Cambois Connection – Marine Scheme

Environmental Statement – Volume 2

ES Chapter 5: Project Description

SSE Renewables

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Acronyms

Acronym	Description
AEZs	Archaeological Exclusion Zones
ARPA	Automatic RADAR Plotting Aid
BBWF	Berwick Bank Wind Farm
CaP	Cable Plan
Cefas	Centre for the Environment, Fisheries and Aquaculture Science
CoCP	Code of Construction Practice
CPS	Cable Protection System
CPT	Cone Penetration Tests
CTV	Crew transfer vessel
DAS	Distributed Acoustic Sensing (DAS)
DTS	Distributed Temperature Sensing
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMF	Electric and magnetic field
ES	Environmental Statement
E2DC	Scotland England Green Link / Eastern Link 1: Torness to Hawthorn Pit
E4DC	Eastern HVDC Link: Peterhead to Hawthorn
E4D3	Eastern Green Link 2: Peterhead to Drax
E4L5	Eastern Scotland to England Third Link: Peterhead to South Humber
FLO	Fisheries Liaison Officer
FO	Fibre Optics
FOC	Fibre optic cable
HDD	Horizontal Directional Drilling
HVDC	High Voltage Direct Current
ICPC	International Cable Protection Committee
ICNIRP	International Commission on Non Ionizing Radiation Protection

Acronym	Description
INNS	Invasive Non-Native Species
MCA	Maritime and Coastguard Agency
MDS	Maximum Design Scenario
MFE	Mass Flow Excavator
MHWS	Mean High Water Springs
MMO	Marine Management Organisation
MMMP	Marine Mammal Mitigation Protocol
MD-LOT	Marine Directorate Licensing and Operations Team
NCC	Northumberland County Council
NOAA	National Oceanic and Atmospheric Administration
NSL	North Sea Link
OCSP	Offshore Converter Station Platform
OCT	Open-Cut Trench
OEMP	Operational Environmental Management Plan
oWSI	Outline Written Scheme of Investigation
PAD	Protocol for Archaeological Discoveries
PLONOR	Pose Little Or No Risk
pUXO	Potential Unexploded Ordance
RADAR	Radio Detection And Ranging
ROV	Remotely operated vehicle
SBP	Sub-bottom Profiling
SOPEP	Shipboard Oil Pollution Emergency Plan
SSS	Side Scan Sonar
TGDC	South East Scotland to South Humber
TJB	Transition Joint Bay
USV	Unmanned surface vessel
UXO	Unexploded ordnance

Units

Unit	Description
A	Ampere
km	Kilometres
m	Metres
nm	Nautical miles
μT	Microtesla

5. Project Description

5.1. Introduction

1. This chapter of the Environmental Statement (ES) describes the Marine Scheme part of the Cambois Connection Project (which comprises both the Marine Scheme and Onshore Scheme) proposed by Berwick Bank Wind Farm Limited (the Applicant). The Marine Scheme comprises up to four High Voltage Direct Current (HVDC) subsea cables linking the Berwick Bank Wind Farm (BBWF) to Landfall at Cambois Beach, Northumberland.

2. The offshore components of the Project seaward of MHWS (the Marine Scheme) are located within both Scottish and English waters. In Scotland, the Marine Scheme is entirely within offshore waters (i.e., between the 12 nautical miles (nm) limit and the outer limits of the Scottish Exclusive Economic Zone (EEZ)). In England, the Marine Scheme is within offshore waters and inshore waters.

3. This chapter describes the proposed methods and indicative timing of the construction, operation and maintenance, and decommissioning phases of the Marine Scheme.

4. The Marine Scheme will facilitate the export of renewable energy from the generation assets associated with the BBWF, located in the outer Firth of Forth in Scottish waters, to the onshore infrastructure required to provide electricity into the national grid (via the Onshore Scheme) located at Blyth, Northumberland.

5. The details outlined within this chapter provide the basis for the assessment of effects within technical Chapters 7 to 15 (Volume 2) of this ES.

6. This chapter considers the Marine Scheme only (all infrastructure and associated works seaward of MHWS), as shown in Volume 4 Figure 5.1. The Onshore Scheme (all infrastructure and associated works landward of Mean Low Water Springs (MLWS)) will be considered within a separate ES prepared in support of an application for planning permission to Northumberland County Council (NCC) which is expected to be submitted in Q4 2023. Further information relating to the Onshore Scheme, in particular the Landfall, can be found in Volume 3, Appendix 3.5.

7. The Marine Scheme and Onshore Scheme overlap in the intertidal area between MHWS and MLWS. For the purposes of this ES, a full description of works below MHWS is provided however potential effects of the Marine Scheme and Onshore Scheme on the intertidal area (area of overlap between MHWS and MLWS) will be assessed accordingly in each EIA (offshore and onshore respectively). Furthermore, where required, the Marine and Onshore schemes will be considered cumulatively with each other. Volume 2, Chapter 1: Introduction provides a summary of the relationship between the Marine Scheme and the Onshore Scheme as well as in Volume 3, Appendix 3.5.

8. Plate 5.1 displays an overview of the key components of the Cambois Connection.

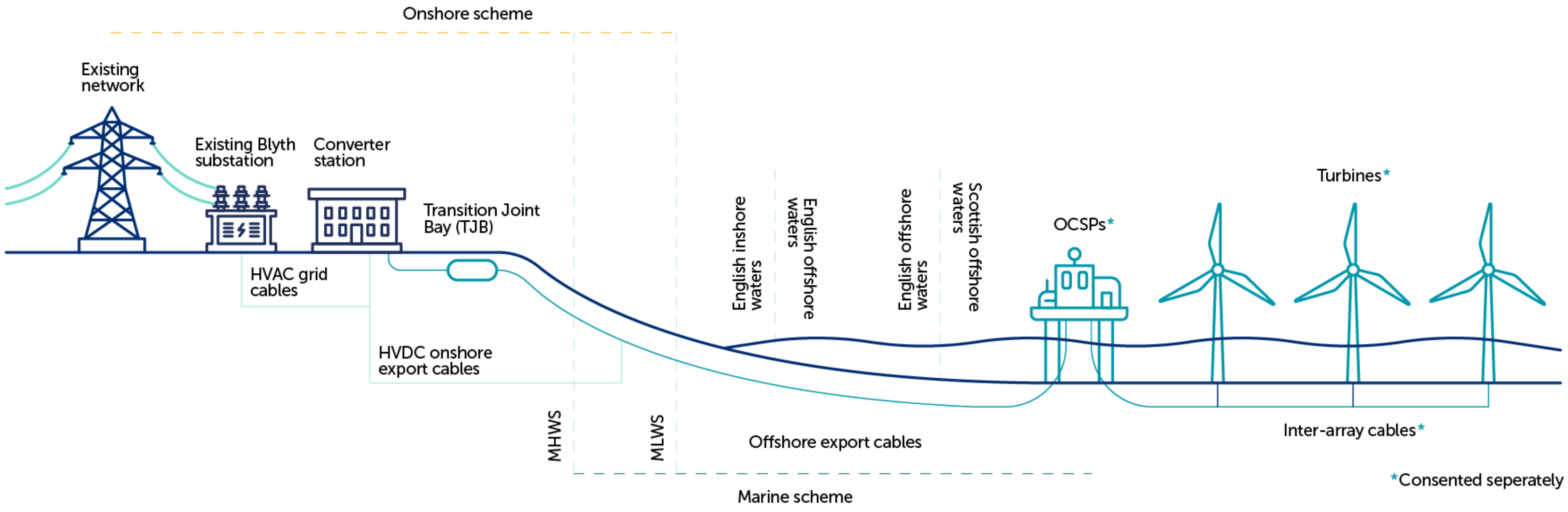

Plate 5.1 Overview of the key components of the Cambois Connection

5.2. Onshore Scheme Overview

9. As outlined above the Onshore Scheme (all infrastructure and associated works landward of Mean Low Water Springs (MLWS)) will be considered within a separate ES to be submitted in support of the Onshore Scheme application, which will be determined by Northumberland County Council as the relevant Local Planning Authority. Further details regarding the Onshore Scheme are included within Volume 3 Appendix 3.5 to provide context with regards to the intertidal area and for consideration within cumulative assessments within this ES. Volume 4 Figure 5.2 shows the boundary of the Onshore Scheme.

5.3. Project Design Envelope

10. The Applicant has commissioned a range of offshore environmental surveys to inform the identification of the Offshore Export Cable Corridor and to inform the impact assessment process. Further survey data will be acquired post-consent to inform final design (e.g. cable route identification and final cable design). This is a routine approach for the majority of marine projects.

11. These limitations relating to seabed data and design definition are therefore managed through the application of the Project Design Envelope (PDE). The PDE approach provides flexibility while ensuring all likely significant effects (beneficial or adverse) are assessed within the EIA process and reported in the Environmental Statement (ES).

12. This PDE approach is in line with Scottish Government (2013) guidance, which states that 'by applying the principles of an approach commonly known as the 'Rochdale Envelope' it is possible to undertake an environmental assessment which takes account of the need for flexibility in the future evolution of the detailed Marine Scheme design, within clearly defined parameters. In such cases, the level of detail of the proposals must be sufficient to enable a proper assessment of the likely significant environmental effects, and any resultant mitigation measures - if necessary, considering a range of possibilities.' This approach is also outlined in detail within the Planning Inspectorate Advice Note Nine (the Planning Inspectorate, 2018).

13. The Marine Scheme PDE has been designed to include sufficient flexibility to accommodate further refinement during the final design stage. Marine Scheme parameters presented include a range of potential values up to and including the Maximum Design Scenario (MDS). For each of the impacts assessed within the technical assessments (Volume 2, chapters 7 to 16), the MDS has been identified from the range of potential options for each parameter set out in the PDE which is described in this chapter.

14. By employing the MDS approach, the Applicant retains some flexibility in the final design of the Marine Scheme and associated offshore infrastructure, but within the maximum parameters that are assessed in the ES. Based on the PDE, this Project Description chapter provides the maximum scenario, thus anything less than that set out in the Project Description chapter and assessed within the technical assessments will have a lesser impact. It is important to note that the EIA has been carried out on the basis of this MDS but as described above and in Volume 1, Chapter 6: Route Appraisal and Consideration of Alternatives, the Marine Scheme is likely to be refined further meaning impacts are likely to be reduced compared to those assessed against the MDS.

15. Given that the Marine Scheme consists of activities in both Scottish and English waters, the MDS described in this chapter is set out for the Marine Scheme in its entirety, as well as providing details specific to the Marine Scheme in Scottish waters and for the Marine Scheme in English waters.

16. Where possible during the EIA process, the MDS of the Marine Scheme has been refined from that which was presented in the Scoping Report. Stakeholder comments received as part of the EIA

Scoping exercise and during consultation meetings have also been considered. Volume 2, Chapter 6: Route Appraisal and Consideration of Alternatives provides a full account of how the Marine Scheme has evolved.

5.4. Marine Scheme Overview

5.4.1. Marine Scheme as a Whole

17. The Marine Scheme is located in the North Sea, extending from within the BBWF array area which is located approximately 48 km offshore of the East Lothian coastline and 38 km from the Scottish Borders coastline at St. Abbs, to the landfall location at Cambois beach, Northumberland (Volume 4, Figure 5.1).

18. The Marine Scheme will comprise up to four HVDC Offshore Export Cables and up to four Fibre Optic (FO) cables which will be bundled with the HVDC cables. The Offshore Export Cables will be installed within the Offshore Export Cable Corridor which will be up to 180 km in length and will have a maximum width of 1 km outside of the BBWF array area for the majority of the corridor[1]. As explained above, the exact configuration of the Marine Scheme has not yet been determined and on this basis, the Offshore Export Cable Corridor allows a necessary degree of flexibility for the final routing of the cables.

19. Part of the Offshore Export Cable Corridor will be located within the BBWF array area. This is necessary to facilitate connection of the Offshore Export Cables to Offshore Convertor Station Platforms (OCSPs) which will be located within the BBWF array area (and are the subject of a separate section 36 consent under the Electricity Act 1989 and Marine Licence applications[2] under the Marine and Coastal Access Act 2009 (offshore waters) and Marine (Scotland) Act 2010 (inshore waters)).

20. The final locations of the OCSPs within the BBWF array area will be subject to detailed design and so will not be finally determined at the point of application of the Marine Scheme. The Offshore Export Cable Corridor currently contains two route options to connect into the BBWF array area (Volume 4 Figure 5.1). These two route options allow for flexibility for the Offshore Export Cables to connect into OCSPs located either in the East or West of the BBWF array area. In accordance with a realistic worst case scenario approach, the assessment will consider the maximum length of the Offshore Export Cable Corridor connecting into the OCSPs located at a maximum distance from the point at which either of the two route options enter the BBWF array area. The maximum length of the Offshore Export Cable Corridor allows for the OCSPs to be located at a maximum distance from the point at which either of the two corridor options shown in Volume 4 Figure 5.1 enter the BBWF array area. Once the location of the OCSPs is confirmed, following detailed design, the Offshore Export Cable route will be refined.

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[1] The Offshore Export Cable Corridor entering into the eastern part of the BBWF array area is currently presented as a funnel which is wider than 1km. This wider funnel is required to allow for connection into OCSPs either in the northern or southern parts of the eastern section of the array area. The Offshore Export Cable route will be significantly less than 1km wide. The study areas for each EIA topic will account for the wider than 1km corridor at this specific section of the Offshore Export Cable Corridor however for brevity within this Chapter the Offshore Export Cable corridor will be described as a 'maximum 1km width' throughout. Where the Offshore Export Cable Corridor approaches the Landfall, the corridor widens to approximately 1.5 km across Cambois beach.

[2] OCSPs are subject to separate Marine Licence applications submitted to Marine Scotland Licencing and Operations Team (MSLOT) in December 2022 as part of the BBWF Section 36, offshore generation and offshore transmission infrastructure Marine Licence applications.

21. Once appointed, the Offshore Export Cable contractor(s) will undertake a detailed appraisal of seabed conditions and carry out detailed route development within the Offshore Export Cable Corridor. Informed by this process, and any other pre-installation surveys, the alignment of cables within the Offshore Export Cable Corridor will then be determined and be subject to micro routeing. This process will allow for optimisation of the Offshore Export Cables routeing and refinement to minimise interaction with localised technical and environmental constraints.

