MarineSpace Limited

Caithness – Moray HVDC Link - Controlled Flow Excavation / Rock Placement Environmental Appraisal

for

NKT

Project Ref: J/7/19/18	Originator: Redacted
Date: January 2019	Circulation: Restricted - commercial in-confidence

Caithness – Moray HVDC Link - Controlled Flow Excavation / Rock Placement Environmental Appraisal

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Date	Originator	Version	Action	Signature
14/12/18 – 23/01/19	Redacted	0.1 – 0.9	Internal Draft	Redacted
29/01/19	Redacted	0.91	Internal Draft	Redacted
30/01/19	Redacted	0.92	Internal Draft	Redacted
30/01/19	Redacted	0.93	Internal Draft	Redacted
31/01/19	Redacted	0.94	Internal Draft	Redacted
31/01/19	Redacted	0.95	Internal Draft	Redacted
01/02/2019	Redacted	1.0	Draft to Client	Redacted
			Choose an item.	

MarineSpace Ltd, 2019. *Caithness – Moray HVDC Link - Controlled Flow Excavation / Rock Placement Environmental Appraisal.*

Executive Summary

Scottish Hydro Electric Transmission Plc (SHET) has developed a High Voltage Direct Current (HVDC) electricity transmission link between Caithness (Noss Head) and Moray (Portgordon), collectively known as the Caithness HVDC Reinforcement project. NKT HV Cables AB commissioned the cable, which was laid in late summer 2017.

While much of the cable is now buried, additional methods for burial of currently exposed cable lengths are required. These additional methods are:

- Controlled Flow Excavation; and
- Rock placement.

MarineSpace Ltd has been commissioned by NKT HV Cables AB to prepare an environmental appraisal (this report) that will consider and assess the potential environmental effect of these additional methods. Therefore, this report represents the environmental appraisal of proposed Controlled Flow Excavation or rock placement on potentially sensitive receptors in the vicinity of the Caithness-Moray High Voltage Direct Current subsea cable. The same methodology is used for assessing environmental impacts as in the original Environmental Impact Assessment, as well as previous environmental appraisals prepared by MarineSpace, to ensure consistency.

The potential impacts of the main cable burial were fully assessed within both the marine Environmental Statement produced for the project and the Shetland HVDC Connection Marine Environmental Appraisal (SHET, 2009). Some of the proposed works assessed here, namely burial/protection of the remaining exposed cable by either Controlled Flow Excavation and/or rock placement are similar to the already assessed (and consented) burial works. Additional works such as the potential use of Cable Protection Systems and/or creation of a rock berm are also fully assessed.

In summary, the majority of impacts predicted via Controlled Flow Excavation were assessed to result in no more than minor impacts. A moderate impact on marine mammals was predicted via the combined works but with mitigation, this was reduced to minor. Increased placement of rock, including a limited length of Cable Protection System was judged to result in no more than minor impacts. Construction and emplacement of a rock berm was assessed to result in no more than minor impacts for the majority of receptors. A moderate impact on commercial fisheries was predicted, reduced to minor with the implementation of well-established mitigation measures.

The detailed MPA assessment undertaken in Appendix A identified associated pressures and footprints and screened the potential exposure of these footprints with MPAs in the vicinity of the cable repair works and their designated features within the study area:

- Annex I and MPA designated benthic habitats;
- Annex II marine mammals and migratory fish species designated within SACs;
- Annex I bird species classified within SPAs; and
- Where appropriate, Ramsar sites.

Where likely significant effects / risks could not be screened out, detailed assessment and determinations of any adverse effects / risk (or where no adverse effect / risk cannot be determined)

is presented. **Overall, no adverse effects on the integrity of any of the MPAs was determined**. This included via potential in-combination effects between the following projects:

- Beatrice Offshore Wind Farm;
- Moray East Offshore Wind Farm;
- Moray West Offshore Wind Farm;
- Previous C-M HVDC Link additional rock placement;
- Telford Offshore Wind Farm;
- MacColl Offshore Wind Farm;
- Stevenson Offshore Wind Farm; and
- Kincardine Offshore Wind Farm.

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1. Introduction

1.1. Project Background

Scottish Hydro Electric Transmission Plc (SHET) has developed a High Voltage Direct Current (HVDC) electricity transmission link between Caithness (Noss Head) and Moray (Portgordon), collectively known as the Caithness HVDC Reinforcement (C-M) project. ABB commissioned the cable which was installed in late summer 2017. On 01 March 2017, ABB AB HVC became NKT HV Cables AB (NKT). This document will, henceforth, refer to NKT rather than ABB, but they are one and the same.

1.2. Overview of Works

While much of the cable is now buried, and natural sediment transport will ensure cable burial in some areas, additional methods for burial of currently exposed cable lengths are also required. The purpose of this backfill work is to provide the required depth of cover (DOC) protection to the cable bundle, and also to return the seabed to its original profile, or as close as reasonably practicable. The additional methods proposed, and assessed in this report are:

- Controlled Flow Excavation (CFE);
- Rock placement via Fall Pipe Vessel (FPV) and / or shallow water grab placement;
    - Installation of cable protection systems (in areas where rock placement in shallow water cannot be undertaken), including need for localised excavation; and
- Remedial rock placement, creating a berm, associated with cable repair.

Descriptions of these techniques, along with quantified parameters for impact assessment, are presented in Section 2 of this report; however, in overview, further backfilling is required to the route where the DOC of the cable is less than 0.6 m. The planned primary method of backfill of the main route is the use of CFE to mobilise sediment that is currently in berms either side of the cable trench, and allow this sediment to backfill, and further bury, the cable. Where CFE cannot be used to backfill, suitably sized rock will be placed in the cable trench to provide the cover and infill the trench, restoring the seabed to its original profile, or as close as reasonably practicable. In areas where rock placement in shallow water cannot be undertaken for any reason, an alternative cable protection system (CPS) may be utilised.

In addition, along a short length of the cable between Kilometre Point (KP) 10.90 and KP 14.95, where cable repair works are planned, remedial rock placement may be undertaken. Some of this rock placement may involve the construction of a rock berm, where rock will extend above a mean seabed level (MSBL).

The proposed location of these works is shown in Figure 2.4.1.

1.3. Objective of this Report

This report has been prepared by MarineSpace Ltd, on behalf of NKT, in order to support the end client (SHET) in discussions with Marine Scotland. The report focuses on the potential environmental impacts that may arise via this series of works which are additional to the works assessed via the original Environmental Impact Assessment (EIA) for the project (SHET, 2009) and another, stand-alone Environmental Appraisal reports (MarineSpace, 2017; MarineSpace, 2018). The exact scope of work for CFE / rock placement is variable, on a sliding scale between 100% CFE and 100% rock placement. This report will assess both 100% CFE and 100% rock placement to allow flexibility between scopes, depending on exact ground conditions, and operational constraints, along the length of the cable trench. This report will also assess the environmental impacts associated with the emplacement of a rock berm associated with a planned cable repair between KP 10.90 and KP 14.95 and the impacts associated with deployment of the CPS.

1.4. Domestic Nature Conservation Marine Protected Areas

The Marine and Coastal Access Act 2009 and the Marine (Scotland) Act 2010 require Marine Scotland to exercise its duties and commitments to designate an ecologically coherent network of Marine Protected Areas (MPAs). In designating the domestic Nature Conservation MPA (NCMPA) network, Marine Scotland has to have regard to a number of issues set out in the legislation, including the extent to which such designations would contribute to a UK network.

NCMPAs have been identified for a range of marine flora and fauna that are either considered to be rare, representative, and / or threatened and declining within Scottish territorial waters. Since 2013 30 NCMPAs have been designated.

The rationale for the assessment process of NCMPAs follows the principles of the Habitats Regulation Appraisal (HRA) process related to the published or draft conservation objectives and designated features of any NCMPA screened for likely significant risks (effects); in relation to the pressures associated with these additional works.

A stand-alone MPA assessment for these proposed works is provided as Appendix A to this report.

1.5. European Protected Species Licence and Basking Shark Licence

Under the Habitats Regulations and the Offshore Habitats Regulations certain activities which would normally constitute an offence against Annex IV European Protected Species (EPS) can be carried out legally under a licence. In addition, under the Wildlife and Countryside Act (as amended), activities which would normally disturb basking shark *Cetorhinus maximus* and therefore constitute an offence are legally permitted under a licence. These licences are granted by Scottish National Heritage (SNH) or the Scottish Ministers depending on the reason for the licence application. A previous EPS licence already existed for the C-M project which was due to expire at the end of 2017. A new EPS consent application was, therefore, submitted in late 2017 along with a basking shark consent application.

Both licences were granted by the Scottish Ministers through Marine Scotland in March 2018. The EPS licence reference is MS EPS 01 2018 2, and the basking shark licence reference MS BS 02 2018 0. These consents still apply, and no revisions are required as a result of the works assessed in this document.

2. Descriptions of Techniques

2.1. Controlled Flow Excavation

Controlled Flow Excavation (CFE) works by directing a high-volume flow of water, under low pressure, towards the seabed in order to displace seabed sediment. This contrasts with traditional jetting techniques which direct a low-volume flow of fluid, but under high pressure, towards the seabed. Therefore, in CFE, it is the mass or volume of flow which moves or removes sediment; while in jetting, it is the speed, and thus pressure of the jets which does the cutting.

The flow initiated by the CFE is, therefore, designed to cause sediment resuspension and transport. The subsequent behaviour and settling rate of the resuspended sediments is partly dependent on the grain size of the material displaced. Resuspended sediment is advected and transported from the point of excavation by the local hydrodynamic flows (including waves and tides) and by turbulent diffusion (ABPmer, 2017).

If the CFE is working in coarse grained sediments (coarse sands and gravels), this will likely give rise to locally-high suspended sediment concentrations. Coarse grains are, however, also likely to fall out of suspension quickly and plumes will be spatially constrained (see Section 2.3.1.2 of this report). In contrast, fine grained sediments resuspended as a result of CFE may remain in suspension for prolonged periods of time (hours) and potentially disperse over a larger spatial area (at reducing concentrations) (see Section 2.3.1.2).

Depositional thicknesses following settlement of resuspended sediment will also vary depending on the grain size of material. Fine grained material, which disperses over a wide area, will give rise to small (or very small) bed level changes; while coarse material may give rise to localised, thicker, deposits (ABPmer, 2017).

It should be noted that these generalised effects on sediment are similar for both CFE and conventional jetting, however the magnitude of the effects may be different if both techniques were to be used at the same location, and under the same conditions. Higher-power jetting may be likely to introduce more sediment into suspension, compared with CFE; and potentially, therefore, lead to a wider dispersion of sediment plumes under local conditions.

2.1.1. CFE Equipment

A CFE tool will be used to backfill and bury currently exposed cable, by mobilising the existing berms created by the previous cable trenching phase. These will provide the source of sediment to cover the cable in the existing trench and to return the seabed to its original profile, or as close as reasonably practicable. A potential tool is the TWIN R2000 provided by James Fisher Subsea Excavation (JFSE) (Figure 2.1.1), however a similar tool may be substituted. The TWIN R2000 generates two controllable columns of seawater which travel down towards the seabed at a velocity of up to 10 ms^{-1} at a maximum flow rate of 4,000 litres per second. This tool is a low pressure / high flow tool which is the most suitable to displace the spoil with minimum loss of sediment.

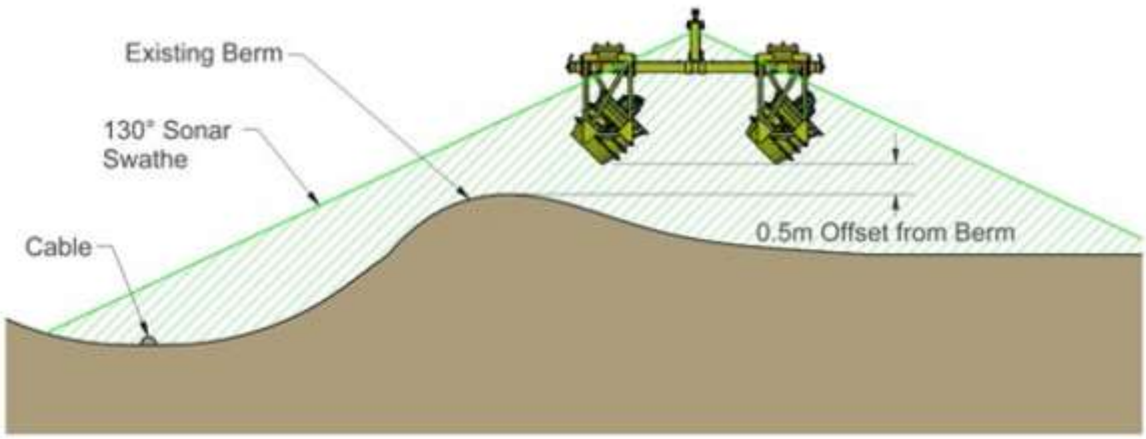
After review of the pre-backfill multibeam survey data on site, the TWIN R2000 tool (or similar tool) will be configured in backfill mode (Figure 2.1.2). Under operation, the CFE tool is powered up slowly to identify the power settings required to backfill to the required specifications, and the altitude of the tool is adjusted to alter the depth and shape of the backfilling effect. Once correct depth has been established the vessel will start moving along the backfilling route, using the existing berms created by the previous cable trenching phase as the source of material to cover the cable in the existing trench. In backfill mode, the tool is aligned to run parallel with the cable trench; and both sides of the existing trench, along the entire route, may require multiple passes of the tool to achieve correct depth of backfilling (Figure 2.1.2). The displacement of soil in the berms will be monitored using multibeam sonar, and an altimeter and Octans will be used to measure height above seabed and heading / pitch / roll in real time.

Figure 2.1.1: The TWIN R2000 CFE Tool

In operation, the CFE may leave a secondary trench as a result of the flow and induced erosion of the seabed sediment. Any potential secondary trench created by CFE will be managed so that no running average, per 100m length of secondary trench, would exceed 0.3 m below a MSBL. This depth of 0.3 m on running average, is based on NKT's successful trial usage of the CFE (see Figure 2.1.3 and Section 2.4.1.3).

