and the switch to low carbon over the coming decades will increase those fluctuations on the supply side (e.g. wind, wave, solar, hydro and biomass), since renewable generation tends to be heavily weather dependent. The increase fluctuations are also influenced on the demand side through changing our energy-consuming behaviours (e.g. carbon tariffs, energy efficiency, the switch to electric vehicles and micro-generation such as home solar or ground source heat pumps).

Interconnection helps to ensure that across Europe, despite those fluctuations in supply and demand (and hence price), any one consumer can be connected to the most cost-effective source of power at any one time, and this is where much of the economic benefit of interconnection derives from through the following mechanisms:

- At times of high renewable generation in GB, when GB power prices are relatively low, NorthConnect will export electricity towards Norway, thus enabling GB generators to earn higher revenues;
- Conversely, at times of low renewable generation in GB, NorthConnect will facilitate a benefit from the storage capacity present in the Norwegian power system by importing hydro power to GB; and
- Both of these mechanisms benefit GB consumers by reducing the average wholesale electricity price and by stabilizing the price pattern.

NorthConnect will also bring additional security of supply benefit in being able help stabilise the grid in Scotland and also by helping to relieve grid constraints (which result in very high costs to consumers) at the border between Scotland and England. The fast reacting Voltage Sourced Converter (VSC) modern design, coupled with Pelton Wheel hydro plants in the Norwegian system enables the interconnector to be used in such a way to support the Scottish grid for system frequency and voltage control, as well as reactive power and inertia services. It can also be used to re-start the grid in Scotland in a very short space of time following a 'Black-Out' scenario.

The Department of Energy & Climate Change (now Business, Energy & Industrial Strategy) in their report on the economics of interconnectors (Redpoint-Baringa, 2013), quantified the saving from all UK interconnection at between £800 million and £1.3 billion per annum.

In January this year, the NorthConnect project received the Cap & Floor IPA decision from the UK Regulator Ofgem. Ofgem assessed the needs case for the project on behalf of GB electricity consumers and concluded NorthConnect had a socio-economic net present benefit over 25 years in the region of £2-3 billion in the base case scenario, with positive consumer benefit in all scenarios. A further study by National Grid, since the IPA using improved models of the Norway-Scotland system interactions specifically, revealed a possible further £1bn+ of grid savings* in the base scenario, driven by the relief of Scottish constraints costs by having NorthConnect in place. The grid savings remain positive in all scenarios over the 25-year assessment, even with the assumption of the East Coast HVDC (sometimes referred to as the Eastern Link "Bootstrap") construction between Scotland and England by 2028. This demonstrates the value of the 3-way flexibility for grid balancing between Scotland, England and Norway with NorthConnect in place.

> *[*Note: Grid savings values derived from constraints relief only. The ancillary services such as Black Start and grid stability services provided by NorthConnect will also have a positive socio-economic benefit through being able to deliver these cost-effectively to the Scottish Market at zero to negligible marginal cost (i.e. the modern design of the interconnector can inherently deliver these services with the costs already accounted for in the base case cost-benefit figures above)]*

NorthConnect will therefore have a beneficial socio-economic case in Norway and a positive impact on the Norwegian grid.

The Norwegian central grid is divided into several price areas which differ widely. In some areas there are few or no foreign connections, in others there are many. For example, in southern Norway, there are currently five interconnector cables, and there are also two under construction. NorthConnect will be associated with an area in Western Norway where it will be the first international connection. At the same time, this area has the highest power surplus, which is currently not exploited during precipitous periods because there is not enough capacity in the network, in the same way that Scotland is not able to exploit all of its wind power during very windy periods. In reverse, the region also has locked in storage capability which cannot be accessed easily from other areas of the Nordic region. Without NorthConnect, substantial investments would have to be made in network development in Norway in order to transport the power or access storage by other areas of the country which would require investment from the Norwegian consumer. This also holds true for the UK.

NorthConnect would handle this surplus power and storage capability through exchange of power with the UK. Calculations show that NorthConnect will yield NOK14 billion (£140 million) per-annum in socio-economic gains for Norway also.

The socio-economic benefits associated with electricity transmission through the interconnector at a **national** and **international** level are long-term and measurable and hence have a **high** impact value giving rise to a **positive major: significant** effect. It should however be recognised that this is the effect of the whole NorthConnect project and will only be realised if all elements of the project can be developed.

21.6.2.2 Employment

Once the project is operational, there will be minimal routine maintenance carried out on the onshore HVDC Cable, and hence no direct job opportunities expected. The operations and maintenance staff requirements are associated with the Converter Station. Additional, short-term, one-off, or specialist contractual opportunities may also arise for services at the Fourfields site, for example, cleaning, grass-cutting, landscaping, building maintenance, etc. The employment opportunities associated with the converter station were assessed as part of the Environmental Statement accompanying the planning application for that element of the works, and as such will not be reassessed here to avoid double counting (NorthConnect, 2015).

As detailed in the Post Installation Survey Plan (NorthConnect, 2018b) there will be periodic surveys of the cables completed, and potentially maintenance on the marine cables. This will require specialist vessels, equipment and personnel to carry out the operations. The work could be carried out by national or internationally based companies. The survey and maintenance will be carried out in short campaigns; hence, it is estimated that 1 FTE job would be created for the lifetime of the project giving rise to a **low** impact magnitude, and a **negligible: non-significant** effect.

21.6.2.3 Local Residents

Impacts on local residents of operations have been assessed in topic specific chapters and, as such, will not be repeated here. Once the site is operational it is expected that there will be no significant impacts on local residents. As such the potential impacts on local residents during operation are assessed as **no-change**.

21.6.2.1 Navigation and Shipping, and Commercial Fisheries

Whilst there is the potential risk of disruption to fishing activities as well as to shipping and navigation as assessed in Chapters 19: Shipping and Navigation, and 20: Commercial Fisheries, no significant residual effects were identified. As such, with regard to the socioeconomic impacts, the impact magnitude is **low**, on a receptor of **national** value, giving rise to a **minor**: **non-significant** effect.

21.6.2.2 Recreation

All existing onshore paths/climbing routes will be fully available during operations. Recreational sailing will not be affected by the operational phase.

NorthConnect and the construction contractor will ensure that during all phases of the Proposed Development, the requirements of both the Land Reform Act (Scotland) 2016 (as amended) and the Scottish Outdoor Access Code are met in full.

As such the potential impacts on recreation during operation are assessed as **no-change**.

21.7 Mitigation Measures

21.7.1 Construction

21.7.1.1 Direct and Indirect Employment

NorthConnect will take steps to maximise both direct and indirect socio-economic effects in relation to employment on the local economy. Supply chain plans have been developed to make local content an important and appropriate component of tenderers proposals for contract delivery. They include requirements for the encouragement and timely communication of local sourcing opportunities to the market, in order to maximise the projects benefits to the local economy.

NorthConnect has already initiated engagement with the local supply chain (http://northconnect.no/northconnect-meet-the-buyer-days) presenting the potential opportunities available within each of the packages of work as well as overall project requirements. Over 70 delegates attended over two days. Prior to construction works commencing, there will be a programme of further supply chain engagement, including more 'Meet the Buyer' events, to allow local companies to meet with the potential tier 1 and 2 contractors to offer their services.

NorthConnect has worked with economic development agencies and business networks locally during the project planning stage including: Energetica, Scottish Enterprise, Aberdeenshire Council, Aberdeen Renewable Energy Group, and the Aberdeen and Shire Chamber of Commerce. Through this relationship, NorthConnect has initiated a supply-chain communications exercise, with attendance at events (All Energy 2018, AGCC and AREG business networking events) as well as arranging the 'Meet the Buyer' days in Aberdeen and Peterhead noted above. Engagement activity will continue and is designed to gather details of potential suppliers, facilitate networking up and down the supply chain and inform the market of the significant potential opportunities available.

Works will be publicly tendered wherever possible to ensure fair competition and to allow local companies to compete for work.

NorthConnect is also in discussion with Scottish Government and Scottish Renewables about how to maximise the promotion of opportunities to the wider renewables supply chain in Scotland.

21.7.1.2 Local Residents

An onshore construction communications plan will be developed by NorthConnect and the Cable Contractors, to ensure that local residents are kept informed about the project. Contact details will be provided to allow any concerns or queries residents may have to be raised and dealt with in a timely manner.

21.7.1.3 Recreation

The onshore communications plan will include communications with recreational users of the area around the proposed development during construction. This will ensure that prior warning to any changes in path routes etc. is provided, or if there is a need for a short-term closure of any areas for safety reasons. Contact details will be provided on signage around the site to allow recreational users to raise concerns or queries.

NorthConnect have developed a communications strategy relating to marine users has also been developed, this will guide communications with marine stakeholders during construction and operation of the project. Further detail can be found in the NorthConnect HVDC Cable Infrastructure UK Communications Strategy NCGEN-NCT-X-FA-0001 (NorthConnect, 2018a).

21.8 Residual Effects

The mitigation identified aims to minimise negative effects and maximise positive effects in line with best practice. However, none of the mitigation is sufficient to significantly change the effect significance determined in Section 21.6.

21.9 Cumulative Effects

It should be recognised that the HVDC cable infrastructure which this EIAR focuses on cannot operate without the other project elements including: the Converter Station at Fourfields, the HVAC cable connection to the Peterhead Substation and the Norwegian elements of the project. In addition, the UK connection to the grid is currently via the planned 400kV Substation at Peterhead, which is yet to be constructed. Hence it is acknowledged that the main operational socioeconomic benefits are in effect a cumulative benefit of all the parts, no one element can bring the benefits without the others.

21.10 Summary

During construction there is a potential for short-term direct and indirect positive impacts on the local economy. However, there may be a low level of negative effects on users due to short-term impacts on the local path network and installation of the marine HVDC cables.

Once operational, the NorthConnect Interconnector project will have significant positive Socio-Economic benefits at an international level.

Table 21.6 summarises the socio-economic effects of the project, both before and after mitigation.

Table 21.6 Summary of Effects on Local Community and Economy

Nature of Impact	Receptor Value	Impact Magnitude	Significance of Effect	Mitigation Summary	Residual Impact Magnitude	Residual Significance of Effect
Construction						
Direct Employment	N/A	High Positive	Major: Significant	Procurement Policy Supply Chain Engagement	High Positive	Major: Significant
Indirect Employment	N/A	Low Positive	Minor/Negligible: Non-Significat	Procurement Policy Supply Chain Engagement	Low Positive	Minor/Negligible: Non-Significant
Local Residents	Moderate Local	Low Negative	Minor: Non-Significant	Onshore Communications Plan	Low Negative	Minor: Non-Significant
Navigation and Shipping and Commercial Fisheries	National	Low Negative	Minor: Non-Significant	Marine Communications Plan	Low Negative	Minor: Non-Significant
Recreation – Impacts on Coastal Paths and Climbers	High Local	Low Negative	Minor: Non-Significant	Onshore Communications Plan	Low Negative	Minor: Non-Significant
Recreation – Impacts on Core Paths	Moderate Local	Low Negative	Minor: Non-Significant	Onshore Communications Plan Approprate Diversions Reinstatement of Paths	Low Negative	Minor: Non-Significant
Recreation – Impacts on Recreational Sailors	Regional	Low Negative	Minor: Non-Significant	Marine Communications Plan	Low Negative	Minor: Non-Significant
Operations						
Energy Market	National/ International	High Positive	Major: Significant	No Specific Mitigation Required	High Positive	Major: Significant
Employment	N/A	Low Positive	Negligible: Non-Significant	Procurement Policy	Low Positive	Negligible: Non-Significant
Local Residents	Moderate Local	None	No-Change	No Specific Mitigation Required	None	No-Change
Navigation and Shipping and Commercial Fisheries	National	Low Negative	Minor: Non-Significant	Marine cable over-trawlable Marine Communications Plan	Low Negative	Minor: Non-Significant
Recreation – Impacts on local Paths.	High Local	None	No-Change	No Specific Mitigation Required	None	No-Change
Recreation – Impacts on Recreational Sailors	Regional	None	No-Change	No Specific Mitigation Required	None	No-Change

Key	Significant

21.11 References

Aberdeenshire Council. (2012). *Economic Development Strategy 2011 - 2016*. Retrieved from Aberdeen: https://www.aberdeenshire.gov.uk/media/11581/econdev_strategy.pdf

Aberdeenshire Council. (2016a). *Aberdeenshire Profile: Population Age Structure*. Retrieved from Unkown: https://www.aberdeenshire.gov.uk/media/21434/aberdeenshire-profile-2016.pdf

Aberdeenshire Council. (2016b). Settlements in Aberdeenshire which have a population greater than 500. In (pp. 1): Aberdeenshire Council.

Aberdeenshire Council. (2017). Supplementary Guidance - Energetica. 1-25.

Marine Management Organisation. (2017). Annual Report and Accounts 1 April 2016 to 31 March 2017. In (pp. 74). London: Stationery Office

National Statistics. (2018). *Mid-Year Population Estimates Scotland, Mid-2017*. Retrieved from Edinburgh: https://www.nrscotland.gov.uk/files//statistics/population-estimates/mid-17/mid-year-pop-est-17-publication.pdf

NorthConnect. (2015). NorthConnect Interconnecter Convertor Station and High Voltage Alternative Current Cable Route Environmental Statement. *2*.

NorthConnect. (2018a). HVDC Cable Infrastructure - UK Marine Communication Strategy.

NorthConnect. (2018b). HVDC Cable Infrastructure - UK Post Installation Survey Plan. In Jonathan Ashburner (Ed.).

Personal Communications. (2018). Facebook Discussion between Fiona Milligan and Aberdeen Divers.

Scottish Goverment. (2015). Scotland's National Marine Plan. In (pp. 144): Scottish Government.

Scottish Goverment. (2018). Scottish Neighbourhood Statistics. Retrieved from https://data.gov.uk/dataset/c4930839-8a32-4a71-b5d7-aec4a51ed1e2/scottish-neighbourhood-statistics

Scottish Government. (2011). *2020 Routemap for Renewable Energy in Scotland*. Retrieved from Edinburgh: http://www.gov.scot/Resource/Doc/917/0120033.pdf

Scottish Ministers. (2014). Scotland’s Third National Planning Framework (NPF3) SG/2014/100.

UK Climbing. (2018). Climbs at Hare Craig. In: UK Climbing,.

Chapter 22: Noise and Vibration (In-Air)

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Contents

22 Noise and Vibration (In-Air)

22.1 Introduction

Environmental, or community noise is a broad term that encompasses noise emitted from many sources, including road, rail & air traffic, industry, construction, public work and neighbourhood noise. All of these sources potentially contribute adversely to the overall noise environment. It is therefore reasonable to expect communities to be sensitive to any deterioration in their acoustic environment as a result of a proposed development.

This chapter considers the likely significant noise effects associated with the construction of the onshore elements of the HVDC Cabling. Specifically, the chapter considers the construction activities that are likely to occur between the landfall location at Long Haven Bay and the previously consented HVAC Converter Station at Fourfields. This chapter considers terrestrial noise effects only. Marine noise effects are dealt with in Chapter 23: Noise and Vibration (Underwater).

As the cable will be buried for the entire length of the onshore cable corridor, no operational noise effects are anticipated. As such, operational noise effects have been scoped out.

The Chapter also does not consider decommissioning noise effects as decommissioning noise effects have been scoped out.

Significant vibration effects from construction activities typically come about from either piling activities or blasting. No piling or blasting is proposed for this development. Localised vibration impacts may occur in the immediate vicinity of Horizontal Directional Drilling (HDD) rig locations, however, due to the separation distances between the HDD rig and any sensitive receptors, significant vibration impacts are unlikely to occur. Therefore, a quantitative assessment of vibration has not been undertaken.

The specific objectives of the chapter are to:

- Identify potential noise sensitive receptors in the vicinity of the onshore cable corridor and quantify the existing baseline sound levels at these locations;
- Calculate the likely levels of construction noise at the nearest receptors to determine the potential for significant noise effects associated with the proposed development; and
- Indicate any requirements for mitigation measures in order to provide sufficient levels of protection for nearby receptors.

As well as assessing the noise effects on human receptors, the Chapter also predicts the levels of noise likely to occur in areas with ornithological receptors, for both terrestrial and marine-dependent species. The potential impacts on ornithological receptors resulting from in-air noise emissions are considered further in Chapter 17: Ornithology.

The chapter is supported by:

- Appendix H.1: Baseline Noise Level Data;
- Appendix H.2: Construction Noise Assessment Data;
- Appendix H.3: 3D Noise Contours for Ornithological Assessment;
- Drawing NCFFS-NCT-X-XG-0009-01 (In-Air Noise assessment Study Area); and,
- Drawings NCFFS-NCT-X-XG-0010-01 through to NCFFS-NCT-X-XG-0010-12 (Noise Assessment Contour Plots)

Baseline sound level monitoring has been undertaken by Affric Limited, whilst the Noise Impact Assessment (NIA) and authoring of this chapter has been undertaken by TNEI Services Ltd (TNEI). All of the TNEI team contributing to this chapter are appropriately qualified and affiliated with the Institute of Acoustics (IOA).

22.2 Nomenclature

Please note the following terms and definitions, which are used throughout this Chapter:

- **Emission** refers to the sound level emitted from a sound source, expressed as either a sound power level or a sound pressure level;
- **Immission** refers to the sound pressure level received at a specific location from a noise source(s);
- **SWL** indicates the sound power level in decibels (dB);
- **SPL** indicates the sound pressure level in decibels (dB);
- **NSR** (Noise Sensitive Receptor) identified receptors which are sensitive to noise;
- **NML** (Noise Monitoring Location) refers to any location where baseline or specific noise levels have been measured; and
- **NAL** (Noise Assessment Location) refers to any location where the noise immission levels are calculated and assessed.

Unless otherwise stated, all noise levels refer to free field levels, i.e. noise levels without influence from any nearby reflective surfaces.

22.3 Sources of Information

22.3.1 Planning and Legislative Framework

The overarching European legislation in relation to terrestrial environmental noise is the '*Environmental Noise Directive'* (The European Parliament and the Council of the European Union, 2002) (END). The END aims to limit people's exposure to environmental noise but does not prescribe noise limits. Instead, it requires each member state to provide data on noise exposure, and to develop action plans to prevent or reduce noise exposure, and to preserve existing quiet areas. In Scotland the END is transposed and implemented within *'The Environmental Noise (Scotland) Regulations'* (Scottish Statutory Instruments, 2006).

At a national level the relevant policy documents are: Planning Advice Note (PAN) 1/2011 – *'Planning and Noise*,' (The Scottish Government, 2011); and the associated *Technical Advice Note (TAN) – 'Assessment of Noise' (*The Scottish Government, 2011).

PAN 1/2011 provides little guidance in respect of construction noise, other than recommending that the use of planning conditions is not the preferred method for controlling temporary construction noise. Specifically, the document states:

"32. While planning conditions can be used to limit noise from temporary construction sites, it is most effectively controlled through the Control of Pollution Act 1974 (COPA74) and the Pollution and Prevention Control Act 1999 for relevant installations. Notice can be served in advance of works and site conditions set to control activities."

BS5228:1997 'Noise and vibration control on construction and open sites. Code of practice for basic information and procedures for noise and vibration control' parts 1 to 5 (BSI, 1997) is the approved Code of Practice under COPA74, however, it is the 2009 version of the Standard which should be used for Environmental Impact Assessments (EIA) and planning applications. In this regards the TAN states:

"However, under Environmental Impact Assessments and for planning purposes i.e. not in regard to the Control of Pollution Act 1974, the 2009 version of BS 5228 is applicable. The 2009 version of the standard consists of Parts 1 and 2 for noise and vibration respectively."

22.3.2 Relevant Guidance

The BS5228:2009 standard provides useful guidance on practical noise control. Part 1, provides recommendations for basic methods of noise control including sections on community relations, training, occupational noise effects, neighbourhood nuisance and project supervision. The annexes provide information on noise sources, noise calculation procedures, mitigation measures and their effectiveness.

Part 1 also contains sound power level data for a variety of construction plant. This data was obtained from field measurements of actual plant operating on construction and open sites in the United Kingdom and is therefore appropriate to use as source level data for construction noise propagation calculations.

The 2009 version of BS5228 was subject to an additional update in 2014. Accordingly, the construction noise assessment in this chapter has been undertaken in accordance *with BS5228 1:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites. Noise'*, (BSI, 2009), hereafter referred to as BS5228.

22.4 Assessment Methodology

22.4.1 Study Area

Noise Sensitive Receptors (NSRs) are properties, people or fauna which are sensitive to noise and, therefore, may require protection from nearby noise sources. The Study Area has been defined through the identification of the closest NSRs to the development and after reviewing the Scoping Report and stakeholder Scoping Responses. Specifically, the study area is defined by the closest NSRs to the development on the assumption that if noise levels are within acceptable levels at the closest receptors then it is reasonable to assume they will also be acceptable at more distant locations.

Table 22.1 details the closest identified residential NSRs to the Development considered within the NIA.

Table 22.1 Nearest Identified Residential Receptors

NSR ID	Descriptor	Grid Reference
NSR01	Denside Hill of Sandford	NK 11250 41792
NSR02	Lendrum Terrace	NK 12134 41734
NSR03	Highfield	NK 11765 41585
NSR04	Denside	NK 11212 41414
NSR05	Glen Ugie	NK 12373 40673
NSR06	Four Winds Croft	NK 11319 40520
NSR07	Longhaven Mains	NK 11582 40480
NSR08	Five Acres	NK 11367 40200
NSR09	Station House	NK 11545 40150

A number of non-residential NSRs also require consideration.

It is noted that Scottish Natural Heritage (SNH) have requested that noise impacts should be assessed within the ES to consider bird species within the following areas:

- Buchan Ness to Collieston Coast Special Protection Area (SPA); and
- Bullers of Buchan Coast Site of Special Scientific Interest (SSSI).

Accordingly, this chapter reports the predicted levels likely to occur in these areas, whilst the associated noise impacts are reported within Chapter 17: Ornithology.

SNH also suggested that it may be appropriate to assess noise impacts on recreational users of the area. Accordingly, noise levels have also been considered for the following areas:

- Longhaven Nature Reserve Footpath, part of the coastal Core Path linking Whinnyfold to Boddam (see Chapter 21: :ocal Community and Economy for more information); and,
- Rock climbing routes at 'The Warlord Cliff'.

No other NSRs have been identified within the local area for consideration within the NIA.

The study area and NSRs are detailed on Drawing NCFFS-NCT-X-XG-0009-01.