22. The Offshore Export Cables will make landfall at Cambois, Northumberland. The exact location of the Landfall is not yet known but it will be located within the 1.5 km landfall corridor that extends across Cambois beach (Volume 4, Figure 5.2).

23. The design and methods of installation for both the Offshore Export Cables and the Landfall are described in detail in sections 5.7 and 5.8 below. Whilst the Offshore Export Cables are located in both Scottish and English waters, as surmised in section 5.4.2, the Landfall only applies to the Marine Scheme in English waters.

5.4.2. Scottish Waters and English Waters

24. The Marine Scheme is located in both Scottish and English waters. The length of the installation corridor within Scottish and English waters is summarised in Table 5.1.

Table 5.1 Extent of Offshore Export Cable Corridor within Scottish and English waters

Area	Length (km)	Regulatory body
Scottish waters	Up to 40	Marine Directorate Licensing Operations Team (MD-LOT)
English waters	Up to 140	Marine Management Organisation (MMO)

5.5. Indicative Programme

25. An outline of the programme for construction of the Marine Scheme is given below to provide indicative commencement and completion dates, together with estimated durations of key construction activities.

26. Until detailed design of the Marine Scheme is progressed and further refined pre-construction, this programme is indicative and subject to further refinement, but is used to inform assessment of construction phase impacts for the Marine Scheme.

27. The indicative outline construction programme includes the following:

- Commencement of offshore construction (including site preparation works) expected in Q4 2026;
- Commencement of construction at landfall estimated in Q4 2027;
- Commencement of Offshore Export Cable installation estimated in Q3 2028;
- Completion of construction in Q4 2029;
- Key construction activity and estimated durations:
  - Site preparation works: up to 39 months;
  - Landfall construction: up to 15 months; and
  - Offshore Export Cable installation: up to 18 months.

28. Whilst the site preparation works will occur for the duration of the construction phase, these will not be continuous. As up to four Offshore Export Cables are to be installed, there are expected to be periods when some site preparation, landfall and cable installation works occur concurrently.

5.6. Export Cable Route Pre-Installation Preparation Activities

29. Various site preparation activities will be required along the Offshore Export Cable Corridor ahead of cable installation. Site preparatory works are assumed to begin prior to the first installation activity within the Marine Scheme and will continue as required throughout the installation programme.

5.6.1. Pre-Installation Surveys

30. A number of pre-installation surveys (geophysical and geotechnical and unexploded ordnance (UXO) (the Applicant’s approach to UXO is discussed in section 5.5.1.1 below)) will be required along the length of the Offshore Export Cable Corridor to:

- Further assess seabed conditions and morphology (e.g. to identify seabed features which may present technical constraints to cable installation);
- Identify presence and absence of potential obstruction, hazards or sensitive features (e.g. UXO, archaeological or ecological sensitivities); and
- Inform detailed design work e.g. specific cable routes, cable protection, final landfall location and installation techniques.

31. These surveys will be conducted across the Marine Scheme. Timings of surveys will be dependent on programme and survey vessel availability and the duration of the surveys could range from a few weeks e.g. four to six weeks to six months (or longer) depending on the nature of the survey and accounting for factors such as weather downtime for example.

32. The pre-installation surveys are likely to involve a range of industry-standard techniques, including but not limited to:

- **Bathymetry:** multi-beam and single beam acoustic echo sounder systems to accurately record water depth and produce a 3D digital elevation model to identify bedforms, to model seabed terrain and topography, and to identify seabed features such as sandwaves, rock outcrops and obstructions;
- **Side Scan Sonar (SSS):** to map the seabed surface and sediment types. Obstructions lying on the seabed, such as wrecks, debris, boulders, UXO and surface-laid or exposed pipelines and cables that might impede cable installation;
- **Sub-bottom Profiling (SBP):** Directing a pulse of acoustic energy into the seabed and using reflections from the sub-surface geology to assess the thickness, stratification and nature of seabed sediments;
- **Magnetometer/gradiometer:** Passively detect magnetic anomalies compared to the earth's magnetic field, to identify buried ferrous objects such as UXO, pipelines, cables and archaeological features; and
- **Geotechnical:** geotechnical investigations will comprise techniques such as boreholes, vibrocores, and Cone Penetration Tests (CPT) to obtain samples to inform engineering method decisions. The outputs from this activity will inform: the position of the Offshore Export Cables within the Marine Scheme; the selection of installation tooling at specific locations; the confidence level in achieving the required cable burial; and the assessment of the bearing capacity of the seabed sediments with regards to crossing structures.

5.6.1.1. APPROACH TO UNEXPLODED ORDNANCE

33. The development of the Offshore Export Cable Corridor has been informed by consideration of a range of environmental, technical and commercial criteria. This includes high level consideration of UXO risk and based on available information in advance of offshore surveys. Routeing has sought to, where possible, avoid areas where there is a higher likelihood that a UXO would be encountered based on modern history and available datasets.

34. Informed by ongoing survey activities, the Applicant will seek to further refine the Offshore Export Cable route such that it avoids areas of highest UXO risk, and indeed individual potential targets which have been identified through survey outputs / engineering studies.

35. Notwithstanding, some UXO investigation may be required along the offshore export cable route in advance of construction. If required, (and subject to a separate marine licence application as explained below) this is expected to include:

- More detailed investigation of potential UXO (pUXO) including invasive / penetrative techniques if required;
- Use of ROVs and/or divers to investigate the pUXO;
- Excavation of seabed sediment from around the pUXO to ascertain potential risk, and/or the requirement for clearance; and
- Movement of the pUXO.

36. UXO will be avoided via cable routeing where possible. The potential for interaction with UXO along the length of the Offshore Export Cable Corridor will be informed by a desk-based UXO risk assessment.

37. Following this desk-based assessment, UXO will be managed through the following approach:

- Pre-construction engineering and UXO geophysical surveys along the engineered Offshore Export Cable route will be carried out to help inform the management of UXO risk;

- An assessment of UXO risk at each sampling / borehole location will be required in advance of geotechnical surveys. Where pUXO is identified, alternative locations will be selected for the geotechnical surveys and the location of the pUXO recorded to inform micro-routeing;
- Where possible and safe to do so, any pUXO) will be avoided via micro-routeing within the Offshore Export Cable Corridor; and
- Where micro-routeing is not possible for technical and safety reasons, individual pUXO investigations will be carried out to confirm the status and risk associated with specific targets. This is anticipated to include the localised removal of material surrounding the target (diver or ROV-based).

38. Based on this approach and the width of the Offshore Export Cable Corridor, it is assumed that UXO will be avoidable and clearance of UXO is unlikely and therefore not included within the scope of this Marine Licence Application (MLA) and supporting EIA. In the unlikely event that UXO clearance is required at a future stage, this will be subject to separate licencing requirements (Marine Licences and European Protected Species (EPS) Licences from the MMO and/or MD-LOT, depending on the location of the UXO) together with supporting impact assessments including an EPS Risk Assessment and associated Marine Mammal Mitigation Protocol (MMMP).

5.6.2. Cable Route Preparation

39. Prior to installation of the Offshore Export Cables, seabed features (e.g. sandwaves and boulders) and obstacles (e.g. discarded fishing gear and other debris) identified within the Offshore Export Cable Corridor may need to be cleared or avoided, depending on the final cable route (a relatively flat seabed surface is typically required for installation tools to achieve target burial depth).

40. It is not anticipated that there are any out of service cables within the Offshore Export Cable Corridor, however if out of service cables are identified through pre-construction surveys, where possible and safe to do so, these will be avoided via micro-routeing within the Offshore Export Cable Corridor. Where micro-routeing is not possible for technical and safety reasons, individual investigations will be carried out to confirm the status and risk associated with the out of service cables. Following the investigation, a decision would be made on action to take with respect to the crossing or removal of the out of service cable section.

41. Route preparation techniques are anticipated to include:

- Seabed levelling: required to level the seabed prior to cable installation. Involves levelling or lowering of seabed features e.g. sandwaves to create a level surface for cable installation. Approach to seabed levelling is described in section 5.6.2.1 below;
- Boulder clearance: where large boulders are present along the final cable routes these will also need to be cleared within a swathe of 25 m along each cable route to enable cable installation. Approach to boulder clearance is described in section 5.6.2.2 below;
- Pre-lay grapnel run (PLGR): this is required to clear debris and other obstacles from the cable routes and involves towing a heavy grapnel with a series of specially designed hooks along the centreline of the route to gather debris such as trawler warps or crane wires from ships.

42. These techniques will typically be undertaken by the support vessels (see section 5.7.6.3).

5.6.2.1. SEABED LEVELLING

43. In some areas along the Offshore Export Cable Corridor, existing sandwaves and similar bedforms may need to be removed or lowered prior to the installation of the Offshore Export Cables. This is carried out mainly for two reasons, although others may arise:

- Many of the cable installation tools require a relatively flat seabed surface in order to work effectively. Installing cables on up or down a slope over a certain angle, or where the installation tool is working on a camber may reduce the ability to meet target burial depths; and
- The Offshore Export Cables must be installed to a depth where they may be expected to stay buried for the duration of the assumed operational lifetime of 35 years. Sandwaves are generally mobile in nature therefore the cables must be buried beneath the level where natural sand wave movement could uncover it. Sometimes this can only be achieved by removing the mobile sediments before installation takes place.

44. Seabed levelling would involve removal of the peaks of the seabed features and placement of the removed material into adjacent troughs where practicable, thereby levelling the seabed along the Offshore Export Cable route. This is likely to be achieved through the use of a Mass-Flow Excavator (MFE) (see section 5.7.2.2). Seabed levelling may also be undertaken using pre-installation ploughing tools to flatten sand waves, pushing sediment from wave crests into adjacent troughs and levelling the seabed.

45. It is anticipated that seabed levelling tools may affect a 25 m wide corridor per cable route, however it should be noted that the width of the levelled seabed will be approximately 10 m per cable, the remaining 15 m width is to allow for profiling of the seabed to form stable angles of repose. Table 5.2 provides the project design envelope for seabed levelling in the Offshore Export Cable Corridor. There is no anticipated requirement for dredgers to level the seabed or clear sandwaves via removal of the sediment onto a vessel with associated deposit elsewhere outside of the Offshore Export Cable Corridor. Final locations requiring seabed levelling will be refined following completion of a geophysical survey campaign prior to construction.

5.6.2.2. BOULDER CLEARANCE

46. Boulder clearance is commonly required during route preparation. A boulder is typically defined as being over 200 mm in diameter/length. During the course of boulder clearance, boulders will not be removed but rather re-positioned within the consented corridor for the Marine Scheme to facilitate the installation of the Offshore Export Cables. Locations of boulder clearance (including locations of re-positioned boulders) will be recorded to allow dissemination to relevant stakeholders.

47. It is expected that the boulder clearance campaign will be carried out with the use of a Dynamic Positioning (DP) vessel. Boulder clearance is required to reduce the risk of boulders hindering trenching tools, resulting in a failure to achieve target burial depths, and hence the need for further cables burial works and/or cable protection, as well as minimising risk of damage to cables during installation.

48. Table 5.2 provides the project design envelope for boulder clearance in the Offshore Export Cable Corridor.

49. Cable routes may be pre-ploughed to remove boulders or, alternatively clearance may be undertaken using a boulder grab deployed from a specialist boulder clearance vessel. The method to be deployed will be informed by geophysical and pre-construction surveys and will be dependent on the size, density and location of boulders, and more than one method of boulder removal may be deployed across the Marine Scheme.

Table 5.2 PDE for site preparation activities

Activity	Parameter	Value (Marine Scheme whole)	Value (Scottish waters)	Value (English waters)
Seabed levelling	Maximum clearance swathe / width of seabed disturbance (m)	25	25	25
	Maximum area of seabed levelling (m^2)	3,600,000	800,000	2,800,000
	Maximum volume of seabed levelling (m^3)	10,800,000	2,400,000	8,400,000
Boulder clearance	Maximum clearance swathe / width of seabed disturbance (m)	25 m	25 m	25 m
	Maximum area of boulder clearance (m^2)	3,600,000	800,000	2,800,000

5.6.2.3. CROSSING PREPARATION

50. The Marine Scheme does not cross any third party assets within Scottish waters, therefore this section is applicable to English waters only.

51. Within English waters, the Marine Scheme crosses a number of third-party assets (this is discussed in full within section 5.7.5). Each specific crossing will be designed in detail as part of the development of crossing agreements for each asset crossed by the Marine Scheme.

52. Crossing and/or proximity agreements will be developed with regard to the International Cable Protection Committee (ICPC) recommendations as detailed within 3-10C which provides guidance on crossings between telecommunications cables, power cables and pipelines (ICPC, 2021). In order to prepare for crossings, a number of pre-installation activities are anticipated; they include survey(s) and ROV-based inspection of the crossing and installation of external protection, such as rock placement or concrete mattress over the existing in-situ asset. Further information on survey is provided in section 5.6.1 and further information on cable protection required for crossings is detailed within section 5.7.5.

5.6.3. Sea Trials

53. In areas of especially hard or soft seabed, installation tools may be trialled by the installation contractor(s) to determine their capability to achieve the required depth. This could include trials of pre-trenching using a displacement plough, mechanical trencher / jet trencher or other similar means and to determine the efficacy of boulder clearance methodologies so as to minimise the potential use of cable protection.

54. It is important to note that the installation tooling required to complete the Marine Scheme will be based on the completion of comparable infrastructure projects and well-tested and extensively used approaches in UK waters and around the world. For these reasons, sea trials are considered unlikely but included for completeness as part of the EIA.

5.7. Offshore Export Cables

5.7.1. Offshore Export Cables

55. The Offshore Export Cables will originate at the OCSPs within the BBWF array area from where they will be installed within the Marine Scheme boundary (section 5.4.1) to a Landfall location at Cambois, Northumberland (the Landfall is discussed in detail within section 5.8.1).

56. The Offshore Export Cables will transfer power from the OCSPs within the BBWF array area, however as explained above, the exact location of the OCSPs is not currently defined. The Offshore Export Cables will connect into the OCSPs via a J-tube arrangement. There are no other activities associated with the OCSPs as part of the Marine Scheme. Therefore, they are not discussed further in this PD chapter.

57. Throughout the installation process, a range of survey activities may be required; this will be consistent with the techniques and activities described in section 5.5.1 above for the pre-installation surveys and is therefore not repeated here.