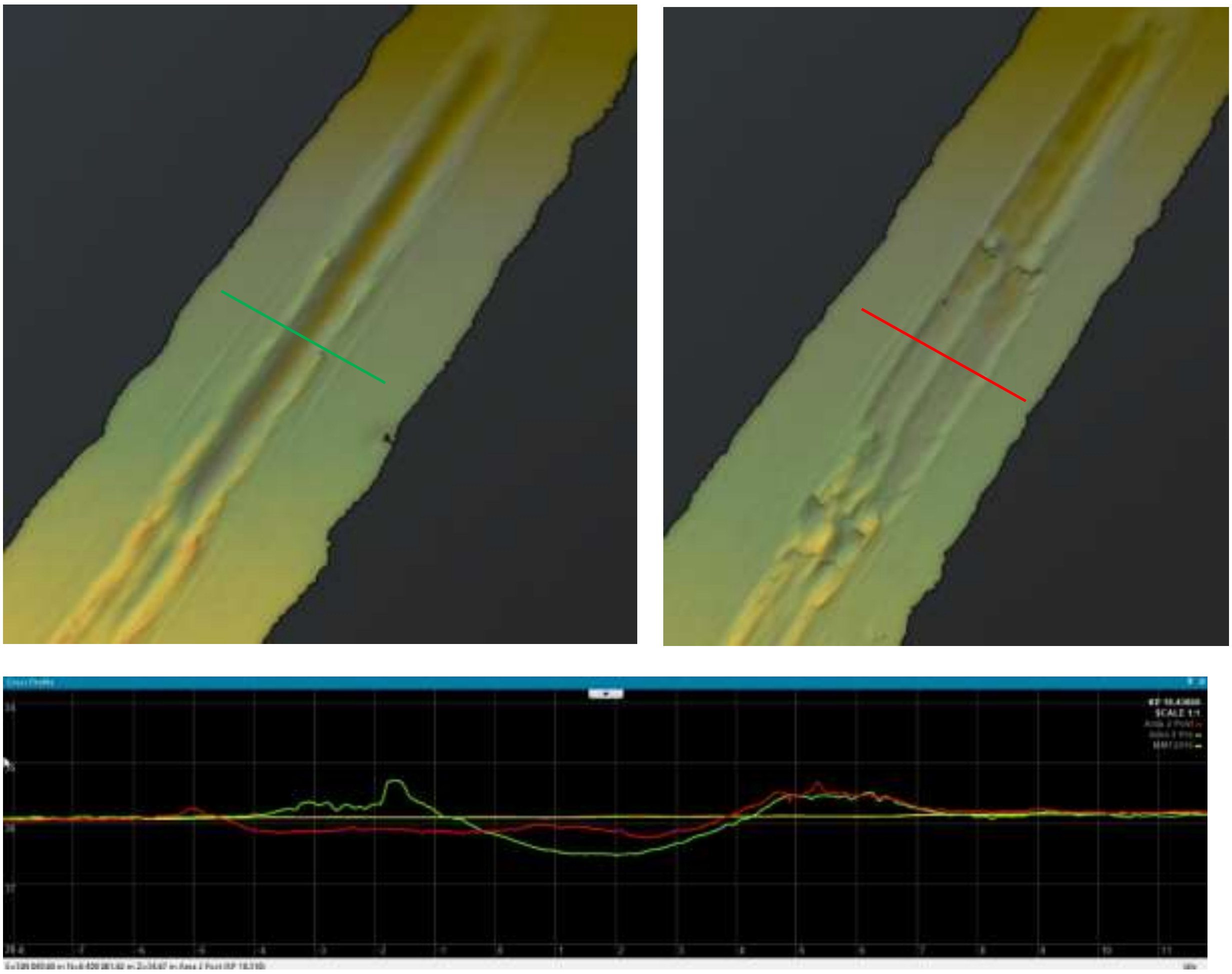
It should be noted, however, that in order to overestimate the potential effects associated with the operations, and thus provide a conservative assessment of the potential impacts, this appraisal will be based on a secondary trench depth of no more than 0.45 m, on running average, per 100m length of secondary trench, below a MSBL. Post-works seabed levels will be surveyed with a multibeam sonar, following completion of operations.

Figure 2.1.2: Schematic of the TWIN R2000 during backfill operations



A number of backfill trials were completed by NKT in 2018 (NKT, 2018a-c), and surveyed over short sections of the cable route, to verify that flow settings of the tool are effective. In this way the residual features can be minimised, and the trench will be partially or wholly backfilled. An example of the CFE backfill trial results is shown in Figure 2.1.3 and further information is contained in Section 2.4.1.3:

Figure 2.1.3: Result from CFE backfill trials, before (left) and after (right), and a comparative cross section (From NKT, 2018a)



2.2. Rock Placement

In areas where the CFE is ineffective (defined as not resulting in the agreed DOC on parts of the cable), further burial work using rock placement within the trench will be required. The method of installing this will be as per detailed in previous method statements and environmental assessments submitted by NKT and can be summarised as:

1. Fall-pipe set-up: done away from existing cable to avoid risk of damage to the asset;
2. On-site preparation: series of positional, equipment and survey checks done on-site as well as launching of the fall-pipe;
3. Pre-rock placement survey: undertaken using a ROV as a stable platform;
4. Rock placement operations: will follow a carefully developed task plan which will be based on the results of the pre-rock placement survey data. This plan will function as a guideline for all personnel involved in the rock placement operations. Excavators in the bunkers will start loading the rock onto longitudinal conveyor belts located along the starboard side of the vessel. These two conveyor belts feed a central “buffer” hopper located adjacent to the Stone Dumping Unit (SDU) on the same side of the vessel. A feeder, underneath the central “buffer” hopper, controls the rate at which material is fed into the fall pipe by a central conveyor belt. The gravel is guided to its destination by the fall pipe; and

5. Post-rock placement survey: after execution of the rock placement operations, a post-survey will be executed and will be compared to the pre-survey to establish the fulfilment of the specifications (and the consented parameters / locations).

In event that the selected fall pipe vessel is unable to access shallow water areas e.g. Portgordon landfall, rock placement will be performed using a shallow water vessel / barge. Installation engineering is ongoing to confirm the placement method, however employed methods may include both side dumping and placement by grab. Reduction in local depth tolerances specified within the navigable depth reduction agreements with the Maritime and Coastguard Agency (MCA) on 30/01/19 will be maintained. The placement of rock in shallow waters will be measured and documented by multibeam surveys both pre and post rock placement.

2.2.1. Cable Protection System

In areas where rock placement in shallow water cannot be undertaken for any reason (primarily operational restrictions), between the three Portgordon Horizontal Direct Drilling points which are all located at approximately KP 1.5, and KP 2.0 where the water depth is in excess of 10 m LAT, an alternative protection strategy of a CPS such as cast-iron shells, Tekmar, or similar may be utilised.

This protection system would be installed as a maximum from HDD exits at circa. KP 1.622 - KP 2.0. The CPS would be installed from a point close to where cables exit the Portgordon HDDs, physical attachment to the HDD ducts may not be possible. An appropriate size of CPS would be utilised to address the bundled section, individual HVDC cable and the fibre optic cable. The CPS installation may be made intermittently if rock protection has been possible in limited locations. To permit the installation of lower CPS halves limited excavation of seabed beneath the cables may be required, this would be carried out using diver manipulated airlift excavators.

A similar cable protection system has been installed at Noss Head and has a diameter of 326 mm and is composed of articulated sections which are locked or bolted together. In this case, as the cables have already been installed, the CPS would be installed post-lay using an air diving spread. It would likely be necessary for some localised excavation under the cable to install the lower part of the CPS.

The proposed length of CPS protected cable (up to 1000 m) has a smaller effect footprint (m^2), in terms of further temporary seabed disturbance, and seabed sediment alteration than for rock placement. In order, therefore, to provide a conservative assessment of these effects, this appraisal will include the CPS deployment within the parameterisation of effect envelopes for temporary seabed disturbance and seabed sediment alteration applied for rock placement i.e. the assessment uses the larger seabed footprint and pressure envelopes associated with rock placement, rather than the smaller footprint associated with the use of the CPS at KP 1.5-2.0 alone.

In addition, any localised excavation associated with installation of the CPS will have a smaller effect footprint, in terms of sediment advection, than for CFE. In order, therefore, to provide a conservative assessment of this effect, this appraisal will utilise the worst case sand advection envelope associated with CFE (200 m either side of the works), and the maximum fine sediment (< 63 µm) advection associated with a plume generated at the south of the cable (4.5 km either side of the works) i.e. the assessment uses the larger sediment advection and fine sediment plume footprints and pressure envelopes associated with CFE, rather than the smaller footprints associated with the use of the CPS at KP 1.5-2.0 alone (see Table 2-1 and Table 2-6).

During all rock placement / CPS works, an advisory exclusion zone of 50 m around the export cable and 500 m around all vessels involved in the works will be notified via Notice to Mariners (NtM).

2.3. Rock Berm Associated with Cable Repair

Damage to a section of the C-M HVDC cable means that a cable repair between approximately KP 11 and KP 15 is planned (Note: an environmental assessment of this proposed repair has already been undertaken (MarineSpace, 2018) and all these works, apart from the potential rock berm, are already consented). As part of this repair, jet trenching between these KPs will be undertaken, and rock placement may be undertaken in places as protection and stabilisation measures for the new section of cable and nearby exposed sections of the existing cable (Xodus, 2019). Some of this rock placement may involve the construction of a rock berm, where rock placement will extend above MSBL. The jet trenching associated with the cable repair has previously been assessed and consented, therefore will not be considered, further, within this appraisal.

While only sections of the cable repair corridor (between approximately KP 11 and KP 15) are likely to undergo rock placement above MSBL, in order to overestimate the potential effects associated with the operations, and thus provide a conservative assessment of the potential impacts, this appraisal will be based on the entire length of the repair corridor (approximately 4.5 km) being subject to the construction of a berm with a maximum seabed footprint (i.e. width) of 6 m (see Table 2-6). The maximum potential height of the berm, above MSBL, is 1.7 m.

To support the options detailed within Section 2.2 and Section 2.3 a variation to the existing rock licences (06600/18/1 and 06043/18/3) is applied for to allow up to an additional 90,000 t within the offshore zone and 25,000 t within the nearshore zone.

2.4. Summary of Impact Assessment Parameters

2.4.1. CFE

Quantitative data regarding the effects of CFE are currently sparse, however some information is available and summarised below.

2.4.1.1. Hornsea Project One and Project Two

The effects of using a CFE[1] tool for sandwave clearance were assessed for the export cable routes of the Hornsea Project One and Hornsea Project Two offshore windfarms (SMart Wind, 2013; and 2015). These effects were modelled for a location offshore of The Wash, and the environmental conditions are summarised in Table 2-5.

The results of the assessment showed that while using the tool would cause local increases in suspended sediment content (with highest values of approximately 900 mg/l above background),

[1] The SMart Wind (2013, 2015) reports describe the use of a Mass Flow Excavator (MFE) however the terms CFE and MFE are synonyms

these were spatially constrained and occurred extremely close to the area of operation (10s of metres). Increased suspended sediment concentrations were also temporally constrained such that high levels of suspended sediment concentration (i.e. > 100 mg/l) only occurred for very short periods (i.e. < 1 hour).

Fine sediment plumes (<63 µm) were predicted to extend a maximum distance of approximately 19 km along the flood and ebb tidal axis, although these were at very low levels of concentration, and were within the limits of natural variability caused by storms. Because of the increased spatial dispersion, the depth of seabed deposition as a result of these plumes was predicted to be < 1 mm in thickness (SMart Wind Ltd, 2013).

The total distance of travel of a fine sediment plume is controlled, to a large extent, by the tidal advection in the area of operation. Current speeds and sediment conditions at the Caithness-Moray (C-M) site are similar to those found at the Hornsea site (see Table 2-5), however tidal advection at the C-M site is less than at Hornsea, and plume advection is, therefore, likely to be comparatively reduced compared with Hornsea. In general, however, the quantitative predictions of the effects of CFE at Hornsea may be used to inform the assessments of the C-M site.

In order to develop a more nuanced, site-specific, understanding of the potential behaviour of a fine sediment plume at C-M when compared with Hornsea, tidal diamond data in the vicinity of the C-M cable route were analysed. These show that the direction and speed of the tidal currents vary along the cable route, with three distinct areas where speeds and directions change. Potential plume advection distances and directions, therefore, are also likely to vary along the route. Figure 2.4.1 shows the three distinct areas of tidal variation along the proposed route of works (north, central and south). Table 2-1 summarises the potential plume advection distances in tide-parallel[2] and cross-tide[3] directions, as well as the dominant tidal bearing, based on the tidal diamond data for a single tidal cycle.

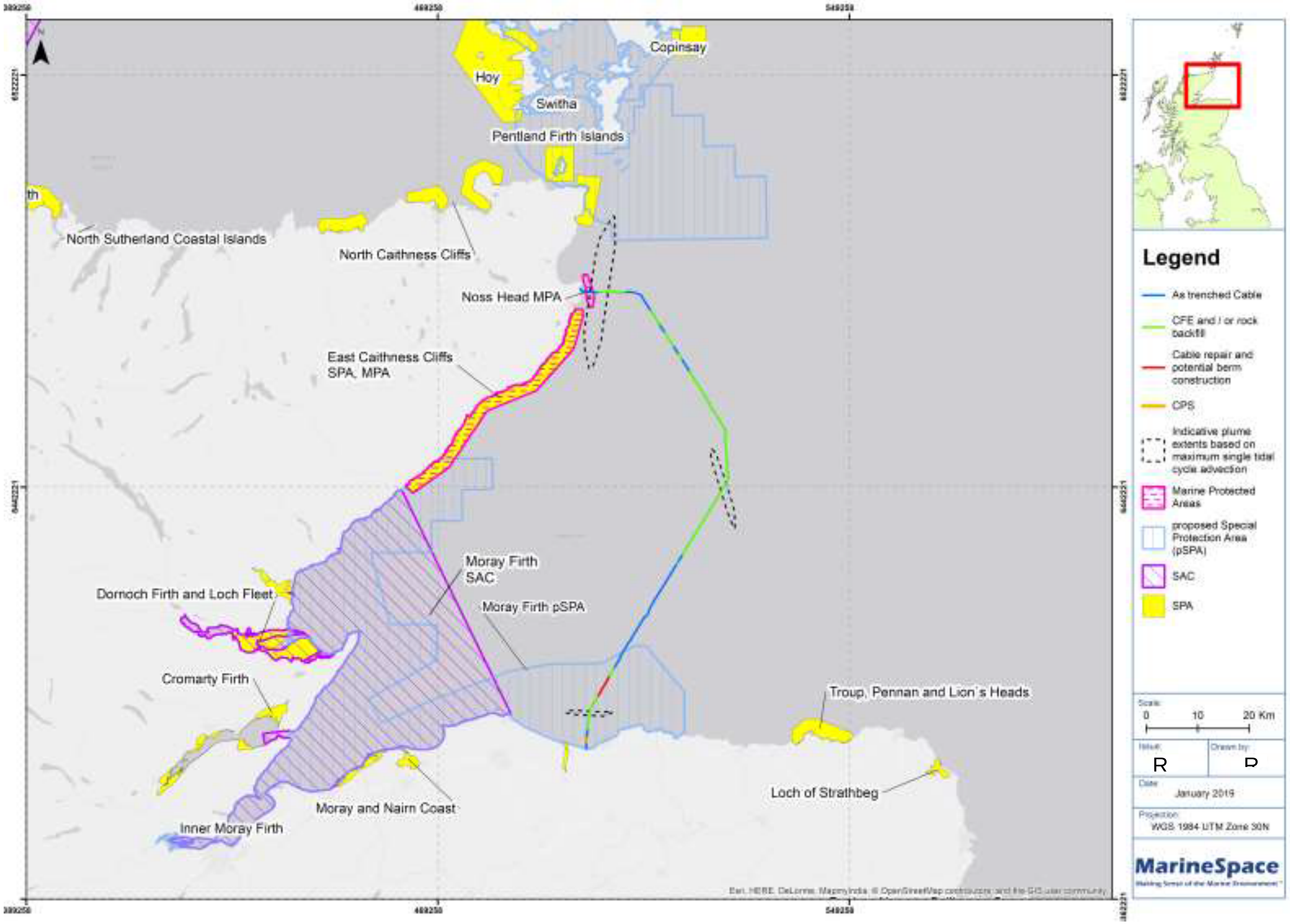
Table 2-1: Indicative potential tide-parallel and cross-tide plume directions for sites along the Caithness-Moray cable route based on tidal diamond data for a single tidal cycle

Site	Indicative tide-parallel plume advection (from centre point of cable route)	Indicative cross-tide plume advection	Bearing
North	15 km	3.5 km	010° - 190°
Central	8 km	1.4 km	165° - 345°
South	4.5 km	0.8 km	095° - 275°

[2] Tide-parallel = moving in the direction of the main ebb / flood water flow

[3] Cross-tide = moving perpendicular to the main ebb / flood water flow i.e. at right angle to the tidal flow

Figure 2.4.1: Indicative potential plume advection for three sites along the Caithness-Moray cable route, based on tidal cycle data for a single tidal cycle



2.4.1.2. Race Bank Offshore Windfarm

Additional quantitative estimates for the use of a CFE tool have been reported by ABPmer (2017) in an environmental appraisal, for DONG Energy, on the effects of usage for cable burial on the Race Bank offshore windfarm. ABPmer's (2017) predictions are the results of the outputs of spreadsheet based numerical models, which incorporate a number of assumptions. ABPmer (2017) indicates that, among the assumptions are:

- Coarser sediments (sand and gravel) will settle relatively rapidly to the seabed while finer sediments may stay in the water column for hours (or longer) and can therefore be dispersed by waves and tides;
- Modelled representative current speeds are used, from 0.25 m/s to 1.0 m/s, which are typical of tidal flow conditions during flood and ebb for spring and neap conditions. ABPmer (2017) indicates that *"a higher value will increase dispersion, decrease SSC and reduce the thickness of subsequent deposits and vice versa"*;
- The local sediment type consists of medium to coarse sand and gravel with <5% fine content (sub-63 µm);
- Excavation occurring through 100% (coarse) gravel (15,000 µm) and through 100% (medium) sand (375 µm); and
- Settling velocities are as per Soulsby (1997) and are 0.0001 m/s for fines, 0.05 m/s for (medium) sands and 0.5 m/s for gravels.