22.4.2 Baseline Data Collection

Attended baseline sound level monitoring was undertaken for NorthConnect during 2014 at nine locations for both daytime and night-time periods and this data is presented in the Noise Chapter of the HVAC Converter Station Environmental Statement. Additional monitoring was undertaken by Affric Limited at two locations during 2017 to supplement the previous data, as proposed in the Scoping Report. Data from five of the original seven locations has been considered along with the two new locations, which provides an appropriate geographical spread of monitoring points for the NSRs considered within this assessment.

22.4.3 Impact Assessment Methodology

Annex E, part E.3.2 of BS5228, clearly sets criteria for assessing the significance of construction noise effects and gives examples of acceptable limits for construction noise.

Table E.1 of BS5228 (represented here as Table 22.2) contains an example of the significance criteria that can be used to assess construction activities.

Table 222.2 Example of Threshold of Potential Significant Effect at Dwellings (dB(A)).

Assessment Category and Threshold Value Period	**Threshold Value LAeq,T dB**		
	Category A(A)	**Category B(B)**	**Category C(C)**
Night-Time (23:00 – 07:00)	45	50	55
Evenings and Weekends	55	60	65
Daytime (07:00 – 19:00) and Saturdays (07:00 to 13:00)	65	70	75
(A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values; (B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values; (C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values;			

The threshold values can be considered limits for the construction noise levels (quantified using the LAeq noise metric). The limits in each category are to be used where the existing noise level at each location, rounded to the nearest 5dB, is below the level given for a particular time of day. BS5228 provides the following advice regarding the threshold limits:

"Note: 1 A potential significant effect is indicated if the LAeq,T noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level.

Note 2: If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total LAeq,T noise level for the period increases by more than 3dB due to site noise.

Note 3: Applied to residential receptors only."

Therefore, the assessment of significance of effects for construction noise reflects a specific noise threshold for the locality for a particular period of the day, rather than an absolute noise level.

22.4.3.1 Evaluation of Receptors

The TAN (1/2011) states; "*The initial process requires the identification of all noise sensitive receptors (NSR) that may potentially be affected by the development and to prioritise each NSR according to their level of sensitivity.*"

Table 2.1 of the TAN, presented here as Table 22.3, presents the levels of sensitivity associated with a variety of receptors.

Table 22.3 Level of Sensitivity Associated with NSRs.

Sensitivity	Description	Examples of NSR
High	Receptors where people or operations are particularly susceptible to noise.	• Residential, including private gardens where appropriate. • Quiet outdoor areas used for recreation • Conference facilities • Theatres/Auditoria/Studios • Schools during the daytime • Hospitals/residential care homes • Places of worship
Medium	Receptors moderately sensitive to noise, where it may cause some distraction or disturbance.	• Offices • Bars/Cafes/Restaurants where external noise may be intrusive. • Sports grounds when spectator noise is not a normal part of the event and where quiet conditions are necessary (e.g. tennis, golf, bowls)
Low	Receptors where distraction or disturbance from noise is minimal.	• Buildings not occupied during working hours • Factories and working environments with existing high noise levels • Sports grounds when spectator noise is a normal part of the event • Night Clubs

The nearest identified human NSRs are either residential receptors or "*Quiet outdoor areas used for recreation*"; therefore, this assessment assumes all receptors are of high sensitivity.

The sensitivity of different species of bird, including those that are listed in the SPA and SSSI designations, and the subsequent impact assessment, is dealt with separately in Chapter 17: Ornithology.

22.4.3.2 Magnitude of Impact

The assessment of construction noise against fixed guideline noise level limits is simply a case of pass or fail and as such cannot be used to determine the magnitude of impact.

22.4.3.3 Significance of Effect

Having due regard to the existing ambient noise levels at NSRs around the proposed development, the BS5228 threshold values for daytime, evenings and weekends (as detailed in Table 22.2) have been used for the construction noise assessment. Accordingly, any predicted levels above the relevant category threshold (A, B or C) is assessed as a significant effect, whilst predicted levels below the relevant category threshold is assessed as a non-significant effect.

22.4.4 Methodology for the Prediction of Noise

In order to predict the noise immission levels attributable to the construction of the Proposed Development, noise propagation models are produced using the propriety noise modelling software CadnaA. Within the software, complex models can be used to simulate the propagation of noise according to a range of international calculation standards.

For each Noise Assessment Location (NAL), the $L_{Aeq(12hours)}$ levels have been predicted in accordance with ISO9613-2:1996 *'Acoustics - Attenuation of sound during propagation outdoors: General method of calculation'* (International Organization for Standardization, 1996). The ISO 9613 propagation model was chosen in preference to the calculation method presented in BS5228, primarily because of some of the significant distances from source to receptor evident on this site. Specifically, BS5228 notes in F 2.2.2.2, that at distances over 300 m noise predictions using the BS5228 methodology should be treated with caution, especially where a soft ground correction factor has been applied because of the increasing importance of meteorological effects, whereas ISO 9613-2 provides equations that have been validated up to 1,000 m.

The ISO 9613 model can take account of the following factors that influence sound propagation outdoors:

- geometric divergence;
- air absorption;
- reflecting obstacles;
- screening;
- vegetation; and
- ground reflections.

The model uses the octave band sound power output of the proposed plant as its acoustic input data, and calculates on an octave band basis, attenuation due to geometric spreading, atmospheric absorption and ground effects.

For the purposes of this assessment, all noise level predictions have been undertaken using a receiver height of 1.5m above local ground level. Mixed ground (G=0.5) attenuation has been assumed at all locations except for roads and the sea, which have been modelled with a ground attenuation of G=0 (hard ground). Air absorption based on a temperature of 10°C and 70% relative humidity has been assumed.

All stationary items of plant and activities have been modelled as single point sources, however, for construction activities which will occur along a linear activity area, for example, the construction of the mains water pipes, these have been modelled as a line source. Specifically, the relevant plant has been modelled assuming the SWL is distributed along the entire length of the work area.

22.4.5 Limitations of Assessment

The noise propagation models are intended to give a good approximation of the specific noise level and the contribution of each individual source. However, it is expected that measured levels are unlikely to be matched exactly with modelled values and the following limitations in the model should be considered:

- In accordance with ISO 9613-2, all assessment locations are modelled as downwind of all noise sources and propagation calculations are based on a moderate ground-based temperature inversion, such as commonly occurs at night;
- The predicted barrier attenuation provided by local topography, embankments, walls, buildings and other structures in the intervening ground between source and receiver can only be approximated and not all barrier attenuation will have been accounted for;
- Unless specifically stated the models assume all fixed noise sources are operating continuously and simultaneously, estimating a worst-case source noise level; and
- All mobile plant (excavators, bulldozers, rollers, etc.) have been modelled as a line source along their anticipated movement paths and the sound power level of the source averaged out across the length of the entire line. This will give an approximation of the overall noise levels from mobile plant at receptor locations, however, in reality noise levels will fluctuate as construction plant and activities moves along the activity area.

22.5 Baseline Information

Baseline sound level monitoring was undertaken at multiple locations in the vicinity of the Proposed Development in 2014 in order to support the EIA for the associated HVAC Converter Station. Table 22.4 presents the noise monitoring locations (NMLs) from this survey which have been included as part of this NIA.

Table 22.4 Noise Monitoring Locations Used from Converter Station ES Noise Assessment.

Noise Monitoring Location		**Grid reference**
NML ID	**Descriptor**	
NML01	Converter site	NK 11950 41270
NML02	Highfield	NK 11730 41590
NML04	Hill of Boddam viewpoint	NK 12270 40950
NML06	Longhaven Mains	NK 11550 40480

In addition to the above, attended baseline sound level monitoring was undertaken by Affric Limited at two locations during both the daytime and night-time periods of the 28th of September and into the morning of the 29th of September 2017. Monitoring was conducted at the NMLs proposed in the Scoping Report, as detailed in Table 22.5.

Table 22.5: Supplementary noise monitoring locations.

Noise Monitoring Location		**Grid reference**
NML ID	**Descriptor**	
NML08	A90 (nr Station House)	NK 11562 40222
NML09	North Sea Trail	NK 12266 40037

Detailed information regarding the sound level monitoring at NML01, NML02, NML04 and NML06 can be found in Chapter 6 of '*NorthConnect Interconnector Converter Station and High Voltage Alternating Current Cable Route, Environmental Statement Volume 2 Main Document'* and '*Volume 3 Appendixes'* (NorthConnect, 2015), hereafter known as the *'Converter Station ES - Noise '.*

Noise measurement data and field data sheets for the most recent measurements (NML08 and NML09), including subjective observations made during the survey, are included in Appendix H.1.

All measurements were made with the sound level meter (SLM) mounted on a tripod at approximately 1.2 – 1.5 metres above the ground and away from nearby reflective surfaces i.e. building façades, fences etc.

The noise monitoring equipment consisted of a Cirrus Optimus Green integrating sound level meter (SLM) fitted with a standard wind shield. All noise monitoring equipment (calibrator, SLM and microphones) used for the study are categorised as Class 1, as specified in IEC 61672-1 '*Electroacoustics. Sound level meters. Specifications*' (International Electrotechnical Commission, 2002). The equipment was calibrated on site at the beginning and end of each measurement period with no significant deviations noted. Appendix H.1 contains the equipment and laboratory calibration details.

22.5.1 Results of Noise Monitoring

Table 22.6 details the measured L_{Aeq} noise levels for daytime and night-time periods at each of the NMLs. For NML01, NML02, NML04 and NML06 these levels are taken from *Table 6.4.2* of Converter *Station ES - Noise*.

LAeq levels for NML08 and NML09 have been calculated after data analysis in Cirrus NoiseTools software. It should be noted that a low flying helicopter overflew the SLM at NML09 towards the end of the daytime survey period, therefore, this section of the data has been removed so as not to artificially raise the overall ambient sound level. This is detailed in Appendix H.1.

Table 22.6 Measured ambient noise levels, dB $L_{Aeq(t)}$.

Noise Monitoring Location		**Ambient Sound Level, dB $L_{Aeq(t)}$**	
NML ID	**Descriptor**	**Daytime$_{(60mins)}$**	**Night-time$_{(30\ mins)}$**
NML01	Converter site	53	33
NML02	Highfield	43	41
NML04	Hill of Boddam viewpoint	54	40
NML06	Longhaven Mains	45	47
NML08	A90 (nr Station House)	64	55
NML09	North Sea Trail	53	54

22.5.2 Summary of Noise Monitoring Results

Having due regard to the existing ambient noise levels at NSRs around the proposed development, the BS5228 threshold values (as detailed in Table 22.2) have been determined. Table 22.7 details the Assessment Category to be used after rounding the measured ambient noise levels to the nearest 5dB.

Table 22.7 BS5228 Threshold Categories per NML.

Noise Monitoring Location		Threshold Value Category		
NML ID	**Descriptor**	**Daytime**	**Evening ***	**Night-time**
NML01	Converter site	Category A	Category A	Category A
NML02	Highfield	Category A	Category A	Category A
NML04	Hill of Boddam viewpoint	Category A	Category A	Category A
NML06	Longhaven Mains	Category A	Category A	Category A
NML08	A90 (nr Station House)	Category A	Category A	Category C
NML09	North Sea Trail	Category A	Category A	Category C

* As no evening sound level monitoring has been conducted the assessment for evening and weekend working assumes Category A threshold values, which represents a conservative approach to the assessment.

22.6 Noise Impact Assessment

Noise levels will vary throughout the construction period as construction activities, plant and locations vary. For much of the working day the noise associated with construction activities would be less than predicted, as the assessment has assumed all equipment is continually operating at full power, whereas in practice, equipment load and precise location may vary throughout the day. This approach has been adopted to represent a worst-case assessment.

At this stage, a detailed plant list is not available, so a generic plant list based upon experience of similar projects has been used, as well as input from NorthConnect's engineers on what predicted plant may be required.

Machinery onsite would produce noise levels that are transient in nature and fluctuate due both to the location of the activity and the load on any individual machine. The works would generally comprise both moving and static sources. Mobile sources include mobile construction plant and HGVs, while static construction plant such as the HDD drilling rig, generators, lighting rigs and pumps are usually located at a fixed location for an extended period of time.

22.6.1 Construction

The hours of operation are anticipated to be 07:00 to 19:00 Monday to Friday, and 07:00 to 13:00 on Saturdays for all onshore construction stages, except for cable winching and the HDD drilling operations (both landfall and under A90 and disused railway). The cable winching will occur for a concentrated period that will require 7-day, 24-hour working. The HDD drilling operations are planned to be conducted on a 7-day per week basis, between 07:00 and 23:00, however in order to ensure that the drilling works are completed in the available window prior to the bird breeding season, 24hr working may be required dependant on the rate of progress.

Construction will be carried out in two main phases: Enabling Works; and HVDC Cable Installation. Each phase will consist of a number of work activities with the possibility of some of these activities overlapping. For the purpose of modelling the construction programme has been divided up as follows:

- **Phase 1 Enabling Works:**
    - Activity 01, Installation of waterpipe (Longhaven Mains to Fourfields);
    - Activity 02, Installation of cable ducts under footpaths (by Fourfields);
    - Activity 03, Installation of waterpipe (A90 to HDD site);
    - Activity 04, Laying of temporary access road to HDD site; and,
    - Activity 05, HDD site setup.
- **Phase 2 HVDC Cable Installation:**
    - Activity 06, Jointing Bay 1 construction (offshore/onshore connection);
    - Activity 07, HDD drilling (by onshore entrance point);
    - Activity 08, Jointing Bay 2 construction (northern connection);
    - Activity 09, HDD drilling (under A90 and disused railway);
    - Activity 10, Cable pull (landing of offshore cable); and,
    - Activity 11, HVDC onshore cable laying.

A detailed description of the cable installation methods is included within Chapter 2: Project Description. The equipment and machinery assumed to be operational during each of the above stages and included within the noise models are detailed in Appendix H.2 along with the associated noise data split into octave bands (where available). All SPL data has been sourced from Annex C of BS5228 and have been converted to sound power levels for input into CadnaA, except for the following items/activities:

HDD Drilling (Activities 07 and 09)

The HDD rig will likely be a PD 250 or similar. Manufacturer supplied data provides a SWL of 86 dBA for the drilling unit, and this has been input directly into the noise model.

A Fluid Recycling System will also be required and for the purposes of modelling the specification of an American Augers MPR-600 has been used. Manufacturer supplied data quotes the SPL of the unit, including generator, to be 104 dBA at 1 m.

A number of mud pumps will be connected to the recycling unit and these have been modelled separately as individual point sources. No specific noise level data is available for the pumps, however, to predict their operational noise levels the model calculates the noise output from each pump based on the following formula:

$$SWL = 73 + s + 10\ Log\ (a)$$

Where *s* represents a variable for the octave band of interest and *a* is the power of the pump in kW. Appendix H.2 details the calculation used and the octave band sound power levels for each pump.

Cable Pull (Activity 10)

Three main vessels will be required during the cable pull from offshore to onshore, with additional small work boats possibly required. The noise model assumes that the following vessels will be in use:

A Diver Support Vessel (Mulitcat or similar) has been modelled close to the base of the cliffs at the HDD exit point. No specific noise data is available for this type and size of vessel, however, a Noise Impact Assessment undertaken for the Aberdeen Harbour Expansion Project does provide sound level measurement data for a tug vessel and this has been used as appropriate proxy data. Specifically,

Appendix 20-D of the Aberdeen Harbour Expansion Project Environmental Statement (Fugro, 2015) details a SWL of 87 dBA for a 'Waiting tugboat engine' i.e. not manoeuvring. This is likely to be the state of the vessel during these operations for the majority of the time. The vessel has been modelled as single point source with a broadband SWL of 87 dBA.

The Cable Lay Vessel has not been specified as a Contractor has not yet been appointed. However, a vessel with an assumed Dead Weight Tonnage (DWT) of 10,000 has been modelled located at a distance of approximately 80 m further out from the diver support vessel. Although no specific noise data for this type of vessel is available, the noise level output has been estimated as 102 dBA SWL, which has been calculated follows:

$$\mathrm{SWL} = 66 + 9\ \mathrm{Log}\ (\mathrm{DWT})$$

This method was detailed in the paper, '*Acoustic research - mobile sources in the GRW-area Rotterdam'* (Witte, J 1994), which found a correlation with the DWT of various classes of vessels and their noise output.

A guard vessel is predicted to be positioned close to the Peterhead Pilot Station, approximately 5km from the HDD exit point. The guard vessel will be stationary for the majority of the time. Due to the distance from the cable pull activity, the guard vessel has been excluded from the noise modelling.

Small work boats may be required for additional assistance during the cable pull, operating between the dive support vessel and the cable lay vessel. These are likely to be zodiacs (or similar) with outboard engines. It is not possible to accurately predict the noise emissions for these craft, however, the work boats will be stationary for the majority of the time, and as a precautionary approach, the input data of an additional Diver Support Vessel has been modelled as a proxy for these craft.

TNEI undertook measurements in January 2018 for a similar project, in which a winch was used for the pulling of onshore electrical cables from the Aberdeen Offshore Windfarm to the Blackdog Substation. This octave band SPL measurement data has been used to model the winch and power packs as individual point sources located at the HDD drilling location (onshore landing) and at Jointing Bay 01. The model assumes that winching at both locations is occurring concurrently, however, in reality only one location is likely to be active at any one time.

22.6.1.1 Impact Assessment – Residential Receptors

Table 22.8 (overleaf) provides the noise immission levels for each modelled construction activity at each of the residential NALs. The location of each NAL has been selected to represent a worst-case scenario, i.e. the assessment location represents the most exposed facade or garden boundary to the proposed construction activities.

As the receptor at Longhaven Mains will be exposed to sound from more than one direction (depending on which activity is occurring), two NALs have been selected. This allows the most exposed facade of this receptor for any given activity to be assessed.

Baseline noise level monitoring has identified that the Category A threshold values (as detailed in Table 22.2) are appropriate for all of the residential NALs, therefore the strictest of the BS5228 noise limits are used for assessment. Accordingly, the thresholds for significance are:

- 65dB $L_{Aeq(t)}$ for weekdays (07:00 – 19:00) and Saturday mornings (07:00 – 13:00);
- 55dB $L_{Aeq(t)}$ for evenings (07:00 – 19:00), Saturday (13:00 – 23:00) and all-day Sunday; and
- 45dB $L_{Aeq(t)}$ for night-time (23:00-07:00).

The predicted noise levels at all of the NSRs during all construction stages are below the 65dBA daytime thresholds. In addition, the winching operations (Activity 10), which will occur for a limited 24-hour period, will be below the 55 dBA Evening and Weekend and 45 dBA night-time threshold levels. The HDD operations which will be conducted on a 7-day per week basis from 07:00-23:00 result in immission levels at all receptors which are below the 55 dBA Evening and Weekend criteria. However, if the HDD operations at the landfall (activity 07) require 24hr working, this may result in exceedances of the Night Time 45 dBA criteria at Longhaven Mains #02, Station House, and Jehrada Cottage (52, 48, and 45 dBA respectively).

There is the possibility that some construction activities may overlap. Specifically, activities 06, 08 and 11 could occur concurrently. Noise level predictions for all three activities occurring at the same time indicate that the highest noise level would be 53 dB $L_{Aeq(t)}$ at NAL07 Longhaven Mains. This below the BS5228 threshold levels. Drawing NCFFS-NCT-X-XG-0010-12 details the relevant noise contour plot for this propagation model.

Accordingly, comparison of the predicted levels against the BS5228 Threshold Values for each residential receptor and each construction activity with the exception of night time operations during the landfall HDD drilling works, indicates that construction noise impacts are **Non-Significant.** If 24hr working is required in order to complete the landfall HDD operations within the available window, this activity results in minor exceedances of the night time noise criteria, and hence has the potential to result in **Significant** night time noise impacts at 3 receptors.

Table 22.8 Predicted Noise Immission Levels, dB $L_{Aeq(12\ hours)}$.

Receiver		Activity 01	Activity 02	Activity 03	Activity 04	Activity 05	Activity 06	Activity 07	Activity 08	Activity 09	Activity 10	Activity 11
Name	**NAL ID**	**Water pipe (LM to Fourfields)**	**Cable ducts (Fourfields)**	**Water pipe (A90 to HDD site)**	**Site access road**	**HDD setup**	**Jointing Bay 1**	**HDD Drilling (onshore landing)**	**Jointing Bay 2**	**HDD Drilling (A90)**	**Cable pull**	**Cable laying**
Denside Hill of	**NAL1**	65	31	35	23	26	27	28	32	35	34	23
Lendrum Terrace	**NAL2**	65	35	36	24	25	28	29	33	36	34	25
Highfield	**NAL3**	65	42	41	25	28	29	30	34	40	36	26
Denside	**NAL4**	65	34	38	24	29	29	30	34	38	36	24
Glen Ugie	**NAL5**	65	31	35	35	38	44	42	46	35	46	34
Four Winds	**NAL6**	65	40	36	35	41	39	40	41	37	45	33
Longhaven Mains#01	**NAL7a**	65	40	38	38	44	43	43	41	39	48	33
Longhaven Mains #02	**NAL7b**	65	35	30	44	51	51	52	44	31	55	40
Five Acres	**NAL8**	65	32	32	40	47	42	42	43	33	48	35
Station House	**NAL9**	65	32	33	51	61	50	48	46	34	54	40
Jehrada Cottage	**NAL10**	65	32	33	45	54	46	45	45	34	51	37

22.6.1.2 Impact Assessment – Longhaven Nature Reserve Footpath

Drawings NCFFS-NCT-X-XG-0010-01 through to Drawing NCFFS-NCT-X-XG-0010-12 presents the noise contour plots for each construction stage showing the predicted noise immission levels in the vicinity of the site. The 65 dB LAeq noise contour is shown where the contour colours change from green to blue. The 55 dB LAeq noise contour is shown where the contour colours change from blue to pink. The Longhaven Nature Reserve Footpath is shown as a dashed pink line.

Walkers using the Nature Reserve footpath will experience varying noise levels during the construction period, depending upon which section of the path they are on, wind conditions and the construction activities that are occurring. The drawings illustrate that the activities that generate the highest levels of noise along the footpath are those activities occurring within the HDD areas and detail where the footpath crosses over the 55 dBA and 65 dBA contours.

Existing ambient noise levels measured on the path (NML09), varied between 52 dB and 53 dB $L_{Aeq(t)}$ and remained relatively constant throughout the daytime and night-time periods. The change of level at those locations where the path intercepts the 55dBA contour, therefore, will be around 3 dB.