58. The Marine Scheme will consist of up to a maximum of four HVDC cables, bundled with up to four FO cables (the FO cables are used for communication purposes from BBWF and condition monitoring for the cables, e.g. Distributed Temperature Sensing (DTS) and/or Distributed Acoustic Sensing (DAS) applications) and a metallic return cable. The Offshore Export Cable configuration will either be a bipole or monopole design and will transmit power at a voltage up to 525 kV.

59. If a monopole design is selected, it will comprise of four HVDC cables which will be laid in sequence with the adjacent cables having opposite polarities to reduce the cable's overall Electromagnetic Fields (EMF) emissions (subject to seabed, water depth, wave/tidal speed, conductor's current rating etc.). Following appointment of the cable (or electrical) design and installation contractor and once detailed design of the cable routes has been undertaken, the EMF produced by the cable circuits will be calculated ensuring they are within International Commission on Non Ionizing Radiation Protection (ICNIRP) guidelines (ICNIRP, 2009) (for further discussion related to EMF, please refer to section 5.10 below).

60. Full detail on construction of the Offshore Export Cables is provided in section 5.7.2.

61. An Indicative Cable Burial Appraisal including parameters such as minimum and maximum target burial depths, has been undertaken. The Indicative Cable Burial Appraisal gives an indication of zones of the Offshore Export Cable Corridor where it may not be possible to achieve the minimum target burial depth of 0.5 m due to ground conditions (see Section 5.6.5 for further detail). In these areas, additional cable protection may be required to ensure the cables are suitably protected.

62. Depending on seabed conditions, Offshore Export Cables will be buried to a minimum target burial depth of 0.5 m with a maximum target burial depth of 3 m. This is the minimum depth required to achieve adequate cable protection through burial. If burial is not possible due to ground conditions, then surface lay and external protection techniques will be employed (refer to section 5.7.4). Each Offshore Export Cable will be buried in a separate cable trench. Each cable trench will have a maximum width of 2.5 m per cable circuit.

63. It is anticipated that a 25 m width of seabed disturbance will be required per trench to allow sufficient width for pre-installation route preparation, such as clearance. The 2.5 m maximum width per trench is included within this disturbance width. Further details on clearance activities are provided in section 5.6.2 . 0

Table 5.3 PDE for Offshore Export Cables

Parameter	Value (Marine Scheme whole)	Value (Scottish waters)	Value (English waters)
Maximum number of Offshore Export Cables	4	4	4
Maximum number of Fibre Optic Cables	4	4	4
Maximum total cable length* (km)	720	160	560
Maximum Operating voltage (kV)	525	525	525
Maximum corridor width (km)	1	1	1
Maximum number of trenches	4	4	4
Maximum trench width (per circuit) (m)	2.5	2.5	2.5
Minimum target burial depth (m)	0.5	0.5	0.5
Maximum target cable burial depth (m)	3	3	3
Maximum width of temporary zone of influence (per trench) (m)	25	25	25

**Maximum of four cable circuits at a maximum of 180 km each*

5.7.2. Offshore Export Cable Installation and Burial

64. There are a number of options available for the installation of the Offshore Export Cables. The preferred method that will be used for the Marine Scheme will be dependent on a number of factors including seabed conditions, sediment type and effectiveness of the selected cable trenching tool available for achieving minimum target burial depth of 0.5 m.

65. Cable burial is essential to protect the Offshore Export Cables from third party activities, including damage from vessel anchors, fishing equipment and other dropped objects, and to prevent future exposure (and risk of damage) of the cables due to natural processes. This is achieved by burying the cables in the seabed. Options for achieving cable burial are outlined below.

66. In areas where minimum target burial depth of 0.5 m is not achieved e.g. due to trenching being limited by seabed conditions outcropping bedrock, or where there is insufficient surficial sediment depths, it will be necessary to use alternative methods to protect the cables such as rock protection. This is discussed further in section 5.7.4.

67. The main options being considered for the installation and burial of the Offshore Export Cables are outlined below.

- Separate cable lay and burial campaigns - cable is pre-laid (placed on the seabed in advance of trenching and burial); (see Plate 5.2 below)
- Simultaneous cable lay and burial – cable is laid at the same time as cable trenching and burial; and (see Plate 5.3 below)
- Pre-lay trenching – cable is laid directly into pre-cut cable trenches, formed by a displacement plough for example.

68. During separate cable lay and burial, a trench is created for the pre-laid cable by a plough or trencher, known as ‘post-lay burial’. The cable sinks into the trench which is then simultaneously backfilled by the plough or trencher (achieving burial). Depending on the effectiveness of the backfilling there may be a requirement to complete additional remedial backfilling / burial works.

69. During simultaneous cable lay and burial, either the cable laying vessel or a support vessel following closely behind (typically less than 1 km) will deploy the cable trenching / burial equipment (see section 5.7.6) and the cable will be buried almost immediately after it is laid. Jet trenchers (described below) can be used to achieve simultaneous trenching and cable lay as they fluidised the sediment within the trench which allows the cable to sink into the seabed. The sediment then reconstitutes above the cable once installation is complete.

70. Where pre-lay trench and burial campaigns are utilised, the trench is pre-cut using a plough or trencher, the cable is laid, and the trench is then backfilled separately using a plough or natural backfill. Additional cable protection may be required where minimum target burial depth is not achieved (see section 5.7.4 below).

71. A range of cable trenching tools may be required to install and bury the Offshore Export Cables to the minimum target burial depths, including:

- **Jet trenching:** water is injected at high pressure in the area surrounding the cable using a jetting tool. The cable sinks to the required target burial depth and sediment reconstitutes above the cable achieving simultaneous burial;
- **Mass Flow Excavating (MFE):** A method of trenching which can be used to precisely excavate material without direct interaction with the seabed by using a specialist MFE tool;
- **Mechanical trenching:** a trench is excavated in the seabed into which the cable is laid. This is generally used for hard/stiff sediments; and
- **Cable plough**: a towed plough is used to create a trench by mechanical interaction through the seabed, into which the cable is simultaneously inserted. Types of plough can also be used to backfill trenches post cable installation.

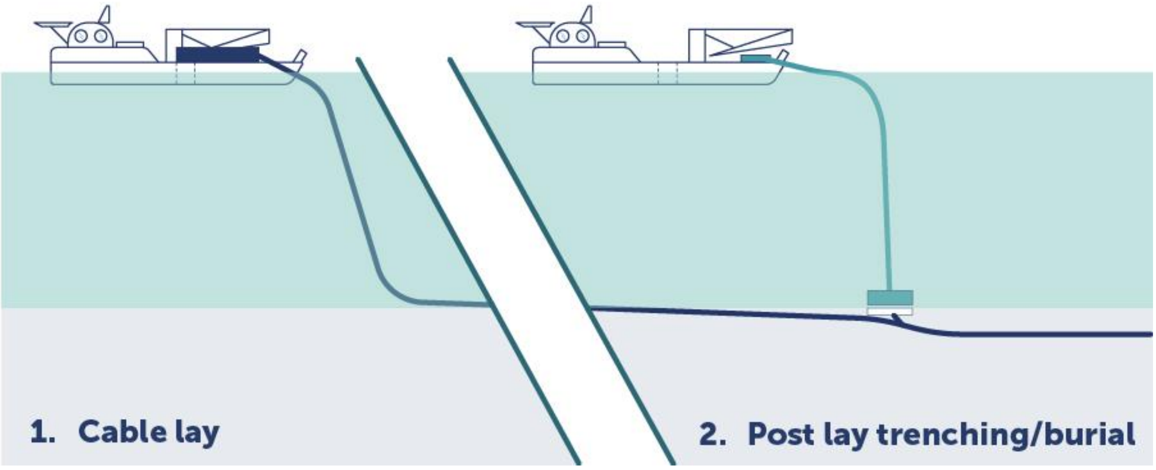


Plate 5.2 Example of approach to separate cable lay and burial campaigns

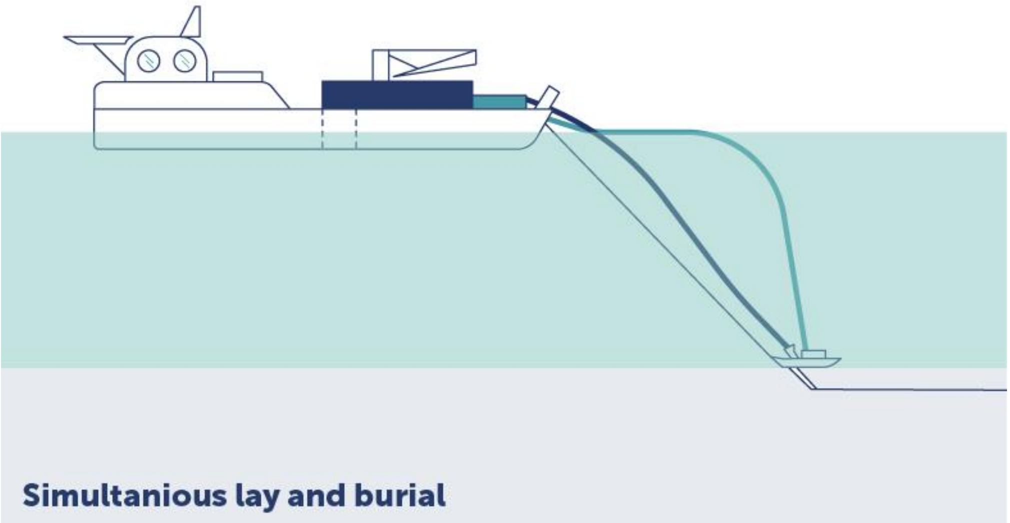


Plate 5.3 Example of approach to simultaneous lay and burial

5.7.2.1. JET TRENCHING

72. Jet trenching machines use high-pressure water jets to disrupt the seabed in front of and underneath the cable, forming a trench full of fluidised sandy material which becomes temporarily suspended, allowing the Offshore Export Cables to 'settle' into the seabed typically under its own weight or directed into the made trench through a depressor arm. Although usually deployed for

operations in sands, the tool can be used to achieve “cutting” when installing Offshore Export Cables in very soft to soft clays.

73. The efficacy of jet trenching depends on the sediment type in which it is deployed. The reconsolidation process is generally fast in fine to coarse sands and gravelly sands but slower in coarse sediments (where lots of rocks and boulders are present), stiff clays and silty muds. Jet trenchers are not viable in areas of hard substrate e.g. rock outcrops

74. There is little or no trench created by the jetting machine in fluidised sands and the seabed is normally left to backfill through natural movement of the sediment.

75. Jetting machines may be deployed:

- Directly behind the cable laying vessel;
- Onto a cable that has been laid previously;
- Self-propelling on an ROV; and
- Mounted on ‘jetting sledges’ that are towed by the cable laying vessel.

76. In all cases the machine function is controlled remotely from the surface vessel via an umbilical cable.

5.7.2.2. MASS FLOW EXCAVATION

77. MFE is a non-contact method of excavation, with the MFE tool positioned above the seabed when operating. MFE is particularly effective in locations with coarser sediment, such as medium to coarse sands and gravels, and is often deployed in the place of other tools that are less efficient in such sediments.

78. Similar to jet trenching, MFE uses water to fluidise the seabed around the cable which causes the cable to sink into the sediment.

79. MFE creates a hollow in the sediment, which forces the cable into the depression. The MFE causes turbidity in the water column immediately surrounding the activity, similar to jet trenching. As the MFE passes over, the sediment re-settles, backfilling the hollow and covering the cable (see Plate 5.4)

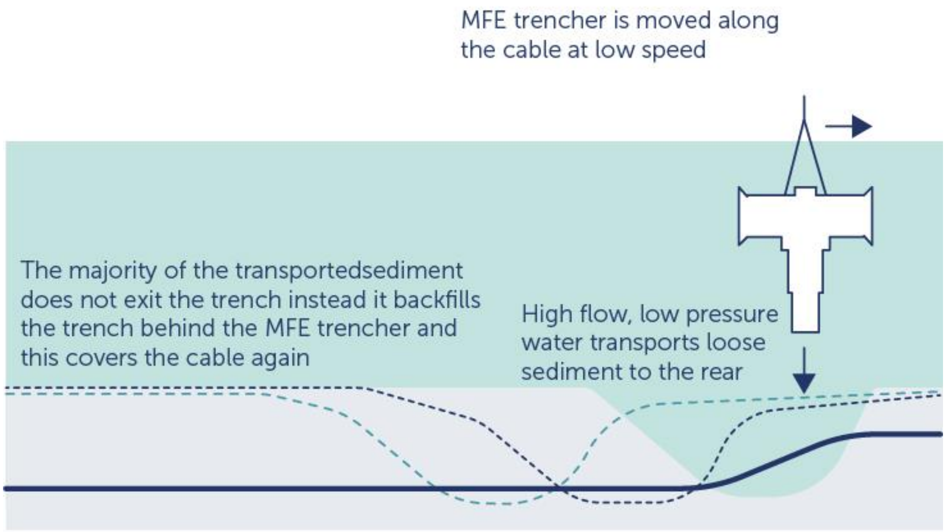


Plate 5.4 Depiction of Mass Flow Excavation

5.7.2.3. MECHANICAL TRENCHING

80. Mechanical trenchers are usually mounted on tracked vehicles and use chainsaw or wheeled arms with teeth or chisels to cut a defined trench. They are suitable for a range of sediments including stiff clays, coarse sediments and exposed bedrock, although they are less effective where boulders are present as the boulders can damage the teeth. They are also not effective in fine sands, gravels and muds.

5.7.2.4. CABLE PLOUGHS

81. There are broadly two types of plough: a displacement plough which creates an open V-shaped trench into which the cable can be laid; or a non-displacement plough which lowers the cable into the sediment. Cable ploughs can used for a range of sediments.

82. Non-displacement ploughs are usually towed from a vessel or by a vehicle on the seabed and can be controlled remotely from the cable laying vessel via an umbilical cable. They are typically associated with simultaneous cable lay and burial campaigns as trench backfilling is not required. Non-displacement ploughs have a typical disturbance swathe of 8-12 m which is due to the width of the plough itself, and the actual footprint of seabed disturbance is typically 1 m.

83. Displacement ploughs are used to create a trench prior to the cable being laid. The displacement plough is typically towed across the seabed by a support vessel, creating a trench by displacing the sediment onto the seabed either side of the trench. The trench is left to backfill naturally, or backfilled using a plough to push sediment back into the trench. MFE tools can also be used to assist with backfilling.