The results from ABPmer are reproduced in Table 2-2 and Table 2-3 below.

Current speeds and sediment conditions at the C-M site are similar to those found at Race Bank (Table 2-5) and the results from ABPmer (2017) can, therefore, inform assessments of effects at the C-M site.

Table 2-2: Resuspension and settling parameters, and advection distances of sediment transport as a result of cable burial in 100% gravel (settling rate 0.5 m/s) (From: ABPmer, 2017)

Representative current speed (m/s)	Height of resuspension (m)	Time for resettlement (s)	Distance plume advected by current (m)	Limited duration of influence on SSC locally (s)
0.25	1	2	0.5	2
0.50	1	2	1.0	2
0.75	1	2	1.5	2
1.00	1	2	2.0	2
0.25	5	10	2.5	10
0.50	5	10	5.0	10
0.75	5	10	7.5	10
1.00	5	10	10.0	10
0.25	10	20	5.0	20
0.50	10	20	10.0	20
0.75	10	20	15.0	20
1.00	10	20	20.0	20

Table 2-3: Resuspension and settling parameters, and advection distances of sediment deposition as a result of cable burial in 100% sand (settling rate 0.05 m/s) (From ABPmer, 2017)

Representative current speed (m/s)	Height of resuspension (m)	Time for resettlement (s)	Distance plume advected by current (m)	Limited duration of influence on SSC locally (s)	Average thickness of seabed deposition (m)
0.25	1	20	5	20	1.5
0.50	1	20	10	20	1.3
0.75	1	20	15	20	1.1
1.00	1	20	20	20	1.0
0.25	5	100	25	20	0.9
0.50	5	100	50	20	0.6
0.75	5	100	75	20	0.4
1.00	5	100	100	20	0.3
0.25	10	200	50	20	0.6
0.50	10	200	100	20	0.3
0.75	10	200	150	20	0.2
1.00	10	200	200	20	0.2

2.4.1.3. NKT CFE Trials

NKT has recently (2018a-c) conducted trials of the CFE equipment at five locations along the C-M cable corridor to assess its suitability for backfilling of the cable trench by displacement of the trenching spoil berms into the trench. The five trial areas have differing soil and berm profiles, and a number of success criteria were defined, including:

- For each trial section, a minimum 50% needs to be successful;
- A successful backfill area is:
    - Minimum 10 m long;
    - Have a confirmed DOC of 0.6 m; and
    - Any potential secondary trench formed by CFE to be, on running average per 100 m length, less than 0.3 m deep below a MSBL.

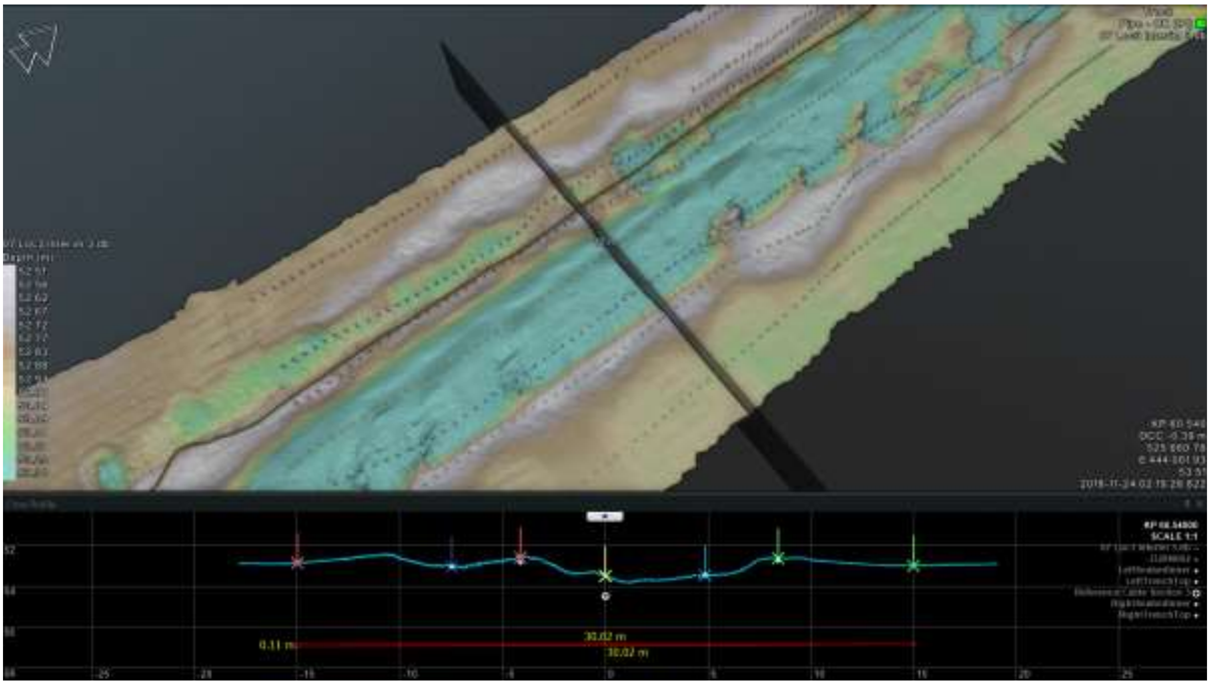
Initial results from the trial were encouraging, with results summarised in Table 2-4.

Table 2-4: Results of NKT Controlled Flow Excavator trial – Caithness-Moray cable route November 2018

Trial area	Backfill depth of cover	Average depth of secondary trench (Left)	Average depth of secondary trench (Right)
Section 1	>0.6 m – average = 0.9 m	0.02 m	0.21 m
Section 2	>0.6 m – average = 0.9 m	0.29 m	0.11 m
Section 3	>0.6 m – average = 0.8 m	0.00 m	0.28 m
Section 4	Superseded by Section 5		
Section 5	>0.6 m – average = 0.9 m	N/A	0.36 m
Section 6	>0.6 m – average = 0.7 m	0.17 m	0.05 m
Section 7	Not carried out		
Section 8	<0.6 m – average = 0.5 m	0.45 m	-0.06 m

The disturbed seabed around the main cable trench extends for approximately 15 m in each direction, therefore the total disturbance around the trench extends for approximately 30 m (Figure 2.4.2).

Figure 2.4.2: Multibeam echosounder image of CFE area around the Caithness-Moray cable trench, showing a maximum width of disturbance of approximately 30 m



2.4.1.4. Summary

CFE is a technique which uses the mass or volume of water flow to move sediment. The flow initiated by the CFE is designed to cause sediment resuspension and transport and the subsequent behaviour and settling rate of the resuspended sediments is partly dependent on the grain size of the material displaced. In operation, NKT's trials confirm that the CFE may leave a secondary trench on the seabed as a result of the flow and induced erosion of the seabed sediment, however the depth of this secondary trench can be reasonably controlled by varying the operation of the CFE. Results from NKT's CFE trial during November 2018 show average depths of secondary trenches of approximately 0.25 m. The trials also show that the maximum width of the area of disturbed seabed is in the region of 30 m.

The behaviour and settling of the sediments resuspended by CFE is dependent on the settling rate of the material displaced (partly controlled by grain size) and the local hydrodynamic flows (current speed). These environmental parameters for Hornsea Projects One and Two, and those for Race Bank, are summarised in Table 2-5, and compared with the environmental conditions for the C-M route as indicated in the original Marine Environmental Appraisal (SHET, 2009) and subsequent documents.

Table 2-5: Comparison of environmental parameters from Hornsea Project One and Project Two and Race Bank, where CFE effects have been previously assessed, with environmental parameters at the Caithness-Moray site

Environmental parameter	Hornsea P1 and P2	Race Bank	Caithness-Moray
Current speed	0.6-1.2 m/s	0.25-1.0 m/s	0.25-1.25 m/s
Sediment type	Sandy gravel, gravelly sand and sand. Some muddy samples	Medium to coarse sand and gravel. Muds <5%	Sandy gravel, gravelly sand and sand, with some patches of mud

It can be seen, therefore, that current speeds and sediment conditions at the C-M site are similar to those found at both Hornsea and Race Bank. Tidal advection at the C-M site is less, however, than at Hornsea and plume advection is also likely to be comparatively reduced. In general, though, the quantitative predictions of the effects of CFE at those sites are applicable to the C-M site. Given this, the predictions for the Hornsea and Race Bank sites have been used to inform the parameters that are used as the basis of this environmental assessment. These are set out in Table 2-6 below.

Table 2-6: Impact assessment parameters

Parameter	Maximum	Notes
A: Temporary seabed disturbance CFE		
Maximum width of (temporary) seabed disturbance	30 m	Maximum width of seabed disturbance created by CFE operation, including possible production of secondary trench
Maximum length of (temporary) seabed disturbance	35,000 m	Maximum length of seabed disturbance via CFE
Maximum footprint of (temporary) seabed disturbance	**1.05 km^2**	30 m width x 35,000 m length. This footprint of seabed would experience temporary disturbance via CFE operations
B: Temporary seabed disturbance rock placement (and CPS)		
Maximum width of (temporary) seabed disturbance	6 m	Maximum width of seabed disturbance created by rock placement (includes areas where rock placement cannot be undertaken, and CPS is instead deployed). CPS has a smaller effect footprint, in terms of further temporary seabed disturbance than rock placement; however, in order to provide a conservative assessment this appraisal uses the larger seabed footprint and pressure envelope associated with rock placement, rather than the smaller footprint associated with the use of the CPS alone.

Parameter	Maximum	Notes
Maximum length of (temporary) seabed disturbance	35,000 m	Maximum length of seabed disturbance via rock placement (includes areas where rock placement cannot be undertaken and CPS is instead deployed). CPS has a smaller effect footprint, in terms of further temporary seabed disturbance than rock placement however in order to provide a conservative assessment this appraisal uses the larger seabed footprint and pressure envelope associated with rock placement, rather than the smaller footprint associated with the use of the CPS alone.
B: Maximum footprint of (temporary) seabed disturbance	**0.21 km^2**	6 m width x 35,000 m length. This footprint of seabed would experience temporary disturbance via rock placement (includes areas where rock placement cannot be undertaken and CPS is instead deployed). CPS has a smaller effect footprint, in terms of further temporary seabed disturbance than rock placement however in order to provide a conservative assessment this appraisal uses the larger seabed footprint and pressure envelope associated with rock placement, rather than the smaller footprint associated with the use of the CPS alone.
C: Temporary seabed disturbance construction of rock berm		
Maximum width of (temporary) seabed disturbance	0 m	The rock for berm construction is precisely placed by Fall Pipe Vessel. There is no subsequent movement of the rock after placement, therefore there is no additional width of temporary seabed disturbance outside the berm location
Maximum length of seabed disturbance	0 m	No temporary seabed disturbance outside the berm location
C: Maximum footprint of (temporary) seabed disturbance	**N/A**	No temporary seabed disturbance outside the berm location
D: Sediment advection CFE (and CPS)		
Maximum cross-tidal[4] distance of sand plume advection	400 m	Maximum cross-tidal distance of sand plume advection (200 m either side of the cable) - settling occurs within 20 s CPS has a smaller effect footprint, in terms of sand advection than CFE, however in order to provide a conservative assessment this appraisal uses the larger sand advection footprint and pressure envelope associated with CFE, rather than the smaller footprint associated with the use of the CPS alone.
Maximum length of (temporary) seabed disturbance	35,000 m	Maximum length of seabed disturbance via CFE and CPS

[4] Cross-tidal = perpendicular to the main ebb / flood tide water flow i.e. at right angle to the tidal flow.

Parameter	Maximum	Notes
D: Maximum footprint of sand advection CFE and CPS	**14.0 km²**	400 m cross-tidal width x 35,000 m length. This footprint of seabed would experience temporary disturbance via advection of sand by CFE and CPS
Maximum tide-parallel[5] distance of fine sediment (< 63 µm) advection – north cable route site (CFE)	30,000 m	Maximum tide-parallel distance of fine sediment (< 63 µm) advection (15 km either side of the cable). This value is only applicable in the northern part of cable route. Maximum fine sediment advection distances are lower in the central and southern parts of the cable route because of differing tidal conditions. It should also be noted that this is a highly conservative metric and would require CFE to be in operation at a single site in the north of the cable route for an entire tidal cycle. This is an extremely unrealistic scenario; however, the metric is presented as an absolute worst case. It should also be noted that CFE will not simultaneously occur everywhere along the 35 km assessed length of works
Maximum tide-parallel distance of fine sediment (< 63 µm) advection – south cable route site (CPS)	9,000 m	Maximum tide-parallel distance of fine sediment (< 63 µm) advection (4.5 km either side of the cable). This value is only applicable in the southern part of cable route where CPS will be undertaken.
Typical thickness of deposition following settlement of fine sediment (< 63 µm) plume	<1 mm	Thickness of deposited fine sediment (< 63 µm) away from the immediate vicinity of the CFE and CPS operations
E: Sediment advection rock placement		
Maximum distance of sand plume advection	0 m	Rock is precisely placed using a Fall Pipe Vessel which allows placement without generating uncontrolled high flow rates at the discharge end of Fall Pipe. There is, therefore, no significant sand resuspension and advection predicted with the rock placement.
Maximum length of (temporary) seabed disturbance	35,000 m	Worst case scenario – 100% of the remaining trench to be filled via rock placement
E: Maximum footprint of sand advection	**0 m²**	There is no significant sand advection predicted with rock placement.
Maximum distance of fine sediment (< 63 µm) advection	0 m	There is no significant fine sediment (< 63 µm) advection predicted with rock placement
Typical thickness of deposition following settling of fine sediment (< 63 µm) plume	N/A	There is no significant fine sediment (< 63 µm) advection predicted with rock placement

[5] Tide-parallel = in the direction of the main ebb / flood water flow.