At the closest locations to the HDD areas the increase in noise level will be in the region of 13 dB, which will be noticeable, intrusive and clearly audible. As such it is recommended that mitigation measures are put in place to limit the noise exposure along this short section of path.

For short sections of the path during some activities at the HDD locations, therefore, noise levels are indicated as failing the BS5228 criteria, which in simple numerical terms it does, however the duration of exposure for walkers along these sections is very limited, typically lasting a few minutes, while the BS5228 thresholds are based upon 12 hours of exposure.

To put this into context, Table 22.9 presents the length and percentage of the path exposed to levels above the 55 dBA and 65 dBA thresholds for each construction activity.

Table 22.9 Length and Percentage of Path Exposed to Noise Above Threshold Levels.

Activity	Length of Path (m)			Percentage of path (%)		
	Above 65 dBA	Above 55 dBA	Below 55 dBA	Above 65 dBA	Above 55 dBA	Below 55 dBA
1) Water pipe (LM to Fourfields)	0	0	4401	0%	0%	100%
2) Cable ducts (Fourfields)	0	0	4401	0%	0%	100%
3) Water pipe (A90 to HDD site)	0	3	4398	0%	0%	100%
4) Site access road	0	16	4385	0%	0%	100%
5) HDD setup	0	111	4291	0%	3%	97%
6) Jointing Bay 1	0	0	4401	0%	0%	100%
7) HDD Drilling (onshore landing)	75	461	3941	2%	10%	90%
8) Jointing Bay 2	0	0	4401	0%	0%	100%
9) HDD Drilling (A90)	0	211	4190	0%	5%	95%
10) Cable pull	0	0	4401	0%	0%	100%
11) Cable laying	0	74	4327	0%	2%	98%

It can be seen that for the majority of the time, walkers using the path will not be exposed to levels above the BS5228 thresholds. Without additional mitigation the threshold exceedance will occur for a maximum of 10% of the path length during some of the HDD activity and only during weekend operations. Considering that the BS5228 threshold limits are based on a 12 hour time period and the fact that walkers are unlikely to be exposed to noise levels above the BS5228 thresholds for only a few minutes, the impacts on the path has been classed as **Non-Significant.**

22.6.1.3 Impact Assessment – Climbing Routes

Table 22.9 presents the noise immission levels at the nearest cliff detailed within local climbing guidebooks and shown to be active on ukclimbing.com, namely The Warlord Cliff. Two NALs have been used, one positioned on the cliff top and one positioned at the base of the cliff face. The highest anticipated noise level at the cliff top NAL is 54 dB $L_{Aeq(12hours)}$, which will occur during Activity 07 HDD Drilling (onshore landing). At the base of the cliff the highest levels are predicted to be 42 dB $L_{Aeq(12hours)}$, which will occur during Activity 10 Cable Pull.

At both NALs the noise levels will remain below the BS5228 Category A threshold levels, therefore, noise levels when assessed in simple accordance with BS5228 are deemed to be **Non-significant**, however, the effects of construction noise on nearby climbing routes may have a detrimental impact on safety through the masking of vocal communication between climbers. Accordingly, further assessment is required.

Standard climbing practice requires climbing partners to communicate vocally to establish when it is or isn't safe to climb and to indicate any potential hazards. ANSI/ASA S3.5 '*American National Standard Methods for Calculation of the Speech Intelligibility Index*' (ANSI, 1997) presents the SWL of typical speech for a range of 'vocal effort' and this is detailed in Table 22.10. For climbing activities TNEI have assumed that the level of vocal effort would be 'Shouted', as communication between climbers generally requires the participants to shout to one another due to the separation distances involved and the potential for rock faces and other topographical features to interrupt the direct line of sight between participants.

Table 22.10 Speech Spectrum by Vocal Effort, from ANSI S3.5, SWL dBZ.

Frequency (Hz)	63	125	250	500	1000	2000	4000	8000	SWL dBA
Normal	45.0	55.0	65.3	69.0	63.0	55.8	49.8	44.5	68.4
Raised	48.0	59.0	69.5	74.9	71.9	63.8	57.3	48.4	75.5
Loud	52.0	63.0	72.1	79.6	80.2	72.9	65.9	54.8	82.6
Shouted	52.0	63.0	73.1	84.0	89.3	82.4	74.9	64.1	91.0

Using the ISO9613 model, two scenarios have been modelled in CadnaA: Scenario 1 assumes a climber is on the clifftop and is shouting down to their climbing partner at the base of the cliff; and Scenario 2 assumes a climber is shouting from the base of the cliff up to their partner on the cliff top.

At the base of the cliff the predicted noise level from the cliff top climber communicating is 49 dBA. At the cliff top the predicted level from the climber shouting at the base of the cliff is 48 dBA. This is based on a simplistic model with no directivity, i.e. noise propagation from the point source (climber) is assumed to have an omnidirectional (spherical) radiation. In reality, voices are directional and therefore, levels may be higher than predicted by the model (assuming the speaker is facing in the approximate direction of the listener).

In simple numerical terms, during Activity 07 there is the potential for noise levels from the construction activities to mask communication between climbers. For all other construction activities construction noise levels will be below the predicted communication levels. However, it should be noted that the measured ambient noise levels in the area of the clifftop are already between 52 dBA and 53 dBA, therefore, ambient noise levels are already likely to mask vocal communication. Furthermore, although not quantified through measurement, the existing ambient noise levels at the base of the cliffs is likely to be higher still than at the measurement location, as this is closer to the dominant noise source in this area, which are the waves breaking.

Therefore, given that the increase in noise levels on the existing soundscape is likely to be minimal, noise impacts are expected to be **non-significant.**

22.6.1.4 Impact Assessment – Areas of Ornithological Interest

The effects of construction noise on ornithological interests are presented in Chapter 17: Ornithology.

22.7 Mitigation measures

Once a main contractor is appointed, careful consideration will be given to the type of plant to be used for each stage of construction as well as construction work schedules.

Section 8 of BS5228 recommends a number of simple control measures, which will be incorporated into the construction plans. The principal contractor would:

- keep local residents informed of the proposed working schedule, where appropriate, including the times and duration of any abnormally noisy activity that may cause concern;
- ensure that haulage vehicles would not arrive at or leave the site between 19.00 and 07.00 hours;
- ensure all vehicles and mechanical plant would be fitted with effective exhaust silencers and 'smart' reversing alarms and be subject to programmed maintenance;
- select inherently quiet plant where appropriate - all major compressors, pumps and generators would be 'sound reduced' models fitted with properly lined and sealed acoustic covers, which would be kept closed whenever the machines are in use;
- ensure all ancillary pneumatic percussive tools would be fitted with mufflers or silencers of the type recommended by the manufacturers;
- instruct that machines would be shut down between work periods or throttled down to a minimum;
- ensure regular maintenance of all equipment used on site, including maintenance related to noise emissions;
- ensure that vehicles are loaded carefully to ensure minimal drop heights so as to minimise noise during these operations; and
- ensure all ancillary plant such as generators and pumps would be positioned so as to cause minimum noise disturbance and if necessary, temporary acoustic screens or enclosures should be provided.

If it is identified that 24hr working is required for the landfall HDD operations, then a Section 61 Consent will be applied for under the Control of Pollution Act 1974. The application will be informed by additional noise modelling once further details of the HDD equipment are available. Depending on the output of the model, further mitigation measures may be identified in order to reduce the night time noise impacts on residential receptors, which will also be detailed in the application.

Whilst the noise impacts on the path and climbing routes were determined to be non-significant, however there are potential safety concerns for climbers due to the possible masking of vocal communication between climbers during the landfall HDD operations. As such, NorthConnect will liaise with local climbing groups and conduct construction monitoring during HDD activities to check on noise levels in the area of the Warlord Cliff. If it is found that the noise is causing a safety concern, additional mitigation will be considered at this time.

22.8 Residual effects

Use of best practice noise control measures will reduce construction noise levels to lower levels than reported in the noise assessments, however, this will not result in a change of assessment outcome for individual construction activities.

22.9 Cumulative effects

It is necessary to consider the construction of the HVAC Converter Station which may overlap with the construction of the proposed HVDC cable.

Both the HVAC and HVDC cables will run close to each other from the Converter Station to the north-west corner of Fourfields, at which point the HVDC cable route heads south and the HVAC cable route heads north. Hence for the majority of the routes there is a significant spatial separation which will mean that cumulative noise effects on any given receptor do not occur.

When the routes converge, the civils work will be coordinated and due to space constraints and health and safety implications, the amount of equipment will be restricted to that utilised for the HVAC cabling.

Predicted cumulative noise levels at NAL03 Highfield, the closest NSR to both developments, are therefore expected to be similar to those predicted for Activity 11 Cable Laying. Similarly, construction noise levels at properties further afield are expected to be no higher than those reported for Activity 11. Accordingly, cumulative noise impacts are anticipated to be **Non-Significant**.

There are no other developments which need to be considered within the cumulative assessment.

22.10 Summary of effects

Table 22.11 presents a summary of the anticipated in-air noise impacts.

The assessment has considered the existing noise environment at local residential receptors and presented the anticipated construction and operational noise immission levels for a number of construction activities.

The assessment of construction noise on nearby residential receptors has been undertaken following the guidance contained within BS5228. All predictions assume that all plant is operating concurrently in full operational mode in order to provide a worst-case scenario (whereas in reality only a proportion of the plant may be operating for a proportion of time).

The construction noise levels at all of the assessed residential receptors during all individual assessed construction stages are below the daytime, weekend, evening and night-time thresholds adopted for this project.

The assessment also considers noise levels along the Longhaven Nature Reserve footpath and local climbing routes. Predicted noise levels indicate that small sections of the path will be exposed to noise levels above the BS5228 threshold values for some construction activities, however, given the short lengths of path affected and the limited duration of exposure, the assessment concludes that noise impacts on the path are Non-Significant.

Predicted noise levels will remain below the BS5228 threshold levels at all times for the closest climbing routes. There is the potential during HDD drilling for communication between climbers to be masked by construction noise, however, it is possible that this situation already occurs due to the high ambient noise levels in the area, and the increase in noise levels attributable to construction activities is anticipated to be minimal. Accordingly, the assessment concludes that noise impacts on nearby climbing routes are Non-Significant.

In practice, for much of the working day the noise associated with construction activities would be less than predicted as the predictions assume that all plant is operating concurrently and continuously, whereas in reality only a certain proportion of plant would be operating at any one time, while others maybe idling or turned off.

Table 22.11 Summary of Effects

Nature of Impact	Receptor Sensitivity	Significance of Effect	Mitigation Summary	Residual Significance of Effect
Noise from construction activities (daytime) on residential receptors.	High	Non-Significant Effect	Best practice mitigation measures to be employed as detailed in BS5228	Non-Significant Effect
Noise from HDD activities (daytime and evening/weekend) on residential receptors.	High	Non-Significant Effect	Best practice mitigation measures to be employed as detailed in BS5228	Non-Significant Effect
Noise from HDD activities (night time) on residential receptors.	High	Significant effect at Longhaven Mains, Station House, and Jehrada Cottage.	Best practice mitigation measures to be employed as detailed in BS5228 Additional modelling once equipment details are better understood. Provision of additional mitigation as required. Section 61 Consent.	Non-Significant Effect
Noise from winching activities (evening, weekend and night-time) on residential receptors.	High	Non-Significant Effect	Best practice mitigation measures to be employed as detailed in BS5228	Non-Significant Effect
Noise from construction activities (daytime, evening and weekend) on Nature Reserve path.	High	Non-Significant Effect	Best practice mitigation measures to be employed as detailed in BS5228	Non-Significant Effect
Noise from construction activities (daytime, evening and weekend) on nearby climbing routes.	High	Non-Significant Effect	Monitoring to be undertaken to determine actual noise levels associated with HDD activities at climbing routes to ensure no increased safety risks.	Non-Significant Effect

Key

	Significant Effect

22.11 References

BSI (2014). *BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Noise*. UK: British Standards Institute.

IEC (2013*). IEC 61672-1:2013 Electroacoustics - Sound level meters - Part 1: Specifications*. Geneva: Commission Electrotechnique Internationale.

ISO (1996). *ISO 9613-2:1996 Acoustics – Attenuation of Sound during Propagation Outdoors: Part 2 – General Method of Calculation*. Geneva: International Organization for Standardization.

Scottish Statutory instruments (2006). *2006 No. 465 Environmental Protection. The Environmental Noise (Scotland) Regulations 2006*. Scotland: The Crown.

The European Parliament and the Council of the European Union (2002), *Relating to the Assessment and Management of Environmental Noise*. European Parliament

The Scottish Government (2011). *PAN 1/2011 Planning and Noise*. Scotland: The Crown

The Scottish Government (2011). *Technical Advice Note, Assessment of Noise*. Scotland: The Crown

Chapter 23: Noise and Vibration (Underwater)

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23.1 Introduction

The relatively high density of water means that underwater noise is readily transmitted in the marine environment. This means there is the potential for underwater noise emissions resulting from the installation and operation of the NorthConnect HVDC marine cables to disturb, injure or kill noise sensitive receptors at extensive distances from the working areas. The noise sensitive receptors likely to be present in the vicinity of the Consenting Corridor include marine mammals and fish. This chapter will outline the predicted noise levels resulting from the installation and operation of the NorthConnect HVDC cables, ascertain the potential effects on marine mammals and fish that could result from the noise emissions, and estimate the range from source where each affect can be expected. This in turn will inform the detailed impact assessments on marine mammals and fish, provided in Chapters 15 and 16.

23.2 Sources of Information

23.2.1 Planning and Legislative Framework

The Scottish Government has released general policies as part of the Scotland's National Marine Plan in favour of sustainable development and use of the marine environment which include:

- ***GEN 13 Noise:*** *Development and use of the marine environment should avoid significant adverse effects of man-made noise and vibration, especially on species sensitive to such effects* [Scottish Government, 2015a].

The Scottish government has released a series of good environmental status descriptors within Scotland's National Marine Plan. These include:

- ***GES 11:*** *Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.* [Scottish Government, 2015c].

23.2.2 Relevant Guidance

There are no internationally agreed standards with regard to the assessment of underwater noise, but it is current practice to undertake assessments based on criteria provided in the scientific literature or guidance published by regulatory authorities. For this assessment, the criteria are based on:

- Southall et al. [2007] Marine mammal noise exposure criteria: Initial scientific recommendations. *Aquatic Mammals 33, 411 - 521.*
- Popper A N et al. [2014]. Sound Exposure Guidelines for Fishes and Sea Turtles.

23.3 Assessment Methodology

The aim of this this chapter is not to assess the potential impacts from underwater noise on ecological receptors; these assessments are provided in Chapters 15 & 16. Instead this chapter will identify the ranges to which marine ecological receptors may be affected by underwater noise resulting from the installation and operations of the proposed HVDC cables.

23.3.1 Baseline Data Collection

Ambient underwater noise levels are highly variable, depending on a range of both natural and anthropogenic factors. Natural factors include sea state, rain, currents, movement of seabed materials, as well as sounds and vocalisations from marine animals. These factors can result in seasonal and even daily changes in the baseline noise levels. Anthropogenic noise will also contribute to the background levels; however, the significance of this contribution is difficult to quantify (due to the variability in the natural sources).

Very little data is available regarding baseline underwater noise levels in the North Sea along the marine Consenting Corridor. However, the highly variable nature of the ambient noise levels in the vicinity of the Consenting Corridor, means that baseline noise monitoring would not add substantially to the current understanding of the existing sound scape. As such no monitoring has been undertaken, and the baseline is informed by a review of the available literature.

23.3.2 Impact Assessment Methodology

In order to assess the potential impacts of underwater noise generated during the installation and operation of the NorthConnect HVDC cables, it is necessary to understand whether the noise is in a frequency range that can be detected by the marine noise sensitive receptors likely to be present in the vicinity of the consenting corridor. Where a noise source is detectable, it is then necessary to ascertain the nature of the potential impact resulting from the receptor being exposed to the noise source, as well as the distance to which that impact is likely to be experienced.

The primary underwater noise sensitive receptors in the marine environment are marine mammals and fish. Southall et al. [2007] presents hearing frequency thresholds for marine mammals, as well as noise exposure criteria for sound pressure levels which have the potential to cause injury and disturbance. The scientific literature also provides similar information for fish [Popper et al., 2014 & Slabbekoorn et al., 2010]. The frequencies and sound pressure levels of the noise sources likely to be associated with the installation and operation of the HVDC cables will be compared against the exposure criteria, in order to ascertain whether a risk of injury or disturbance to marine mammals and fish exists. Where a risk of injury or disturbance exists for a noise source, the range from the source to which that effect could be expected to occur will be calculated.

23.3.2.1 Marine Mammals Sensitivity

Marine mammals have hearing sensitivity thresholds, which are the frequency bands in which they can detect and are sensitive to underwater noise (Southall et al, 2007). Southall et al., has published a table, detailing the hearing thresholds of different marine mammal species. This will be used to ascertain which noise sources associated with the installation and operation of the HVDC cables will be detected by the marine mammals likely to be present within the vicinity of the consenting corridor, and hence need to be considered further in the assessment. This information is summarised in Table 23.1.

Table 23.1. Hearing Thresholds of Marine Mammals. After Southall et al, 2007.

Species	Hearing Threshold (kHz)
Harbour Porpoise	0.2-180
Bottlenose Dolphin	0.15-160
Minke Whale	0.007-22
White Beaked Dolphin	0.15-160
Short-Beaked Common Dolphin	0.15-160
Atlantic White-Sided Dolphin	0.15-160
Long-Finned Pilot Whale	0.15-160
Killer Whale	0.15-160
Risso's Dolphin	0.15-160
Grey & Common Seals	0.075-75

Southall et al, [2007] also propose precautionary noise exposure criteria for marine mammal disturbance and injury; where injury is defined as either Permanent or Temporary Threshold Shift (PTS and TTS respectively); these criteria are presented in Table 23.2.

Table 23.2. Auditory Injury and Disturbance Criteria for Marine Mammals. After Southall et al, 2007.

Effect		Exposure Limit (dB re 1 µPa)
Injury	PTS Onset Cetaceans	230
	PTS Onset Seals	218
	TTS Onset Cetaceans	224
	TTS Onset Seals	212
Disturbance	All marine mammals	160

23.3.2.2 Fish Sensitivity

Considerably less information is available for the hearing capabilities of fish, or their sensitivity to underwater noise. The current guidance and exposure criteria are based on very sparse information from limited field studies, and as such should be treated with caution, however it is thought that the current criteria are overly conservative, and as such the assessment can be taken as the worst case [Popper et al., 2014].

Fish hearing thresholds depend greatly on the hearing mechanisms of the species, and can be broadly grouped into two classes; fish that do not have a swim bladder (or have a swim bladder that is not involved in hearing), and hearing specialists which have a swim bladder that is linked to the hearing mechanism (including herring) [Slabbekoorn et al., 2010]. Both groups of fish are likely to be present within the vicinity of the Consenting Corridor, and will be considered in the assessment. A summary of the hearing thresholds is presented in Table 23.3.

Table 23.3. Hearing Thresholds of Fish. After Slabbekoorn et al., 2010.

Fishing Hearing Group	Hearing Threshold (kHz)
No swim bladder involved in hearing	0.03-1
Swim bladder involved in hearing	0.03-5

Currently there are no nationally accepted standard noise exposure criteria for fish, however the United States National Marine Fisheries Service (NMFS) developed a set of interim injury and disturbance criteria, which have been broadly adopted [Popper et al., 2014]. It should be noted that the literature strongly criticises the disturbance threshold, as the basis for setting the threshold is not provided, and further studies suggest it is significantly lower than the sound pressure level which results in a behavioural response [Popper et al., 2014]. However, no alternative threshold value has been suggested, due to a lack of empirical evidence in the area, so the NMFS value is used for information. A summary of the fish noise exposure criteria is provided in table 23.4.

Table 23.4. Auditory injury and disturbance criteria of fish. After Popper et al., 2014.

Effect	Exposure Limit (dB re 1 µPa)
Onset of physical injury in fish.	206
Onset of behavioural disturbance	150

23.3.2.3 Range Estimation

Where a noise source is detectable to marine mammals or fish, and has a sound pressure level which exceeds the disturbance criteria; a simple but conservative propagation loss model will be used to estimate the range of potential disturbance from the noise source. The propagation loss model used is:

$$PL = 15\log_{10}(R)$$

Where PL is propagation loss in dB re 1 µPa, and R is the distance from the noise source.

The use of 15 as the scaler in the above equation makes it a hybrid between the cylindrical spreading model and the spherical spreading model. The cylindrical model is appropriate for shallow water, and assumes more horizontal spreading than vertical, so uses 10 as the scaler, while the spherical spreading model is appropriate for deeper water, and assumes equal vertical and horizontal spreading, so uses 20 as the scaler. Since the majority of the consenting corridor is in waters greater than 100m in depth, the spherical model could be applied throughout, however using 15 as the scaler will result in a reduced propagation loss, and hence can be considered a conservative approach.

23.3.3 Identification and Assessment of Mitigation

This chapter only identifies the range to which there is potential for injury or disturbance to sensitive receptors, resulting from the installation and operation of the HVDC cables. No consideration is made to the significance of these impacts on an individual or population level. This assessment is conducted in Chapters 15 & 16, and where necessary, appropriate mitigation measures identified. As such, no mitigation will be presented in this chapter.

23.3.4 Assessment of Residual Effects

Since no mitigation is proposed in this chapter, the residual effects cannot be considered.

23.3.5 Limitations of Assessment

This assessment is based on predicted source noise levels, using data currently available in the literature. In addition, the propagation loss model is rather simplistic and does not take into account bathymetry and sediment types. As such there is a potential for the actual noise levels, and hence impact ranges to differ from those predicted. However, a conservative approach has been used throughout, so this assessment should be considered to be a worst-case scenario.

23.4 Baseline Information

The marine consenting corridor in general passes through open water, with only three main types of anthropogenic acoustic source. The predominant acoustic sources that are present along the cable corridor include: shipping, fishing grounds (and associated fishing vessels), and oil and gas installations.

The oil and gas installations are localised sources, which may generate high underwater noise levels in their vicinity. The oil and gas installation are concentrated along the UK-Norway median line, in the north east of the consenting corridor. This infrastructure has been avoided by a minimum of 500m during the initial cable routing, however it is likely that the baseline in the vicinity of oil and gas infrastructure will be elevated.