5.7.3. Cable Jointing

84. The Offshore Export Cables will comprise a number of sections. Each section of Offshore Export Cable will be transferred on to the cable carousel which is located on the cable lay vessel. Each section of Offshore Export Cable will need to be jointed to the next section which is undertaken on the cable lay vessel.

85. The number and type of joints required will depend on the maximum lengths of the cable sections which will be dependent on the final design specification of the cable. This will be influenced by a range of factors including final cable size, weight, core materials and armouring.

86. Effort will be made to avoid cable jointing in areas of high-density marine activities, to reduce the length of time the installation vessels are required to be stationary.

5.7.4. Cable Protection Measures

87. As discussed above, the primary aim is to achieve minimum target burial depths through burial of the cables in the seabed. Where it is not possible to achieve minimum target burial depth due to seabed conditions, additional cable protection will be required to protect the cable from third party damage or future exposure.

88. A range of additional cable protection measures are being considered for the Marine Scheme. These include:

- Rock protection;
- Concrete mattresses;
- Sand, rock and grout bags; and
- Cable protection systems such as split pipe or other tubular protection system.

5.7.4.1. ROCK PROTECTION

89. This method of protection involves the placement of rock on top of cables (including within the trench where there is insufficient sediment to rebury the cables) to provide additional protection. Protection is achieved by creating a rock berm. The rock berms will be designed to provide protection from anchor strike, dropped objects, interactions with fishing gear and scour, and to minimise snagging risks as far as is practicable. The cross-section of the berm may vary dependent on detailed design, but will have a maximum width of 9.5 m, height of 1.5 m and an approximate slope of 1:3 both sides of the cable (in accordance with DNVGL, 2016 and DNV, 2010). The length of the berm is dependent on the length of the cable which requires protection.

90. Rock placement is achieved using a vessel with equipment such as a fall pipe (See Plate 5.5 and Plate 5.6) which is used to direct the rock to specific locations on the seabed. This ensures that rock is placed exactly where it is required and to the agreed design specification in terms of berm width and height.

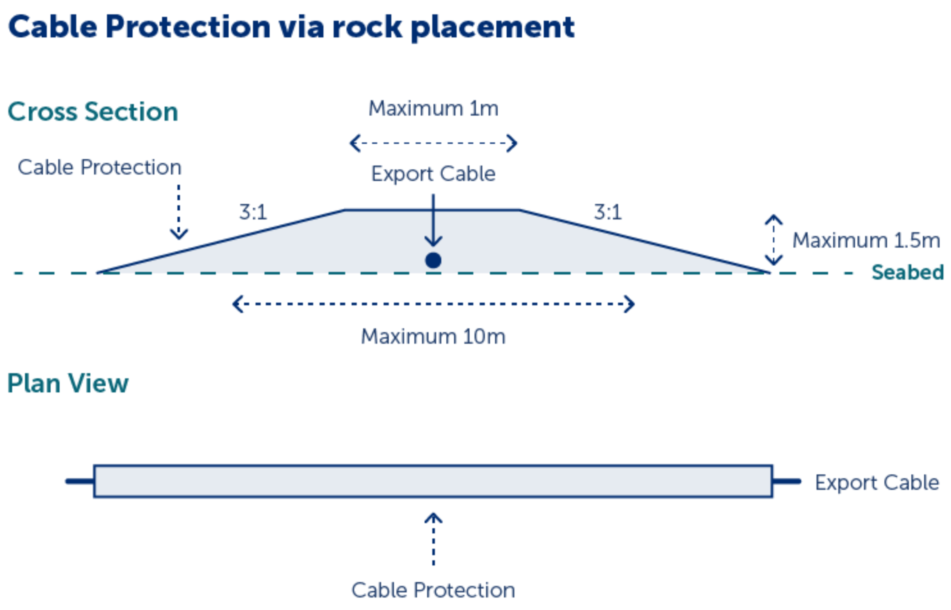
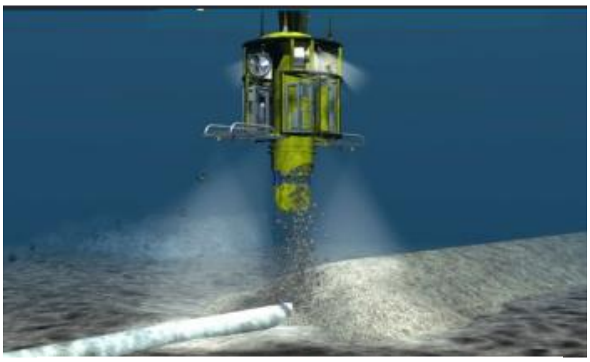
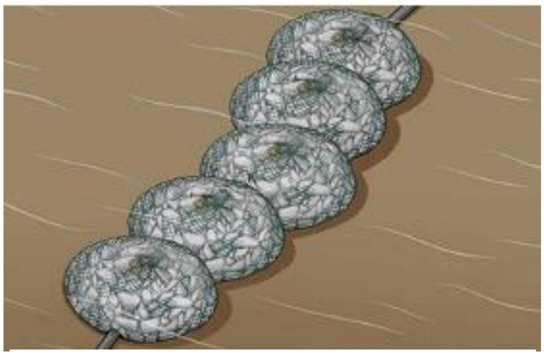


Plate 5.5 Cable protection via rock placement



Example 'Fall Pipe' used to install rock protection



Rock bags

Plate 5.6 Example 'Fall Pipe' used to install rock protection

5.7.4.2. CONCRETE MATTRESSES

91. Concrete mattresses are constructed using high strength concrete blocks and ultraviolet stabilised polypropylene rope. At the time of writing of this assessment, they are typically supplied in standard 6 m x 3 m x 0.3 m units of standard density, however modifications to size, density, and shape (tapered edges for high current environments, or denser concrete) can be engineered bespoke to the locality.

92. The concrete mattresses are lowered to the seabed from a specialist vessel using a free-swimming installation frame (or similar). Once the correct position is confirmed, a frame release mechanism is triggered and the mattress is deployed onto the seabed. This single mattress installation is repeated for the length of cable that requires protection. The mattresses may be gradually layered in a stepped formation on top of each other dependant on required level of protection. Use of concrete mattresses will be assessed based on localised ground conditions and infrastructure use (see Plate 5.7).

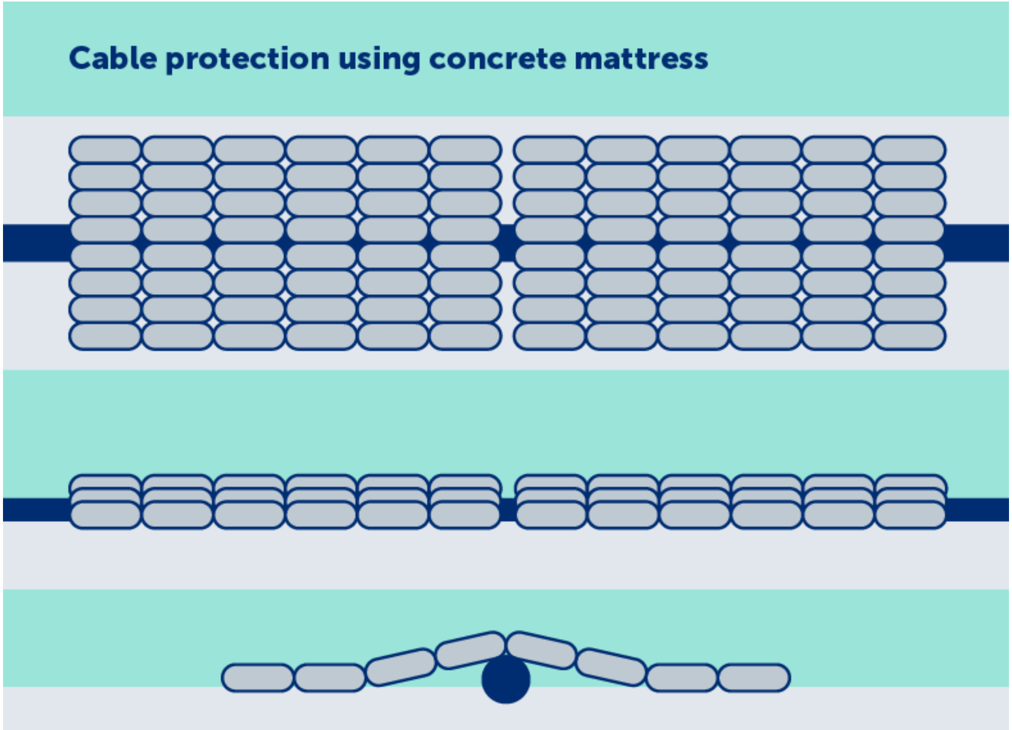


Plate 5.7 Cable protection using concrete mattress

5.7.4.3. SAND, ROCK AND GROUT BAGS

93. The placement of sand, rock or grout bags over the Offshore Export Cables provides more localised protection relative to concrete mattresses. Sand and rock bags are pre-filled prior to being placed above the cables. Rock bags consist of various sized rocks contained within a rope or wire net. Sand and rock bags are lowered towards the seabed. Once they are in the correct position they are released on to the seabed. Rock bags are circular in design (see below) with dimensions typically 0.7 m in height by 3 m in diameter.

94. The bags are either pre-filled or placed on the seabed empty and then filled with structural grout from a pumping spread on a vessel. The grout cures to provide an effective over cover protection system. Use of sand, rock or grout bags will be assessed based on localised ground conditions and infrastructure use.

5.7.4.4. CABLE PHYSICAL PROTECTION SYSTEM

95. Articulated half pipes, generally made of polyurethane or cast-iron can be used to provide protection against impact, abrasion and overbending. Use of articulated half pipes will be assessed based on localised ground conditions and infrastructure use.

5.7.4.5. SUMMARY OF CABLE PROTECTION MEASURES

96. The design and engineering options available to the Marine Scheme are dependent on the specific conditions and environmental factors along the length of the route. Detailed design studies to refine design parameters will continue beyond the current planning phase and extend into procurement and contracting.

97. Estimated indicative requirements for cable protection along the length of the Offshore Export Cable Corridor have been developed, as detailed within Table 5.4. These indicative estimates have been based on preliminary design information, a preliminary Unmanned Survey Vessel Geophysical Cable Route Survey, and the outputs from an Indicative Cable Burial Appraisal which the Applicant has commissioned.

98. The estimates have been developed in order to provide the basis for the EIA, and to inform the approximate upper bound of cable protection sought for the Marine Licence (both to MD-LOT for Scottish waters, and to the MMO for English waters).

99. The estimates represent a realistic worst case prediction of the volumes and footprints of cable protection anticipated to be required for the Marine Scheme at this stage of the development. The estimates provided are accompanied with a summary of areas where cable protection is more or less likely; for the purposes of the EIA, this has been categorised according to nine zones; they are described in full in Section 5.7.4.6. Linear zonation has been used to help provide a spatial basis for the assessment and is subject to refinement following further geophysical and geotechnical investigation and design works.

100. Further Offshore Export Cable investigations along with further engineering will inform the exact cable design and installation plan (and indeed the location of the cable within the consented corridor – the Route Position List (RPL)). Similarly, a Cable Plan (CaP) will be developed which will provide a more refined level of detail on the installation of the Offshore Export Cables, and associated protection measures. This level of definition will – by necessity – be provided at a later stage and the detailed design will conform to the maximum quantities for the Marine Scheme, and the MDS presented within Table 5.4 which will be included on the Marine Licence.

101. The PDE for cable protection parameters is provided in Table 5.4 below.

Table 5.4 PDE for cable protection parameters

Aspect	Parameter	Value (Marine Scheme whole)	Value (Scottish waters)	Value (English waters)
Cable protection	Maximum height of cable protection (m)	1.5	1.5	1.5
	Maximum width of cable protection (m)	9.5	9.5	9.5
	Maximum length of cable protection[3] (m) per cable.	37,131	6,000	31,131
	Maximum total footprint for cable protection (m^2) per cable	352,748	57,000	295,748
	Maximum volume of cable protection required (m^3)	1,113,940	180,000	933,940

5.7.4.6. INDICATIVE LINEAR CABLE PROTECTION ZONES FOR ASSESSMENT PURPOSES

102. As outlined above, linear zonation has been used to help provide a spatial basis for the assessment and is subject to refinement following further geotechnical investigation and design works. The assessments within the technical chapters have been based on the maximum lengths and volumes as outlined in Table 5.4, however some assessments with reference to specific features in specific areas, for example the Marine Conservation Zone (MCZ) Assessment, have used the information included in Table 5.5. The Offshore Export Cable was categorised into indicative linear zones which considered the nearshore area, approximate 25 km intervals along the Offshore Export Cable Corridor in English waters until the Offshore Export Cable Corridor branches into the eastern and western branches, and then the Offshore Export Cable Corridor within Scottish waters, which was considered as one zone.

103. A wide range of obstacles and seabed users have the potential for direct interaction with the Offshore Export Cables, all of which can present a hazard to subsea cables with the potential to cause damage to the Offshore Export Cables. Such hazards include ship anchors which could impact or snag the Offshore Export Cables if dragged along the seabed; and fishing, where bottom trawling gear can snag and damage cables.

104. As part of the Indicative Cable Burial Appraisal, the Offshore Export Cable Corridor was assessed to determine potential hazards, associated risks, and evaluating the level of protection that may be afforded to the cable by its armouring (internal and/or external), cable burial beneath the seabed or any other means, such as rock placement or other external protection measures. This allowed zones of the Offshore Export Cable Corridor to be assigned a burial level classification of A (target or beyond), B (within target) or C (less than target), with a corresponding level of risk, and therefore the estimated upper bound amounts of cable protection are calculated based on these risk levels along the length of the route.

105. A summary of the areas where cable protection is more or less likely; for the purposes of the EIA is provided Table 5.5 and Volume 4, Figure 5.3)

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[3] It should be noted that the length is based on the longest potential Offshore Export Cable Route option, being the eastern branching corridor option.