Parameter	Maximum	Notes
F: Sediment advection construction of rock berm		
Maximum distance of sand plume advection	0 m	Rock to create the berm is precisely placed using a Fall Pipe Vessel which allows placement without generating uncontrolled high flow rates at the discharge end of Fall Pipe There is, therefore, no significant sand resuspension and advection predicted with the rock placement
Maximum length of seabed disturbance	4,500 m	Worst case scenario – rock berm will potentially be constructed between KP 10.9 and KP 14.95. In order to provide a conservative assessment of the potential impacts, this appraisal will be based on a 4.5 km length of rock berm
F: Maximum footprint of sand advection	**0 m²**	There is no significant sand advection predicted with rock placement
Maximum distance of fine sediment (< 63 µm) advection	0 m	There is no significant fine sediment (< 63 µm) advection predicted with rock placement (see above)
Typical thickness of deposition following settling of fine sediment (< 63 µm) plume	N/A	There is no significant fine sediment (< 63 µm) advection predicted with rock placement
G: Seabed sediment alteration CFE		
Maximum width of (temporary) seabed sediment alteration	30 m	CFE redistributes the majority of the current seabed material in berms back into the cable trench. There may, however, be some preferential sorting, with larger particles deposited closer to the site of operation and finer particles travelling further. This is temporary, and natural seabed sediment transport processes will continue post-operation with relatively strong tide-driven currents or wave action transporting the surface seabed layers and restoring the natural composition
Maximum length of (temporary) seabed alteration	35,000 m	Maximum length of seabed alteration via CFE operation
G: Maximum footprint of (temporary) seabed alteration	**1.05 km²**	30 m width by 35,000 m length. There may be some temporary preferential sorting as a result of CFE operations.
H: Seabed sediment alteration rock placement (and CPS)		
Maximum cable trench width (at seabed surface) for rock placement	6 m	Width of trench that will be filled during rock placement (includes areas where rock placement cannot be undertaken and CPS is instead deployed). CPS has a smaller effect footprint, in terms of further seabed sediment alteration than rock placement; however. in order to provide a conservative assessment this appraisal uses the larger seabed footprint and pressure envelope associated with rock placement, rather than the smaller footprint associated with the use of the CPS alone.
Maximum length of (temporary) seabed alteration	35,000 m	Worst case scenario – 100% of the remaining trench to be filled via rock placement (includes areas where rock placement cannot be undertaken and CPS is instead deployed).

Parameter	Maximum	Notes
		CPS has a smaller effect footprint, in terms of further seabed sediment alteration than rock placement; however, in order to provide a conservative assessment this appraisal uses the larger seabed footprint and pressure envelope associated with rock placement, rather than the smaller footprint associated with the use of the CPS alone.
F: Maximum footprint of (temporary) seabed alteration	**0.21 km²**	6 m width of trench x 35,000 m trench length. This footprint of seabed would experience temporary alteration via rock placement (includes areas where rock placement cannot be undertaken and CPS is instead deployed). CPS has a smaller effect footprint, in terms of further seabed sediment alteration than rock placement; however, in order to provide a conservative assessment this appraisal uses the larger seabed footprint and pressure envelope associated with rock placement, rather than the smaller footprint associated with the use of the CPS alone.
I: Permanent seabed sediment alteration construction of rock berm		
Maximum berm width (at seabed surface) after rock placement	6 m	Width of rock berm, at seabed surface, after rock has been placed
Height of rock berm after rock placement	1.7 m	Maximum height of rock berm above mean sea bed level following placement of suitable rock material
Maximum length of seabed disturbance	4,500 m	Rock berm will potentially be constructed between KP 10.9 and KP 14.95. In order to provide a conservative assessment of the potential impacts, this appraisal will be based on a 4.5 km length of rock berm
I: Maximum footprint of permanent seabed alteration after berm construction	**0.027 km²**	6 m width of berm x 4.5 km of berm length. This footprint of seabed would experience permanent alteration via rock placement

2.5. Impact Assessment Methodology

This report represents an environmental appraisal rather than a full Environmental Statement (ES). However, for consistency with the original EIA undertaken by Aquatera in 2011 (SSE, 2011) for the C-M project, and in line with previous environmental appraisals prepared by MarineSpace since November 2017, in respect of cable repair / protection works along the entire cable, the same methodology for assessing environmental impacts as used in these previous reports has also been used here.

Potential impacts of the proposed works have been categorised as shown in Table 2-7. As per the original EIA, the assessment of potential effects via the cable remediation, replacement and protection is based upon the sensitivity of key receptors and the magnitude of the impact. Definitions of receptor sensitivity and magnitude of impact vary between parameters (physical, biological, human), therefore, specific details of the criteria used are provided in Sections 3.2, 3.3 and 3.4, respectively.

Table 2-7: Summary of impact definitions used in this report

Impact Type	Definition
Neutral	No detectable change to the environment
Negligible	A change within existing variability, difficult to measure or observe
Minor	A detectable but non-material change to the environment
Moderate	A material but non-fundamental change to the environment
Major	A fundamental change to the environment

Impacts categorised as being **Moderate** or **Major** (adverse or beneficial) are considered in this appraisal to be significant.

3. Environmental Appraisal

3.1. Overview

The potential impact of the main cable installation was fully assessed within both the marine ES produced for the project (SSE, 2011) and the Shetland HVDC Connection Marine Environmental Appraisal (SHET, 2009). The proposed works assessed here are similar in effect to the main works already assessed (and consented), albeit with different spatial extents, magnitude and durations to works already assessed.

Table 3-1: Summary of receptors assessed within this appraisal

Receptor	Scope for potential impact from CFE and/or localised excavation for CPS	Scope for potential impact from rock placement or CPS	Scope for potential impact from construction of rock berm
Physical Environment			
Seabed sediments	Alteration of seabed sediment character as a result of redeposition of the temporary, localised suspended sediment mobilised via the CFE process or excavation associated with CPS	Temporary change in seabed sediment type to gravel seabed (or hard seabed where CPS is deployed), until such time as natural sediment transport and deposition covers emplaced gravel or CPS	Permanent change in seabed sediment type to gravel seabed within footprint of the berm between KP10.9-14.9. Natural sediment transport and deposition likely to occur at the margins of structure
Water Quality (Pollution Prevention)	None beyond those already assessed for previous works. Scoped out of this assessment	None beyond those already assessed for previous works. Scoped out of this assessment	None beyond those already assessed for previous works. Scoped out of this assessment
Biological Environment			
Benthic Ecology	Temporary, localised increase in suspended sediment levels and disturbance to benthic habitats via CFE operation or excavation associated with CPS Potential temporary disturbance of larger area of seabed habitat around the trench due to CFE creating secondary depressions (as	Benthic organisms will already have been removed from cable corridor as a result of trenching. Emplaced gravel (or CPS) will become covered, over time by natural sediment transport and deposition, with recovering benthos colonising the sediment	Loss of existing sedimentary seabed habitats via placement of rock berm between KP10.9-14.9

Receptor	Scope for potential impact from CFE and/or localised excavation for CPS	Scope for potential impact from rock placement or CPS	Scope for potential impact from construction of rock berm
	evidenced by CFE trials)		
Marine Non-Native Species (MNNS)	None beyond those already assessed for previous works. Scoped out of this assessment	None beyond those already assessed for previous works. Scoped out of this assessment	None beyond those already assessed for previous works. Scoped out of this assessment
Fish and Shellfish Ecology	Temporary, localised disturbance via suspended sediment levels and vessel noise from CFE operation or excavation associated with CPS Potential impact on salmon migration Potential impact on scallops of suspended sediment levels from CFE operation or excavation associated with CPS Potential impact on mussel bed at Noss Head from suspended sediment levels from CFE operation	Temporary, localised disturbance via vessel noise from rock placement or CPS deployment process Potential impact on salmon migration	Temporary, localised disturbance via vessel noise from berm construction Potential impact on salmon migration Potential impact on habitat supporting prey species of SPA designated classified populations Loss of existing sedimentary seabed habitats (feeding/spawning grounds) via placement of rock berm at KP10.9-14.9
Marine Mammals	Impact on marine mammals from increase in subsea noise due to CFE process	Impact on marine mammals from increase in subsea noise due to rock placement or CPS deployment process	Impact on marine mammals from increase in subsea noise due to berm construction Potential impact on habitat supporting prey species of SAC designated species
Ornithology	Disturbance / displace ment of bird populations as a result of vessel presence during CFE process	Disturbance / displace ment of bird populations as a result of vessel presence during rock placement or CPS deployment process	Disturbance / displace ment of bird populations as a result of vessel presence during rock placement berm construction at KP10.9-14.9

Receptor	Scope for potential impact from CFE and/or localised excavation for CPS	Scope for potential impact from rock placement or CPS	Scope for potential impact from construction of rock berm
			Potential impact on habitat supporting prey species of SPA classified populations
Nature Conservation	Temporary and localised disturbance via suspended sediment levels to designated site features and prey species. Displacement of designated site features (species) and prey items during CFE operation / and or acoustic survey Potential in-combination impacts (HRA Requirement) Direct seabed footprint impacts on designated site features (SAC, SPA, pSPA NCMPA)	Displacement of designated site features (species) and prey items during rock placement operation, CPS deployment and / or acoustic survey Potential in-combination impacts (HRA Requirement) Direct seabed footprint impacts on designated site features (SAC, SPA, pSPA, NCMPA)	Displacement of designated site features (species) and prey species during berm construction and / or acoustic survey Potential in-combination impacts (HRA Requirement) Direct seabed footprint impacts on designated site features (SAC, SPA, pSPA, NCMPA)
Human Environment			
Commercial Fisheries	Temporary disturbance / displace ment of fishing vessels as a result of CFE works	Temporary disturbance / displacement of fishing vessels as a result of rock placement or CPS deployment Potential effect on scallop dredging gear of emplaced rock	Temporary disturbance / displacement of fishing vessels as a result of berm construction Potential effect on scallop dredging gear of rock berm Potential effect on other fisheries of rock berm
Shipping and Navigation	Temporary restrictions around CFE operation	Temporary restrictions around rock placement operation or CPS	Temporary restrictions around berm construction operation

Receptor	Scope for potential impact from CFE and/or localised excavation for CPS	Scope for potential impact from rock placement or CPS	Scope for potential impact from construction of rock berm
		deployment	Potential effect on shipping and navigation of rock berm via reduction in navigable depths
Marine Archaeology	None beyond those already assessed for previous works.	None beyond those already assessed for previous works.	None beyond those already assessed for previous works.
Water Framework Directive	Works resulting in deterioration of waterbody status	No impacts of rock placement or CPS deployment on WFD.	No impacts of berm construction on WFD.
Scottish National Marine Plan	None beyond those already assessed for previous works.	None beyond those already assessed for previous works.	None beyond those already assessed for previous works.
Cumulative Impacts	Cumulative effect on range of receptors of CFE combined with rock placement on other nearby projects (Beatrice, Moray East, Moray West OWF's)	Cumulative effect of rock placement or CPS deployment combined with rock placement on other nearby projects (Beatrice, Moray East, Moray West OWF's)	Cumulative effect of rock berm combined with rock placement on other nearby projects (Beatrice, Moray East, Moray West OWF's)

3.2. Physical Environment

3.2.1. Existing Environment

This section of the report provides details of the existing physical environment in the area where CFE and / or rock placement works (including installation of CPS) are proposed, i.e. between KP 1.5-2.0, 3.5-16.7; 41.4-96.8; 103.9-108.5 (an assessed total length of 35 km). The information is largely based on data presented in the original ES produced for the project (SSE, 2011), the Shetland HVDC Connection Marine Environmental Appraisal (SHET, 2009) and the CMS HVDC Cable Plan (LR, 2019).

Bathymetry

The subsea cable route comprises a relatively flat seabed with a depth ranging from 25 m to 69 m under Lowest Astronomical Tide (LAT) (SSE, 2011).

Tidal / Wave Regime

Tidal current speeds of 0.25 m/s to 0.5 m/s during neaps, and 1 m/s to 1.25 m/s during springs can be predicted along the entire cable route (except for the landfall approach). The range of spring and neap tides along most of the cable route is 2.5-3 m (SHET, 2009; SSE, 2011).

Seabed Sediments

The seabed sediments consist mainly of sandy gravel, gravelly sand and sand, with some patches of silty clay also present in the mid-section. Sand ripples are common in sandy gravel and sand areas.

Sediment Transport

A predominantly sandy seabed with extensive areas of ripples indicates the presence of relatively strong tide-driven currents or wave action capable of transporting the surface seabed layers.

3.2.2. Impact Assessment (Physical Environment)

The impact assessment criteria used to assess impacts on physical receptors in the original EIA process (and this updated appraisal) are summarised below.

Table 3-2: Definitions of receptor sensitivity for physical receptors assessed in this appraisal

Level of value	Example of criteria
High	• Seabed features that are vulnerable to change and damage, which are not subject to other forms of disturbance, and which may in turn support rare and valued communities, which will often be designated at international levels; these areas may also be quite restricted in extent amounting to perhaps less than 0.1 % of the study area • Sediments that are already heavily polluted where any disturbance could release currently unavailable contaminants into the water column and nearby sediments • Areas where water quality guidelines indicate that conditions are unfavourable or areas that are considered to be polluted to the extent that local wildlife is affected; areas where added pollutants would lead to water quality objectives not being met.
Medium	• Seabed features that are reasonably robust to change and are likely to be subject to modest existing disturbance and may support species and communities of national and local importance; in extent may cover an area at between 0.1 % to 10 % • Seabed sediments generally be considered clean and uncontaminated; discharges would not result in exceeding water quality objectives • Water quality generally be considered clean and achieving good water quality objectives for degradable pollutants; discharges would not result in exceeding water quality objective.
Low	• Seabed features not particularly vulnerable to change/damage, often subject to existing natural/long term disturbance; features that are distributed extensively within the study area (> 10 % coverage) Sediment which has chronic levels of pollutants associated with it at more than trace or background levels; such areas may be affected by plumes from current discharges or legacy areas from previous industrial activities; this would also include areas subject to high concentrations of naturally occurring “contaminants”; discharges would not result in exceeding water quality objectives.

Table 3-3: Definitions of magnitude of effect for physical environment impacts

Level of value	Example of criteria
High	Major change to the baseline, e.g.; • a change that affects more than 5 km^2 of the seabed; • a change returning to baseline/undetectable levels within 10 km of works.
Medium	A moderate shift from the baseline conditions, e.g. • a change that affects 0.5 km^2 to 5 km^2 of seabed • a change returning to baseline/undetectable levels within 10 km of works.
Low	A minor shift from baseline conditions over a local area, e.g. • a change that affects 0.05 km^2 to 0.5 km^2 of seabed • a change returning to baseline / undetectable levels within 1 km of works; detectable levels but not to concentrations that cause noticeable effects on biota
Very Low	A very slight change to the baseline condition; change barely distinguishable, approximating the 'no change' situation: • a change that affects up to 0.05 km^2 of seabed • a change returning to baseline / undetectable levels within 100 m of works; changes that are difficult to detect against background, no effects on biota.