Shipping density is generally low throughout the cable corridor; however, there are localised areas of high vessel traffic. Shipping provides numerous transient, low intensity noise sources which in isolation have a negligible effect on baseline noise levels. However, in high traffic areas, shipping noise can result in a significantly elevated baseline. High traffic areas in the vicinity of the consenting corridor include route between Aberdeen and Peterhead, and the waters around the offshore oil and gas installations. Shipping is covered in more detail in Chapter 19.

The North Sea is an important region for the commercial fisheries, and the consenting corridor passes through numerous fishing grounds. Fishing grounds result in high densities of fishing vessels, focussed specific areas where the target species is located. The grounds are not targeted year-round, but instead the fleet follows the seasonal movements of their target species throughout the year. This results in transient areas of localised high fishing vessel density, and associated elevated baseline noise levels. Further information on commercial fisheries is available in Chapter 20.

McDonald et al. [2008] and Walker et al. [2018] suggest that shipping noise is resulting in a chronic increase in deep sea baseline noise levels. In the North Sea region, it is likely that anthropogenic noise, specifically from shipping, is prominent in the soundscape [Ainslie et al., 2009]. Due to propagation loss, the anthropogenic noise levels will vary from the distance to the noise sources, such as shipping routes, fishing grounds, and oil and gas areas. A review of the available literature indicates that underwater noise levels of between 100 to 130dB re 1µPa are representative baseline for the Northern North Sea region, in the vicinity of the consenting corridor [Bailey et al., 2010; Nedwell et al., 2007; Robinson et al., 2011; Theobald et al., 2010].

23.5 Noise Impact Assessment

This section will identify the noise sources that will be associated with the installation and operation of the HVDC cables. The ranges to which potential impacts on noise sensitive marine receptors could expected be will then be identified.

23.5.1 Installation

23.5.1.1 Noise Sources

Previous studies have demonstrated that the principal noise source associated with marine cable installation is vessel noise, and the acoustic devices utilised during the pre-installation surveys [NSN Link Limited, 2014 & Meißner et al., 2006]. However, all potential sources will be identified and discussed for completeness, following advice provided in the scoping opinion. The acoustic sources that may be associated with the marine cable installation process include:

- Vessel Noise;
- Subsea survey equipment including;
    - Multibeam Echo Sounder (MBES),
    - Side-Scan Sonar (SSS), and
    - Sub Bottom Profiler (SBP).
- Horizontal Directional Drilling (HDD);
- Cable Burial; and
- Installation of external protection.

Further information on the vessels and installation techniques is provided in Chapter 2.

23.5.1.1.1 Vessel Noise

Installation of the marine HVDC cables will require multiple vessels including cable lay vessels, support vessels (cable burial/trenching, rock placement, route clearance vessels etc), as well as guard vessels to protect exposed sections of cable. The cable laying and support vessels will be large, potentially exceeding 150m in length and will operate Dynamic Positioning 2 systems (DP). The guard vessels (usually fishing vessels appointed to the project) will be much smaller, <50m in length, and will operate conventional positioning systems. While the actual properties of the underwater vessel noise will depend on the vessels selected by the installation contractor, numerous studies have detailed the characteristics of various vessel types ranging from large DP vessels equivalent to the cable lay and support vessels, to smaller tugs and fishing vessels which are analogous to the guard vessels.

Vessel noise from large DP vessels is described as being a low frequency broadband sound, with some tonal components ranging from 30Hz to 3kHz, with sound pressure levels reported between 180 to 197 dB re 1µPa at 1m [Talisman Energy, 2006; Wyatt, 2008; & Xodus, 2014]. Noise from DP vessels does not vary significantly with speed, as a DP system relies on all thrusters working simultaneously, regardless of whether the vessel is moving or holding station. However, noise levels will vary with climatic and tidal conditions, which affect a vessels ability to maintain position, since these factors change the amount of thrust required to keep the vessel in position. In moderate wind, sea state and current; the noise levels can be expected to be lower than in more challenging conditions.

Smaller, non-DP vessels are reported as also emitting broadband noise with tonal components, however the bandwidth is generally lower, concentrated between 50Hz and 2kHz. The reported sound pressure levels are also lower than for the larger DP vessels, and range between 170 to 180 dB re 1µPa at 1m, for a selection of tugs boats and offshore fishing vessels [Richardson, 1995; Walker et al., 2018 & Wyatt, 2008]. Unlike DP vessels, the noise emission levels from these vessels are highly dependent on speed, and these figures are all for vessels at transit speed. As such the noise levels reported here are representative of those when the vessels are travelling between sites, but will overestimate the emission levels when the vessel is in position, since the guard vessels will generally hold a fixed position or only travel slowly around their station.

When compared to the marine mammal and fish hearing thresholds (Tables 23.1 & 23.3), it is clear that vessel noise from both the large DP2, and smaller vessels is detectable to both marine mammals and fish. This source will therefore be considered further in the assessment.

23.5.1.1.2 Subsea Survey Equipment

Pre-installation subsea surveys will be required in order to inform the final cable route design, within the Consenting Corridor. Several acoustic survey devices including multibeam echo sounder (MBES), side scan sonar (SSS), and sub-bottom profiler (SBP) will be utilised to locate natural and man-made objects on the sea bottom, identify geological formations, and determine sub bottom soil characteristics. Similar survey equipment will also be utilised during the installation works, in order to ensure the cables are properly installed. Routine post installation surveys will be utilised during the operational phase, in order to ensure the cables remain properly protected.

MBES is used to create detailed digital terrain models that can be used to define topography and assist in the planning the cable route identifying any constraints. The sound energy produced by a MBES is transmitted directly beneath the unit, in a fan shape. The return signal (echo) that has bounced off the seafloor or other objects is then analysed to produce the terrain model. MBES operates at a sound pressure level of approximately 215 dB re 1µPa at 1m with a peak frequency between 200-400kHz.

SSS is used to determine the texture, topography and character of the seabed sediments and to detect features such as boulders, outcrops, pipelines and other infrastructure lying on, attached to or buried immediately beneath the seafloor. The beam of sound energy produced by SSS is formed into the shape of a fan that sweeps the seafloor directly under the unit, and to either side, typically to a distance of 150m (depending on factors including water depth, and signal strength). The strength of the return echo is continuously recorded, creating a 'picture' of the sea floor. SSS operates in the frequency range 200 - 600kHz with a sound pressure level of between 200-210 dB re 1µPa at 1m.

SBP is used to investigate the shallow (generally < 10m) subsurface structure beneath the seabed, particularly with regard stratification, and soil densities. The SBP directs a focussed acoustic pulse toward the seafloor, parts of this pulse reflect off of the seafloor, while other parts penetrate the seafloor. The portions of the sound pulse that penetrate the seafloor are both reflected and refracted as they pass into different layers of sediment. It is likely that a Chirp SBP system will be used during the pre and post-installation surveys, which operates in a frequency range from 1kHz to 10kHz, with sound pressure levels of between 185-200dB re 1µPa at 1 m.

When compared to the marine mammal and fish hearing thresholds (Tables 23.1 & 23.3), it is clear that MBES and SSS bandwidths are out with the hearing capabilities of any receptor likely to be present in the vicinity of the Consenting Corridor, and hence will not be considered further in this assessment. The SBP however is within the hearing thresholds of both marine mammals and fish, and an impact range will be calculated for this source.

23.5.1.1.3 Horizontal Directional Drilling (HDD)

HDD will be used to link the onshore and marine elements of the cable route, passing underneath the sea cliffs at the UK landfall, to the marine HDD exit which is located approximately 200m from the shore, in 25m of water depth. A land-based rig will be used to drill the HDD ducts from the cliff tops out to sea.

Nedwell et al. [2012] details the findings of underwater noise monitoring conducted during HDD operations in a shallow riverine environment, while drilling was taking place directly below the riverbed. The environment was quiet, with no other potential noise sources, and the resulting underwater noise levels are reported as 129.5dB re 1µPa on the riverbed. The reported sound pressure levels can be considered comparable to those from the proposed NorthConnect HDD operation, and are within the range of the baseline noise levels expected in the area, as detailed in section 23.4. Due to the very low noise levels expected for the HDD operation, this source will not be considered further in this assessment.

23.5.1.1.4 Cable Burial

Once the HVDC cables are laid on the sea bed, they will be buried in order to provide protection from both anthropogenic and natural risks. A variety of tools may be used to bury the NorthConnect HVDC cables, including ploughs, jet trenchers and mechanical trenchers. Little empirical data is available for noise emission levels resulting from cable burial works, due to the fact that the potential impacts of such operations are generally considered to be minimal and hence construction noise monitoring is not a priority [Meißner et al., 2006].

Noise monitoring was conducted during the installation of the offshore transmission cable for the North Hoyle wind farm using a mechanical trencher. The source noise levels were reported to be 178dB re 1µPa at 1m, with a mixture of broadband noise, tonal components, and transients associated with rock breakage. The noise levels were highly variable, and were directly related to the seabed type [Nedwell et al., 2003]. This level is broadly similar to the noise resulting from dredging works (considered by other projects to be a similar activity to cable trenching), which is reported as between 172 - 185dB re 1µPa at 1m [NSN Link Limited, 2014; Richardson et al., 1995; & Xodus, 2014]. The broadband cable installation noise is within the hearing thresholds of both marine mammals and fish, hence an impact range will be calculated for this source.

23.5.1.1.5 Installation of External Protection

External protection will need to be installed over the cable in areas where it cannot be trenched, such as existing infrastructure crossings, and areas of hard ground where trenching cannot be achieved. External protection involves constructing rock berms over the cable (rock placement), or installing other materials such as concrete mattresses or grout bags. Rock placement is considered to be the nosiest external protection method, since the rocks fall down a fall pipe from the rock placement vessel, which may result in underwater noise. Other external protection measures such as mattresses and grout bags will be placed using an ROV or crane, and as such are unlikely to result in any significant underwater noise, so will not be considered further.

Noise monitoring was conducted of the rock placement vessel M/V Rollingstone, while she was working in Yell Sound [Nedwell & Edwards, 2003]. The Rollingstone is capable of placing rock to depths of 600m, and is representative of the rock placement vessels likely to be utilised in the Consenting Corridor. It was found that the noise of rock placement was not detectable over the vessel noise, since there was no determinable difference between measurements taken when rock placement was ongoing, and when the vessel was holding station without placing rock [Nedwell & Edwards, 2003]. Therefore, the noise from rock placement is accounted for under the assessment of vessel noise, and will not be considered further.

23.5.2 Operation and Maintenance

Since the NorthConnect Interconnector will utilise direct current for power transmission in the marine cables, no underwater noise will result from the normal operation of the cable. Periodic surveys, and repairs to the cable will be required, however this will involve similar activities to those detailed for the installation phase, although in much more limited areas. As such no separate assessment will be conducted for the operation and maintenance of the marine cables.

23.5.3 Decommissioning

The removal of the cable from the seabed will not require any equipment or techniques that have the potential to generate greater underwater noise emissions than those considered above. As such the acoustic impact ranges resulting from decommissioning will be equal to or lower those resulting from construction.

23.5.4 Impact Range Calculation

The maximum predicted source noise levels resulting from the installation and operation of the NorthConnect marine HVDC cables have been used together with the effect criteria exposure limits, and noise dissipation model, in order to calculate the maximum predicted impact ranges for marine mammals and fish. The results are summarised in Table 23.5.

Table 23.5. Maximum predicted impact ranges on marine mammals and fish resulting from underwater noise associated with the installation and operation of the marine HVDC cables.

Noise Sensitive Receptor	Effect Criteria	Exposure Limit (dB re 1 µPa)	Maximum Predicted Impact Ranges			
			DP Vessel Noise	Non-DP vessel Noise	Sub Bottom Profiler	Cable Burial
			Source Level 197dB re 1µPa	Source Level 180dB re 1µPa	Source Level 200dB re 1µPa	Source Level 185dB re 1µPa
Marine Mammals	PTS Onset - Cetaceans	230	*Effect Criteria Exposure Limit Not Reached*			
	PTS Onset - Seals	218	*Effect Criteria Exposure Limit Not Reached*			
	TTS Onset - Cetaceans	224	*Effect Criteria Exposure Limit Not Reached*			
	TTS Onset - Seals	212	*Effect Criteria Exposure Limit Not Reached*			
	Disturbance - All Groups	160	293m	22m	464m	46m
Fish	Physical Injury	206	*Effect Criteria Exposure Limit Not Reached*			
	Behavioural Disturbance	150	1359m	100m	2154m	215m

None of the noise sources associated with the installation or operation of the NorthConnect marine HVDC cables are predicted to exceed the injury criteria exposure limits for marine mammals or fish. Therefore, the underwater noise associated with the NorthConnect project poses no risk of injury to marine mammals or fish. However, the exposure limits for disturbance are exceeded for both marine mammals and fish.

For marine mammals, the maximum predicted disturbance range is 464m, resulting from the sub bottom profiler. DP vessel noise results in the next largest disturbance range of 293m, while the noise resulting from the cable burial and non-DP vessel activities have very small predicted disturbance ranges of 46m and 22m respectively.

The exposure limit for disturbance in fish is 10dB re 1µPa lower than that for marine mammals, as such the impact ranges are greater. The sub bottom profiler has the potential to disturb fish to a range of 2154m from the source, while the DP vessel noise has a maximum predicted disturbance range of 1359m. Cable burial and non-DP vessel activities could cause disturbance to maximum ranges of 215m and 100m respectively. It is noted that the 150dB re 1µPa exposure limit for fish disturbance is widely disputed, and considered to significantly over estimate fish sensitivity to noise [Popper et al., 2014]; therefore, these disturbance ranges are likely to be an extremely conservative over estimate.

23.6 Cumulative Effects

Details of the marine projects which could result in cumulative underwater noise effects are provided in Chapter 6. The underwater noise levels and resulting maximum impact range of 2.2km associated with the installation and operation of the NorthConnect HVDC cables are not great enough to result in any cumulative effect with these projects.

23.7 Summary of Effects

The predicted underwater noise emissions from the installation and operation of the NorthConnect marine HVDC cables do not pose any risk of injury to marine mammals or fish, however they do have the potential to cause disturbance to both. The greatest disturbance ranges result from the SBP, which could disturb fish to a range of 2.2km, and marine mammals to 0.5km.

The next largest disturbance ranges result from DP vessel thruster noise, which could disturb fish to a range of 1.4km, and marine mammals to 0.3km. It should be highlighted that the DP vessel thruster noise resulting from the NorthConnect project is set against the of the background of the North Sea oil and gas activities; DP vessels are utilised regularly by the oil and gas industry to support the offshore infrastructure in the North Sea. The Consenting Corridor passes through an area with numerous oil and gas assets, so DP vessels will regularly operate in the vicinity of the corridor, so this noise source is unlikely to be considered a significant change from baseline conditions.

The disturbance ranges resulting from the Cable installation works, and the non-DP vessel noise are all below 0.2km and hence are unlikely to result in any significant impact to marine mammals or fish.

23.8 References

Ainslie, M. A., de Jong, C. A. F., Dol, H. S., Blacquière, G. and Marasini, C., 2009. Assessment of natural and anthropogenic sound sources and acoustic propagation in the North Sea. TNO-report TNO-DV 2009 C085.

Bailey, H., Senior, B., Simmons, D., Rusin, J., Picken, G., & Thompson, P. M., 2010. Assessing underwater noise levels during pile-driving at an offshore windfarm and its potential effects on marine mammals. Marine pollution bulletin, 60(6), 888-897.

McDonald, M.A., Hildebrand, J.A., Wiggins, S.M., Ross, D., 2008. A 50-year comparison of ambient ocean noise near San Clemente Island: a bathymetrically complex coastal region off Southern California. J. Acoust. Soc. Am. 124, 1985–1992.

Meißner K, Schabelon H, Bellebaum J, and Sordyl H, 2006. Impacts of submarine cables on the marine environment: a literature review. Federal Agency of Nature Conservation/ Institute of Applied Ecology Ltd.

Merchant, N. D. *et al*. 2016. Underwater noise levels in UK waters. *Sci. Rep*. **6**, 36942; doi: 10.1038/srep36942.

Nedwell J., & Edwards B., 2004. A review of the measurements of underwater man-made noise carried out by Subacoustech Ltd 1993 – 2003. Subacoustech 134.

Nedwell J., Langworthy J., & Howell D., 2003. Assessment of sub-sea acoustic noise and vibration from offshore wind turbines and its impact on marine wildlife; initial measurements of underwater noise during construction of offshore wind farms, and comparison with background noise. Report No. 544 R 0424.

Nedwell, J. R., Parvin, S. J., Edwards, B., Workman, R., Brooker, A. G., & Kynoch, J. E., 2007. Measurement and interpretation of underwater noise during construction and operation of offshore windfarms in UK waters. Subacoustech Report to COWRIE Ltd.

Nedwell, J.R., Brooker A.G., and Barham R.J., 2012. Assessment of Underwater Noise During the Installation of Export Power Cables at the Beatrice Offshore Wind Farm. Report No. E318R0106.

NSN Link Limited, 2014. Norway - UK Interconnector. UK Marine Environmental Statement. National Grid.

Popper A N, Hawkins A D, Fay R R, Mann D A, Bartol S, Carlson T J, Coombs S, Ellison W T, Gentry R L, Halvorson M B, Løkkeborg S, Rogers P H, Southall B L, Zeddies D G, Tavolga W N, 2014. Sound Exposure Guidelines for Fishes and Sea Turtles. Springer Briefs in Oceanography, DOI 10. 1007/978-3-319-06659-2.

Richardson, W.J., Fraker, M.A., Wuersig, B., and Wells, R.S., 1995. Behaviour of bowhead whales, *Balaena mysticetus* summering in the Beaufort Sea: Reactions to industrial activities. Biological Conservation, 32: 195-230.

Robinson, S., Theobald, P., Hayman, G., Wang, L., Lepper, P., Humphrey, V., & Mumford, S. 2011. Measurement of noise arising from marine aggregate dredging operations. MALSF, 978 (0907545), 57.

Slabbekoorn, H., Bouton, N., van Opzeeland, I., Coers, A., ten Cate, C., Popper, A.N., 2010. A noisy spring: The impact of globally rising underwater sound levels on fish. Trends in Ecology and Evolution 25 (7), 419–427.

Southall B. L., Bowles A. E., Ellison W. T., Finneran J. J., Gentry R. L., Greene Jr. C. R., Kastak D., Ketten D. R., Miller J. H., Nachtigall P. E., Richardson W. J., Thomas J. A., and Tyack P. L., 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. Aquatic Mammals 33, 411 - 521.

Talisman Energy (UK) Ltd, 2006. Noise impact assessment for Beatrice Demonstration Wind Farm.

Theobald, P., Pangerc, T., Wang, L., & Lepper, P. 2013. Environmental Statement Chapter 13 Appendix H - NPL Underwater Noise Technical Report.

Walker T., Adebambo O., C Del M., Feijoo A., Elhaimer E., Hossain M.T., Johnston Edwards S., Morrison, C., Romo J., Sharma N., Taylor, S., & Zomorodi, S., 2018. Environmental Effects of Marine Transportation. 1-27. 10.1016/B978-0-12-805052-1.00030-9.

Wyatt, R., 2008. Joint Industry Programme on Sound and Marine Life Review of Existing Data on Underwater Sounds Produced by the Oil and Gas Industry - Issue 1. Ref. S186.

Xodus, 2014. Marine noise inputs. Technical Note on Underwater Noise for Statoil's Hywind Project.

Chapter 24: Resource Usage and Waste

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Contents

24 Resource Usage and Waste

24.1 Introduction

This chapter provides an understanding of the resources required to construct and install the HVDC cables and infrastructure, both onshore and offshore. In addition, it identifies the main sources of wastes arising. The proposed material and waste management to mitigate environmental effects, as far as practicable, are also detailed.

24.2 Planning and Legislative Framework

24.2.1 Policy

In 2010 the Scottish Government published Scotland's Zero Waste Plan (Scottish Government, 2010), which sets out the government's vision for a sustainable and resource efficient future. While the sustainable resourcing aspect of the vision is still to be brought into the legislation, NorthConnect will strive to fulfil the following two components of the vision:

> *'Individuals, the public and business sectors - appreciate the environmental, social and economic value of resources, and how they can play their part in using resources efficiently.'*

And;

> *'Reduce Scotland's impact on the environment, both locally and globally, by minimising the unnecessary use of primary materials, reusing resources where possible, and recycling and recovering value from materials when they reach the end of their life.'*

The Scottish Government's general policies require the consideration of marine litter:

- **GEN11 Marine Litter**: Developers, users and those accessing the marine environment must take measures to address marine litter where appropriate. Reduction of litter must be taken into account by decision makers (Scottish Government, 2015).

In addition, the Scottish Government in 2014 developed "A Marine Litter Strategy for Scotland". The development and implementation of which is led by Marine Scotland. Consideration is given that responsibility for delivery lies across all local and national business, environmental and community groups, governments and individuals (Marine Scotland, 2014). The strategy aims to fulfil the vision of:

> *"clean, healthy, safe, productive and biologically diverse marine and costal environment that meets the long-term needs of people and nature"*

The strategy builds upon previous work and initiatives by detailing five strategic directions to assist in the delivery of the Marine Strategy Framework Directive, the first two of which are directly relevant in the context of the NorthConnect project:

1) *Improve public and business attitudes and behaviours around marine and coastal litter, in co-ordination with the national litter strategy; and*
2) *Reduce marine and coastal based sources of litter, in co-ordination with land sourced litter being reduced by the national litter strategy (Marine Scotland, 2014).*

24.2.2 Regulatory Framework

24.2.2.1 Waste management

Section 34 of the Environmental Protection Act 1990 (As Amended) (UK Parliament, 1990) lays out a duty of care for waste producers. It states that waste must be managed correctly by storing it properly, only transferring it to the appropriate persons and ensuring that when it is transferred it is sufficiently well described to enable its safe recovery or disposal without harming the environment.

The Waste (Scotland) Regulations 2012 (Scottish Ministers, 2012) amended Section 34 of the Environment Protection Act to implement a number of actions in the Scottish Government's Zero Waste Plan. Under these amendments, holders of waste, including producers, have a duty to take reasonable steps to increase the quantity and quality of recyclable materials. This includes implementing the waste hierarchy and promoting high quality recycling.