Table 5.5 Estimates of cable protection for indicative linear zones along the Offshore Export Cable Corridor[4]

Parameter	Estimates for Indicative Linear Zones								
	Nearshore, English Waters 1	English Waters 2	English Waters 3	English Waters 4	English Waters 5	Eastern Branch (English Waters)	*Eastern Branch (Scottish Waters)*	Western Branch (English Waters)	*Western Branch (Scottish Waters)*
Maximum length of cable protection (m)[5]	1,951	4,560	5,392	8,238	7,148	3843	*6000*	994	*6000*
Maximum volume of cable protection required (m^3)	58536	136800	161756	247128	214444	115280	*180000*	29812	*180000*
Percentage of cable protection required	33	24	22	33	42	8	*15*	2	*15*

[4] Text in italics indicates Scottish Waters

[5] It should be noted that the route length is based on the longest potential Offshore Export Cable Route option, being the eastern branching corridor option.

5.7.5. Cable Crossings

106. It is anticipated that up to five cable crossings will be required across the extent of the Offshore Export Cable Corridor. All crossings are within English Waters. This count includes:

- North Sea Link (NSL) developed by National Grid Ventures (installed);
- Eastern Green Link 1 (EGL1): Torness to Hawthorn Pit, understood to be jointly developed by National Grid Electricity Transmission (NGET) and Scottish Power Transmission (SPT) (in planning);
- Blyth Offshore Demonstrator Project Array 2 (Phase 1) export cable (installed);
- Whilst it is unlikely the final route for the Marine Scheme Offshore Export Cables will cross this export cable, it is included as a potential crossing as a worst case;
- Blyth Offshore Demonstrator Project Array 4 (Phase 2) export cable (consented)
- The exact location and timescales for construction are unknown, however, this asset is included as a potential crossing as a worst case;
- Blyth Offshore Demonstrator Project Array 3a export cable (consented)
- The exact location and timescales for construction are unknown, however, this asset is included as a potential crossing as a worst case.

107. Crossing agreements and designs will be sought with the relevant operators or owners to agree exclusion zones for works in proximity to the assets, including agreements on exclusion zones for trenching equipment to reduce risk to third party assets. The Applicant will also follow ICPC 3 - Telecommunications Cable and Oil Pipeline / Power Cables Crossing Criteria recommendations where appropriate.

108. A crossing angle of 90 degrees relative to the installed cable will be targeted, however this will be influenced by the existing cable condition, seabed, final crossing design and selection of protection technology as well as installation contractor requirements.

109. Crossing design is dependent on the requirements of the relevant operators and owners, as well as physical characteristics of the marine environment in which the crossings are located. Crossings will be protected by the installation of standard cable protection techniques designs including rock protection and/or concrete mattresses. Where cable crossings are required, these will have a maximum width of 12.5 m, maximum height of 2 m and maximum length of 200 m per crossing.

110. Eastern Green Link 2 (EGL2): Peterhead to Drax (in planning) is located approximately 3.25 km east of the Offshore Export Cable Corridor at the nearest point. Whilst a cable crossing is not considered likely to be required based on the current indicative location of EGL2, a proximity agreement may be required between the Applicant and the operator to ensure installation works in proximity to the cable route are undertaken at a sufficient distance so as to not impact operation.

111. Volume 4, Figure 5.4 illustrates the locations of the identified third party assets that will require crossing and/or proximity agreements.

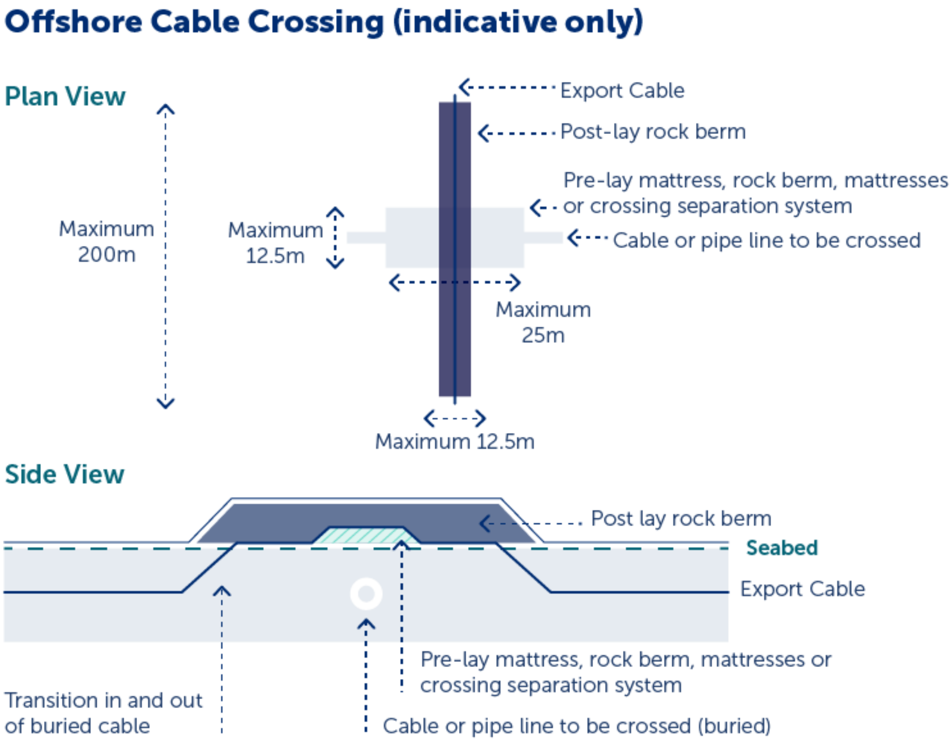

Plate 5.8 Offshore cable crossing (indicative only)

112. There is the potential that currently unknown cable crossings will be required and, where required, crossing agreements will be sought with the respective operators. However, on a precautionary basis, the MLA for the Marine Scheme includes all foreseeable crossings at this time and the EIA has been carried out on this basis.

113. The exact process for the installation of cable crossings will be determined following consent, and as informed by discussions with third parties, the crossing design and contractor requirements.

5.7.5.1. SUMMARY OF CABLE CROSSINGS

114. Table 5.6 summarises the PDE for the offshore cable crossings as discussed above.

Table 5.6 PDE for offshore export cable jointing and crossings

Aspect	Parameter	Value (Marine Scheme whole)	Value (Scottish waters)	Value (English waters)
Cable crossings	Maximum number of crossings	5	0	5
	Crossing material / method	Rock placement/rock bags/concrete mattress/cast iron cast / CPS system	n/a	Rock placement/rock bags/concrete mattress/cast iron cast / Cable Protection System

Aspect	Parameter	Value (Marine Scheme whole)	Value (Scottish waters)	Value (English waters)
	Maximum height of each crossing (m)	2	n/a	2
	Maximum width of each crossing (m)	12.5	n/a	12.5
	Maximum length of each crossing (m)	200	n/a	200
	Total area per crossing (m^2)	2,500	n/a	2,500
	Maximum volume of material (per crossing) (m^3)	3,120	n/a	3,120
	Maximum total area of all crossings (m^2) per cable	12,500	n/a	12,500
	Maximum volume of material for all crossings (m^3) per cable	15,600	n/a	15,600

5.7.6. Cable Installation Vessels

115. A range of installation vessels will be required to complete the cable installation works. The types of vessels anticipated to be required for the installation activities are summarised below. Installation methods and technologies will be confirmed on award of the installation contract and will be within the maximum design scenario described. All vessels specified may also be supported by guard vessels.

5.7.6.1. CABLE INSTALLATION VESSELS

116. A cable laying vessel will be required to carry and handle the lengths of the Offshore Export Cables, and accurately position the cable on the seabed. The cable laying vessel will have a dynamic positioning system which is used to hold the position of the vessel accurately without the need for anchoring. The vessel will include a cable carousel (to hold the cable) and will be equipped with a cable tensioner on board which will control the laying of the Offshore Export Cables from the cable carousel onto the seabed. The specialist subsea installation market is always evolving and cable lay vessels have various cable carrying capacities depending on design specifications.

5.7.6.1.1. JACK-UP BARGE

117. A jack-up barge may be used to support cable landfall operations in the nearshore area at Cambois. They make contact with the seabed and jack up from the water when the base structure of each leg ('spud cans') are lowered into place.

Table 5.7 PDE Jack up vessels

Parameter	Value
Maximum number of legs per vessel	6
Maximum individual effective leg diameter (m)	8.6
Maximum area of spud cans (m^2)	250
Maximum seabed footprint (m^2)	1000

5.7.6.2. CABLE PROTECTION INSTALLATION VESSELS

118. Rock placement vessels will be required to transport the rock to the required location and deploy the rock onto the seabed. Rock placement vessels typically use DP, and will be used in areas where the water depth is greater than 10 m and rock placement will be achieved through a fall-pipe from the vessel and/or side placement. In shallower waters closer to the Landfall, rock will be directly placed with a grab device that lowers the rock to the seabed (likely using an arm from a barge or similar technique). Further detail on rock protection measures is provided in section 5.7.4. Alternative cable protection methods can be installed by Support vessels, as outlined in Section 5.7.6.3, as appropriate.

5.7.6.3. SUPPORT VESSELS

119. Specialised support vessels typically use DP, and may be required to support a range of other activities, including surveys using ROV or geophysical equipment, diving activities, cable trenching (e.g. ploughing, jet trenching, trenching, pre-lay grapnel run), installation of required cable protection systems.

5.7.6.4. GUARD VESSELS

120. The installation vessels described above are typically slow-moving and with restricted manoeuvrability, particularly in areas of high-density activity. Guard vessels may therefore be appointed during installation, major maintenance works, and decommissioning works, where required, to ensure effective communication with other third party vessels during the Marine Scheme activities. This also aids coordination with fishing vessels to reduce the potential for interaction with commercial fishing activities.

121. Where required during cable installation, guard vessels will maintain surveillance around the cable laying vessel or other vessels with restricted manoeuvrability, particularly in areas of high-density marine activities, where it is considered necessary to ensure other vessels keep clear of the installation activity to avoid the risk of collision.

122. Additionally, they may be required to protect the cable prior to trenching or external protection and also to protect free ends of cable left on the seabed in between installation campaigns (see section 5.7.2 above, and section 5.8.2 below).

123. All guard vessels will use RADAR with Automatic RADAR Plotting Aid (ARPA) to monitor vessel activity and predict possible interactions.

5.7.6.5. CREW TRANSFER VESSELS

124. A small number of Crew Transfer Vessels (CTVs) may be required to transfer personnel to and from the installation vessels.

5.7.6.6. SUMMARY OF VESSEL PARAMETERS

125. Table 5.8 below summarises the PDE for installation vessels. Vessel activity will be broken up into campaigns and that activity will not be continuous across the duration of the construction period. It should also be noted that cable installation is a transient activity and as cable laying and associated protection and support vessels will be using DP, so it is not anticipated that vessels would be required to drop anchor.

Table 5.8 MDS for installation vessel parameters

Parameter	Maximum number of vessel actively working at Marine Scheme at any one time
Pre-installation boulder removal / clearing vessels	2
Cable installation vessels	2
Guard vessels	10
Survey vessels	2
Crew transfer vessels	2
Cable protection installation vessels	2
Jack-up barge	1

5.8. Landfall

5.8.1. Landfall

126. The Landfall is part of the Marine Scheme in English (inshore) waters only.

127. The landfall location at Cambois forms the interface between the Marine Scheme and Onshore Scheme where the Offshore Export Cables will be brought ashore, as shown in Volume 4, Figure 5.2. The landfall corridor is approximately 1.5 km wide at Cambois beach, at the widest point between the River Wansbeck and the Port of Blyth. The final location of the Landfall at Cambois is still to be determined but will be located within this wider Landfall corridor. This will accommodate a trenchless technique (such as horizontal directional drilling (HDD)) to bring up to four Offshore Export Cables ashore.

5.8.2. Landfall Installation

128. The development of a landfall will require construction work within the marine environment (i.e., below MHWS) as well as onshore work (i.e., above MLWS). Works landward of MLWS are described and assessed in the Onshore Scheme ES, to be submitted Q4 2023, and are assessed cumulatively with the Marine Scheme in this Marine Scheme ES, as outlined in Volume 3 Appendix 3.5 which summaries information relating to both the Marine Scheme and the Onshore Scheme and Landfall within the intertidal area.

129. The Offshore Export Cables will be installed at the Landfall using a trenchless technology such as HDD. This involves installing an underground cable duct by drilling a bore (or holes) from one point to another. The Offshore Export Cables are then installed through the duct(s). It is likely that the holes will be drilled from a trenchless technology compound which will be located above MHWS (onshore) to an agreed ‘punch out’ location in the nearshore marine area (below MLWS), therefore completely bypassing the intertidal zone. There will be up to five exit pits, each 20 x 5 m, for up to four cable ducts (with one spare in case of failure) due to trenchless cable installation at the Landfall.

130. HDD is discussed in detail below to provide an example description of trenchless techniques, other trenchless technologies may be selected however these would have no worse likely significant effects than HDD, as described below, therefore the MDS is presented and assessed within this ES.

5.8.2.1. HORIZONTAL DIRECTIONAL DRILLING

131. HDD is a trenchless installation methodology which avoids direct interactions within the intertidal zone, as shown in Plate 5.9. HDD can be carried out via a marine or shore-led methodology; it is described in detail below based on a shore-led approach - which is most likely - however the principles are largely the same for either methodology.