Table 3-4: Assignment of impact significance for the physical environment based on sensitivity of receptor and magnitude of effect

Sensitivity of receptor	Magnitude of effect								
	High	Medium	Low	Very Low	None	Very low	Low	Medium	High
High	Major	Major	Moderate	Minor	Neutral	Minor Positive	Moderate Positive	Major Positive	Major Positive
Medium	Major	Moderate	Minor	Minor	Neutral	Minor Positive	Minor Positive	Moderate Positive	Major Positive
Low	Moderate	Minor	Minor	Negligible	Neutral	Negligible Positive	Minor Positive	Minor Positive	Moderate Positive
None	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral

3.2.2.1. Alteration of Seabed Sediment Character as a Result of CFE and CPS

CFE works have the potential to temporarily affect the local seabed sediments as a result of the redeposition of sediments suspended through the operation of the CFE tool. Sediment along the majority of the cable route is coarse in nature, mostly consisting sandy gravel, gravelly sand and sand. Resuspension of coarse sediments is spatially and temporally limited. Modelling results for Race Bank (ABPmer, 2017) indicate that coarser sediments (sand and gravel) will settle relatively rapidly to the seabed. Modelled results from a 100% sand seabed indicated values in the region of 200 m for the distance resuspended sand would be advected by a current, and with a duration of influence on local suspended sediment concentrations of approximately 20 s. Seabed sediment types and current speeds along the C-M cable route are similar to those modelled at Race Bank so this scale and duration would appear to be applicable. In addition, deployment of the CPS in shallow waters between approximately KP 1.5 and KP 2.0 will likely involve some local excavation and. therefore, some limited sand and fine sediment advection. The sediment advection associated with CPS deployment will be significantly smaller than that associated with CFE; however, in order to provide a conservative assessment, this appraisal also uses the worst-case sand advection envelope associated with CFE described above.

In operation, the CFE will leave a secondary trench as a result of the flow and induced erosion of the seabed sediment. This appraisal is based on a secondary trench depth of no more than 0.45 m, on running average, per 100m length of secondary trench, below a MSBL. CFE will redistribute the majority of the current seabed material in berms back into the cable trench. There may, however, be some preferential sorting, with larger particles deposited closer to the site of operation of the tool and finer particles travelling further. This is temporary, and natural seabed sediment transport processes will continue post-operation with the relatively strong tide-driven currents or wave action transporting the surface seabed layers and restoring the natural composition. The ES (SSE, 2011) indicates that variability in the seabed will be reworked by currents, wave action and seabed animals, so that within months the discontinuities in sediment sorting would not be expected to be visually distinguishable at the seabed.

The seabed itself is assessed as having a **Low** sensitivity to redistribution of seabed sediments (N.B.: the sensitivity of biological receptors to redistribution of sediments will be assessed within the appropriate biological environment sections below).

The magnitude of impacts is assessed as **Very Low** (redistribution of natural sediments means any changes will be barely distinguishable and approximate the natural pre-works condition after the action of local and regional sediment transport processes). The impact on the seabed sediment is **Negligible** when using the criteria detailed in Table 3-4.

Table 3-5: Impact assessment: changes to seabed sediment as a result of CFE process and CPS

Sensitivity of receptor	Low
Magnitude of effect	Very Low
Significance of impact	**Negligible**

3.2.2.2. Alteration of Seabed Sediment Character as a Result of Rock Placement and CPS and Construction of a Rock Berm

It is anticipated that some temporary modification of seabed character will take place as a result of rock placement along the cable route. The preferred option for cable burial will be to use CFE, however in areas where CFE is ineffective, rock placement within the existing trench and to seabed level only will occur. In areas where rock placement in shallow water cannot be undertaken, an alternative cable protection system (CPS) such as cast-iron shells may be utilised. The exact length of rock placement required (and including CPS) is currently unknown, however a worst-case (if unrealistic) scenario would be for rock placement (including a limited length of CPS) to occur along the entire assessed 35 km of the proposed works.

The ES (SSE, 2011) indicates that the route chosen for the cables has taken into account seabed character, and mostly lies in areas without any particularly discernible features. During the rock placement process the sediments in the burial trench may be agitated and displaced, however the amount of agitation and displacement will be mitigated by the use of a fall pipe vessel during rock placement. The use of the fall pipe means that rock placement can be precise and tightly controlled, will reduce the extent of seabed affected, and minimise disturbance through the water column during installation. There will, therefore, be very limited sediment advection as a result of rock placement.

Placement of suitably sized rock within the cable trench will, however, temporarily alter the current seabed sediments from predominantly gravelly sand and sandy gravels, to a gravel sediment within the backfilled trench. It should be noted, however, that the level of this placed rock will, typically, remain at or below the mean seabed level surrounding the trench, and that natural seabed sediment transport will, over time, deposit local sands into and over the emplaced rock. The ES (SSE, 2011) suggests that *"the seabed will gradually be reworked by currents, wave action and seabed animals until within a few months or years the tracks of the cables are not expected to be visually distinguishable at the seabed."* Deployment of the CPS, which is composed of cast iron shells, will also alter the seabed at the site of the CPS to a hard substrate, however natural seabed sediment transport is expected, over time, to also gradually deposit local sediments over the CPS.

The ES (SSE, 2011) assessed the sensitivity of the seabed as **Low** for the presence of new structures on the seabed (this includes placement of suitably sized rock within the trench and CPS). Assuming a worst-case scenario that the entire 35 km assessed length of remediated trench is filled with emplaced rock (or a short section of CPS), and the maximum width at surface is 6 m, then the overall footprint of effect is calculated as 0.21 km^2. This is a **Low** magnitude of effect, and combined with the Low sensitivity of the receptor, results in a **Minor** impact for seabed alteration as a result of rock emplacement (or CPS).

Damage to a section of the C-M HVDC cable means that a cable repair between approximately KP 11 and KP 15 is planned and, as part of this repair, rock placement will occur which may involve the construction of a rock berm. This berm may extend above MSBL by a maximum of approximately 1.7 m. The ES (SSE, 2011) suggests that the area between approximately KP 11 and KP 15 is free of large sand waves. The scale of the proposed rock berm, and the associated magnitude of effects are so small in comparison with the original assessment envelope (SSE, 2011) and the additional cable protection works (MarineSpace, 2017c) that there is no impact on water flow and hydrological processes. Storm-driven sediment transport may, in time, begin to bury the margins of any berm, however it is likely to remain as a permanent alteration to the seabed sediment character.

While only sections of the cable repair corridor (between approximately KP 11 and KP 15) are likely to undergo rock placement above MSBL, in order to overestimate the potential effects associated with the operations, and thus provide a conservative assessment of the potential impacts, this appraisal assumes the entire length of the repair corridor (4.5 km) is subject to the construction of a berm, with a maximum seabed width of 6 m. The overall footprint of such an effect is calculated as 0.027 km^2. While this can be considered as a permanent alteration to the sediment character, the very restricted footprint means this is a **Very Low** magnitude of effect. Combined with the Low sensitivity of the receptor, the potential construction of a berm results in a **Negligible** impact on seabed character.

Table 3-6: Impact assessment: changes to seabed sediment as a result of rock placement and CPS; and construction of a rock berm

Sensitivity of receptor	Low
Magnitude of effect	Low (Very Low for construction of rock berm between approximately KP 11 and KP 15)
Significance of impact	**Minor** (**Negligible** for construction of rock berm between approximately KP 11 and KP 15)

3.3. Biological Environment

3.3.1. Existing Environment

This section of the report provides details of the existing biological environment in the area where CFE and / or rock placement works (including installation of CPS) are proposed, i.e. between KP 1.5-2.0, 3.5-16.7; 41.4-96.8; 103.9-108.5 (an assessed total length of 35 km). The information provided is largely based on data presented in the ES produced for the project (SSE, 2011), the Shetland HVDC Connection Marine Environmental Appraisal (SHET, 2009) and the CMS HVDC Cable Plan (LR, 2019).

Subtidal Benthic Ecology

The Moray Firth coastline comprises a mix of rocky shores, sandy bays and large sheltered firths (bays that often form parts of estuaries) and some parts of these shores are considered to be of high marine biological importance due to the presence of rich assemblages.

In deeper lying areas, where mixed sandy sediments dominant the epifauna present is typically sparser than nearshore areas, with only occasional crabs, scallops and starfish recorded. Benthic infauna is typical of similar benthic infauna in this region. There are no known sensitive benthic habitats in the areas of the proposed CFE and / or rock placement.

A particularly sensitive seabed habitat occurs close to the northern part of the works route (horse mussel bed off the Noss Head landfall area in the Noss Head Nature Conservation Marine Protected Area (NCMPA)).

Fish and Shellfish Ecology

A recent review by Marine Scotland indicated that Atlantic salmon travel in both directions along the north and northeast coasts of Scotland. Freshwater pearl mussel (FWPM) is dependent on salmonids for part of their freshwater life cycle. Therefore, a development that has the potential to affect salmonids may also indirectly affect FWPM. Atlantic salmon may also provide a prey species for cetaceans within the region and, therefore, any effect on salmon or salmon migration may indirectly affect cetaceans. Atlantic salmon are designated features of several SACs in the area:

The following rivers designated as SACs feed into the Moray Firth:

- Berriedale and Langwell Waters SAC – Atlantic salmon;
- River Oykel SAC - Atlantic salmon and freshwater pearl mussel;
- River Moriston SAC - Atlantic salmon and freshwater pearl mussel; and
- River Spey SAC – Atlantic salmon, sea lamprey and freshwater pearl mussel.

In addition, there are other SACs distributed along the coastline to the north and south of the Moray Firth that may also have qualifying features that interact with the waters of the firth:

- River Borgie SAC – Atlantic salmon and freshwater pearl mussel;
- River Naver SAC - Atlantic salmon and freshwater pearl mussel;
- River Thurso SAC – Atlantic salmon; and
- River Dee SAC - Atlantic salmon and freshwater pearl mussel.

In a precautionary manner these sites and qualifying features have been screened for likely significant effects and assessed in Appendix A to this report.

The basking shark is particularly associated with tidal fronts on the continental shelf and shelf edge where they feed on plankton. They have been recorded around the whole Scottish coast, with sightings peaking in the summer months especially at a number of hot spots on the west coast. There are occasional but regular summer sightings in the outer Moray Firth. The basking shark is of conservation importance as an internationally recognised endangered species.

Fish populations are rich and varied within the Moray Firth. The following species are known to spawn in the area: sandeel, *Nephrops*, Atlantic cod, whiting, sprat, Atlantic herring, lemon sole and plaice. Five of these also use the inshore waters as nursery grounds (sandeel, sprat, Atlantic herring, whiting and lemon sole). All these species are likely to occur in and around the area of proposed works at certain times of year.

Marine Mammals

To date, a total of 14 cetacean species and two pinnipeds have been recorded within the Moray Firth (Moray Offshore Windfarm (West) Limited, 2017), with four key species occurring all year round – bottlenose dolphin, harbour porpoise, grey seal and harbour seal (Natural Power, 2017). Two of these are European Protected Species (EPS) (bottlenose dolphin and harbour porpoise).

A fifth EPS occurs in late summer – minke whale – although spring and early summer sightings are now being made more regularly. Other EPS including short-beaked common dolphin, Risso's dolphin, white-beaked dolphin, humpback whale, killer whale and long-finned pilot whale occur in the Moray Firth on a more occasional basis (Natural Power, 2017).

Harbour porpoise was the most commonly encountered species by Thompson *et al.* (2012), being seen throughout inshore and offshore waters of the Moray Firth. Harbour porpoise is considered to be in favourable condition in respect of range, population, habitat, prospects and overall status (Scottish Government, 2011a). This is the species of cetacean most likely to be encountered by the project during proposed cable works. This is one of the species of cetacean most likely to be encountered by the project during proposed cable works, along with bottlenose dolphins. Sightings data also suggest that common and grey seals are commonplace.

The Moray Firth is an area of the Scottish east coast where high concentrations of common seal have been recorded. The majority of seals are found within the inner Moray Firth. The Moray Firth SAC and Dornoch Firth and Morrich More SAC, are designated for a range of features including the presence of bottlenose dolphin and common seal. There are a number of small haul-outs along the coast and common seal have been recorded at Seal Skerry, near to the landfall. The Moray Firth does not contain any of the main breeding colonies.

Further information on the assessment of potential pressures on SACs designated for marine mammals is included in Appendix A MPA Assessment.

Marine Ornithology

Auks (guillemot, razorbill, and puffin), kittiwake and fulmar are known to forage widely in the Moray Firth, especially over Smith Bank. Gannet can range widely throughout the Moray Firth and beyond and for this reason is also considered in this assessment. The nearest gannet colonies are at Troup Head on the southern coast of the Moray Firth but gannet can forage at distances of hundreds of kilometres from breeding sites.

The black guillemot unlike the other auks present in the region, does not nest colonially or on cliffs, tending to favour low rocky shores often on islets. It is generally observed in ones or twos in nearshore waters. Its distribution includes the Caithness coast and Orkney.

During baseline surveys to inform the original EIA process, the following results were obtained:

- The most frequently recorded bird species / species groups in this area were auks, with high numbers of fulmar, kittiwake and other gulls also recorded;
- Other bird species recorded included gannet, along with very low numbers of divers, Leach's petrel, Arctic skua, great skua, and unidentified terns;
- Seasonal variations in bird numbers present included:
    - Increasing numbers of fulmar in November compared to other months;
    - Highest numbers of gannet and kittiwake in June and August, with low numbers during the winter; and
    - Higher numbers of auks during May and June compared to the winter.

Further information on the assessment of potential pressures on SPAs and qualifying bird populations is included in Appendix A MPA Assessment.

3.3.2. Impact Assessment (Biological Environment)

The impact assessment criteria used to assess impacts on biological receptors in the original EIA process (and this updated appraisal) is summarised below.

Table 3-7: Definitions of receptor sensitivity for biological receptors assessed in this appraisal

Level of value	Example of criteria
Very High	• Internationally important sites include: SACs, SPAs and Ramsar sites. Candidate SACs, potential SPAs and proposed Ramsar sites should be given the same consideration as designated sites • A qualifying feature of a SAC, SPA or Ramsar site or notified feature of a SSSI • A regularly occurring population of an internationally important species (listed on Annex I of the Birds Directive or Annex II or IV of the Habitats Directive) • Rare, easily disturbed, low populations, threatened populations or distribution
High	• A nationally important designated site e.g. SSSI, or a site considered worthy of such designation • A viable area of a habitat type listed in Annex I of the Habitats Directive or of smaller areas of such habitat which are essential to maintain the viability of a larger whole • A regularly occurring population of a nationally important species, e.g. Listed on schedules 1 and 5 of the Wildlife and Countryside Act (1981) (as amended) • Uncommon, quite easily disturbed, declining or diminished population or distribution
Medium	• UK BAP Priority species and habitats • Areas of internationally or nationally important habitats which are degraded but are considered readily restored • A regularly occurring, regionally significant population of a species listed as being nationally scarce • Sites supporting species in regionally important numbers (>1 % of regional population) • Abundant, normal response to disturbance, stable population and distribution
Low	• Viable areas of UK BAP priority habitat or smaller areas of such habitat which are essential to maintain the viability of a larger whole • A regularly occurring, substantial population of a nationally scarce species, including species listed in the UK and Local BAPs • Common, quite resilient to disturbance, rising populations and distribution
Very Low	• Areas of internationally or nationally important habitats which are degraded and have little or no potential for restoration • A good example of a common or widespread habitat in the local area, Species of national or local importance, but which are only present very infrequently or in very low numbers within the subject area • Any other species or habitats for which there are no designations