The Special Waste Regulations 1996 (As Amended) (UK Parliament, 1996) controls the movements of hazardous or special waste. The law refers to a list of materials in the schedule of the act, including oils and alkaline solutions. Special wastes must be disposed of or treated by specifically licensed facilities and covered by separate consignment notes. Mixing of special wastes is strictly prohibited.

The Waste Management Licensing (Scotland) Regulations 2011 (Scottish Ministers, 2011) lay out licensing requirements for waste management facilities and mobile plant.

24.2.2.2 Controlled Activities Regulations

The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) (CAR) (Scottish Goverment, 2011) as explained in Chapter 10: Water Quality (Onshore), are intended to control activities which have the potential to cause pollution to the water environment.

2017 amendments to CAR included the requirements for oil storage, previously provided for in the Water Environment (Oil Storage) (Scotland) Regulations (Scottish Ministers, 2006), being included as General Binding Rules (GBR).

24.2.3 Guidance

14.1.1.1 Waste Hierarchy

Guidance on waste management in Scotland is provided in the document Guidance on Applying the Waste Hierarchy (Scottish Government 2013). This guide sets out how to apply the waste hierarchy. The waste hierarchy identifies the prevention of waste as the highest priority, followed by reuse, recycling, recovery of other value (e.g. energy), with disposal as the least desirable option. This principal has been used throughout the design phase of NorthConnect and will continued to be implemented moving into construction, operation and, if required, decommissioning.

14.1.1.2 Pollution Prevention Guidelines

Pollution Prevention Guideline Note (PPG) 6: Work at Construction and Demolition Sites (SEPA, 2014), provides guidance on the storage of materials and oils, waste management, the use of cement and management of cement washings.

For above ground oil storage tanks, Guidance on Pollution Prevention 2 (GPP2) (NIEA, SEPA, & Natural Resources Wales, 2017) provides information on how fuel oil should be stored, including a very useful checklist for oil storage tanks.

24.3 Assessment Methodology

It is not proposed that an assessment of effect significance is undertaken in this Chapter, as per the approach detailed in Chapter 3. Instead, as discussed in the scoping report (NorthConnect, 2016), it is proposed that the construction materials are identified and quantified in terms of volume and environmental lifecycle cost, and an understanding of the environmental impacts associated with the materials given, to facilitate the minimisation of effects.

24.3.1 Resource and Waste Identification and Quantification

Resources that have been identified through the design process to date are included in this document and, where possible, initial estimates of quantities provided, with assumptions made, are detailed. It should be noted that the final routing, installation and design for the HVDC Cables and Infrastructure will be determined by the Cable Contractor and, as such, accurate detailed design figures are not all available at this stage.

Potential waste streams arising are based on the existing knowledge of the project. However, due to the lack of specific detail available at this point, it cannot be assumed to be comprehensive. Nevertheless, it gives an indication of the main waste types expected.

24.3.2 Mitigation and Management

Mitigation and management techniques proposed with regards to both resource use and waste management are based primarily on construction best practices. The waste hierarchy has been employed throughout to minimise environmental impacts.

24.4 Material and Waste Quantification

24.4.1 Construction

24.4.1.1 Materials

During construction, various types and volumes of material will be required for the installation of the HVDC cables, both onshore and in the marine environment. Materials required are detailed in Table 24.1. The majority of materials utilised are the cables themselves and then the rock associated with cable protection and temporary construction measures. The material usage has an intrinsic carbon cost, as discussed in Chapter 9: Air Quality.

The construction machinery will require onsite refuelling, hence diesel will be stored on the site for this purpose in the likely form of mobile fuel bowsers, holding approximately 1000l of diesel. A range of oils and chemicals will be required for machinery and maintenance, including hydraulic oils, are anticipated. Vessels requiring refuelling will utilise the nearby bunkering facilities at either Peterhead or Aberdeen ports. Delivery vehicles onshore are expected to refuel at local fuel stations.

The HDD operation is likely to utilise a bentonite drilling fluid, although alternatives are available and may be selected by the principal contractor. Bentonite is a silicate-based non-toxic fluid that increases drilling efficiency.

The HDD drilling operations also require a water supply of suitable quality and flow rate. A main water supply adjacent to the A90 will be utilised, by creating a temporary connection to pipe the water to the HDD site. The water will also be utilised for the welfare facilities. Generators will be utilised to provide power at the HDD entrance sites.

Cement is required for onshore cable protection, waterstops and joint pit formation, and most components will be pre-cast off site and delivered ready for installation. If elements need to be poured in-situ, ready mix will be utilised, hence, there will be no onsite cement production specifically for the HVDC cable installation.

Table 24.1 Material required for the HVDC cable installation both on and offshore.

Material	Use	Volumes/Area/Lengths	Assumption	Specific Gravity	Tonnages
HVDC cable	Interconnector between Scotland and Norway.	2 HVDC Cables each 232km in length – total length 464km Plus test cable 0.5km long.	UK Cables only, 230km marine cables 2km onshore cables. Test Cable will be removed.	52 kg/m	Approximately 24,154 tonnes.
Fibre optic cable	Communication cable between converter station in Scotland and Norway.	232km length.	UK Cables only, 230km marine cables 2km onshore cables	1.7 kg/m	Approximately 395 tonnes.
Gravel (2mm≤ Gravel < 64mm)	Rock protection of cables	10,000m^3	Rock protection, the anticipated rock grading to be used is 1”-5” (CP45/125mm), with D10 45mm, D50 80mm, D90 125mm, with an installed bulk density of 1.5 – 1.7 tonnes/ m^3.	1.7 tonnes/m^3	17,000 tonnes
Cobbles (64mm ≤ Cobbles <256mm)		90,000m^3		1.7 tonnes/m^3	153,000 tonnes
Landfall HDD cable ducts	Cable ducts for Landfall HDD	3 times 450m	Three ducts, of 0.6m external diameter and 450m in length.		
Landfall HDD Equipment	Bellmouths and Duct Seals Bell mouths are attached to the end of the HDD Ducts to help guide the cables into the ducts. Once the cable is in place the duct seal is fitted.	3 of each.			
Concrete Matressing	Upto 2 No. concrete mattresses (18m2 each) will be placed over each of the 3 No. HDD marine exit points, to protect them prior to cable pull.	6 No. 18m^2 = 108m^2	Will be removed from seabed when cable is installed.		
Concrete	Joint pits, cable covers and waterstops.	600m^3.	Two joining pits of 20m length and 4m width.		

Material	Use	Volumes/Area/Lengths	Assumption	Specific Gravity	Tonnages
Stone fill surfacing, Type 1 grade or similar.	Temporary HDD access road, cable trench haul road and HDD sites.	Approximately 5275m^3.	4m wide, 450m length and 750mm thick access road. 1.6km of 3.5m wide haul road thickness of 400mm. HDD Compound 3370m^2 by 500mm deep.	1.9tonnes/m^3	Approximately 10,000 tonnes.
Onshore Cable Ducts	Road Crossing HDD, core path crossing and on the Fourfields site.	~ 600 to 1,200m	3 ducts total 200 to 400m in length.		
Sand	Trench bedding for cables	1,200m^3	0.5m deep, approx 2m wide approx. 1.2km long	1 tonne/m3	1,200 tonnes
Bitumen	Inital section of temporary HDD access road.	75m^3	Bellmouth plus 4m wide 50m long section 250mm deep	0.72tonnes/m3	54 tonnes
Protector Piping	Piping that acts as a sleeve on the cable to protect the cable at marine crossings.	1080m external diameter ~200mm	30m per cable per crossing, 18No. Crossing.		
Bentonite	Drilling fluid	HDD operation at landfall site - 192 tonnes of powdered bentonite HDD operation at road crossing - 30 tonnes of powdered bentonite for HDD operation at road crossing.	HDD operation landfall site - 1 tonnage bentonite with 64 tonnes per hole, 3 holes. HDD operation at road crossing 10 tonnes per hole, 3 holes.		222 tonnes
Fuel: Diesel and Marine Fuel Oil	Site Machinery and Vessels	600 to 1,000 tonnes			600 to 1,000 tonnes
Hydrocarbons: Oils, and hydraulic fluids	Site machinery maintenance and construction and guard vessels.	Small-scale for maintenance.	Utilisation during maintenance works.		
Miscellaneous consumables	Welfare facility, vessel, equipment, machinery consumables.				
Timber	Concrete shuttering, fencing etc				

24.4.1.2 Waste

A list of wastes likely to be produced during the construction works and their sources are provided in Table 24.2. It is not possible to give accurate quantities of waste at this point, but available indications have been provided. Consideration is also given as to how the waste hierarchy will be implemented for each waste stream.

During the marine works, there is a potential that abandoned or lost fishing nets and other man-made items will be encountered, especially during seabed preparation works. These will be removed from the sea and taken onboard the vessel for appropriate disposal upon return to port.

Table 24.2: Potential Construction Waste Arisings.

Waste	Source	Waste Hierarchy	Comments
Soils	Excess material arising from onshore cable installation activities.	Soils will be reused where practicable onsite, where	1,200m^3 of sand is being utilised in the trenches this will displace soils, however compaction of placed materials will determine the actual waste volumes (tonnages arising).
Stone fill surfacing, Type 1 grade or similar.	Temporary HDD access road, cable trench haul road and HDD sites.	Aggregate can be reused for other construction works.	5275m^3 (10,000 tonnes)
Bitumen	Temporary access road removal	Bitumen can be recycled for reuse in construction products.	75m^3 (55 tonnes)
Concrete Mattresses	Concrete mattresses removed from the HDD marine exit points.	Concrete mattresses, if in a suitable condition could be reused on another project. Alternatively, they can be broken up and recycled as aggregate.	6 mattresses.
Welfare Wastes	Welfare facilities onshore and onboard vessels	Wastes appropriately segregated to facilitate recycling where practicable.	
HDD Drilling Fluids	From Landfall and Road Crossing HDD works.	Fluids treated and reused on site, to minimise volumes of waste arising. Waste will be tankered off site for treatment, liquids will probably be removed allowing solids to be landfilled.	
Consumables including: packaging wastes and waste oils.	Vessel and equipment maintenance activities will give rise to wastes.	Wastes appropriately segregated to facilitate recycling where practicable.	
Cement Washings	Cleaning of tools and equipment which have been in contact with cement.	Washings collected, settled and if required pH corrected to allow resultant waters to be discharges appropriately. Solids if suitable may be recycled as aggregate.	
Telecommunication Cables	Out of service cables removed from seabed prior to cable lay.	If suitable the cables will be recycled.	2 lengths of cable up to 2km each.
Timber	Cement shutterings, pallets from packaging etc.	Wood can be reused, recycled, mulched, for burned with heat recovery depending on its form.	

24.4.2 Operation

24.4.2.1 Maintenance

Over time, maintenance activities for the HVDC cable may be required. During these activities, it is likely that similar consumable material, such as fuel and maintenance oils as detailed in Table 24.1, will be required, but in much smaller volumes. Sections of cable could be replaced, the lengths of which will be determined by the nature of the damage, but it will be a fraction of that required for the original installation, e.g. 0.5 – 1km lengths. Similarly, areas of rock protection may need to be augmented leading to small volume of additional rock placement.

Waste arising from maintenance will primarily involve small volumes of consumables.

24.4.3 Decommissioning

During decommissioning it is likely that the majority of the cables will be removed. As detailed in Table 24.1 there will be 24,154 Tonnes of HVDC Cabling and 395 Tonnes of fibre optic cable which will become waste at the point of decommissioning. One of the drivers for removing the cables is to recover the materials due to their value. Cables recovered during decommissioning, will be stripped, and materials recycled where practicable.

24.5 Mitigation Measures

Mitigation measures associated with the storage and management of materials and waste are laid out below.

24.5.1 Procurement

The procurement strategy for NorthConnect will be rolled down through the principal contractor and their supply chain. It will include the need for due consideration to sustainability, consideration of components and materials lifecycle cost, including their ability to be recycled. Where possible, materials should be sourced locally to minimise impacts associated with transport to site and to maximise the projects benefits to the local economy.

24.5.2 Fuels, Oils and Chemicals

The fuel bowsers will be under strict management controls to prevent pollution incidents, secured to protect against oil thefts and tampering and to comply with the CAR General Binding Rules (GBR) 26 and 28 for oil storage. The fuel bowsers will be double skinned with a level site gauge and stored in an appropriate area away from aquatic environments where it is protected from vehicle damage. They will be locked when not in use, with the keys under management control to ensure appropriate use and accountability. Refuelling will be carried out away from watercourses, by trained operatives following site refuelling procedures. The refuelling procedure will take into account the CAR GBR's and best practice laid out in GPP2 (NIEA et al., 2017) and PPG6 (Environmental Agency, NIEA, & SEPA, 2012).

Where practicable, bio-degradable hydraulic fluids will be utilised in machinery during construction. All oils and chemicals will be subject to Control of Substances Hazardous to Health (COSHH) assessments under the COSHH Regulations (UK Government, 2002). All COSHH assessments will include a section on the environment to highlight any particular precaution or mitigation requirements. Oils and chemicals will be appropriately stored and managed.

Appropriately bunded oil and chemical storage cabinets will be utilised. These will be kept locked, with the keys under management control to ensure appropriate use and accountability.

Bentonite utilised for the HDD drilling activity is expected to arrive at site in a powder form in 1 tonne bags. The dry bentonite is required to be mixed with water to produce the drilling fluid for the HDD operation. Significant disturbance to large volumes of powdered bentonite may give rise to dust, causing potential environmental and human harm as detailed in Chapter 9: Air Quality. Therefore, volumes of bentonite stored at site will be minimised to those required for the operation and, when not in use, bentonite bags will be covered to prevent loss of the powder.

24.5.3 Waste Management

The waste hierarchy shall be utilised throughout the project. To facilitate this, waste shall be appropriately sorted and segregated. In Scotland, The Waste (Scotland) Regulations 2012 include specific requirements regarding the segregation of waste. NorthConnect will have developed an overarching Site Waste Management Plan for the UK elements of the project as part of the Construction Environmental Management Plan (CEMP). The Cable Contractor will be responsible for the preparation of a detailed Site Waste Management Plan specific to their scope of works. This shall align with the overarching Site Waste Management Plan (SWMP). Through the preparation of this plan, the design and construction works will seek to minimise the creation of waste throughout the project lifecycle.

The Cable Contractor will maximise opportunities for reducing, segregating and recycling of waste. The Cable Contractor will also ensure waste storage is safely maintained and managed, such that waste segregation is ensured, and escape of waste materials prevented.

Compliance with all relevant waste regulations will be ensured, including the retention of waste transfer notes and copies of licences. Under duty of care, it will be ensured that all wastes are dispatched to an appropriately licenced facility.

The use of single-use plastics will not be permitted wherever reasonable alternatives are available and, if they have to be utilised, then recycling arrangements shall be in place.

Cement washings will be carried out in a dedicated area. Washing arisings will be collected for onsite treatment. This will include settlement and, if required, pH correction. The liquids will be reused on site as grey water, if suitable, or disposed of via a consented waste route. The solids will be disposed of as solid waste potentially to be recycled as aggregate.

24.5.4 Litter

The close proximity of the onshore cable site to the marine environment makes it likely that any litter left could enter the marine environment. Similarly, loose materials or littering on the vessels could lead to litter entering the marine environment.

All personnel working on the project will need to undertake site induction. This will include a section on waste management and the use of the waste receptacles provided. It will be made clear that littering will not be tolerated. The use of single use plastics will be discouraged, and reusable crockery and cutlery will be provided in the welfare facilities.

Environmental walk rounds or Health & Safety inspections will identify if littering is becoming an issue on the construction site, or vessels, allowing corrective action to be taken. Similarly, appropriate storage of materials and waste, and regular checks of arrangements on the vessels, will aid in ensuring marine litter is not created.

Following the completion of the onshore works, a full litter sweep will be conducted.

24.6 Summary

The construction phase of the HVDC cable will utilise multiple raw materials, the largest of which are the cables and associated rock protection. Appropriate materials storage arrangements will be put in place with relevant legislation and best practice. The waste hierarchy and good waste management practices will be employed to manage waste arising. During operation, minimal resource usage and waste generation is expected during maintenance works.

24.7 References

Environmental Agency, NIEA, & SEPA. (2012). *PPG 6: Work at Construction and Demolition Sites*. Retrieved from http://www.netregs.org.uk/environmental-topics/pollution-prevention-guidelines-ppgs-and-replacement-series/guidance-for-pollution-prevention-gpps-full-list/.

Marine Scotland. (2014). A Marine Litter Strategy for Scotland.

NIEA, SEPA, & Natural Resources Wales. (2017). GPP 2: Above ground oil storage tanks.

NorthConnect. (2016). *HVDC Cable Route Scoping Report*.

Scottish Goverment. (2011). The Water Environment (Controlled Activities) (Scotland) Regulations 2011. In: Scottish Parliament.

Scottish Government. (2010). *Scotland's Zero Waste Plan*. Edinburgh, UK: The Scottish Government.

Scottish Government. (2013). Guidance on Applying the Waste Hierarchy.

Scottish Government. (2015). Scotland's National Marine Plan: A Single Framework for Managing our Seas. In. Edinburgh Scottish Government.

Scottish Ministers. (2011). The Waste Management Licensing (Scotland) Regulations 2011

Scottish Ministers. (2012). The Waste (Scotland) Regulations 2012.

SEPA. (2014). Pollution Prevention Guidance (PPG) 6: Work at Construction and Demolition Sites.

Chapter 25: Schedule of Mitigation

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Contents

25 Schedule of Mitigation

25.1 Introduction

Mitigation measures, which have been identified throughout the Environmental Impact Assessment (EIA) process, are collated within this chapter to form the Schedule of Mitigation (SoM) for the HVDC Cable Infrastructure elements of the NorthConnect project. The mechanisms by which they will be implemented are also provided.

25.2 Schedule of Mitigation

The mitigation measures identified in the various EIA Report (EIAR) chapters for the different stages and aspects of the installation and operation of the NorthConnect HVDC Cable Infrastructure, are collated together in Table 25.1. References to the relevant sections of the EIAR and other associated guidance documents are also provided.

Table 25.1. Schedule of Mitigation

<table>
<tr><th>Topic</th><th>Stage</th><th>Aspect</th><th>Mitigation/Enhancement Management</th><th>Associated Guidance</th><th>EIAR Reference</th></tr>
<tr><td rowspan="5">Seabed Quality</td><td rowspan="5">HVDC Marine Cable Installation</td><td>Reduction in sediment quality through loss of containment of hazardous substances by installation spread.</td><td>Adherence to mitigation detailed in Chapter 11: Water Quality (Marine Environment).</td><td>International Convention for the Prevention of Pollution from Ships (MARPOL)</td><td>Chapter 11 Section 11.5.4</td></tr>
<tr><td rowspan="4">Disturbance and loss of seabed features and release of hazardous substances through inadvertent UXO detonation.</td><td>A UXO survey will be conducted prior to installation works commencing.</td><td rowspan="4">CIRIA: Assessment and management of unexploded ordnance (UXO) risk in the marine environment (C754)</td><td rowspan="4">Chapter 7 Section 7.5.5</td></tr>
<tr><td>Where potential UXO are identified, the areas will be avoided by an appropriate safety buffer.</td></tr>
<tr><td>Where avoidance is not possible, the UXO items will be disposed of by an appropriately licenced explosives ordnance disposal contractor, or by the Royal Navy.</td></tr>
<tr><td>A UXO risk assessment will be undertaken by the installation contractor.</td></tr>
<tr><td rowspan="3">Geology and Hydrogeology</td><td rowspan="3">HVDC Onshore Cable Installation</td><td>Disturbance of topsoil during cable installation works, HDD site preparation and jointing pit installations.</td><td>All removed topsoil will be reinstated and the land returned to its former use.</td><td>PPG6: Working at Construction and Demolition Sites</td><td>Chapter 8 Section 8.4.1.1</td></tr>
<tr><td>Release of hazardous substances impacting soil, rock or groundwater.</td><td>Adherence to mitigation detailed in Chapter 10: Water Quality (Onshore) regarding pollution prevent, and appropriate material storage in Chapter 24: Resource Usage and Waste.</td><td>GPP 5: Works and Maintenance in or Near Water</td><td>Chapter 10 Section 10.6.1 Chapter 24 Section 24.5.2</td></tr>
<tr><td>Encountering of groundwater during cable installation has the potential to cause hydrogeological effects.</td><td>Where dewatering during construction works is required, the CAR compliance will be ensured.</td><td>GPP 5: Works and Maintenance in or Near Water</td><td>Chapter 8 Section 8.4.1.4 & Chapter 10 Section 10..5.1.3</td></tr>
<tr><td>Air Quality</td><td>General Onshore HVDC Cabling</td><td>Earthworks may see dust deposition, resulting in soiling of surfaces.</td><td>Development of Dust Management Plan.</td><td>PPG6: Working at Construction and Demolition Sites</td><td>Chapter 9 Section 9.7.1</td></tr>
</table>

Topic	Stage	Aspect	Mitigation/Enhancement Management	Associated Guidance	EIAR Reference
Air Quality	General Onshore HVDC Cabling	Earthworks may see dust deposition, resulting in soiling of surfaces.	Appropriate planning to minimise movement of material during earthworks.	Guidance on the Assessment of dust from demolition and construction	Chapter 9 Section 9.7.1
			Minimisation of the time ground is left bare.		
			Compacting of removed soil during cable trench refilling, reducing the amount of loose material and reducing the potential for dust.		
			Installation of directional dust deposit gauges 2 weeks prior to construction works, to gain understanding of background levels. The gauges will also be utilised throughout the construction period, with monitoring results reviewed to ensure employed mitigation is effective.	Guidance on Air Quality Monitoring in the Vicinity of Demolition and Construction Sites	
			Dust audits will be undertaken. A checklist will be utilised to ensure all issues are covered and recorded. The audit will include: material storage status; use of dust covers by delivery vehicles; inspection of the access roads and the A90; and looking for signs of surface soiling on surfaces around site. Dust audits will be carried out more frequently in periods of dry weather and when cable trenches are open.		
			Utilisation of mobile water bowsers or equivalent during dry weather conditions to damp down potential dust sources and, where possible, they will utilise runoff water gathered on the site.		
			Overburden material removed at the Landfall HDD site will be used to create temporary bunds on which vegetation is allowed to establish, binding the soil and reducing potential dust.		
	General Onshore HVDC Cabling	Potential of trackout from construction sites depositing on public roads and leading to dust spread beyond the site boundaries.	Material transported by vehicles will be covered to prevent material escape.	PPG6: Working at Construction and Demolition Sites	Chapter 9 Section 9.7.1
			The access road will be appropriately surfaced such that vehicles returning to the A90 will travel over clean stone and bituminous surfaces for at least 50m.		