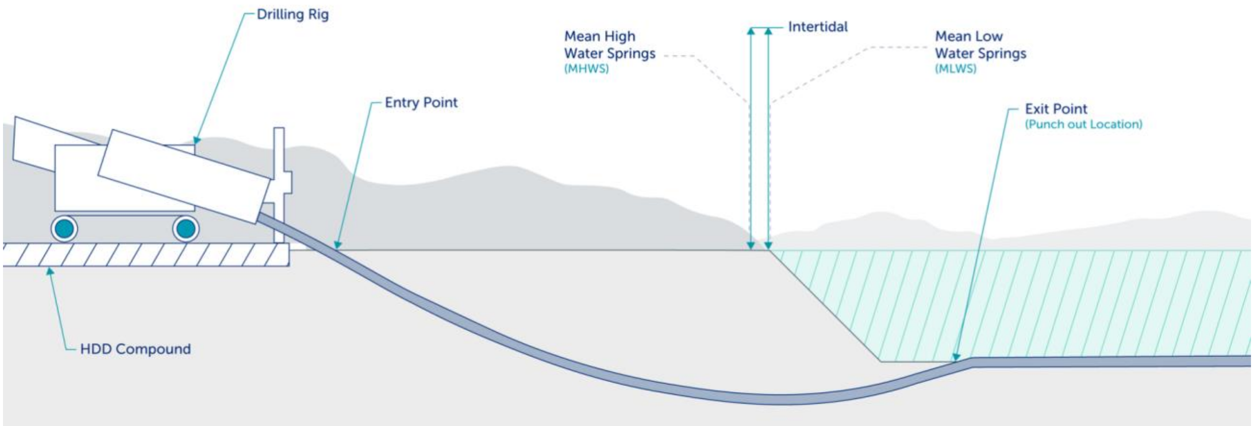

Plate 5.9 Depiction of HDD (indicative trenchless installation methodology)

132. HDD involves drilling a hole (or holes) along an underground pathway from one point to another, through which the Offshore Export Cables are installed, without the need to excavate an open trench. To achieve this a drill rig is located onshore, landward of MHWS. A working area would be established containing the drill rig, electrical generator, water tank, mud recycling unit and temporary site office. The drilling installation would commence from above the MHWS, with the HDD exit point (punch out location) located seaward of MLWS between 500 m and 2,400 m from the HDD entry point. The HDD exit pits are expected between the -2.5 m LATs and -10 m LATs, as such, no works are planned to take place in the intertidal zone.

133. A drilling fluid, such as Bentonite, is pumped into the drilling head during the drilling process to stabilise the hole and retrieve the drilled material. Once the drilling is complete, cable ducts may be installed from land and pushed out, or towed into position by a vessel offshore and pulled in. The offshore export cables are then pulled through the pre-installed ducts from the cable lay vessel by land-based winches.

134. The HDD punch out may also require the excavation of HDD exit pits.

135. Indicative HDD works may comprise the following main stages:

a) A pilot hole will be drilled from onshore to offshore.

b) Once the pilot hole has been completed, the reaming process will commence, increasing the diameter of the pilot hole to accommodate the safe installation of HDD duct. The reaming process will continue back and forth for a number of passes to achieve a minimum bore diameter. During the drilling procedure, drilling fluid is continuously pumped to the drill head to act as a lubricant. Solids are removed from the returning fluid, and the spoil is transported off site or into the mud pit (landward of the MHWS) to settle.

c) A jack-up vessel or MFE/dredger will be used at the at the HDD exit pit to create a HDD exit pit. In the case of backwards reaming, a drill rig would be positioned on the jack-up vessel.

d) In the case of forward reaming, the last forward HDD reamer exits the seabed at the HDD exit pit.

e) In the case of backward reaming, drilling may be required from the offshore HDD Exit Pit. This would entail the HDD reamer running backward and forward between the two drilling rigs.

f) The HDD reamer is then disconnected from the drill pipe and recovered.

g) The High-Density Polyethylene (HDPE) liner pipe will be pre-assembled and then floated in, connected to the drill pipe, and pulled onshore from the offshore end through the pre-drilled bore into position.

h) Steps a to f are then repeated for each Offshore Export Cable.

i) Trenches are then excavated from the HDD entry points above the MHWS to the transition joint bay (TJB) and backfilled; (this is covered as part of the Onshore Scheme).

j) HDD construction equipment and plant is then demobilised from site.

k) The ducts are then proved ready for cable pull in and messenger wires are installed.

l) Cables will then be installed in the ducts by pulling onshore with winches through the ducts from the cable lay vessel to the transition joint bays.

136. The temporary construction compounds (which are assessed as part of the Onshore Scheme and information is presented here for information only) will be located landwards of MHWS and located outside of the Cambois Beach dune system. As outlined above, trenchless techniques will be carried out from within temporary construction compounds which will also be used to install the TJB. Access to the trenchless technology/TJB construction compound would be via the existing road network in Cambois.

137. The trenchless technology/TJB construction compounds (which are assessed as part of the Onshore Scheme and information is presented here for information only) will house the trenchless technology (e.g. HDD) drill rig and other equipment, machinery and plant including but not limited to excavators, bulldozers and cranes. The trenchless technology / TJB construction compounds may also house temporary portable cabin structures to be used as the site office and welfare facilities, including but not limited to toilets, kitchens, and the provision of sealed waste storage and removal. Temporary construction compounds may also be used for the storage of infrastructure components, parking for vehicles, storage for tools and small parts, as well as oil and fuel storage and an emergency electrical generator.

138. Secure temporary fencing and lighting will be erected around the trenchless technology / TJB construction compound (which are assessed as part of the Onshore Scheme and information is presented here for information only). The security fencing will define the working area, protect any sensitive areas, and prevent third party access. Access gates may be installed that are suitable for both personnel and for movement of plant and equipment.

139. Once commenced, the HDD activities may be required to operate continuously over a 24-hour period until each bore is complete. Subject to further construction planning and availability of drilling rigs, drilling may be carried out concurrently to accelerate the construction works programme.

140. There are typically two pull in techniques considered for the HDD landfall installation. The first being direct pull in, where the cable vessel will sit a short stand-off distance from the HDD exit point, where the cable is pulled directly and unreeled from the vessel. The second being floated pull in, where the vessel will stand-off at a suitable water depth for its safe operation and float the cable

toward the duct, with a second vessel assisting located above the HDD exit point to guide the cable through the duct.

141. Some material removed from the bore path will be lost to the marine environment, as will small volumes of drilling fluid (this is a normal event as part of the HDD process and is unavoidable). During HDD works the estimated discharge to the sea per borehole is up to 1,900 m^3 of fluid and up to 100 m^3 of solids. There is therefore estimated to be a total of up to 9,500 m^3 of fluid and 500 m^3 of solid discharged from up to five exit pits. These losses are unavoidable, however will be minimised insofar as practicable through the implementation of industry best practice for example, clearing runs or reducing the volume of drilling fluids in the borehole prior to breakout to the marine environment. This will be adequately controlled via the Environmental Management Plan (EMP) for the Marine Scheme.

142. The preferred drilling fluid(s) will be selected by the installation contractor(s) on the basis of technical performance, environmental requirements and other installation considerations. The drilling fluid(s) selected by the installation contractor(s) will be biologically inert and selected from the Centre for Environment Fisheries and Aquaculture Science (Cefas) approved drilling fluid suite.

143. Based on comparable infrastructure projects, the most common fluid used is bentonite based. Bentonite consists of a clay-like material which is generated (typically) through the alteration of volcanic ash product. It is a 'PLONOR' substance which is considered to Pose Little Or No Risk to the environment according to OSPAR[6] (OSPAR Commission, 2021). Bentonite comprises 95% water and 5% bentonite clay which is a non-toxic, natural substance. Bentonite drilling fluid is non-toxic and can be commonly used in farming practices. Every endeavour will be made to avoid a breakout (loss of drilling fluid to the surface). A typical procedure for managing a breakout under water would include:

- stop drilling immediately
- pump lost circulation material (mica), which will swell and plug any fissures;
- check and monitor mud volumes and pressures as the works recommence; and
- repeat process as necessary until the breakout has been sealed.

144. As part of the detailed design work required to inform the final landfall methodology, the potential risks relating to cable exposure due to coastal recession and beach lowering will be considered in greater detail including the effects to climate change over the operational and maintenance phase of the Project.

145. The PDE for landfall installation parameters using HDD are provided in Table 5.9 below, it should be noted these are subject to further refinement post consent.

[6] The mechanism by which 15 Governments and the EU cooperate to protect the marine environment of the North-East Atlantic.

Table 5.9 PDE for HDD parameters (seaward of MHWS)

Parameter	Maximum value (English waters only)
Maximum number of trenchless cable ducts*	4
Diameter of cable ducts (m)	0.3 – 2.5
Maximum length of cable ducts (per duct) (m)	2,400
Estimated trenchless burial depth (m) (intertidal)	30
Dimension of exit punches out (m) (subtidal)	20 x 5

* Maximum number of permanent trenchless cable ducts assumed. Should during trenchless landfall installation a bore fail through encounter of unforeseen ground conditions or other failure, a spare bore may be required.

5.9. Operation and Maintenance Phase

146. This section provides an overview of the main activities which are anticipated to be associated with the operation and maintenance phase of the Marine Scheme.

147. Note that throughout the operation and maintenance phase, a range of survey activity may be required; this will be consistent with the techniques and activities described in 5.6.1 above for the pre-installation surveys (although with a greatly reduced frequency) and therefore the surveys are not described in detail here but are, however, included within technical assessments where relevant.

5.9.1. Routine Inspections

148. Routine inspections of the Offshore Export Cables will be undertaken to monitor the condition of the cables and the cable protection methods. It is expected that these will be undertaken using a survey vessel, unmanned survey vessel (USV) or ROV. It is anticipated that routine surveys/inspections will initially be required up to annually in the initial years of operation.

149. The findings from early inspections will be used to determine the frequency of future surveys, particularly where sections of the Offshore Export Cable Corridor may require additional inspection if there are conditions which may generate a higher risk of cable damage (i.e. where the cable has, for example, been unexpectedly uncovered due to a storm event).

5.9.2. Maintenance Activities and Repairs

150. The installation methods described in section 5.7 are designed to minimise the requirement for cable repair. However, natural processes and human activity may uncover buried cable and damage cable protection. The requirement for maintenance will be identified by inspections carried out by the Applicant.

151. Where sections of the Offshore Export Cables require repair or replacement, it is expected that this will be undertaken by a number of different vessels consistent with those described above for the installation process, and depending on the location and seabed conditions where the repair is required (e.g. intertidal or subtidal).

152. Cable repairs will be undertaken in a similar process to that described in section 5.7.2 The damaged cable section will be cut and removed by a diver, replaced with the new cable and jointed. Cable protection, if required, will then be laid on top of the cable.

153. A worst case assumption has been made that up to four export cable repair events of up to 1000 m each will be required over the lifetime of the Marine Scheme. Cable repair vessels will maintain a 500 m clearance with third party vessels during periods of major maintenance.

154. Sections of the Offshore Export Cable may require reburial, where marine conditions (including anthropogenic activities) expose the cable, particularly in areas of mobile seabed. In certain instances, an increased minimum target burial depth may be required to provide increased protection.

5.10. Electro Magnetic Fields (EMF)

155. The transmission of electricity through subsea cables results in the formation of EMF. EMF comprise electrical fields (E-fields), measured in volts per metre (V/m), and magnetic fields (B-fields), measured in microtesla (μT). B-fields penetrate most materials and so are emitted into the marine environment which, can result in an induced electric field (iE-field). Comparatively, direct E-fields are blocked by conductive metallic sheathing within the cables, and are not emitted from the cables. The Earth has its own natural geomagnetic field (GMF), and in the vicinity of the Marine Scheme, background measurements of the magnetic field are approximately 50 μT, and the naturally occurring electric field in the North Sea is approximately 25 microvolts per metre (μV/m) (Tasker *et al*., 2010).

156. A high level EMF study has been conducted to ascertain the likely EMF strengths at varying distances from the Offshore Export Cables for two maximum design scenarios. An overview is provided below.

Cable Configurations for EMF modelling:

157. Pair of symmetrical monopoles comprising four 320 kV HVDC cables. This configuration requires a positive and negative HVDC cable in each pair. Power is transferred on both the positive and negative cables.

158. Bipole arrangement comprising two 525kV HVDC cables. This system requires HVDC cables, operating at opposite polarity and full voltage.

159. For both arrangements the currents within the two poles will be equal in magnitude and opposite in polarity, due to their alternate polarity lay arrangement. For this arrangement, a degree of field cancelling will occur. However, to provide 'worst case' calculations, the electromagnetic field from a single Offshore Export Cable is calculated.

Assumptions:

160. For the EMF study, the following inputs and assumptions were made:

- For the symmetrical monopole arrangement, a current of 6250 A has been calculated based on a maximum power transfer requirement of 2 GW. This is assumed to be split equally through the Offshore Export Cables, meaning each Offshore Export Cable would carry a maximum current of ±1562.5 A;
- For the bipole arrangement, a current of 3810 A has been calculated based on a maximum power transfer requirement of 2 GW. This would be required to be carried by the bipole pair of Offshore Export Cables, meaning each Offshore Export Cable would carry a maximum current of ±1905 A;
- Induced currents that would flow within the metallic sheath of each power core are not included;

- The Offshore Export Cables are assumed to have infinite length, and there is no consideration of external influences such as other cables or nearby metallic structures or pipelines;
- Calculations do not include the mitigating effects of the armour wires or the helical lay up of the overall Offshore Export Cable.
- The minimum target depth of burial is 0.5 m from the seabed to the top of the Offshore Export Cable. Modelled burial depths of 0.5 m, 1.0 m and 2.0 m have been applied;
- The geomagnetic (GM) field in the vicinity of the Marine Scheme is 50,244.2 nT. The earth's magnetic field would naturally vary each year, this is not included in any calculations.

Results:

161. Table 5.10 below provides the maximum calculated magnetic field strengths for each of the four burial depths, for the bipole arrangement. These summary strengths are the calculated field strengths directly above the Offshore Export Cable. The calculation methodology to obtain these field intensities involved calculating the distance to the point of interest, based on the geometry of the laid Offshore Export Cable and adding the resultant vectors (within each plane; X, Y and Z) together to obtain a resultant, combined cable-GM field vector. A plot showing how EMF reduces with horizontal distance from the cable is provided in Plate 5.10.