Table 3-8: Definitions of magnitude of effect for biological environment impacts

Level of value	Example of criteria
High	• A long-term effect (>2 years) on the integrity of a site or conservation status of a habitat, species assemblage / community, population or group; if adverse, this is likely to threaten its sustainability • Major loss or major alteration to key elements of the baseline (pre-development) conditions such that the post-development character / composition / attributes will be fundamentally changed • Affects over 1 % of the seabed area • Multiple mortalities to marine mammals or larger sea life, change in regional distribution of marine mammal population
Medium	• A medium-term effect (1-2 years) on the integrity of a site or conservation status of a habitat, species assemblage / community, population or group; if adverse, this is unlikely to threaten its sustainability • Loss or alteration to one or more key elements / features of the baseline conditions such that post-development character / composition / attributes will be partially changed • Affects over 0.1% of the seabed area • A single mortality to a marine mammal or larger sea life, change in local distribution to marine mammal population
Low	• A short-term (1-12 months) but reversible effect on the integrity of a site or conservation status of a habitat, species assemblage / community, population or group that is within the range of variation normally experienced between years • Minor shift away from baseline conditions; change arising from the loss / alteration will be discernible but underlying character / composition / attributes of the baseline condition will be similar to the pre-development situation • Affects over 0.01% of the seabed area • Change in behaviour of marine mammals or larger sea life
Very Low	• A very short-term (<1 month) but reversible effect on the integrity of a site or conservation status of a habitat, species assemblage / community, population or group that is within the normal range of annual variation • Very slight change to the baseline condition; change barely distinguishable approximating the ‘no change’ situation • Affects over 0.001% and less of the seabed area • A noticeable response from marine mammals or large sea life

Table 3-9: Assignment of impact significance for the biological environment based on sensitivity of receptor and magnitude of effect

Sensitivity of receptor	Magnitude of effect								
	High	Medium	Low	Very low	None	Very low	Low	Medium	High
Very high	Major	Major	Moderate	Minor	Neutral	Minor Positive	Moderate positive	Major positive	Major positive
High	Major	Moderate	Moderate	Minor	Neutral	Minor Positive	Moderate positive	Moderate positive	Major positive
Medium	Major	Moderate	Minor	Minor	Neutral	Minor Positive	Minor Positive	Moderate positive	Major positive
Low	Moderate	Moderate	Minor	Negligible	Neutral	Negligible Positive	Minor Positive	Moderate positive	Moderate positive
Very low	Moderate	Minor	Minor	Negligible	Neutral	Negligible Positive	Minor Positive	Minor Positive	Moderate positive

3.3.2.1. Temporary, Localised Increase in Suspended Sediment Levels / Deposition and Impact to Benthic Habitats via CFE Operation and Installation of CPS

Sediment suspended into the water column during the proposed CFE (and CPS) works (and the subsequent deposition of this material back to the seabed) has the potential to adversely impact benthic habitats along sections of the cable route. As already discussed in Section 3.2.1, the sediment along the majority of the cable route is sandy gravel, gravelly sand and sand. Data from an assessment for Race Bank (ABPmer, 2017) suggest that sand would be expected to be resuspended no more than 10 m above the seabed. Sand-sized particles will also settle out of suspension relatively rapidly following disturbance with ABPmer (2017) suggesting re-settlement within 200 s of initial suspension. These effects may result in a short-term impact in the localised area.

In terms of the spatial extent of increased suspended sediment levels, Table 2-1 and Table 2-6 indicate that advection of sediment will vary in extent, depending on grain size and where along the cable route the CFE (and CPS) works are taking place. ABPmer (2017) suggests that the maximum distance of sand advection (based on modelling for Race Bank) will be 200 m either side of the site of CFE (CPS) operation, i.e. 400 m in total, and with settling of the resuspended sands predicted to occur within 20 seconds. Current speeds and seabed sediment types are comparable between Race Bank and the C-M site, therefore these results may be used to inform this assessment.

For fine sediment (<63 µm) advection, the spatial extent of plumes will be greatest along the northern section of the cable route, with a maximum potential advection of 15 km either side of the location of the cable where CFE works take place. However, apart from the immediate area around the CFE works, where very elevated suspended sediment levels will occur, the level of suspended sediments in the fine plumes will be barely recordable above background levels within a few hundred metres of the CFE works. The same conclusion applies to the localised excavation that may be undertaken in the area of proposed CPS installation.

It is also important to note that the CFE will not occur simultaneously, everywhere along the 35 km assessed length so, in practice, there will be a series of spatially and temporally discrete plumes generated over the entire duration of these works. Sediment plumes and deposition footprints (indirect effects) will, therefore, result in a short-term (hours), and generally localised (10s and 100s of metres from works) increase in SSC related to the tidal excursion. Turbulence at the seabed may also further disturb sediment resulting in increased suspension.

The sensitivity of the receptor (benthic habitats) in the region of proposed works was assessed as **Low** within the ES and also within this assessment, as similar seabed features are distributed widely within the study area, and it is expected that the benthic communities present will be adapted to suspension of sediment occurring due to existing natural and long-term disturbance and therefore naturally resilient. Based on the criteria set out within Table 2-6, the magnitude of potential effect on benthic habitats via increased suspended sediments and deposition is assessed as **Low**. Therefore, using the criteria outlined in Table 3-9 a **Minor** impact is predicted.

Table 3-10: Impact assessment: increased SSC / deposition on benthic habitats via CFE (and CPS works)

Sensitivity of receptor	Low
Magnitude of effect	Low
Significance of impact	**Minor**

3.3.2.2. Temporary Seabed Disturbance to Benthic Habitats via CFE Operation and Installation of CPS

The areas of seabed covered by the existing sediment berms either side of the trench have already been subject to impact via deposition of sediment derived from trenching during the initial cable installation works. This impact (temporary seabed disturbance) was assessed within the original ES for this project as a **Minor** impact. The current proposed CFE works (and CPS installation between will involve the removal of these existing seabed berms in order for the berm material to backfill the cable trench. This will lead to another form of temporary seabed disturbance.

With respect to the scale of this impact, the maximum distance along which CFE works will be undertaken is assessed as 35 km, and with a conservative estimate of a 30 m wide footprint of disturbance (15 m either side of the cable due to there being a berm on each side) has been defined. This amounts to a total area of 1.05 km^2 that will be subject to temporary seabed disturbance. In real terms, only a small proportion of this area will be subject to direct, temporary disturbance, i.e. the actual area covered by the existing berms which will be the focus of the CFE works. The remaining proportion of this 1.05 km^2 will be subject to indirect, temporary disturbance via deposition of material out of localised plumes which has already been assessed in the preceding impact assessment.

In the areas subject to direct disturbance, the benthic communities were impacted in 2018 due to the deposition of material to create the berms. Therefore, the sensitivity of these receptors is judged to be **Very Low** (currently degraded). The magnitude of effect for this direct, temporary disturbance is judged to be **Very Low**. Therefore, a **Negligible** impact via this temporary, direct disturbance to seabed habitats in the areas of the berms is assessed (Table 3-11).

Table 3-11: Impact assessment: temporary seabed disturbance on benthic habitats as a result of CFE

Sensitivity of receptor	Very Low
Magnitude of effect	Very Low
Significance of impact	**Negligible**

It is also important to note that the planned CFE works aim to restore the seabed to its original profile, or as close as reasonably practicable. Therefore, it is predicted that upon removal of these berms, natural seabed sediment compositions and benthic community recovery will be restored, over a period of 6 months to 1 year.

3.3.2.3. Temporary Disturbance of Benthic Habitat around the Trench due to CFE Creating Secondary Depressions (as Evidenced by CFE trials) and / or Changes to Seabed Type as a Result of Rock Placement and CPS

There are two potential direct impacts on seabed habitats as a result of the proposed CFE works, with differing temporal effects:

- Direct disturbance to the area around the cable trench subject to CFE works, resulting in the existing berms being removed and this material backfilling the existing trench – see preceding impact assessment; and
- The same direct disturbance to the area around the cable trench subject to CFE works, resulting in the creation of secondary trenches either side of the backfilled trench, as a result of the flow and induced erosion of the seabed sediment.

In operation, the CFE will disturb an area around the cable trench, and also potentially leave a secondary trench as a result of the flow and induced erosion of the seabed sediment. This appraisal is based on the premise that the depth of any potential secondary trench will be less than 0.45 m deep, on running average per 100 m length, below a MSBL mean seabed level. The total width of disturbance around the trench, indicated by multibeam monitoring of the NKT CFE trial, is approximately 30 m.

In terms of impact on benthic communities, it is important to recognise that any secondary trenches will be created in areas currently covered by the berms that exist either side of the main cable trench. The benthic communities on these areas have been recently impacted via the deposition of this berm material derived from the initial cable installation works. Following the CFE works secondary trenches will naturally backfill as a result of local and regional sediment transport and deposition. Due to the fact that the secondary trenches will be no more than 0.45 m lower, on running average per 100 m length, than a MSBL, they are predicted to act as a sediment sink and will accumulate sediment over the medium term (1-2 years). Even before sediment naturally accumulates in these secondary trenches, juvenile forms of common benthic species will colonise these areas and recovery of benthic communities will begin.

Based on the criteria for magnitude of effects, it is predicted that there will be a **Medium** scale of effect. The sensitivity of benthic receptors in this region is judged to be **Very Low** as they have already been recently impacted (in 2018) as a result of the deposition of the sediment which created the berms. Therefore, a **Minor** impact is predicted on benthic communities as a result of the creation of secondary trenches.

Table 3-12: Impact assessment: impact on benthic habitats via creation of secondary trenches

Sensitivity of receptor	Very Low
Magnitude of effect	Medium
Significance of impact	**Minor**

In addition, the seabed sediment type may be temporarily changed as a result of rock placement and CPS within the cable trench. The exact length of rock placement required (and including CPS) is currently unknown, however a worst-case (if unrealistic) scenario would be for rock placement (including a limited length of CPS) to occur along the entire assessed 35 km of the proposed works. Placement of rock or CPS will, however, temporarily alter the current seabed sediments from predominantly gravelly sand and sandy gravels, to a rock sediment within the backfilled trench or a hard seabed at the site of the CPS.

Natural seabed sediment transport will, over time, deposit local sands into and over the emplaced rock, or the CPS. The ES (SSE, 2011) suggests that *"the seabed will gradually be reworked by currents, wave action and seabed animals until within a few months or years the tracks of the cables are not expected to be visually distinguishable at the seabed."* The sensitivity of the benthos to these sediment changes is **Very Low** (as a result of the relatively recent impacts of trenching), and the change to sediment type will be temporary. Assuming a worst-case scenario that the entire assessed 35 km length of remediated trench is filled with emplaced rock (or a short section of CPS), and the maximum width at surface is 6 m, then the overall footprint of effect is calculated as 0.21 km^2. This is a **Very Low** magnitude of effect and, combined with the **Very Low** sensitivity of the receptor, results in a **Negligible** impact for seabed alteration as a result of rock emplacement or CPS.

Table 3-13: Impact assessment: impact on benthic habitats via rock placement

Sensitivity of receptor	Very Low
Magnitude of effect	Very Low
Significance of impact	**Negligible**

3.3.2.4. Permanent Alteration of Benthic Habitat as a Result of Berm Construction between KP11-15

Damage to a section of the C-M HVDC cable means that a cable repair between approximately KP 11 and KP 15 is planned and, as part of this repair, rock placement will occur which may involve the construction of a rock berm. This berm may extend above MSBL by a maximum of approximately 1.7 m. The ES (SSE, 2011) suggests that the area between approximately KP 11 and KP16 is free of large sand waves. Storm-driven sediment transport may, in time, begin to bury the margins of any berm, however it is likely to remain as a permanent alteration to the seabed sediment character, and hence a change to the benthic habitat.

The sensitivity of the receptor (benthic habitats) in the region of proposed works was assessed as **Low** within the ES and also within this assessment, as similar seabed features are distributed widely within the study area.

While only sections of the cable repair corridor (between approximately KP 11 and KP 15) are likely to undergo rock placement above MSBL, in order to overestimate the potential effects associated with the operations, and thus provide a conservative assessment of the potential impacts, this appraisal assumes the entire length of the repair corridor (4.5 km) is subject to the construction of a berm, with a maximum seabed width of 6 m. The overall footprint of such an effect is calculated as 0.027 km^2. This is a **Very Low** magnitude of effect and, combined with the **Low** sensitivity of the receptor, results in a **Negligible** impact on benthic ecology as a result of berm construction.

Table 3-14: Impact assessment: impact on benthic habitats of berm construction

Sensitivity of receptor	Low
Magnitude of effect	Very Low
Significance of impact	**Negligible**

3.3.2.5. Temporary, Localised Disturbance of Fish and Shellfish via Suspended Sediment Levels due to CFE Operations and Installation of CPS

The proposals have the potential to affect six river systems in the northeast of Scotland designated as SACs either entirely or in part due to their importance to Atlantic salmon through noise disturbance from vessels or sediment suspension during cable burial. This has the potential to affect migrating salmon at sea (SSE, 2011).

Concerns have been raised previously by SNH about possible impacts upon migrating salmon and sea lamprey populations. The fish of particular interest and concern are those that spawn in rivers designated as SACs, which empty into the Moray Firth basin. The ES considered that salmon typically swim in the top 5 m in shallow coastal waters, whereas any seabed sediment plume is likely to stay within 5m of the seabed and is unlikely to mix vertically. It is therefore unlikely that salmon would be present in the area of sea affected by any sediment plume. There would most likely be a minimum of at least 15 m, and up to 40 m, vertical separation between the seabed plume and migrating salmon (SSE, 2010).

The area of the cable corridor is considered to be of **Medium** sensitivity because it holds regionally important sea fish resources, including shellfish such as scallops and also squid. Migrating species such as salmon and sea lamprey may also pass through the area and are considered to be of **Very High** sensitivity. Basking sharks are classed as a **High** sensitivity species.

Some sections of the cable where these additional CFE/rock placement works are planned may also lie within areas that support populations of scallops, which are a key commercial species in parts of the Moray Firth region.

Sediment plumes and deposition footprints (indirect effects) will result in a short-term (hours), localised (10s and 100s of metres from works) increase in SSC related to the tidal excursion (tidal prism). Turbulence at the seabed may also further disturb sediment resulting in increased suspension. Any elevations in SSC larger (sand) particles in the near-field will be localised (less than 1 km tidal-aligned) and short-term (no more than one single tidal excursion (SSE, 2010; MarineSpace Ltd, 2017)). The time during which mobile, migratory fish could be exposed to any increases in sediment is **Short-Term** and particularly in any one location and therefore the magnitude is considered to be **Very Low**. Therefore, using the criteria outlined in Table 3-9, the potential impact arising from the proposed cable works on fish, including salmon, is assessed as **Minor**.

With respect to potential scallop resources in the deeper offshore region of proposed works, the ecological sensitivity of this species to sediment plumes and deposition is Very Low[6]. The magnitude of effect via increased SSC and subsequent deposition is judged to be **Very Low**, therefore, a **Negligible** impact is concluded.

Table 3-15: Impact assessment: increased SSC effects on fish and shellfish ecology

Sensitivity of receptor	Medium to Very High
Magnitude of effect	Very Low
Significance of impact	Migratory Fish = **Minor** Scallops = **Negligible**

[6] https://www.marlin.ac.uk/species/detail/1398

3.3.2.6. Potential Impact on Fish and Shellfish via Rock Berm between KP11 and KP15

Damage to a section of the C-M HVDC cable means that a cable repair between approximately KP 11 and KP 15 is planned and, as part of this repair, rock placement will occur which may involve the construction of a rock berm. This berm may extend above MSBL by a maximum of approximately 1.7 m.

While only sections of the cable repair corridor (between approximately KP 11 and KP 15) are likely to undergo rock placement above MSBL, in order to overestimate the potential effects associated with the operations, and thus provide a conservative assessment of the potential impacts, this appraisal assumes the entire length of the repair corridor (4.5 km) is subject to the construction of a berm, with a maximum seabed width of 6 m. The overall footprint of such an effect is calculated as 0.027 km^2.