Topic	Stage	Aspect	Mitigation/Enhancement Management	Associated Guidance	EIAR Reference
Air Quality	General Onshore HVDC Cabling	Potential of trackout from construction sites depositing on public roads and leading to dust spread beyond the site boundaries.	Monitoring of signs of trackout, with appropriate action taken if problems are identified, such as water-assisted dust sweeper(s) utilised on A90 and bituminous section of access roads.	Guidance on Air Quality Monitoring in the Vicinity of Demolition and Construction Sites	Chapter 9 Section 9.7.1
	General Onshore HVDC Cabling	Potential of trackout from construction sites depositing on public roads and leading to dust spread beyond the site boundaries.	Dust audits will be undertaken. A checklist will be utilised to ensure all issues are covered and recorded. The audit will include: material storage status; use of dust covers by delivery vehicles; inspection of the access roads and the A90; and looking for signs of surface soiling on surfaces around site. Dust audits will be carried out more frequently in periods of dry weather and when cable trenches are open.	Guidance on Air Quality Monitoring in the Vicinity of Demolition and Construction Sites	Chapter 9 Section 9.7.1
			Rumble strips will be installed on the access road at least 45m before exit onto the A90 to assist in the removal of mud from wheels.		
Water Quality (Onshore)	General Onshore HVDC Cabling	Release of Hazardous Substances	Adherence to mitigation detailed in Chapter 24: Resource Usage and Waste with regard to the storage of materials.	GPP 5: Works and Maintenance in or Near Water	Chapter 24 Section 24.5.2
			Spill response plan in place.	GPP 21: Pollution Incident Response Planning	Chapter 10 Section 10.6.1
			Spill kits available.	GPP 5: Works and Maintenance in or Near Water	
			Site personnel are trained in the spill response plans.	PPG 22: Incident Response - Dealing with Spills	
				PGG 18: Managing Fire Water and Major Spillages	
	General Onshore HVDC Cabling	Surface water runoff from trenching earthworks with potential to reach watercourses or waterbodies, leading to potential sediment loading of water column and pollutant entry.	Clean water will be diverted away from exposed soils and work areas.	GPP 5: Works and Maintenance in or Near Water.	Chapter 10 Section 10.6.2
			Silt fences or equivalent (straw bales) will be utilised in the vicinity of watercourses to prevent silt laden water reaching the watercourses.		
			Stabilising of soil as soon as practical (refilling trenches and reinstating vegetation).		
	Enabling Works		Where viable, the surface vegetation and upper layer of topsoil is removed as 'turf', which will be utilised to cover topsoil bunds.		Chapter 10 Section 10.5.1.2

Topic	Stage	Aspect	Mitigation/Enhancement Management	Associated Guidance	EIAR Reference
Water Quality (Onshore)	General Onshore HVDC Cabling	Surface water runoff from trenching earthworks with potential to reach watercourses or waterbodies, leading to potential sediment loading of water column and pollutant entry.	Where stored soils are not covered, they will be bladed off or other suitable means to reduce the potential for dust and silt run-off.	GPP 5: Works and Maintenance in or Near Water.	Chapter 10 Section 10.5.1.2
			A Pollution Prevention Plan will be produced.		
			A CAR Construction Licence will be obtained.		
	General Onshore HVDC Cabling	Potential for Flooding	Field drains found during the works will be maintained or replaced as necessary.		Chapter 10 Section 10.5.1.4
			A Pollution Prevention Pan will be produced.		
			A CAR Construction Licence will be obtained.		
	General Onshore HVDC Cabling	Physical disturbance of watercourse during culvert insertion and cable installation.	Stream to be dammed up and down stream of the crossing point for the duration of the works.	Engineering in the Water Environment: Good Practice Guide Temporary Construction Methods	Chapter 10 Section 10.5.1.3
			Prior to the removal of dams, culverts will be cleared of loose material.		
			Water to be pumped from upstream of the crossing point to downstream of the crossing point, such that flows up and downstream of the crossing point are maintained throughout.	GPP 5: Works and Maintenance in or Near Water.	
			Vegetation clearance will be minimised.		
			Silt fences installed as required to prevent silt spreading down stream of construction works.	CAR GBR6: Construction and Maintenance (or removal) of a temporary bridge over a river, burn or ditch that has a channel width of less than 5 metres	
Water Quality (Marine Environment)	HDD Drilling	HDD drilling fluid discharges to the marine environment leading to increased sediment loading for the water column.	The drilling will stop before drilling through the HDD marine exit point. Excess fluid will be extracted before the final drilling reaches the marine exit point.	GPP 5: Works and Maintenance in or Near Water.	Chapter 11 Section 11.5.1.1
	HVDC Marine Cable Installation	Release of hazardous substances from cable installation vessels.	Vessels to have shipboard oil pollution emergency plans (SOPEP).	International Convention for the Prevention of Pollution from Ships (MARPOL)	Chapter 11 Section 11.5.1.4.1
			Vessels to be well maintained.		
			Operators suitably trained in pollution response.		
			Spill kits available.		

Topic	Stage	Aspect	Mitigation/Enhancement Management	Associated Guidance	EIAR Reference
Water Quality (Marine Environment)	HVDC Marine Cable Installation	Damage to an existing subsea pipeline leading to a release of hazardous substances.	Crossing agreements in place with asset owners. Detailed crossing engineering and cooperation with asset owners. Asset owners have contingency plans in place in case of damage to pipelines.	International Cable Protection Committee (ICPC) Recommendations	Chapter 11 Section 11.5.1.4.3
	General Marine HVDC Cabling	Waste water release from installation vessels.	Vessels compliant with MARPOL convention.	International Convention for the Prevention of Pollution from Ships (MARPOL)	Chapter 11 Section 11.5.1.4.2
	General Marine HVDC Cabling	Introduction of invasive non-native species through ballast water.	Compliance with the International Convention for the Control and Management of Ships' Ballast Water and Sediments Convention.	International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM)	Chapter 11 Section 11.5.1.5
		Introduction of invasive non-native species through biofouling of vessel and equipment.	Requirement for sourced vessels from outside the North Sea to be cleaned and inspected prior to mobilisation.	GreenBlue MNNS Guidance The Guidelines for the control and management of ships' biofouling to minimise the transfer of invasive aquatic species (Biofouling Guidelines) (resolution MEPC.207(62))	
Archaeology and Cultural Heritage	HVDC Onshore Cable Installation	Potential damage to the Boddam Branch, great North of Scotland Railway from cable installation works.	Any vehicular movement to access the working area for Joint Pit 1 and the HDD site to the south of the railway will be from the southwest, off the temporary access track after it has crossed the railway. An archaeological watching brief will be undertaken to monitor ground breaking works associated with the forming of the temporary water main and access track which cross the railway where there is a shallow cutting. Where feasible, the existing engineered surfaces will be retained and overlain by a new temporary structure.	PAN 2/2011: Planning and Archaeology	Chapter 12 Section 12.6

Topic	Stage	Aspect	Mitigation/Enhancement Management	Associated Guidance	EIAR Reference
Archaeology and Cultural Heritage	HVDC Onshore Cable Installation	Potential damage to the Boddam Branch, great North of Scotland Railway from cable installation works.	Upon completion of works, the original platform of the railway cutting will be restored to maintain the integrity of the linearity of the monument.	PAN 2/2011: Planning and Archaeology	Chapter 12 Section 12.6
		Disturbance of previously unknown archaeological material.	An archaeological watching brief will be undertaken to monitor shallow ground breaking works.		
			Appropriate and proportionate further stages of on-site mitigation (excavations and recording), technical reporting and subsequent analysis will be undertaken, to ensure the appropriate treatment of this material.		
	HVDC Marine Cable Installation	Disturbance of previously unknown archaeological material in the marine environment.	An Archaeological Discovery Protocol compliant with 'Protocol for Archaeological Discoveries' will be created in advance of marine works and included within the CEMP.	Protocol for Archaeological Discoveries for Offshore Renewables Projects 2014	Chapter 12 Section 12.6
			A retained archaeologist will be appointed who will liaise between the Project Manager, Nominated Contact and the Implementation Service, to ensure the smooth delivery of the protocol. These roles will be defined within the Archaeology Discovery Protocol.		
Terrestrial Ecology	General Onshore HVDC Cabling	Potential spread of the invasive non-native species Montbretia.	Locations supporting the invasive non-native species Montbretia near the works will be identified on relevant constraints drawings.	GreenBlue MNNS Guidance	Chapter 13 Section 13.6.1.1
			If works are located within 50m of invasive species, then the areas containing the invasive species will be clearly marked to prevent any disturbance.		
			If areas containing non-native or invasive species need to be disturbed, then a suitably experienced professional will be consulted with respect to the most appropriate method of managing the invasive species.		
	HVDC Onshore Cable Installation	Disturbance of protected species' habitat, resulting from the construction activities.	Pre-construction protected mammal surveys will be undertaken to ascertain whether any protected mammal species, or areas of importance to these species, are present within, or in the immediate vicinity of, the construction area. This will focus on all watercourses within 200m of the proposed HVDC corridor for otters and water voles, and all areas within 200m of the HVDC cable corridor for badgers, and will be completed within 8 weeks of the start of construction.	Water Vole Conservation Handbook (Strachan, 2011) Scottish Wildlife Series: Otters and Development	Chapter 13 Section 13.6.2.1

Topic	Stage	Aspect	Mitigation/Enhancement Management	Associated Guidance	EIAR Reference
Terrestrial Ecology	HVDC Onshore Cable Installation	Disturbance of protected species' habitat, resulting from the construction activities.	Depending on the results from the pre-construction surveys, an assessment of the likelihood of disturbance of protected mammals will be undertaken and the need for an EPS or derogation licence will be assessed and discussed with SNH.		Chapter 13 Section 13.6.2.1
			Checks for protected mammals will be carried out close to the time of works commencing.		
			Any identified protected mammal features in close proximity of the works will be clearly marked and an appropriate buffer zone created.		
			Any newly identified otter holt or badger sett will see a minimum buffer of 40m implemented, although this will be reviewed dependent on the level of activity identified during the survey.	Scottish Wildlife Series: Otters and Development	
			Depending on the identified nature of the protected mammal feature, appropriate mitigation will be implemented or altered to achieve maximum protection of the feature.		
			Artificial lighting within the site, and along watercourses, will be minimised wherever possible, and directed to only the areas where it is required.		
	HVDC Onshore Cable Installation	Potential physical harm and entrapment of protected species.	All personnel will be instructed to remain vigilant for protected mammals and stop operations where a risk of causing harm to a protected mammal is possible.		Chapter 13 Section 13.6.2.2
			There will be an ongoing watching brief for protected mammals by the sites' environmental staff, during all works with the potential to cause damage or injury to protected mammals, in areas identified as being sensitive during the preconstruction surveys.		Chapter 13 Section 13.6.2.2
			Any pipes or other material will be stored upright, have covers fitted to the ends or be appropriately fenced off, to prevent entrapment or occupation by a protected mammal species.	Scottish Wildlife Series: Otters and Development	Chapter 13 Section 13.6.2.2
			Temporary ramps will be utilised within the cable trenches to allow mammals to escape by themselves, should they fall in.		Chapter 13 Section 13.6.2.2

Topic	Stage	Aspect	Mitigation/Enhancement Management	Associated Guidance	EIAR Reference
Benthic Ecology	General Marine HVDC Cabling	Damage to sensitive habitats and species.	Annex 1 habitats have been excluded from the Consenting Corridor with a buffer of at least 50m.		Chapter 14 Section 14.5.2
	HDD Drilling	HDD drilling fluid discharges to the marine environment leading to increased sediment loading for the water column.	Mitigation as per Chapter 11: Water Quality (Marine). The drilling will stop before drilling through the HDD marine exit point. Excess fluid will be extracted before the final drilling reaches the marine exit location.		Chapter 14 Section 14.5.2 Chapter 11 Section 11.5.1.1
	Operations Marine	Sediment heating and electro-magnetic fields from cables	For cable operation, a depth of lowering of at least 0.4 m in hard substrate and 0.5 m in soft substrate will be achieved, which will reduce EMF and sediment heating effects.		Chapter 14 Section 14.5.2
	General Marine HVDC Cabling	Introduction of invasive non-native species through ballast water.	Compliance with the International Convention for the Control and Management of Ships' Ballast Water and Sediments Convention.	International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM)	Chapter 14 Section 14.5.2
	General Marine HVDC Cabling	Introduction of invasive non-native species through biofouling of vessel and equipment.	Requirement for vessels and equipment sourced from outside the North Sea to follow procedures to reduce or remove biofouling.	The Guidelines for the control and management of ships' biofouling to minimise the transfer of invasive aquatic species (Biofouling Guidelines) (resolution MEPC.207(62)) GreenBlue MNNS Guidance	Chapter 14 Section 14.5.2
	General Marine HVDC Cabling	Release of hazardous substances from cable installation vessels.	Pollution prevention and spill response procedures as detailed in Chapter 11: Water Quality (Marine Environment).	International Convention for the Prevention of Pollution from Ships (MARPOL)	Chapter 14 Section 14.5.2
	General Marine HVDC Cabling	Waste water release from installation vessels	Following of MARPOL convention.	International Convention for the Prevention of Pollution from Ships (MARPOL)	Chapter 14 Section 14.5.2

Topic	Stage	Aspect	Mitigation/Enhancement Management	Associated Guidance	EIAR Reference
Fish and Shellfish Ecology	General Marine HVDC Cabling	Damage to sensitive habitats and species.	The consenting corridor has been designed to minimise environmental impacts by avoiding sensitive areas.		Chapter 15 Section 15.5.1
	HDD Drilling	HDD drilling fluid discharges to the marine environment leading to increased sediment loading for the water column.	Mitigation as per Chapter 11: Water Quality (Marine). The drilling will stop before drilling through the HDD marine exit point. Excess fluid will be extracted before the final drilling reaches the marine exit location.		Chapter 15 Section 15.5.1 Chapter 11 Section 11.5.1.1
	HDD Drilling	HDD drilling fluid discharges to the marine environment leading to increased sediment loading affecting spawning herring.	Timing restrictions have been put in place so that drilling activities will only occur between September and March only, with activities commencing in September. No breakouts of the drilling will therefore occur during herring spawning season (August/September).		Chapter 15 Section 15.5.1
	HVDC Marine Cable Installation	Smothering of sandeel eggs through resuspension of sediments and increased sediment loading.	Timing restrictions on cable installation activities mean that these activities will not occur during the sandeel spawning season (January/February).		Chapter 15 Section 15.5.1
	HVDC Marine Cable Installation	Harm to spawning sandeels resulting from releases of hazardous substances.	Timing restrictions on cable installation activities mean that these activities will not occur during the sandeel spawning season (January/February).		Chapter 15 Section 15.5.1
	HVDC Marine Cable Installation	Sediment heating and electro-magnetic fields from cables	For cable operation, a depth of lowering of at least 0.4 m in hard substrate and 0.5 m in soft substrate will be achieved, which will reduce EMF and sediment heating effects.		Chapter 15 Section 15.5.1
	General Marine HVDC Cabling	Introduction of invasive non-native species through ballast water.	Compliance with the International Convention for the Control and Management of Ships' Ballast Water and Sediments Convention.	International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM)	Chapter 15 Section15.5.1

Topic	Stage	Aspect	Mitigation/Enhancement Management	Associated Guidance	EIAR Reference
Fish and Shellfish Ecology	General Marine HVDC Cabling	Introduction of invasive non-native species through biofouling of vessel and equipment.	Requirement for sourced vessels from outside the North Sea to be cleaned and inspected prior to mobilisation.	GreenBlue MNNS Guidance The Guidelines for the control and management of ships' biofouling to minimise the transfer of invasive aquatic species (Biofouling Guidelines) (resolution MEPC.207(62))	Chapter 15 Section 15.5.1
	General Marine HVDC Cabling	Release of hazardous substances from cable installation vessels.	Pollution prevention and spill response procedures as detailed in Chapter 11: Water Quality (Marine Environment).	International Convention for the Prevention of Pollution from Ships (MARPOL)	Chapter 15 Section15.5.1
	General Marine HVDC Cabling	Waste water release from installation vessels.	Compliance with MARPOL convention.	International Convention for the Prevention of Pollution from Ships (MARPOL)	Chapter 15 Section 15.5.1
Marine Mammals	HVDC Marine Cable Installation	Potential impact on marine mammals as a result of release of hazardous substances.	Pollution prevention and spill response procedures as detailed in Chapter 11: Water Quality (Marine Environment).	International Convention for the Prevention of Pollution from Ships (MARPOL)	Chapter 11 Section 11.5.1.4.1
	HDD Drilling	Increased sediment loading as a result of drilling fluid loss during HDD exit which can reduce marine mammal foraging success.	Mitigation as per Chapter 11: Water Quality (Marine). The drilling will stop before drilling through the HDD marine exit point. Excess fluid will be extracted before the final drilling reaches the marine exit location.		Chapter 16 Section 16.5.2.1.3 & Chapter 11 Section 11.5.1.1
	HVDC Marine Cable Installation	Potential harassment of marine mammals by vessels.	All vessels will be required to follow the guidance set out in SNH's 'Scottish Marine Wildlife Watching Code'.	The Scottish Marine Wildlife Watching Code	Chapter 16 Section 16.6.1

Topic	Stage	Aspect	Mitigation/Enhancement Management	Associated Guidance	EIAR Reference
Marine Mammals	General Marine HVDC Cabling	Disturbance of marine mammals from sub bottom profiler operation by survey operations during both cable installation and operation phases.	Marine Mammal Observation (MMO) and Passive Acoustic Monitoring (PAM) protocols will be utilised for the start-up of SBP operations, based on the JNCC guidelines for minimising the risk of injury and disturbance to marine mammals from geophysical surveys. The protocols set out in the JNCC guidance are modified to take into account that SBP devices will not have the capacity to perform a soft start, and a much-reduced potential to cause injury or disturbance to marine mammals compared to the seismic survey operations for which the guidance is intended. The protocol will be incorporated into the CEMD and will be utilised for all SBP operations during both installation and operation. A 200m mitigation zone will be established around the SBP device, which will be monitored by MMO or PAM as appropriate, for a minimum of 20min before the device is activated. If marine mammals are present in the mitigation zone, SBP operations will be delayed for at least 10mins after the zone is clear. Full details of the protocol are provided in Chapter 16: Marine Mammals, Section 16.6.2.	JNCC Guidelines for minimising the risk of injury to marine mammals from geophysical survey operations	Chapter 16 Section 16.6.2
			An EPS licence will be sought from Marine Scotland for any survey operation involving the use of sub-bottom profilers.		
Ornithology	General Onshore HVDC Cabling	Terrestrial Birds - disturbance and accidental nest destruction.	Pre-works survey to locate nests will be carried out immediately prior to the commencement of construction operations.	BTO/JNCC/RSPB Breeding Bird Survey Instructions	Chapter 17 Section 17.7.1.1
			Exclusion zones to be imposed around any active nests found. The size of the zone will be dependent on the bird species and the nature of the present construction activities.		
			Where practicable, onshore works will be carried out outside the terrestrial breeding bird season, or at least started prior to the season.		
			If vegetation clearance is required, it will be carried out outside the terrestrial bird breeding season.		
			Lighting will be directional, within working areas and focused only within the working areas where lighting is required.		

Topic	Stage	Aspect	Mitigation/Enhancement Management	Associated Guidance	EIAR Reference
Ornithology	HDD Drilling	Marine Dependant Birds - disturbance due to HDD Drilling.	Landfall HDD drilling to be carried out between September and March.		Chapter 17 Section 17.7.1.3
			HDD site layout designed to minimise noise at cliff tops, through screening and placement of the noisiest equipment as far as possible from the seabird cliffs.		
	HDD Cable Pull	Marine Dependant Birds - disturbance by small craft.	A seabird observer will be utilised to ensure that small craft travel at slow speeds around the cliffs, and that the vessels do not travel through any substantial rafts of birds.		
	HDD Cable Pull	Marine Dependant Birds - disturbance due to vessel lighting.	During the cable pull and cable installation activity, measures will be put in place to ensure that the vessel lighting is only for the work area required.		
	HVDC Marine Cable Installation		Where possible, and where safe to do so, windows on the vessel will be blacked out at night to decrease the light emission of the vessel.		
	HDD Drilling	Marine Dependant Birds - disturbance.	Observation of birds during first HDD drill to identify any signs of disturbance and, if necessary, the source of disturbance will be investigated and, where practicable, improvements made for future works.		
	HDD Cable Pull		Observation of birds during first cable pull to identify any signs of disturbance and, if necessary, the source of disturbance will be investigated and, where practicable, improvements made for the second pull.		
			Time-lapse photography utilised to observe/record bird activity.		
EMF and Sediment Heating	Operations Onshore	Magnetic Field - cumulative effects of the full project, onshore.	Pre and post-energisation magnetic field measurements at the Fourfields site will be completed, to provide reassurance to local residents.		Chapter 18 Section 18.8.1
Navigation and Shipping	HVDC Marine Cable Installation	Collision of a passing (third party) vessel with a vessel associated with cable installation.	Circulation of information via Notices to Mariners, Radio Navigational Warnings, NAVTEX, and/or broadcast warnings in advance of and during the offshore works. The notices will include a description of the work being carried out.	International Regulations for Prevention of Collisions at Sea (IRPCS). International Regulations for the Safety of Life at Sea (SOLAS)	Chapter 19 Section 19.5.2 & 19.6
			Cable vessels will display appropriate marks and lights, and broadcast their status on AIS at all times, to indicate the nature of the work in progress, and highlight their restricted manoeuvrability.		