Table 5.10 maximum calculated magnetic field strengths for each of the four burial depths, for the bipole arrangement

Measurement height above seabed (m)	Burial Depth (m)		
	0.5	1.0	2.0
	Magnetic Field strength (μT)		
0	658.32	356.24	189.96
5	84.81	80.36	73.66
10	61.84	60.90	59.34
20	53.55	53.40	53.13

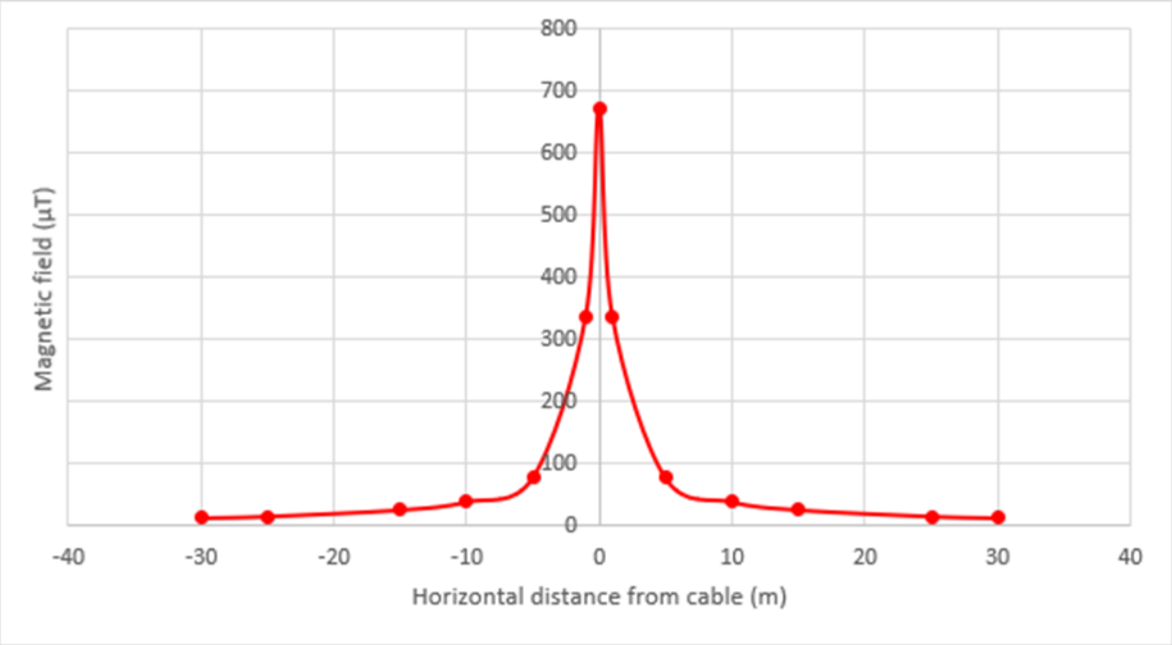

Plate 5.10 Changes of magnetic field strength with horizontal distance from the cable (maximum magnetic field strengths)

162. Electromagnetic field strengths including the GM field calculations for the symmetric monopole arrangement, for assumed burial depths of 0.5 – 2 m are summarised in Table 5.11 below. A plot showing how EMF reduces with horizontal distance from the Offshore Export Cable is provided in Plate 5.11.

Table 5.11 Electromagnetic field strengths including the GM field calculations for the symmetric monopole arrangement.

Measurement height above seabed (m)	Depth of Lowering (m)		
	0.5	1.0	2.0
	Magnetic Field strength (µT)		
0	540.73	293.61	158.44
5	75.27	71.91	66.90
10	58.30	57.63	56.52
20	52.49	52.38	52.20

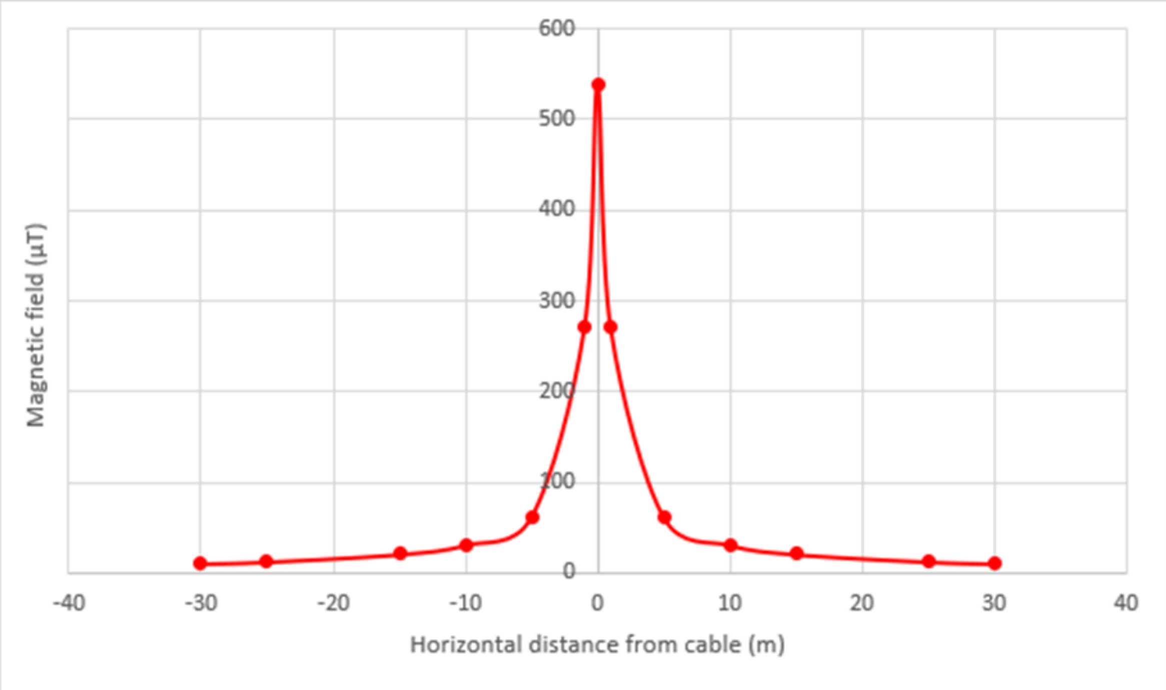

Plate 5.11 Change of magnetic field strength with horizontal distance from the cable (symmetric monopole arrangement)

163. EMF levels at the seabed surface as a result of the Marine Scheme will be reduced through cable burial and/or cable protection measures which increase separation between the cables and the marine environment, this will be delivered through management plans, including the Cable Plan. If the four-cable option is progressed for the Marine Scheme, the Applicant is committed to adjacent cables in opposite polarity to help reduce EMF associated with the Marine Scheme. Grouping cables of opposite polarity will result in deleterious interference between the EMFs from adjacent cables, which will further reduce the field EMF strengths resulting from the Marine Scheme.

164. Furthermore, the design of the Marine Scheme will be further refined, informed by onward detailed engagement with the supply chain and various technical, practical and commercial considerations. As part of this refinement, the cable configuration will be optimised and options to reduce EMF assessed.

5.11. Thermal Emissions

165. During the operation and maintenance phase of the Marine Scheme, low levels of heat will be generated at a highly localised level surrounding the Offshore Export Cables. The process by which submarine power cables, such as those proposed for the Marine Scheme, and other imperfect conductors generate heat is termed resistive heating.

166. Resistive heating is caused by energy loss as electric current flows and leads to the heating of the cable surface and warming of the surrounding environment. There has been very limited study and analysis associated with the actual temperatures generated around submarine cables, with only one reported field study (Meissner et al. 2007) and limited numerical modelling work (Worzyk 2009; Hughes et al. 2015).

167. The thermal output from the cable system will be continuously monitored by a Distributed Temperature Sensing system which utilises a fibre optic cable installed within the cable bundle to monitor the temperature of the cable when in operation. Due to the intermittency nature of wind generation, it is expected that any heating effect to the surrounding environment to the cable will be low. The intermittency of wind means that the cable is unlikely to reach its maximum temperature where heat lost to the environment is most significant. This is due to a number of factors including the thermal capacity of the surrounding ground and sea.

168. Industry research carried out on offshore renewable energy infrastructure has explored this topic in further detail, providing a laboratory-based assessment of the thermal regime around buried submarine high voltage cables (Emeana et al, 2016). In laboratory settings exploring varying sediment permeability and generated temperature, results suggested that for HV cables with surface temperatures up to 60 °C above ambient and buried within clays to coarse silts with low permeability up to ~10−13 m^2, the surrounding thermal regime and mode of heat transfer will be dominantly conductive with temperatures only raised significantly within 40 cm radius of the cable.

169. As described above, the Applicant is committed to protecting the cables along the entirety of the Marine Scheme. Depending on seabed conditions, Offshore Export Cables will be buried to a minimum target burial depth of 0.5 m with a maximum target burial depth of 3 m; and where burial cannot be achieved, cable protection will be utilised. The sediment surrounding the Offshore Export Cables may therefore be heated but the cables have negligible capability to heat the overlying water column because of the very high heat capacity of water and surrounding soils.

5.12. Decommissioning

170. At the end of the operational lifetime of the Marine Scheme, the operator of the Marine Scheme will develop and agree a solution for the onward handling of the Offshore Export Cables with the regulator. This decision will be based on the advice from the marine regulator at the time and informed by the prevailing environmental regulatory requirements at that time, and relevant best-practice.

171. It is proposed that Offshore Export Cables will be removed where practicable and appropriate to do so. This approach will be reviewed at the time of decommissioning following the most up to date and best available guidance. For the purpose of this ES, the maximum design scenario has been assessed for each topic.

172. A decommissioning plan and supporting decommissioning environmental management plan will be prepared prior to commencement of decommissioning and will be subject to its own environmental assessment. It is anticipated that this will be secured via a requirement of seabed leases from Crown Estate Scotland and The Crown Estate; decommissioning conditions are also anticipated to be secured on Marine Licences issued by MD-LOT and the MMO in Scottish and English waters respectively.

5.13. Health and Safety

173. All elements of the Marine Scheme will be risk assessed according to the relevant government guidance as well as the Applicant’s internal best practice. These risk assessments will then form the basis of the methods and safety mitigations put in place across the life of the Marine Scheme.

174. The Applicant has a focus on employee safety and its QHSE policy is designed to ensure that the Applicant's projects are safe by design and that the processes and procedures are adhered to. There is a clearly defined safety culture in place in order to avoid incidents and accidents.

175. There will be constant controls to require that the safety measures are observed and followed and the Applicant provides a safe workplace for its employees and contractors.

176. The focus on QHSE is intended to ensure that everyone feels safe, in a highly controlled and safety-driven environment. This is the Applicant's first priority for the Marine Scheme. It is done by closely monitoring all matters relating to health and safety on all projects operated by the Applicant.

5.14. Waste Management

177. Waste will be generated as a result of the Marine Scheme, with most of the waste expected to be generated during the construction and decommissioning phases.

178. Procedures for handling waste materials will be described in a Waste Management Plan (WMP). The WMP will describe and quantify the waste types arising from the Marine Scheme activities and how these will be managed (dispose, reuse, recycle or recover). The WMP will also provide information on the management arrangements for the identified waste types and management facilities in the vicinity of the Marine Scheme.

179. The WMP will be provided prior to construction when further detailed design information becomes available.

5.15. Mitigation

180. The Marine Scheme includes a number of mitigation measures. The measures that the Applicant has committed to as part of the Marine Scheme are presented in Table 5.12. These measures have been considered in the assessments presented in Volume 2, Chapters 7 to 15.

Table 5.12 Mitigation measures for the Marine Scheme

Title	Commitment and Justification	Applicable Jurisdiction
Route Selection and Avoidance.	The Marine Scheme has been specifically refined to avoid interactions with key designations, environmental sensitivities, and notable inshore fishing grounds as far as reasonably practicable. On the approach to the Landfall at Cambois, the route has been selected to minimise the footprint within European Sites. Nearshore routes with greater levels of interactivity with European Sites along the English and Scottish coast have been de-selected. Further detail on this is provided in Volume 2, Chapter 6: Route Appraisal and Consideration of Alternatives	Scottish and English waters
Cable protection.	The use of cable protection will be minimised as far as practicable, and only used where required. Additional external cable protection (e.g. rock placement) will only be used where the minimum target burial depth cannot be achieved, for example in areas of hard ground or at third-party crossings. This will be informed by outputs from the Cable Burial Risk Assessment completed by the installation contractor(s) prior to the commencement of installation. Rock utilised in berms will be clean with low fines. Use of graded rock and 1:3 profile berms at areas of rock protection will reduce potential fishing gear snagging risk.	Scottish and English waters
Cable burial depth.	Cables will be buried to a minimum target depth of 0.5 m and only protected using external protection (e.g., rock berms) where minimum target burial depth is not achieved or at third-party crossings. Application of target cable burial depth will reduce the potential for cable exposure from interactions between metocean regimes (e.g. wave, sand, and currents) and will reduce interaction with fishing gear. Cable burial also reduces risk of interference with magnetic position fixing equipment.	Scottish and English waters
Monitoring of cable burial and protection.	Infrastructure will be monitored through post lay and burial inspection surveys to identify exposures and any requirements for repair and reburial, with remedial action taken as appropriate and as soon as practicable. Findings will be shared with the fishing industry in order to facilitate co-existence, prevent potential damage to and from fishing gear, and minimise potential safety risks.	Scottish and English waters

Title	Commitment and Justification	Applicable Jurisdiction
Pose Little or No Risk (PLONOR) substances.	During trenchless installation activities at Landfall, there will be an interface between the sea and the drilling fluids used to create the exit pits at the breakouts. Small quantities of drilling fluids may be discharged to the marine environment, however best practice mitigation will be implemented to reduce the amount of drill mud / cuttings released in the event of a release. To limit environmental damage, only biologically inert PLONOR listed drilling fluid will be used.	English waters only
Guard vessels and clearance distances.	Project vessels will implement a 500 m advisory safe passing distances with third party vessels during periods of construction or major repair or maintenance. During operation, where cable exposures exist that would result in significant risk, guard vessels will be used where appropriate until the risk has been mitigated by burial and/or other protection methods. Guard vessels will use Automatic RADAR Plotting Aid (ARPA) to monitor vessel activity and predict possible interactions whilst alongside the construction vessel(s). This facilitates engagement with fisheries stakeholders during specific project works, reduces potential for interactions between the Marine Scheme and fishing activities, as well as maximising awareness of temporary hazards.	Scottish and English waters
Temporary aids to navigation may be deployed (if required) to guide vessels around any areas of construction activity.	Temporary aids to navigation maximises awareness of temporary hazards.	Scottish and English waters
Appointment of a Company Fisheries Liaison Officer (CFLO).	A CFLO will be in place throughout the lifespan of the Marine Scheme.	Scottish and English waters