Migratory fish including salmon and lamprey occur in this region and are also qualifying features of local SAC's. Therefore, they are assigned a **Very High** sensitivity as a receptor. The proposed berm between KP11 and 15 has the potential to create a barrier to movement to/from natal rivers, which could, in turn, lead to impacts on reproductive success and feeding. However, even if the entire length of berm is installed, it will not represent a permanent barrier to movement as there will be sufficient space within the water column above the berm for migratory species to transit. Therefore, the magnitude of effect is assessed as **Very Low**, which when combined with the Very High sensitivity result in a **Minor** impact.

With respect to shellfish, the creation of a rock berm has the potential to create additional habitat, in particular for lobster and, to a lesser degree, crab species. Lobster and crab are judged to have a **Low** sensitivity as they are common and are quite resilient to disturbance. The area of berm that may be created is also small in the context of the wider regional sea area and as such, the magnitude of this effect is Very Low. Therefore, a **Negligible** beneficial impact is predicted.

Table 3-16: Impact assessment: Potential Impact on Fish and Shellfish via Rock Berm between KP11 and KP15

Sensitivity of receptor	Migratory Fish (barrier) = Very High Shellfish (habitat) = Low
Magnitude of effect	Migratory Fish (barrier) = Very Low Shellfish (habitat) = Very Low
Significance of impact	Migratory Fish (barrier) = **Minor** Shellfish (habitat) = **Negligible beneficial**

3.3.2.7. Potential Impact on Horse Mussel Bed at Noss Head via Suspended Sediment Levels from CFE

There is potential for suspended fine sediment created by CFE activities to be transported to the Noss Head horse mussel bed. Levels of suspended fine sediment that reach the horse mussel bed are, however, likely to be extremely low as they are at the outer edge of the potential sediment plume. Outputs from modelling of potential plumes for Hornsea Project One and Project Two suggest that settling of these plumes would lead to a thickness of sediment deposition of less than 1 mm. Furthermore, horse mussels are a relatively resilient form of community, are particularly adapted to fast changing hydrodynamic conditions, and are not particularly sensitive to elevated suspended sediment[7]. The MarLIN sensitivity assessment for horse mussel to increases in suspended sediments concludes that the species is not sensitive, as it is able to tolerate increases in suspended sediment and is likely to recover immediately from any disturbance.

Sediment plumes and deposition footprints (indirect effects) will result in a short-term (hours), localised (10s and 100s of metres from works) increase in SSC related to the tidal excursion (tidal prism). Turbulence at the seabed may also further disturb sediment resulting in increased suspension. Any elevations in SSC in the near-field will be localised (less than 1 km tidal-aligned) and short-term (no more than one single tidal excursion (SSE, 2010; MarineSpace Ltd, 2017b)). The sensitivity of mussels is judged to be **High**. The time during which horse mussels could be exposed to any increases in sediment is short-term and the magnitude is considered to be **Very Low**. The resultant potential impact has therefore been assessed as **Minor**.

MarLIN states that for smothering (deposition) pressure horse mussel shows a high sensitivity. It has an intermediate intolerance and a low recovering rate to this pressure. However, the assessment of sensitivity is based upon a benchmark of the bivalve being smothered by up to 5 cm of sediment for a period or one month. As described in this assessment, the area of potential worst case cross-tidal sediment deposition expected from the use of CFE is no more than 1 mm of fines (<63 µm particles), that are expected to be re-mobilised and winnowed into natural background nearbed transport within a tidal cycle. The pressure resulting from deposition of fines associated with the use of CFE and / or rock placement does not trigger the benchmark and will be effectively undetectable at the location of the reefs in the Noss Head NCMPA.

In addition, it is possible that a positive effect may result from the promulgation of the sediment plume as it may result in a localised increase in biogenic matter and food particles that the reef may beneficially filter-feed from. This possible positive effect is not considered in a material manner in this assessment.

[7] https://www.marlin.ac.uk/species/detail/1532

Considering the temporary temporal nature of the CFE and / or rock installation activity, the extremely small detectable increases in SSC and relatively undetectable deposition of fines, and the fact that horse mussel is either insensitive to the pressure (increased turbidity) or not exposed to the benchmark threshold that triggers sensitivity to smothering seabed footprint it is determined that **no adverse effects on site integrity will result for the Noss Head NCMPA**.

Further information on the assessment of potential impacts on the Noss Head NCMPA is included in Appendix A MPA Assessment.

3.3.2.8. Impact from Increase of Subsea Noise Associated with CFE Operations and / or Rock Placement and CPS; and Construction of a Rock Berm on Migratory Fish

The generation of underwater noise from the planned CFE / rock placement works (including CPS) / construction of rock berm may have an adverse impact on migrating Atlantic salmon and sea lamprey in the area.

Although it is possible for individual migrating Atlantic salmon and sea lamprey to be in the vicinity of marine operations, it is unlikely for the marine operations to impact their migration in any way, given the short duration of the activities and the proximity to the operations that would be expected to elicit any strong avoidance reaction. Evasion of the CFE due to underwater noise will occur but only at very close range and is likely to be followed by resumption of the direction of migration. The magnitude of the potential impacts of noise associated with any marine operations on migratory fish is therefore considered to be **Very Low**.

A transitory avoidance reaction is anticipated for a short time from any fish within the immediate area during the planned operations. As fish are considered to be of **Very High** sensitivity, the resultant possible impacts are considered to be **Minor**.

Where possible, the application of soft-start procedures, in place to protect marine mammals, is also expected to benefit Atlantic salmon and sea lamprey by allowing them adequate time to move away from the operations to avoid injury. This will reduce the potential significance of the impact to **Negligible**.

Further information on the assessment of potential pressures on SACs designated for migratory fish species is included in Appendix A MPA Assessment.

Table 3-17: Impact assessment: underwater noise effects as a result of CFE and / or rock placement and CPS; and construction of a rock berm on migratory fish

Sensitivity of receptor	High to Very High
Magnitude of effect	Very Low
Significance of impact (Post-mitigation)	**Minor (Negligible)**

3.3.2.9. Impact from Increase of Subsea Noise due to CFE and / or Rock Placement and CPS; and Construction of a Rock Berm on Marine Mammals

Cable burial operations by CFE and / or rock placement (including CPS); and berm construction will be started gradually. This will be done for operational purposes (e.g. power on the CFE will be built-up to minimise extent of any secondary trenches) but will also allow animals time to move out of the area and discourage animals from approaching too closely before source noise reaches peak levels. Foraging seals would also most likely move out of the immediate area during this time. This approach effectively facilitates a 'soft start' to the works.

The sensitivity of marine mammals as a receptor to disturbance from increased underwater noise as a result of these proposed activities is considered **Very High** and remains the same as in the previous assessment by MarineSpace (2017) and in the original EIA (SSE, 2011). As stated in earlier sections, whilst the works proposed here are expected to be of a longer duration than previous activities, it is considered here that the proposed works can still be assessed as short-term and expected to result in only a minor shift from baseline conditions. Referring to the criteria for assessing the significance of an impact on a biological receptor, the magnitude here is considered to be **Low**.

Using the criteria outlined in Table 3-9 the initial impact significance is assessed as **Moderate** but with implementation of mitigation measures, is judged to reduce to **Minor** and not significant.

Further information on the assessment of potential pressures on SACs designated for marine mammals is included in Appendix A MPA Assessment.

Table 3-18: Impact assessment: increased subsea noise effects due to CFE and / or rock placement and CPS; and construction of a rock berm on marine mammals

Sensitivity of receptor	Very High
Magnitude of effect	Low
Significance of impact (Post-mitigation)	**Moderate (Minor)**

3.3.2.10. Disturbance / Displacement of Bird Populations as a Result of Vessel Presence during CFE and / or Rock Placement and CPS; and Construction of a Rock Berm

The cable route was chosen to avoid known or likely important feeding areas of seabirds and the original EIA for cable installation did not predict any significant impacts. Whilst these works are expected to be of longer duration than that assessed within the EIA, the proposed works here are still considered and assessed as being short-term. Whilst there may be a number of vessels present on site it is likely that support vessels will only be present for short durations (hours to days).

Increased vessel activity in the area during these proposed CFE / rock placement works (including CPS) / construction of rock berm could cause disturbance to foraging seabirds due to the visual presence of the vessels or surface noise generated by vessels. Any displacement of seabirds from feeding areas may cause stress and affect energy budgets, especially if alternative sources of food are distant. Such effects, if sustained over time or regularly repeated, can impact upon breeding success.

There are several SPAs with important seabird colonies located within 50 km of the offshore cable route and the foraging ranges of these species may overlap the proposed work locations. In addition, there are Annex I species that could forage in the area of the proposals. As such, marine birds are considered to have **Very High** sensitivity.

The spatial extent of the vessel activities associated with the CFE / rock placement works (including CPS) / construction of rock berm are limited and do not intersect any known important feeding areas. In addition, the duration of the vessel activities is short-term and within the normal range of annual variation. Therefore, the magnitude of the potential effect from increased vessel activity during construction is considered to be **Very Low**.

Using the criteria outlined in Table 3-9 therefore, the potential impact arising from the proposed cable works here on marine ornithology is assessed as **Minor**.

Further information on the assessment of potential pressures on SPAs and qualifying populations of birds is included in Appendix A MPA Assessment.

Table 3-19: Impact assessment: disturbance and displacement effects as a result of CFE and / or rock placement (including CPS) / construction of rock berm on marine ornithology

Sensitivity of receptor	Very High
Magnitude of effect	Very Low
Significance of impact	**Minor**

3.3.2.11. Impact of CFE and / or Rock Placement and CPS; and Construction of a Rock Berm on Nature Conservation

Appendix A Marine Protected Areas Assessment presents the full assessment of all MPAs associated with the proposed scope of works and should be referenced.

Designated features within the study area were identified:

- Annex I and MPA designated benthic habitats;
- Annex II marine mammals and migratory fish species designated within SACs;
- Annex I bird species classified within SPAs; and
- Where appropriate, Ramsar sites.

The following activities associated with the CFE and rock placement works (including CPS) / construction of rock berm were screened and assessed where required:

Table 3-20: Pressures associated with proposed Controlled Flow Excavation and / or rock placement works CFE / rock placement works (including CPS) / construction of rock berm and assessed as part of Marine Protected Areas Assessment

Effect type	Pressures and effects	Pathway
Direct effects	Permanent removal of subtidal habitat and loss of, or damage to, benthic organisms or prey species within the footprint of the rock berm at KP 11-KP 15	✓
	Temporary disturbance / abrasion of subtidal habitat and loss of or damage to benthic organisms or prey species within the footprint of the CFE works (incl. secondary trench either side of main cable trench via CFE works)	✓
	Temporary disturbance / removal of subtidal habitat and loss of, or damage to, benthic organisms or prey species within the footprint of the rock placement works (incl. CPS)	✓
	Death or permanent or temporary injury caused by risk of collision with installation vessels	✓
Indirect effects	Increased turbidity from CFE works and installation of the CPS	✓
	Sediment deposition / smothering from suspended sediment deposition from CFE works and installation of the CPS	✓
	Sediment deposition / smothering from suspended sediment deposition from rock placement	×
	Sediment deposition / smothering from suspended sediment deposition from placement of rock berm	×
	Re-mobilisation of contaminated sediments associated with suspended sediment which could impact on water quality from CFE works and / or rock placement (incl. CPS) and rock berm	×
	Alteration of water flow and hydrological processes from CFE works and / or rock placement (incl. CPS) and rock berm	×
	Disturbance / displacement caused by visual presence of vessels	✓
	Death or permanent or temporary injury caused by propagation of underwater sound (via CFE works / rock placement (incl. CPS) / rock berm placement) to a designated feature	✓
	Death or permanent or temporary injury caused by propagation of underwater sound (via CFE works / rock placement (incl. CPS) / rock berm placement) to prey species	✓
	Disturbance / displacement caused by propagation of underwater sound (via CFE works / rock placement (incl. CPS) / rock berm placement) to a designated feature	✓

Effect type	Pressures and effects	Pathway
	Disturbance / displacement caused by propagation of underwater sound (via CFE works / rock placement (incl. CPS) / rock berm placement) to prey species	✓

The full suite of MPAs screened for likely significant effects / risks was:

- Dornoch Firth and Morrich More SAC;
- Moray Firth SAC;
- Faray and Holm of Faray SAC;
- Isle of May SAC;
- Berriedale and Langwell Waters SAC;
- River Oykel SAC;
- River Moriston SAC;
- River Spey SAC;
- River Borgie SAC;
- River Naver SAC;
- River Thurso SAC;
- River Dee SAC;
- Dornoch Firth and Loch Fleet SPA;
- Cromarty Firth SPA;
- Inner Moray Firth SPA;
- North Caithness Cliffs SPA;
- East Caithness Cliffs SPA;
- Moray and Nairn Coast SPA;
- Troup, Pennan and Lion's Heads SPA;
- Loch of Strathbeg SPA;
- Buchan Ness to Collieston Coast SPA;
- Pentland Firth pSPA;
- Moray Firth pSPA;
- East Caithness Cliffs NCMPA; and
- Noss Head NCMPA.

Of these MPAs only the following sites could be screened out of assessment:

- Isle of May SAC;
- Loch of Strathbeg SPA; and
- East Caithness Cliffs NCMPA.

The remainder of the MPAs underwent detailed assessment.

It is important to note that the MPA assessment was conducted concerning populations of Annex II marine mammals designated as features of SACs. A full Annex IV European Protected Species (EPS) assessment has been conducted separately for marine mammals not qualifying as designated populations (see Natural Power, 2017).

All designated Annex I habitats, relevant Annex II species and qualifying classified populations of bird species were assessed.

It was determined that there will be NO ADVERSE EFFECTS ON THE INTEGRITY OF ANY SITE SCREENED INTO THE ASSESSMENT ALONE OR IN-COMBINATION.

3.4. Human Environment

3.4.1. Existing Environment

This section of the report provides details of the existing human environment in the area where the CFE and / or rock placement works (including installation of CPS) are proposed, i.e. between KP 1.5-2.0, 3.5-16.7; 41.4-96.8; 103.9-108.5 (an assessed total length of 35 km).

The information provided is largely based on data presented in the ES produced for the project (SSE, 2011), the Shetland HVDC Connection Marine Environmental Appraisal (SHET, 2009) and the CMS HVDC Cable Plan (LR Senergy, 2015).

Commercial Fisheries

The C-M cable route is located within some important fishing grounds in the Moray Firth, including demersal trawl grounds, scallop grounds and inshore shellfish grounds. Vessels fishing the northern Moray Firth are mainly local, registered in the Moray Firth ports of Wick, Lybster, Buckie, Burghead, MacDuff, Whitehills and Fraserburgh.

The principal fishing activity along the cable route is dredging for scallops (*Pecten maximus*) in the central part of the Firth and trawling for *Nephrops norvegicus* (Dublin bay prawns or langoustines), particularly in the waters just offshore of the southern and northern ends of the cable. In the most part this activity is carried out by larger vessels (over 10m). This may include vessels from ports outside of the Moray Firth and nearby regions. Approximately 30-40 trawlers work the outer Moray Firth, most of which are greater than 15 m

Another significant fishery is potting (creeling) activity carried out by inshore boats (under 10m) based at fishing ports in the Moray Firth region. This activity mainly overlaps with the proposed cable route in coastal waters near the two cable landfalls. These fisheries target shellfish such as lobster (*Homarus gammarus*) and brown crab (*Cancer pagurus*). It is estimated that approximately 40 to 50 creel boats (targeting crab and lobster) are currently working the Moray Firth north coast, although not all of these are likely to be full-time fishermen.