Topic	Stage	Aspect	Mitigation/Enhancement Management	Associated Guidance	EIAR Reference
Navigation and Shipping	HVDC Marine Cable Installation	Collision of a passing (third party) vessel with a vessel associated with cable installation.	Temporary aids to navigation will be deployed (if required) to guide vessels around any areas of installation activity. Guard vessels will be used to monitor and advise vessels in the vicinity of the installation works as appropriate. Compliance with International Regulations for the Prevention of Collision at Sea (IMO, 1972) and the International Regulations for the Safety of Life at Sea (SOLAS). Liaison with local ports and harbours, notably Peterhead. Fisheries Liaison Officer (FLO) will be employed to facilitate communications between the project and the fishing sector. Temporary (advisory) protection zones will be created around the installation works during the cable lay, and monitored by the guard vessel(s). Circulation of information to marinas located along the east coast of the UK (including Peterhead and others north and south) to increase the likelihood of non-local sailors being made aware of the temporary installation work.	International Regulations for Prevention of Collisions at Sea (IRPCS). International Regulations for the Safety of Life at Sea (SOLAS) The European Subsea Cable Association. (2016). Guideline 01 - Fishing Liaison.	Chapter 19 Section 19.5.2 & 19.6
	HVDC Marine Cable Installation	Disruption to passing vessel routeing.	Circulation of information via Notices to Mariners, Radio Navigational Warnings, NAVTEX and/or broadcast warnings, in advance of and during the offshore works. The notices will include a description of the work being carried out. Cable vessels will display appropriate marks and lights, and broadcast their status on AIS at all times, to indicate the nature of the work in progress, and highlight their restricted manoeuvrability. Temporary aids to navigation will be deployed (if required) to guide vessels around any areas of installation activity. Guard vessels will be used to monitor and advise vessels in the vicinity of the installation works as appropriate. Compliance with International Regulations for the Prevention of Collision at Sea (IMO, 1972) and the International Regulations for the Safety of Life at Sea (SOLAS). Liaison with local ports and harbours, notably Peterhead. Fisheries Liaison Officer (FLO) will be employed to facilitate communications between the project and the fishing sector.	International Regulations for Prevention of Collisions at Sea (IRPCS). International Regulations for the Safety of Life at Sea (SOLAS) The European Subsea Cable Association. (2016). Guideline 01 - Fishing Liaison.	Chapter 19 Section 19.5.2 & 19.6

Topic	Stage	Aspect	Mitigation/Enhancement Management	Associated Guidance	EIAR Reference
Navigation and Shipping	HVDC Marine Cable Installation	Disruption to passing vessel routeing	Temporary (advisory) protection zones will be created around the installation works during the cable lay, and monitored by the guard vessel(s).	The European Subsea Cable Association. (2016). Guideline 01 - Fishing Liaison.	
			Circulation of information to marinas located along the east coast of the UK (including Peterhead and others north and south) to increase the likelihood of non-local sailors being made aware of the temporary installation work.		
	HVDC Marine Cable Installation	Snag risk to fishing vessel while cable is exposed	Circulation of information via Notices to Mariners, Radio Navigational Warnings, NAVTEX and/or broadcast warnings, in advance of and during the offshore works. The notices will include a description of the work being carried out.	The European Subsea Cable Association. (2016). Guideline 01 - Fishing Liaison.	Chapter 19 Section 19.5.2
			Guard vessels will be used to monitor and advise vessels in the vicinity of the installation works as appropriate.		
			Cable protection works to be completed within three months of cable laying.		
			Liaison with local ports and harbours, notably Peterhead.		
			Fisheries Liaison Officer (FLO) will be employed to facilitate communications between the project and the fishing sector.		
	HVDC Marine Cable Installation	Vessel dragging anchor over exposed cable	Circulation of information via Notices to Mariners, Radio Navigational Warnings, NAVTEX and/or broadcast warnings, in advance of and during the offshore works. The notices will include a description of the work being carried out.	The European Subsea Cable Association. (2016). Guideline 01 - Fishing Liaison.	Chapter 19 Section 19.5.2 & 19.6
			Guard vessels will be used to monitor and advise vessels in the vicinity of the installation works as appropriate.		
			Cable protection works to be completed within three months of cable laying.		
			Liaison with local ports and harbours, notably Peterhead.		
			Consultation and circulation of information to the Marine Safety Forum (MSF) whose members represent the oil & gas vessels anchoring in proximity to the cable landfall.		
	HVDC Marine Cable Installation	Emergency Anchoring over Exposed Cable	Circulation of information via Notices to Mariners, Radio Navigational Warnings, NAVTEX and/or broadcast warnings, in advance of and during the offshore works. The notices will include a description of the work being carried out.		Chapter 19 Section 19.5.2

Topic	Stage	Aspect	Mitigation/Enhancement Management	Associated Guidance	EIAR Reference
Navigation and Shipping	HVDC Marine Cable Installation	Emergency Anchoring over Exposed Cable	Guard vessels will be used to monitor and advise vessels in the vicinity of the installation works as appropriate.		Chapter 19 Section 19.5.2
			Cable protection works to be completed within three months of cable laying.		
			Liaison with local ports and harbours, notably Peterhead.		
	HVDC Marine Cable Installation	Disruption to Military Exercises	Circulation of information via Notices to Mariners, Radio Navigational Warnings, NAVTEX and/or broadcast warnings, in advance of and during the offshore works. The notices will include a description of the work being carried out.	International Regulations for Prevention of Collisions at Sea (IRPCS). International Regulations for the Safety of Life at Sea (SOLAS)	Chapter 19 Section 19.5.2
			Cable vessels will display appropriate marks and lights, and broadcast their status on AIS at all times, to indicate the nature of the work in progress, and highlight their restricted manoeuvrability.		
			Temporary aids to navigation will be deployed (if required) to guide vessels around any areas of installation activity.		
			Guard vessels will be used to work alongside the cable lay vessel(s) during any work carried out. The guard vessel(s) will alert vessels to the presence of the installation activity and provide assistance in the event of an emergency.		
			Compliance with International Regulations for the Prevention of Collision at Sea (IMO, 1972) and the International Regulations for the Safety of Life at Sea (SOLAS).		
			Liaison with local ports and harbours, notably Peterhead.		
			Temporary (advisory) protection zones will be created around the installation works during the cable lay, and monitored by the guard vessel(s).		
	Operation Marine	Vessel dragging anchor over cable	As built information will be provided to the UKHO for inclusion in admiralty charts and the Kingfisher Cable awareness charts, with appropriate notes.		Chapter 19 Section 19.5.2 & 19.6
			Cable to be installed with appropriate protection as per the Construction Method Statement.		
			Routine surveys will be carried out to verify that the cable protection status is adequate.		

Topic	Stage	Aspect	Mitigation/Enhancement Management	Associated Guidance	EIAR Reference
Navigation and Shipping	Operation Marine	Vessel dragging anchor over cable	Consultation and circulation of information to the Marine Safety Forum (MSF), whose members represent the oil & gas vessels anchoring in proximity to the cable landfall.		Chapter 19 Section 19.5.2 & 19.6
		Emergency Anchoring over Exposed Cable	As built information will be provided to the UKHO for inclusion in admiralty charts and the Kingfisher Cable awareness charts, with appropriate notes.		Chapter 19 Section 19.5.2
			Cable to be installed with appropriate protection as per the Construction Method Statement.		
			Routine surveys will be carried out to verify that the cable protection status is adequate.		
		Vessel foundering onto cable	Cable to be installed with appropriate protection as per the Construction Method Statement.		Chapter 19 Section 19.5.2
			Routine surveys will be carried out to verify that the cable protection status is adequate.		
		Vessel dropping object onto cable	Cable to be installed with appropriate protection as per the Construction Method Statement.		Chapter 19 Section 19.5.2
			Routine surveys will be carried out to verify that the cable protection status is adequate.		
		Vessel grounding due to reduced under keel clearance	Any protection measures used (e.g. rock placement) will not reduce the existing water depths by greater than 5%.		Chapter 19 Section 19.5.2
		Fishing gear snagging on cable or associated protection	As built information will be provided to the UKHO for inclusion in admiralty charts and the Kingfisher Cable awareness charts, with appropriate notes.		Chapter 19 Section 19.5.2
			Routine surveys will be carried out to verify that the cable protection status is adequate.		
		Collision of a passing (third party) vessel with a vessel associated with maintenance/repair	Compliance with International Regulations for the Prevention of Collision at Sea (IMO, 1972) and the International Regulations for the Safety of Life at Sea (SOLAS).	International Regulations for Prevention of Collisions at Sea (IRPCS).	Chapter 19 Section 19.5.2
			Circulation of information via Notices to Mariners, Radio Navigational Warnings, NAVTEX and/or broadcast warnings, in advance of and during the offshore works. The notices will include a description of the work being carried out.	International Regulations for the Safety of Life at Sea (SOLAS)	

Topic	Stage	Aspect	Mitigation/Enhancement Management	Associated Guidance	EIAR Reference
Navigation and Shipping	Operation Marine	Collision of a passing (third party) vessel with a vessel associated with maintenance/repair.	Cable vessels will display appropriate marks and lights, and broadcast their status on AIS at all times, to indicate the nature of the work in progress, and highlight their restricted manoeuvrability.	International Regulations for Prevention of Collisions at Sea (IRPCS).	Chapter 19 Section 19.5.2
		Interference with magnetic compass onboard passing vessel.	Compass deviation effects will be minimised by keeping cable separation distance as short as practicable.		Chapter 19 19.5.2
			As built information will be provided to the UKHO for inclusion in admiralty charts and the Kingfisher Cable awareness charts, with appropriate notes.		
Commercial Fisheries	HVDC Marine Cable Installation	Loss of access to fishing grounds.	Fisheries Liaison Officer (FLO) will be employed to facilitate communications between the project and the fishing sector.	The European Subsea Cable Association. (2016). Guideline 01 - Fishing Liaison.	Chapter 20 Section 20.6.2.1
			Fisheries Liaison Officer will work with local fishing organisations to identify static gear vessels that will be affected. Arrangements will be made with individual vessel owners.		
			Early communications with the fishing sector, to allow preparations to be made for the potential disruption.		
			Ongoing dialogue to update on progress and when re-entry to protection zone for fishing activities is possible.		
			Guard vessels will be used to monitor and advise vessels in the vicinity of the installation works as appropriate.		
			Circulation of information via Notices to Mariners, Radio Navigational Warnings, NAVTEX and/or broadcast warnings, in advance of and during the offshore works. The notices will include a description of the work being carried out.		
			Cable protection works to be completed within three months of cable laying.		
		Change in distribution of target species.	Marine habitat disturbance to be minimised as far as practically possible.		Chapter 20 Section 20.6.2.2

Topic	Stage	Aspect	Mitigation/Enhancement Management	Associated Guidance	EIAR Reference
Commercial Fisheries	Operation Marine	Loss of access to fishing grounds.	Rock berm and mattresses will be designed to have a smooth over trawlable profile, utilising appropriate rock grades.		Chapter 20 Section 20.6.3.1
			Circulation of information via Notices to Mariners, Radio Navigational Warnings, NAVTEX and/or broadcast warnings, in advance of and during the offshore works. The notices will include a description of the work being carried out.	The European Subsea Cable Association. (2016). Guideline 01 - Fishing Liaison.	
		Exposed cable.	As built information will be provided to the UKHO for inclusion in admiralty charts and the Kingfisher Cable awareness charts, with appropriate notes.	The European Subsea Cable Association. (2016). Guideline 01 - Fishing Liaison.	Chapter 20 Section 20.6.3.3
			Cable to be installed with appropriate protection as per the Construction Method Statement.		
			Routine surveys will be carried out to verify that the cable protection status is adequate.		
Local Community and Economy	General Onshore HVDC Cabling	Sourcing of supply chain and workforce.	Supply chains plans have been developed to make local content an important and appropriate component of tender proposals for contract delivery.		Chapter 21 Section 21.7.1.1
			Supply chain event and engagement activities will be carried out to maximise opportunity for local input.		
			Works will be publicly tendered wherever possible to allow fair competition and allow local companies to compete for work.		
	HVDC Onshore Cable Installation	Disturbance of local residents through onshore work for example through noise.	An onshore construction communication plan will be developed by NorthConnect and the Cable Contractors to ensure residents and recreational users are kept informed about the project.		Chapter 21 Section 21.7.1.2
			Contact details will be provided to allow any concerns or queries that residents or recreational users may have, to be raised and dealt with in a timely manner.		
	HVDC Onshore Cable Installation	Disruption of recreation.	NorthConnect and the construction contractor will comply with the Land Reform Act (Scotland) 2016 (as amended) and the Scottish Outdoor Access Code.		Chapter 21 Section 21.7.1.3
			Temporary closure of one section of the core path to the south of the Fourfields site will have diversions in place via the bisecting path.		
			Appropriate notification will be put in place to advise users of this activity.		

Topic	Stage	Aspect	Mitigation/Enhancement Management	Associated Guidance	EIAR Reference
Local Community and Economy	HVDC Marine Cable Installation	Disruption of recreation.	The core path will have vehicular access controlled via a gate system, which will be manned by bankspersons when vehicles are crossing the core path.		Chapter 21 Section 21.7.1.3
			An onshore construction communication plan will be developed by NorthConnect and the Cable Contractors to ensure residents and recreational users are kept informed about the project.		
			Contact details will be provided to allow any concerns or queries that residents or recreational users may have, to be raised and dealt with in a timely manner.		
			Prior warning will be given to any changes in path routes or if there is a need for a short-term closure any areas for safety reasons.		
			Signage with contact details will be around the site to allow recreational users to raise concerns or queries.		
			The UK Marine Communications Plan will be complied with.		
Noise and Vibration (In-Air)	General Onshore HVDC Cabling	Disruption of local residents and ecology from in-air noise and vibration resulting from onshore construction activity.	Hours of operation will be 07:00 to 19:00 Monday to Friday and 07:00-13:00 on Saturdays for all onshore construction stages, except for cable pulling and the HDD drilling operations (both landfall and under A90 and disused railway). The cable pull will occur for a concentrated period that will require 7-day, 24 hour working. The HDD drilling operations are planned to be conducted on a 7-day per week basis, between 07:00 and 23:00, however, in order to ensure that the drilling works are completed in the available window prior to the bird breeding season, 24hr working may be required dependent on the rate of progress.	BSI (2014). BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites.	Chapter 22 Section 22.7
			NorthConnect will keep local residents informed of the proposed working schedule, as appropriate, including the times and duration of any abnormally noisy activity that may cause concern.		
			Haulage vehicles will not arrive at or leave the site between 1900 and 0700 hours.		
			All vehicles and mechanical plant will be fitted with effective exhaust silencers and 'smart' reversing alarms and be subject to programmed maintenance.		
			Where appropriate, inherently quite plant will be selected.		

Topic	Stage	Aspect	Mitigation/Enhancement Management	Associated Guidance	EIAR Reference
Noise and Vibration (In-Air)	General Onshore HVDC Cabling	Disruption of local residents and ecology from in-air noise and vibration resulting from onshore construction activity.	All major compressors, pumps and generators will be 'sound reduced' models fitted with properly lined and sealed acoustic covers, which will be kept closed during machines’ use.	BSI (2014). BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites.	Chapter 22 Section 22.7
			All ancillary pneumatic percussive tools will be fitted with mufflers or silencers of the type recommended by the manufacturers.		
			Machines will be shut down or throttled down to a minimum between work periods.		
			All equipment will be regularly maintained including maintenance related to noise emissions.		
			Vehicles are to be loaded carefully to ensure minimal drop heights so as to minimise noise during these operations.		
			All ancillary plant such as generators and pumps are to be positioned so as to cause minimum noise disturbance. Where necessary, temporary acoustic screens or enclosures will be employed.		
	HDD Drilling	Disruption of local residents and ecology from in-air noise and vibration resulting from 24hr landfall HDD operations.	Where 24hr working at the landfall HDD site is required, a Section 61 Consent will be applied for under the Control of Pollution Act 1974.		
			Any Section 61 Consent application under the Control of Pollution Act 1074 will contain additional noise modelling if details change significantly from those utilised in the EIAR.		
			Where the noise assessment identifies significant additional noise impacts on local residents, additional mitigation measures will be identified and will be detailed in the application.		
		Disruption of climbers' communication on climbing routes at the Warlord Cliff resulting in potential safety concerns for climbers.	During HDD activities, monitoring of noise levels in the area of the Warlord Cliff will be conducted.		
			If it is found that noise is causing a safety concern, additional mitigation will be considered at that time.		
Resource Usage and Waste	General Installation Works	Sustainable Procurement.	All contractors will be required to give due consideration to sustainability, consideration of components and materials lifecycle cost, including their ability to be recycled.		Chapter 24 Section 24.5.1

Topic	Stage	Aspect	Mitigation/Enhancement Management	Associated Guidance	EIAR Reference
Resource Usage and Waste	General Installation Works	Sustainable Procurement.	Material to be sourced locally where practicable.		Chapter 24 Section 24.5.1
	General Onshore HVDC Cabling	The use of fuel bowsers.	Fuel bowsers will be under strict management controls, secured to protect against oil thefts and tampering and locked when not in use.	CAR GBR28: The storage of oil	Chapter 24 Section 24.5.2
			The fuel bowsers will be double skinned with a level site gauge and stored in an appropriate area away from aquatic environments and where it is protected from vehicle damage.	GPP 2: Above ground oil storage tanks	
			Refuelling will be carried out away from watercourses, by trained operatives following site refuelling procedures.		
	General Installation Works	Storage and use of fuels, oils and chemicals.	Bio-degradable hydraulic fluids to be used where practicable.	GPP 5: Works and Maintenance in or Near Water	Chapter 24 Section 24.5.2
			All oils and chemicals will be subject to Control of Substances Hazardous to Health (COSHH) assessments under the COSHH Regulations. All COSHH assessments will include a section on the environment to highlight any particular precaution or mitigation requirements. Oils and chemicals will be appropriately stored and managed.	CAR GBR26: The storage of oil in a portable container with a capacity of less than 200 litres	
			Appropriately bunded oil and chemical storage cabinets will be utilised. These will be kept locked, with the keys under management control to ensure appropriate use and accountability.	PPG6: Working at Construction and Demolition Sites	
			Just in time delivery, when practicable, to minimise bulk storage on site.	PPG 26: Safe Storage - Drums and Intermediate Bulk Containers	
	General Installation Works	Waste management.	The waste hierarchy shall be utilised throughout the project.	CAR GBR26: The storage of oil in a portable container with a capacity of less than 200 litres	Chapter 24 Section 24.5.3
			All waste shall be appropriately sorted and segregated.	PPG 26: Safe Storage - Drums and Intermediate Bulk Containers	

Topic	Stage	Aspect	Mitigation/Enhancement Management	Associated Guidance	EIAR Reference
Resource Usage and Waste	General Installation Works	Waste management	A Site Waste Management Plan will be put in place.	PPG6: Working at Construction and Demolition Sites	Chapter 24 Section 24.5.3
			Waste will be stored safely to prevent escape.	Waste Hierarchy	
			The use of single-use plastics will not be permitted wherever reasonable alternatives are available and, if they have to be utilised, then recycling arrangements shall be in place.		
	HVDC Onshore Cable Installation	Cement washings	Cement washings will be carried out in a dedicated area.	PPG6: Working at Construction and Demolition Sites	Chapter 24 Section 24.5.3
			Washing arisings will be collected for onsite treatment. This will include settlement and, if required, pH correction.		
			The liquids will be reused on site as grey water, if suitable, or disposed of via a consented waste route. The solids will be disposed of as solid waste potentially to be recycled as aggregate.		
	General Onshore HVDC Cabling	Litter	Training will be provided to all personnel with regard to waste management and that littering will not be tolerated.	PPG6: Working at Construction and Demolition Sites	Chapter 24 Section 24.5.4
	General Marine HVDC Cabling		The use of single use plastics will be discouraged, and reusable crockery and cutlery will be provided in the welfare facilities.		
			Environmental walk rounds or Health & Safety inspections will identify if littering is becoming an issue on the construction site, or vessels, allowing corrective action to be taken.		
			Appropriate storage of materials and waste, and regular checks of arrangements on the vessels, will aid in ensuring marine litter is not created.		
			Following the completion of the onshore works, a full litter sweep will be conducted.		
	Decommi-ssioning	Recovery of cables at point of decommissioning.	Cables recovered during decommissioning will be stripped, and materials recycled where practicable.		Chapter 24 Section 24.4.3

25.3 Implementation

A SoM was also produced for the Interconnector Convert Station and HVAC Cable Route (NorthConnect, 2015). There are overlaps between the two SoMs. To ensure consistent implementation of mitigation across the project, the two SoMs will be included within the Overarching Construction Environmental Management Plan (CEMP), which will be produced by NorthConnect. There will be three contract packages of the works in the UK namely:

- Enabling Works;
- Converter Station and HVAC Cables; and
- HVDC Cables.

Each Contractor is expected to work to the Overarching CEMP and will be required to produce a Contract specific CEMP in line with the Overarching CEMP for their elements of the work.

The CEMP's will include the following elements as appropriate:

- Traffic Management Plan;
- Site Waste Management Plan;
- Incident Response and Reporting Procedure;
- Dust Management Plan;
- Traffic Management Plan;
- Drainage Management Plan or CAR Pollution Prevention Plan, as appropriate;
- Species Specific Mitigation Plans; and
- Copies of consents and licences.

The CEMP's will provide the policy and plans of how the construction and cable installation works are to be managed from an environmental perspective. Task specific Risk Assessed Method Statements (RAMS) will be utilised to implement elements of the environmental plans. RAMS will also be provided for all construction tasks, identifying task specific risks, including those to the environment, and detail the mitigation measures in place to prevent or reduce them.

The CEMP will clearly set out the lines of communication between NorthConnect's Management Team and Environmental Lead, and the Contractor's Management Team and their Environmental Representative. It will set out the roles and responsibilities of the various parties to with regard to ensuring that all environmental mitigation is appropriately implemented.

In addition to the CEMP, the Fisheries Liaison and Mitigation Action Plan (FLMAP) (NorthConnect, 2018a) and UK Marine Communication Strategy (NorthConnect, 2018b) will be implemented, these provide the mechanism for the implementation of a number of the mitigation measures identified in Table 25.1.

25.4 Environmental Clerk of Works

Due to the complexity and scale of the works, to ensure that the environmental effects are minimised, and that mitigation is implemented in an effective manner, responding to the actual situation on the site, there will be environmental expertise required to support the construction works.

Environmental Clerk(s) of Works (ECoW) will be utilised to provide environmental site supervision and advice on a day to day basis. The ECoW will carry out regular audits and ensure monitoring requirements are met, and these will be tailored to the aspects arising on the site at the time. The ECoW will have the power to stop works if there is imminent danger to the environment.

In addition, NorthConnect will retain the services of environmental expert(s) who have hands on experience working as an Environmental Clerk of works (ECoW) and detailed understanding of the whole project. Their role will include the following responsibilities:

- Ensuring that the various contractors are implementing the relevant CEMP's effectively;
- Providing support and advice to the ECoWs as required;
- Ensuring compliance with the associated permits and licences; and
- Ensuring any additional permits or licences are obtained as required in a timely manner.