Title	Commitment and Justification	Applicable Jurisdiction
Use of Offshore Fisheries Liaison Officers (OFLOs) where required and appropriate.	The use of OFLOs facilitates engagement with fisheries stakeholders during specific Project works and minimises potential for conflict between the Marine Scheme and fishing activities.	Scottish and English waters
Development of a Fisheries Management and Mitigation Strategy (FMMS) / Fisheries Liaison and Co-existence Plan (FLCP) for Marine Directorate Licencing and Operations Team (MD-LOT) and Marine Management Organisation (MMO) approval, and in consultation with fisheries stakeholders.	The FMMS/ FLCP details the Applicant's proposed approach to fisheries liaison and to facilitating co-existence, including details on the measures which are proposed to be implemented to reduce impacts on commercial fishing as far as practicable. An outline FMMS / FLCP has been provided as part of this application (Volume 5, Appendix 12.2) and will be updated for submission to MMO and MD-LOT prior to construction.	Scottish and English waters
Participation in the Forth and Tay Commercial Fisheries Working Group (FTCFWG).	The FTCFWG provides a forum for information sharing and discussion of key issues with fisheries stakeholders and other developers in the region. Participation in similar groups in England will be explored.	Scottish and English waters

Title	Commitment and Justification	Applicable Jurisdiction
Adherence to appropriate guidance, with regards to fisheries liaison and mitigation (i.e. Fishing Liaison with Offshore Wind and Wet Renewables Group (FLOWW) guidance, as far as is applicable for a subsea cable).	Adherence to appropriate guidance, with regards to fisheries liaison and mitigation to facilitate the establishment of productive relationships with fisheries stakeholders and the implementation of an evidence-based approach to mitigation.	Scottish and English waters
As-Built Information.	The location, extent and nature of the cable protection measures used will be communicated to the relevant stakeholders including the UK Hydrographic Office (UKHO), relevant fishing industry representatives and Kingfisher Information Service. Provides information so all other legitimate users of the sea are aware of the location, extent and nature of cable protection.	Scottish and English waters
Undertaking of assessments to determine cable burial status.	Post lay and burial inspection surveys will be undertaken with remedial action taken as appropriate. In addition, an assessment to determine cable burial status (including cable protection) and identify potential changes to seabed conditions will be undertaken. Findings would be shared with the fishing industry where relevant.	Scottish and English waters
Development of a Code of Good Practice for contracted vessels.	Facilitates co-existence between vessels undertaking works for the Marine Scheme and fishing vessels and helps minimise potential adverse interactions.	Scottish and English waters

Title	Commitment and Justification	Applicable Jurisdiction
Development of suitable procedures to allow claims for loss or damage to gear.	Suitable claims procedures to facilitate co-existence and reduce potential adverse interactions between Marine Scheme vessels and fishing activities.	Scottish and English waters
Marine coordination and communication to manage project vessel movements.	Ensures project vessels are suitably managed to reduce the likelihood of involvement in incidents and maximise the ability to assist in the event of a third-party incident.	Scottish and English waters
Compliance of all project vessels with international marine regulations as adopted by the Flag State, notably the Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs) (IMO, 1972/77) and Safety of Life at Sea (SOLAS) (IMO, 1974).	Reduces the risk introduced due to the presence of project vessels.	Scottish and English waters

Title	Commitment and Justification	Applicable Jurisdiction
Promulgation of information (such as, position and nature of works, vessel routes, Safety Zones, advisory safe passing distances, navigational warnings) as required via Kingfisher Bulletins.	The construction of infrastructure and implementation of safety distances around construction vessels may displace recreation vessels. Likewise, maintenance and decommissioning activities may also displace recreation vessels. Circulation of information via Notices to Mariners (NtM), Kingfisher, Radio Navigational Warnings, Navigational Telex (NAVTEX), and/or broadcast warnings as soon as reasonably practicable in advance of and during the offshore works to inform the commercial fishing industry of vessels routes, timing and locations of construction works, and relevant details the construction activities. These will be augmented with NAVTEX and Radio Navigation Warning broadcasts as appropriate. Maximises awareness of the Marine Scheme allowing vessels to passage plan in advance, in the interests of safety to infrastructure and other users receptors.	Scottish and English waters
Engagement of a Retained Archaeologist.	A Retained Archaeologist will be engaged to implement the agreed mitigation secured through a Written Scheme of Investigation (WSI). The Retained Archaeologist will provide input into specifications for further surveys and archaeological analysis of the outputs from any pre-construction surveys (for example, geophysical and geotechnical), and will provide advice regarding any archaeological finds which occur during construction. Where suitable for archaeological assessment, further geophysical surveys undertaken in advance of the development commencing, for example for the purposes of detailed design, that require magnetometer data (e.g. unexploded ordnance (UXO) survey) will also be assessed by a suitably qualified archaeological contractor. This will allow for the identification of any additional ferrous features of archaeological potential within the Marine Scheme, as well as to confirm the presence of ferrous material at the location of features identified during this assessment. To avoid and/or reduce impacts on sites of archaeological importance.	Scottish and English waters
Archaeological Exclusion Zones (AEZs).	The primary mitigation for the protection of known archaeological receptors is avoidance. This is commonly achieved through the implementation and monitoring of AEZs, which are proposed for identified high value seabed receptors of anthropogenic origin, to avoid direct impacts on sites of known archaeological importance.	Scottish and English waters

Title	Commitment and Justification	Applicable Jurisdiction
Adherence to Berwick Bank Wind Farm (BBWF) WSI, including implementation of Protocol for Archaeological Discoveries (PAD) and AEZs.	The Applicant is committed to the mitigation measures set out in the Outline WSI/PAD for adverse impacts arising from the Marine Scheme within the BBWF array area. Mitigation measures including implementation of PAD and AEZs are secured through adherence to the BBWF WSI (SSER, 2022b).	Scottish waters only
Crossing Agreements.	Crossing and proximity agreements with the owners of third party assets will be developed and agreed to maintain safety to infrastructure.	Scottish and English waters
Environmental Management Plan (EMP).	An EMP will be developed and employed to ensure potential release for pollutants will be reduced as far as practicable. This will include a Marine Pollution Contingency and Control Plan (MPCCP) and an Invasive and Non-Native Species Management Plan (INNSMP). An outline EMP has been provided as part of this application (Volume 5, Appendix 5.1) and will be updated for submission to MMO and MD-LOT prior to construction.	Scottish and English waters
Marine Pollution Contingency and Control Plan (MPCCP).	An MPCCP will be implemented to ensure that, in the unlikely event that a pollution event occurs, any spillage is reduced as far as reasonably practicable and effects on the environment are ideally avoided or reduced as far as reasonably practicable. Implementation of these measures will reduce the accidental release of contaminants from vessels as far as reasonably practicable, thus providing protection for marine life across all phases of the Marine Scheme. This will include but may not be limited to: designated areas for refuelling where spillages can be easily contained; storage of chemicals in secure designated areas in line with appropriate regulations and guidelines; only using substances approved on Cefas list under the Offshore Chemical Regulations (UK Government, 2002); double skinning of pipes and tanks containing hazardous substances; and storage of these substances in impenetrable bunds. This will control the potential release of contaminants from supply and service vessels. An outline MPCCP has been provided as part of this application (Volume 5, Appendix 5.1.A) and will be updated for submission to MMO and MD-LOT prior to construction.	Scottish and English waters

Title	Commitment and Justification	Applicable Jurisdiction
Invasive Non-Native Species Management Plan (INNSMP).	An INNSMP will be implemented to manage and reduce the risk of potential introduction and spread of INNS as far as reasonably practicable. The plan will include, but may not be limited to, measures to facilitate vessel compliance with the International Maritime Organisation (IMO) ballast water management guidelines (International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004) and adherence to the IMO guidelines for the control and management of ships' biofouling to minimise the transfer of invasive aquatic species (Biofouling Guidelines). It will consider the origin of vessels and contain standard housekeeping measures for such vessels as well as measures to be adopted in the event that a high alert species is recorded. An outline INNSMP has been provided as part of this application (Volume 5, Appendix 5.1.B) and will be updated for submission to MMO and MD-LOT prior to construction.	Scottish and English waters
Decommissioning Plan.	The aim of this plan is to adhere to the existing UK and international legislation and guidance, with decommissioning industry practice applied. Overall, this will reduce the amount of long-term disturbance to the environment as far as reasonably practicable. While this measure has been committed to as part of the Marine Scheme, the maximum design scenario for the decommissioning phase has been considered in each of the assessments of effects.	Scottish and English waters
Cable Plan (CaP).	Suitable implementation and monitoring of cable protection through the Marine Scheme and adherence to a CaP. This will be produced and consulted on (in line with consent conditions) prior to installation and will include a detailed cable laying plan including geotechnical data, cable laying techniques and informed by a Cable Burial Risk Assessment (CBRA) which will include details on minimum target burial depths.	Scottish and English waters
Shipboard Oil Pollution Emergency Plan (SOPEP).	All vessels to be used as part of any phase of the Project will adopt a waste management plan in line with the requirements set out as part of the International Convention for the Prevention of Pollution from Ships (MARPOL) and the SOPEP.	Scottish and English waters

Title	Commitment and Justification	Applicable Jurisdiction
Vessel best-practice / MARPOL.	Compliance with MARPOL regulations and best-practice protocols to prevent and manage incidents of accidental release of marine contaminants.	Scottish and English waters
Marine Mammal Mitigation Plan (MMMP).	A MMMP will be developed for the marine mammal species of particular relevance to the Marine Scheme, if and when required. Given the potential for injury arising from the installation of the Offshore Export Cable, including the use of pre-installation survey techniques which have the potential to generate underwater noise, the JNCC guidelines for minimising the risk of injury to marine mammals will be employed.	Scottish and English waters
Code of Conduct.	To reduce potential for collision risk or injury to marine mammals, the Code of Conduct will be issued to all Marine Scheme vessels to be adhered to at all times. This will include requirements to: • Not deliberately approach marine mammals; • Maintain a minimum vessel speed; and • Avoid abrupt changes to vessel speed or direction should a marine mammal approach the vessel.	Scottish and English waters
Adherence to Scottish Marine Wildlife watching code.	Project vessels (in both Scottish and English waters) will adhere to the protocols supplied in the Scottish Marine Wildlife Watching Code and will protect and reduce the risk of direct interactions and disturbance to marine wildlife, including marine mammals, seabirds and waterfowl.	Scottish and English waters
Written Scheme of Investigation (WSI).	The purpose of this document is to identify possible features of marine archaeological importance and to agree mitigation to avoid and/or mitigate potential impacts. The WSI will detail the agreed mitigation that will be implemented during construction of the Marine Scheme. The implementation of a WSI is the mitigation, rather than the document itself. The mitigation measures are designed to either avoid, reduce, or offset any damage/ disturbance occurring as a result of the Marine Scheme upon known receptors, and to establish the presence of unknown sites. An outline WSI has been provided as part of this application (Volume 5, Appendix 14.2) and will be updated for submission to MMO and MD-LOT prior to construction.	Scottish and English waters

Title	Commitment and Justification	Applicable Jurisdiction
Protocol for Archaeological Discoveries (PAD).	In order to provide for unexpected discoveries encountered during the construction, operation and maintenance and decommissioning phases of the Marine Scheme a PAD will be adopted. This is a system for reporting and investigating unexpected archaeological discoveries encountered during construction activities, with a Retained Archaeologist providing guidance and advising on the implementation of the PAD. The PAD also makes provision for the implementation of temporary exclusion zones around areas of possible archaeological interest, for prompt archaeological advice, and, if necessary, for archaeological inspection of important features prior to further activities in the vicinity. The PAD provides a mechanism to comply with the Merchant Shipping Act 1995, including notification of the Receiver of Wreck, and accords with the Code of Practice for Seabed Developers (JNAPC, 2006) and relevant Guidance. A PAD has been provided as part of this application (Volume 5, Appendix 14.2) and will be updated for submission to MMO and MD-LOT prior to construction.	Scottish and English waters
Vessel lighting.	Vessel deck lighting will be directed towards working areas only and kept to the minimum level required to facilitate safe operations. This is to reduce disturbance to seabirds.	Scottish and English waters
Vessel marks and lighting, and AIS.	In order to maximises awareness of temporary hazards, Cable Lay Vessels (CLVs) and other vessels involved in cable construction 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.	Scottish and English waters

Title	Commitment and Justification	Applicable Jurisdiction
Geophysical survey mitigation.	The potential for injury to marine mammals as a result of sub-bottom profiling (SBP) operations, will be mitigated by the Marine Scheme will be mitigation by adoption of measures recommended by in the JNCC 2017 guidelines (JNCC, 2017) for minimising the potential impacts to marine mammals from geophysical survey activities. These measures will be detailed within the MMMP and will include the use of Marine Mammal Observers and/or Passive Acoustic Monitoring (depending on daylight and meteorological conditions) to monitor a marine mammal mitigation zone around the survey vessel.	Scottish and English waters
Micro-routeing within the Marine Scheme.	Micro-siting within the Marine Scheme will be carried out to help avoid or minimise interactions with localised engineering and environmental constraints identified during pre-construction surveys.	Scottish and English waters
Cable grouping.	Grouping cables of opposite polarity will result in deleterious interference between the EMFs from adjacent cables, which will further reduce the field EMF strengths resulting from the Marine Scheme. Furthermore, the design of the Marine Scheme will be further refined, informed by onward detailed engagement with the supply chain and various technical, practical, and commercial considerations. As part of this refinement, the cable configuration will be optimised and options to reduce EMF assessed. Beyond the configuration commitment detailed above, practical solutions for reducing EMF arising from the Offshore Export Cables may include reducing cable separation or adopting a bundled solution.	Scottish and English waters
Material for cable protection.	Where possible, cable protection will match up as much as possible with the existing hard substrate, in terms of size, shape and type of rock/ materials used in order to reduce habitat alteration	Scottish and English waters

Title	Commitment and Justification	Applicable Jurisdiction
Landfall construction.	Trenchless techniques, such as Horizontal Directional Drilling (HDD) will be used at the Landfall for the construction of the Marine Scheme. Works associated with Landfall construction activities will avoid any works in the intertidal environment and will reduce the potential for sediment disturbance.	English waters only
Liaison with local ports and harbours, particularly the Port of Blyth, during the construction phase.	Liaison with local ports and harbours during the construction phase maximises awareness of the Marine Scheme allowing vessels to passage plan in advance.	Scottish and English waters
Location specific review of impacts to shipping and consultation with the MCA for instances of >5% reduction in water depth.	Following further survey and detailed engineering, if areas are identified where external protection is required and the Maritime and Coastguard Agency (MCA) condition of no more than 5% reduction in water depth is not achievable, a location specific review of impacts to shipping and consultation with the MCA will be carried out and additional mitigations agreed as required in order to minimise the risk of vessel collision due to reduced under keel clearance.	Scottish and English waters

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