25.5 Training

The construction site and vessel inductions will cover a range of environmental topics and their management on site. Specific training will be provided to appropriate staff as required, for example, spill response training and refuelling.

'Tool box talks' will be given on environmental topics of particular relevance to the activities that are being undertaken on site at that point, to ensure that the workforce's environmental awareness is current and relevant.

25.6 Environmental Management System

Moving into the commissioning and operational phases of the project, the Overarching CEMP will be replaced with an Environmental Management System, aligned to ISO14001 or equivalent. This will ensure that all aspects are appropriately identified and managed during the project's operational life.

25.7 References

NorthConnect. (2015). NorthConnect Interconnector Convertor Station and High Voltage Alternative Current Cable Route Environmental Statement. *2*.

NorthConnect. (2018a). HVDC Cable Infrastructure - UK Fisheries Liaison Mitigation Action Plan.

NorthConnect. (2018b). HVDC Cable Infrastructure - UK Marine Communication Strategy.

Chapter 26: Conclusion

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26 Conclusion

The NorthConnect Interconnector, once complete, will provide a 1,400 mega-watt electrical connection between Scotland and Norway, to facilitate the transfer of power between the UK and Norway. It will help to ensure the security of supply in both regions, provide a green battery to facilitate the development of intermittent renewable power and reduce energy price fluctuations.

NorthConnect obtained planning permission in 2015 for the Interconnector Converter Station at the Fourfields site near Boddam and the associated High Voltage Alternating (HVAC) cable route to the Peterhead substation. This Environmental Impact Assessment Report (EIAR) has been produced in support of the planning and marine licence applications for the associated HVDC Cables and Infrastructure.

NorthConnect have considered the environment throughout the cable consenting corridor selection and design process, to ensure that adverse environmental effects are minimised. Extensive survey work has been carried out to inform the corridor selection and ecological surveys aided in the identification of the landfall and onshore cable route. Marine surveys have identified suitable seabed conditions in terms of geology and marine sediments, as well as habitats and archaeological assets.

The selected marine consenting corridor specifically avoids wrecks and Annex 1 habitats, while minimising infrastructure crossings to keep the need for rock placement as low as practicable. Horizontal Directional Drilling (HDD) is proposed for use at the landfall and to route the cable under the A90 and disused railway line, in order to avoid disturbing seabirds nesting on the Seacliff's, disrupting traffic on the A90 and excavating the historical railway line embankment. Programming of the Landfall HDD works has taken into account the breeding seabirds associated with the Buchan Ness to Collieston Coast SPA and Bullers of Buchan Coast SSSI. Similarly, the early installation of cable ducts under the core path to the south of Fourfields prior to the bisecting path being closed, will ensure that there is always a path available for recreational users.

Offshore, a cable burial risk assessment and cable protection report have been completed based on the marine survey, to identify the cable protection levels required (NorthConnect, 2018a). The cables will be buried to a minimum of 0.4m with the majority of the cable being buried by at least 0.8m. Burial is expected to be achieved by trenching with natural backfill for 90% of the route. Backfill rock placement maybe required for large sections of the route within Scottish Territorial Waters (STW), but this will not be above original sea levels (OSL). Remedial rock placement above OSL may be required for 5 to 10% of the route in STW. For the full UK section of the route, including the 18 cable crossings in Scottish Territorial Waters (STW) and UK Exclusive Economic Zone (UKEEZ), remedial rock will be required for less than 2% of the route.

NorthConnect require the cable contractor to provide evidence that the burial methods they are proposing will work within the marine sediments present, or prove the technique by carrying out trials. This will de-risk the cable installation process, providing confidence that the cable can be laid, and the appropriate protection afforded, without the need for excessive remedial rock placement.

The EIAR considered eighteen environmental topics covering marine and terrestrial receptors. The assessment was focused on construction and operational effects, with decommissioning considered for topics where there could be specific effects. It is recognised that an assessment will be required prior to decommissioning to inform the approach and associated mitigation based on the environmental conditions at that point in time.

Seventeen significant effects were identified, fourteen adverse and three beneficial, as summarised in Table 25.1. All adverse impacts could be reduced by applying secondary mitigation measures as summarised in Table 25.1 to reduce their effect levels sufficiently to make them non-significant.

Mitigation in line with best practice was also identified where non-significant effects could be reduced further. Mitigation has been consolidated into a Schedule of Mitigation (Chapter 24), the majority of which will be implemented through Construction Environmental Management Plans (CEMP) and Risk Assessments & Method Statements (RAMS) procedures. In addition to the CEMP, the Fisheries Liaison and Mitigation Action Plan (FLMAP) (NorthConnect, 2018b) and UK Marine Communication Strategy (NorthConnect, 2018c) will be implemented.

The NorthConnect project will provide significant benefits in terms of Carbon savings by facilitating an increase in renewable power sources to the energy mix. In addition, it will aid in security of power supply, grid stabilisation services and stabilisation of energy prices to consumers, which all have an associated socio-economic benefit.

NorthConnect are committed to ensuring that adverse environmental effects associated with the development are minimised and beneficial effects are maximised. As the project moves forward, NorthConnect will continue to ensure that the design, construction and installation techniques utilised take account of environmental factors. It is recognised that ongoing communication with stakeholders is key to the project’s successful implementation.

Table 25.1: Summary of Significant Effects in the absence of Secondary Mitigation

Receptor	Nature of Impact	Receptor Sensitivity/ Probability	Impact Magnitude	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
				Construction			
Ground Water	Release of Hazardous Substances	High Sensitivity	Adverse - Medium	Moderate: Significant Adverse	Appropriate storage and handling of materials and wastes as defined in Chapter 24. Spill response plans, spill kits and trained operators as per Chapter 10.	Adverse Low	Minor: Non-significant
Buchan Ness to Collieston Coast SAC, the Bullers of Buchan Coast SSSI designated sites; and Longhaven cliffs SWT nature reserve	Dust: Earthworks	Medium Sensitivity	Adverse - Large	Moderate: Significant Adverse	Dust Management Plan Implemented	Adverse Small	Minor: Non-significant
Watercourse G	Silt laden water from temporary road construction.	Probable	Adverse - Medium	Moderate: Significant Adverse	Utilisation of silt fences (or equivalent) to screen and filter sediment.	Adverse Low	Minor: Non-Significant
Watercourse G	Silt laden water during Landfall HDD bund creation.	Probable	Adverse - Medium	Moderate: Significant Adverse	Utilisation of silt fences (or equivalent) to screen and filter sediment.	Adverse Low	Minor: Non-Significant
Watercourses C, D, E, & G	Surface water runoff from cable installation	Probable	Adverse - Medium	Moderate: Significant Adverse	Utilisation of silt fences (or equivalent) to screen and filter sediment.	Adverse Low	Minor: Non-Significant
Otter	Habitat disturbance	International	Adverse - Low	Moderate: Significant	Avoidance of construction near otter holt location. Pre-construction surveys and exclusion zones.	Negligible	Minor: Non-significant
Otter	Accidental physical damage	International	Adverse - Low	Moderate: Significant	Pre-construction surveys, exclusion zones, and construction watching briefs. Measures to prevent entrapment.	Negligible	Minor: Non-significant

Receptor	Nature of Impact	Receptor Sensitivity/ Probability	Impact Magnitude	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Otter	Water course pollution	International	Adverse - Low	Moderate: Significant	As identified in Chapter 10: Water Quality	Negligible	Minor: Non-significant
Watervole	Habitat disturbance	National	Adverse - Medium	Moderate: Significant	Pre-construction surveys Culverts installed as discussed in Chapter 10: Water Quality (Onshore)	Low	Minor: Non-significant
Marine Mammals: **Harbour Porpoise** **Bottle Nose Dolphin** **Minke Whale** **White-Beaked Dolphin** **Other Cetaceans** **Grey Seals** **Common Seals**	Disturbance due to SBP survey operations during installation works.	International	Adverse-Low Short Term Reversible	Moderate: Significant	Provision of SBP marine mammal protocol, and adherence to the Scottish Marine Wildlife Watching Code.	Adverse Negligible Short Term Reversible	Minor: Non-significant
Marine Mammals: **Harbour Porpoise** **Bottle Nose Dolphin** **Minke Whale** **White-Beaked Dolphin** **Other Cetaceans** **Grey Seals** **Common Seals**	Disturbance due to SBP survey operations during operations.	International	Adverse-Low Short Term Reversible	Moderate: Significant	Provision of SBP marine mammal protocol, and adherence to the Scottish Marine Wildlife Watching Code.	Adverse Negligible Short Term Reversible	Minor: Non-significant
Passerine & Waders Birds (red-list species) **Snipe**	Accidental nest site destruction during construction.	Regional Unlikely	Adverse Medium Permanent	Moderate: Significant	Pre-construction surveys. Exclusion Areas	Adverse Low	Minor: Non-Significant
Static Gear Fishing Operators	Temporary loss of access to fishing ground during installation works	Certain	Adverse Minor	Moderate Significant	Cable protection complete within 3 months. Fisheries Liaison Officer will work with local fishing organisations to identify static gear vessels that will be affected. Arrangements will be made with individual vessel owners.	Adverse Negligible	Non-significant

Receptor	Nature of Impact	Receptor Sensitivity/ Probability	Impact Magnitude	Significance (Absence of Secondary Mitigation)	Mitigation Summary	Residual Impact Magnitude	Significance of Residual Effect
Workforce	Direct Employment	N/A	Beneficial High	Major: Significant	Procurement Policy Supply Chain Engagement	Beneficial High	Major: Significant
Residential Receptors: Longhaven Mains; Station House; and Jehrada Cottage.	Noise from HDD activities (night time).	High	Adverse	Significant	Best practice mitigation measures to be employed as detailed in BS5228. Additional modelling once equipment details are better understood. Provision of additional mitigation as required. Section 61 Consent.	Adverse	Non-Significant
Operations							
Climate Change	CO2 Savings		Beneficial Large	Moderate to Major: significant benefit	Material Optimisation Recycling of Wastes Engagement with Energy Sector	Beneficial Large	Moderate to Major: significant benefit
Socio-economic	Energy Market	National/ International	Beneficial High	Major: Significant	No Specific Mitigation Required	Beneficial High	Major: Significant

Key

	Significant Effect

26.1 References

NorthConnect. (2018a). HVDC Cable Infrastructure - UK Construction Method Statement.
NorthConnect. (2018b). HVDC Cable Infrastructure - UK Fisheries Liaison Mitigation Action Plan.
NorthConnect. (2018c). HVDC Cable Infrastructure - UK Marine Communication Strategy.

Glossary

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Term / Abbreviation	**Definition / Expansion**
AA	Appropriate Assessment
AbC	Aberdeen Council
AC	Alternating Current
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
ALDP	Aberdeenshire Local Development Plan
AOS	Apparently Occupied Breeding Sites
AQMA	Air Quality Management Areas
As	Arsenic
B	Magnetic Flux Density
BAP	Biodiversity Action Plans
BCC	Buchan Community Council
BEIS	Department for Business, Energy and Industrial Strategy
BGS	British Geological Survey
BH	Borehole
BoCC	Birds of Conservation Concern
BS	British Standard
BSI	British Standards Institute
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
BTO	British Trust of Ornithology
BWM	Ballast Water Management
CAT	Cable Avoidance Tool
CBRA	Cable Burial Risk Assessment
CCME	Canadian Council of Ministers of the Environment
CES	Crown Estate Scotland
CEMD	Construction Environmental Management Document
CEMP	Construction Environmental Management Plan
CfD	Contract for Difference
CIRIA	Construction Industry Research and Information Association
CIEEM	Chartered Institute of Ecology and Environmental Management
CLEA	Contaminated Land Exposure Assessment
CoS	Chamber of Shipping
CO_2	Carbon Dioxide
CO_2 e	CO_2 Equivalent
Converter Station	Shorthand for - Interconnector Converter Station
COSHH	The Control of Substances Hazardous to Health
CPAR	Cable Protection Analysis Report
CPT	Cone Penetration Tests
Cu	Copper
dB	Decibels
DC	Direct Current
DDV	Drop Down Video
DECC	The Department of Energy and Climate Change
DEFRA	Department for Environment, Food and Rural Affairs
DGPS	Differential GPS system
DHM	Downhole Motor
DMP	Dust Management Plan

DOB	Depth of Burial
DOL	Depth of Lowering
DP	Dynamic Positioning
DSFB	Associated of District Salmon Fisheries Boards
DWT	Deadweight Tonnage
EAC	Environmental Assessment Criteria
EcIA	Ecological Impact Assessment
ECoW	Environmental Clerk of Works
EEZ	Exclusive Economic Zone
EGPS	Electricity Generation Policy Statement
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMF	Electric and Magnetic Fields
EMS	Environmental Management System
ENSG	Electricity Networks Strategy Group
ENTSO-E	European Network of Transmission System Operators for Electricity
EO	Explosive Ordnance
EOWDC	European Offshore Wind Development Centre
EPS	European Protected Species
ERL	Effect Range Low
ES	Environmental Statement
EU	European Union
Fourfields	Converter StationSite name
FLO	Fisheries Liaison Officer
FSA	Formal Safety Assessment
FTE	Full-time Equivalent
GAC	Generic assesment criteria
GB	Great Britain
GBR	General Binding Rules
GC-FID	Gas Chromatography-Flame Ionisation Detector
GEN	General Planning Principles
GI	Ground Investigation
GIS	Geographic Information System
GPP	Guidance for Pollution Prevention
GPS	Global Positioning System
GT	Gross Tonnage
GW	Gigawatt
Ha	hectares
HDD	Horizontal Directional Drilling
HDPE	High-density polyethylene
HE	High Explosive
HES	Historic Environment Scotland
HF	High Frequency
HGV	Heavy Goods Vehicle
HPDE	High-density polyethylene
HRA	Habitats Regulations Appraisal
HSE	Health and Safety Executive
HVAC	High Voltage Alternating Current

HVAC cables	HVAC connection between the converter station and the substation
HVDC	High Voltage Direct Currnet
Hz	Hertz
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
ICNIRP	International Commission on Non-Ionizing Radiation Protection
ICPC	International Cable Protection Committee
ICP-MS	Inductively Coupled Plasma-mass Spectrometry
IUCN	International Union for Conservation of Nature
IEEE	Institute of Electrical and Electronics Engineers
IEEM	Institute of Ecology and Environmental Management
IEMA	The Institute of Enviromental Management and Assessment
IFG	Inshore Fisheries Group
IMO	International Maritimne Organisation
Interconnector converter station	The station converting the HVDC electricity to HVAC on import from the interconnector and HVAC to HVDC on export to the interconnector.
IMO	International Association of Marine Aids to Navigation and Lighthouse
IMR	Inspection, Maintenance and Repair
INNS	Invasive non-native species
IOA	Institute of Acoustics
IPA	Initial Project Assessment
ISO	International Standards Organisation
JNCC	Joint Nature Conservation Committee
JV	Joint Venture
km	Kilometre
KP	Kilometre Point
kT	Kilo tonnes – 1000 tonnes
kW	Kilowatts – 1000 watts
LA_{10}	The A weighted sound level which is exceeded for 10% of a given monitoring period. A weighting takes account of perceived loudness to different frequencies of the human ear.
LA_{90}	The A weighted sound level which is exceeded for 90% of a given monitoring period
LA_{eq}	The A weighted equivalent continuous sound level which contains the same sound energy as a varying sound level over a given monitoring period.
LA_{max}	The maximum sound level arising during a given monitoring period
LAQM	Local Air Quality Management
LBAP	Local Biodiversity Action Plans
LCA	Land Capability for Agriculture
LDP	Local Development Plan
LF	Low Frequency
LGS	Local Geodiversity SItes
LNCS	Local Nature Conservation Site
LOI	Loss on Ignition
LTS	Local Transport Strategy
LUPS	Land Planning System
LwA	The A weighted sound power level, or the total sound energy radiated from a given source per second.

m	Metre
MAIB	Marine Accident Investigation Branch
MAG	Magnetometer
MARPOL	International Convention for the Prevention of Pollution from Ships
MBES	Multi Beam Echosounder
mbgl	Meters below ground level
MCA	Maritime and Coastguard Agency
MCZ	Marine Conservation Zone
MDS	Multi-dimensional Scaling
MGN	Marine Guidance Note
MGS	Magnetic Guidance System
MHWM	Mean High Water Mark
MHWN	Mean High Water Neaps
MHWS	Mean High Water Springs
MI	Mass Impregnated
MLWS	Mean Low Water Springs
MMT	Manufacture Modules Technologies (Company)
MMO	Marine Mammal Observer
mms^{-1}	Millimetres per second
MNNS	Marine Non-Native Species
MOD	Ministry of Defence
MPA	Marine Protected Area
MPS	Marine Policy Statement
MS-LOT	Marine Scotland Licensing Operations Team
MSF	Marine Safety Forum
MSFD	Marine Strategy Framework Directive
MSPP	Marine Scotland Planning and Policy
MSS	Marine Scotland Science
MT	Millions of Tonnes
MTBE	Methyl tert-butyl ether
MW	Megawatts
NAQ	National Air Quality Objectives
NBN	National Biodiversity Network
NCAP	National Collection of Aerial Photography
NCHE	National Collection of the Historic Environment
NESBReC	North East Scotland Biological Records Centre
NETS	National Electricity Transmission System
NGET	National Grid Electricity Transmission
NGTS	National Grid Technical Specification
NLB	Northern Lighthouse Board
NM	Nautical Mile
NMLs	Noise Monitoring Locations
NAQs	National Air Quality Objectives
HDD	Noise Monitoring Point
NMP	National Marine Plan
NMPi	National Marine Plan Interactive

NnG	Neart na Gaoithe
NNR	National Nature Reserves
NO_2	Nitrogen Dioxide
NPF	National Planning Framework
NPF3	The third NPF
NRA	Navigational Risk Assessment
NSL	North Sea Link
NSR	Noise Sensitive Receptors
NVC	National Vegetation Classification
OREIs	Offshore Renewable Energy Installations (OREIs)
OOS	Out of Service
OOW	Officer of the Watch
OREIs	Offshore Renewable Energy Installations
OS	Ordnance Survey
OWF	Offshore Wind Farm
PAC	Pre-Application Consultation
PACC	Pre-Application Communities Consultation
PAH	Polycyclic Aromatic Hydrocarbons
PAM	Passive Acoustic Monitoring
PAN	Planning Advice Notes
Pb	Lead
PEL	Probable Effect Level
PEXA	Practice and Exercise Area
PM2,5	Particle matter of particles with a diamert of 2,5 micrometer or less
PM10	Particle matter of particles with a diameter of 10 micrometers or less
PMF	Priority Marine Feature
pMPA	Proposed Marine Protected Area
PPC	Pollution Prevention Control
PPG	Polluton Prevention Guidance
PRIMER	Plymouth Routines in Multivariate Ecological Research
PSD	Particle Size Distribution
PTFE	Polytetrafluorethylene
PTS	Permanent Threshold Shift
QGIS	Geographic Information System software package
OWF	Offshore Wind Farm
RAMS	Risk Assessed Method Statement
RBMP	River Basin Management Site
RCAHMS	Royal Commission on the Ancient and Historical Monuments of Scotland
RES	Renewable Energy Systems
RIGS	Regionally Important Geological and Geomorphological Sites
RIVM	Dutch National Institute for Public Health and the Environment
RNLI	Royal National Lifeboat Institution
ROTV	Remotely Operated Towed Vehicle
ROV	Remotely Operated Vehicle
RSPB	Royal Society for the Protection of Birds (RSPB)
RYA	Royal Yachting Association
SAC	Special Areas of Conservation
SBL	Scottish Biodiversity List

SBP	Sub Bottom Profiler
SCDA	Scottish Creelers and Divers Association
SCL	Survey Centreline
SDP	Strategic Development Plan
SEPA	Scottish Environmental Protection Agency
SESA	Study of Environmentally Sensitive Areas
SFF	Scottish Fishermen's Federation
SFO	Scottish Fishermen's Organisation
SG	Supplementary Guidance
SGT	Super Grid Transformers
SHETL	Scottish Hydro Electric Transmission Limited
SINC	Sites of Important Nature Conservation
SINS	Sites of Interest to Natural Science
SLM	Sound Level Meters
Sn	Tin
SNCB	Statutory Nature Conservation Body
SNH	Scottish Natural Heritage
SO	System Operator
SOLAS	Safety of Life at Sea
SPA	Special Protection Area
SPEN	Scottish Power Energy Networks
SPG	Supplementary Planning Guidance
SPL	Sound Pressure Level
SPM	Suspended Particular Matter
SPP	Scottish Planning Policy
SSE	Scottish and Southern Energy
SSEN	Scottish and Southern Energy Networks
SSS	Side Sonar Scan
SSSI	Sites of Special Scientific Interest
STW	Scottish Territorial Waters
SVOC	Semi-Volatile Organic Compounds
SW	Scottish Water
SWMP	Site Waste Management Plan
SWT	The Scottish Wildlife Trust
T	Telsa
t	Time
TBM	Time Based Maintenance
TCE	The Crown Estate
TEL	Threshold Effect Level
TO's	Transmission Owners
TOC	Total Organic Carbon
TP	Trial Pit
TPH	Total Petroleum Hydrocarbons
TS	Transport Scotland
TTS	Temporay Threshold Shift
TWH	Tera Watt Hours, a million, million watt hours
UDSFB	Ugie District Salmon Fishery Board
(µT)	Micro Tesla

UK	United Kingdom
UKAS	United Kingdom Accreditation Service
UK EEZ	United Kingdom Exclusive Economic Zone
UKHO	United Kingdom Hydrographic Office
UNCLOS	United Nations Convention on the Law of the Sea
UNESCO	United Nations Educational, Scientific, and Cultural Organisation
USEPA	United States Environmental Protection Agency
UXB	Unexploded bombs
UXO	Unexplored Ordinance
VC	Vibro-coring
VMS	Vessel Monitoring System
VOC	Volatile Organic Compounds
V/m	Volts per metre
VP	Vantage Point
VS	Visit Scotland
WCA	Wildlife and Country Act 1981
WDC	Whale and Dolphin Conservation
WFD	Water Framework Directive
WL	Wing Lines
WROV	Work Class Remotely Operated Vehicle
YDSFB	Ythan District Salmon Fishery Board
ZTV	Zone of Theoretical Visibility
µT	Microtesla

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UNDERSEA CABLE CONSULTANCY LIMITED