There is also a discrete fishery for squid (*Loligo loligo*) located in the southern part of the cable route, around Portgordon.

Shipping and Navigation

Anatec Ltd was commissioned to produce a Shipping Traffic Survey and Collision Risk Assessment for the original EIA (SSE, 2011). This study identified six shipping routes transited by an estimated 828 ships per year within 10 nm of the cable route. This corresponds to an average of two to three vessels per day.

Typical commercial marine traffic in this region includes oil tankers transiting between the Gullfaks Oil Terminal and the Moray Firth and merchant vessels heading between the Pentland Firth and the northeast coast of Scotland (passing off Rattray Head). This includes regular offshore support vessel traffic between Aberdeen and the Foinaven Oil Field, west of Shetland.

There are also vessels undertaking survey and other support work for oilfield and renewable energy projects operating in or planned for the area. This low intensity vessel traffic includes the servicing of the Beatrice oilfield and demonstration wind turbines, seismic surveys for prospective oilfields and consenting and / or construction traffic for the Beatrice Offshore Windfarm Ltd (BOWL) and Moray Offshore Renewables Limited (MORL) offshore windfarm projects.

Another type of commercial shipping activity relates to fishing vessels which travel between the various fishing grounds and their home ports, as well as between the ports in the Moray Firth and more distant fishing grounds outside the area. They are distributed more widely than merchant vessels but again at lower density. The main fishing ports are on the south coast of the Moray Firth, at Fraserburgh, Banff and Buckie. The closest harbour to the proposed cable route is Staxigoe, a small village 2.5 km north of Wick and about 1.4 km from the cable emergence points.

The principal commercial and general ports in the region are Inverness, Cromarty Firth (Invergordon), and Nigg Energy Park.

Archaeology

According to the ES (SSE, 2011) there are no areas, sites or wrecks protected, designated or controlled under the Ancient Monuments and Archaeological Areas Act 1979, the Protection of Wrecks Act 1973, the Protection of Military Remains Act 1986 or the Marine (Scotland) Act 2010 within 250 m of the proposed offshore cable route. During surveys completed to inform the EIA some ship wrecks were identified near the corridor along the subsea cable route, however, no known wrecks lie within it. Two highly sensitive military aircraft are known to have crashed in the area but have not been located to date, and other losses have been reported in the general region.

Other Marine Users

The hub and part of the adjoining cable route lie within area D809(S), which is used by the Royal Air Force (RAF), the nearest RAF base is RAF Lossiemouth. The following offshore renewable energy projects are located / proposed in the Moray Firth, the Pentland Firth and Orkney waters:

- BOWL;
- MORL (Moray East and Moray West);
- Shetland HVDC cable link;
- Tidal energy developments in the Pentland Firth and Orkney waters strategic area, including:
    - Duncansby Head;
    - South Ronaldsay;
    - Inner Sound;
    - Cantick Head;
    - Westray Firth; and
- Wave energy developments in the Pentland Firth and Orkney waters strategic area.

No existing cables or pipelines intersect the cable corridor; however, it is worth noting that the MORL (East) and MORL (West) cables are proposed to cross the cable in future.

Water Framework Directive

Under the Water Environment and Water Services (Scotland) Act 2003, SEPA is responsible for producing and implementing River Basin Management Plans (RBMPs). River basins comprise all surface waters (including transitional (estuaries) and coastal waters) extending to 3 nm seaward from the Scottish territorial baseline. Any proposed development within these waters must have regard to the requirements of the WFD to ensure that all surface water bodies achieve 'Good Ecological Status (GES)' and that there is no deterioration in status. Five classifications of water quality status are defined: High (near natural), Good, Moderate, Poor and Bad; and each classification is accorded a degree of confidence (high, medium or low) in the overall quality assessment.

The most relevant RBMP areas to the first 3 nm of the Portgordon to 12 nm zone of the C-M cable are the Portgordon to Findochty Water Body and the Lossiemouth to Portgordon Water Body. Based on the most recent (2014) classifications, both these waterbodies are defined as "Good". Both these areas lie several nautical miles inshore of the area of proposed works assessed via this appraisal.

3.4.2. Impact Assessment (Human Environment)

The impact assessment criteria used to assess impacts on human environment receptors in the original EIA process (and this updated appraisal) is summarised in Table 3-21 below.

Table 3-21: Definitions of receptor sensitivity for human receptors assessed in this report

Level of value	Example of criteria
High	• Site of national commercial significance as a source of revenue and employment (e.g. important fishing ground) lies within or overlaps the project footprint • International shipping route traverses the project footprint • Intensively used and localised charted sea use area (i.e. MoD exercise area, disposal site, aggregate extraction site etc.) lies within or adjacent to the project footprint • Existing leased area for oil and gas overlaps the project footprint • Major renewables site with predicted capacity over 100 MW • Site of commercial significance for mainstay local industry (e.g. for specific fishing port in the Moray Firth) lies within or overlaps the project footprint • Regionally or nationally important recreation area lies adjacent to (within 2 km of) the project footprint • Internationally recognised, war grave, Marine Protected Area (MPA); scheduled site or feature (e.g. known wreck)
Medium	• Site of regional (Moray Firth) commercial significance as a source of revenue and employment (e.g. important fishing ground) or lies adjacent to (within 2 km) national area • Regionally or nationally important shipping route traverses the project footprint • Extensive charted sea use area (i.e. MoD exercise area, disposal site, aggregate extraction site etc) lies adjacent to (within 2 km of) or overlaps the project footprint

	• Oil and gas infrastructure nearby, lease area nearby • Renewables site with predictive capacity between 1 and 100 MW • Site of commercial significance for mainstay local industry (e.g. for specific fishing port in the Moray Firth) lies adjacent to (within 2 km of) the project footprint • Established recreation area for local activities lies within or overlaps the project footprint • Areas of sea lying close to important coastal facilities/amenity areas/tourist attractions where there is a link to the sea • Areas regularly frequented by ferries, boat trips, cruise liners and other activities that particularly relate to the sea • Notified feature (e.g. wreck site)
Low	• Local fishing area • No regionally or nationally important shipping routes traverse the project footprint • No designated MoD areas nearby • No special interest for oil and gas activities • No renewables developments planned in the area • Site of commercial significance for non-mainstay local industry lies adjacent to (within 2 km of) the project footprint • No established recreation area for local activities lies adjacent to (within 2 km of) the project footprint • Un-notified features present or area with potential for archaeology to be present

Table 3-22: Definitions of magnitude of effect for human environment impacts

Level of value	Example of criteria
High	• Change to fishing activity leading to a threat to the viability of business • A barrier to shipping, MoD operations, or oil and gas activities beyond that normally experienced in the area • Essential piece of enabling infrastructure for renewables development • Major contract opportunities for local companies • A barrier to recreation beyond that normally experienced in the area • Visibility of large structure, or large vessels in the seascape over a long period of time (e.g. a period of years) • Destruction of archaeological or cultural heritage feature
Medium	• Change to fishing activity leading to a loss of income or opportunity beyond normal business variability / risk • Presence of a long-term obstacle to shipping, MoD operations, or oil and gas activities beyond that normally experienced in the area • Development advantageous to renewables development • Many contract opportunities for local companies • An obstacle to recreation beyond that normally experienced in the area • Visibility of a moderate sized structure, or larger than average vessel(s) in the seascape over a period of months • Damage to archaeological or cultural heritage feature
Low	• Change to fishing activity leading to a loss of income or opportunity within normal business variability / risk • Presence of a long-term obstacle to shipping, MoD operations, or oil and gas activities typical to those normally experienced in the area

	• Slightly advantageous to renewables development • Few contract opportunities for local companies • An obstacle to recreation typical to those normally experienced in the area • Visibility of small structure, or average sized vessels in the seascape over a period of weeks • Disturbance, destabilisation, movement within archaeological feature
Very Low	• Change to fishing activity creating a nuisance but having no effect on income or opportunity • A temporary consideration / nuisance to shipping, MoD operations, or oil and gas activities in the area • No obvious benefit to renewables development • Limited contract opportunities for local companies (value >£1,000) • A typical consideration / nuisance to recreation in the area • Visibility of structure that is barely discernible or smaller than average vessels in the seascape over a period of days • Change to local setting for cultural heritage site

Table 3-23: Assignment of impact significance for the human environment based on sensitivity of receptor and magnitude of effect

Sensitivity of receptor	Magnitude of effect								
	High	Medium	Low	Very Low	None	Very low	Low	Medium	High
High	Major	Major	Moderate	Minor	Neutral	Minor Positive	Moderate Positive	Major Positive	Major Positive
Medium	Major	Moderate	Minor	Minor	Neutral	Minor Positive	Minor Positive	Moderate Positive	Major Positive
Low	Moderate	Minor	Minor	Negligible	Neutral	Negligible Positive	Minor Positive	Minor Positive	Moderate Positive
None	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral

3.4.2.1. Disturbance / Displacement of Fishing Activity around Areas of CFE, and / or Rock Placement Works (Including CPS) and Construction of a Rock Berm

A variety of commercial fishing activities occur at some of the locations proposed for CFE and / or rock placement works (including CPS) and / or construction of rock berm. This includes trawling for whitefish and other key species such as *Nephrops,* scallop dredging and, further inshore, creeling for crab and lobster. There is also an established commercial fishery that targets squid in the southern part of the cable route, around Portgordon.

The presence of construction vessels undertaking the CFE and / or rock placement works (including CPS) and / or construction of rock berm has the potential to displace and disrupt fishing activities at discrete sections along the cable route.

The sensitivity of the receptors, inshore creeling vessels, vessels targeting the squid fishery and larger trawling / dredging vessels remain as per the original EIA (**Medium**).

The magnitude of effect for displacement / disturbance is judged to be medium for all these fishing types, based on the following definition – "*a change to fishing activity leading to a loss of income or opportunity beyond normal business variability / risk*" – see Table 3-23. Therefore, without mitigation, the impact via disturbance / displacement is judged to be **Moderate**. However, with appropriate mitigation measures implemented (see below), the significance of this impact is judged to be **Minor**.

Table 3-24: Impact assessment: disturbance and displacement to fishing activities (commercial fisheries)

Sensitivity of receptor	Disturbance / displacement during works: **Medium**
Magnitude of effect	Disturbance / displacement during works: **Medium**
Significance of impact (Post-mitigation)	Disturbance / displacement during works: **Moderate (Minor)**

The significance of this impact will be reduced to **Minor** significance by implementation of the following mitigation measures, all of which are already being implemented by SHET as part of the ongoing installation phase:

- Preparing and disseminating cable burial depth and cable awareness information to the fishing industry;
- Appointment of project specific **FLO**;
- Use of **Notice to Mariners** and dissemination of information via the **Kingfisher** bulletin service;
- Update to the **CMS Fisheries Liaison and Mitigation Action Plan (FLMAP)** (SHET, 2019) – the FLMAP sets out the fisheries liaison and mitigation action measures to be implemented on the CMS project. These procedures have been established to ensure that the cable is planned, installed and operated as safely as possible in accordance with the licence consent conditions for the project. The FLMAP has drawn on the approach adopted in the FLMAP documents produced elsewhere in Scotland for similar projects subject to similar licence requirements. The FLMAP was issued to the fishing industry organisations as part of the formal consultation process that commenced in 2015. An updated FLMAP will be circulated that captures these additional activities; and
- Adherence of specific consent conditions related to mitigating potential impacts on commercial fisheries. In particular, condition 11 on Marine Licence **04368/18/2** (dated 10th September 2018) which is aimed at minimising disruption to the squid fishery in the southern region of the cable route where CFE and/or rock placement/CPS works will be undertaken.

3.4.2.2. Disruption to Fishing Activity via Change in Seabed Sediments and Morphology as a Result of CFE and/or Rock Placement (Including CPS)

All efforts will be made post CFE and / or rock placement works to ensure the seabed is left in the same condition as it was prior to works commencing. However, after CFE works, there is a risk that a secondary trench will be created either side of the main cable trench. For the purposes of worst-case assessment, it has been assumed that this trench will be no deeper than 0.45 m, on running average per 100 m length, below a MSBL. Also, after rock placement, there will be a period of time where exposed gravel is present (albeit not above seabed level). Under both these scenarios, potential risks exist with respect to commercial fishing activity.

For the secondary trench features, there is a possibility that they will represent a snagging risk for some fishing gears, in particular mobile scallop dredges / trawls. For the period of time when the gravel in the trench has not accumulated a veneer of sediment (via natural processes), a risk also exists that if scallop dredges pass over any such areas, the gravel may get caught in the teeth of the dredge. This may, in turn, lead to a reduction in the operational efficiency of this gear, resulting in reduced catches.

The key receptor for this potential impact is mobile gear. The sensitivity of this receptor to this potential impact is judged to be medium. The magnitude of effect for changes to seabed sediments and morphology is judged to be medium for trawler / dredging vessels, based on the following definition – "*a change to fishing activity leading to a loss of income or opportunity beyond normal business variability / risk*" – see Table 3-23. Therefore, without mitigation, the impact on mobile gears due to changes in seabed sediments and morphology is judged to be **Moderate**.

However, with appropriate mitigation measures implemented (see below), the significance of this impact is judged to be **Minor**.

Table 3-25: Disruption to fishing activity via change in seabed sediments and morphology

Sensitivity of receptor	Changes in seabed sediment and / or morphology: **Medium**
Magnitude of effect	Changes in seabed sediment and / or morphology: **Medium**
Significance of impact (Post-mitigation)	Changes in seabed sediment and / or morphology: **Moderate (Minor)**

The significance of this impact will be reduced to **Minor** significance by implementation of the following mitigation measures, all of which are already being implemented by SHET as part of the ongoing installation phase:

- Ensuring that all measures are taken during the CFE / rock placement works to minimise any secondary trenches and/or exposed gravel. This will be done via well-planned and executed marine operations;
- Undertaking post-work multibeam bathymetric surveys to collate detailed information on seabed condition;

- Preparing and disseminating cable burial depth and cable awareness information to the fishing industry based on up-to-date post-work survey data;
- Appointment of project specific **FLO**;
- Use of **Notice to Mariners** and dissemination of information via the **Kingfisher** bulletin service; and
- Update to the **CMS Fisheries Liaison and Mitigation Action Plan (FLMAP)** (SHET, 2019) – the FLMAP sets out the fisheries liaison and mitigation action measures to be implemented on the CMS project. These procedures have been established to ensure that the cable is planned, installed and operated as safely as possible in accordance with the licence consent conditions for the project. The FLMAP has drawn on the approach adopted in the FLMAP documents produced elsewhere in Scotland for similar projects subject to similar licence requirements. The FLMAP was issued to the fishing industry organisations as part of the formal consultation process that commenced in 2015. An updated FLMAP will be circulated that captures these additional activities.

3.4.2.3. Disruption to Fishing Activity via Rock Berm between KP11-15

Damage to a section of the C-M HVDC cable means that a cable repair between approximately KP 11 and KP 15 is planned and, as part of this repair, rock placement will occur which may involve the construction of a rock berm. This berm may extend above MSBL by a maximum of approximately 1.7 m.

While only sections of the cable repair corridor (between approximately KP 11 and KP 15) are likely to undergo rock placement above MSBL, in order to overestimate the potential effects associated with the operations, and thus provide a conservative assessment of the potential impacts, this appraisal assumes the entire length of the repair corridor (4.5 km) is subject to the construction of a berm, with a maximum seabed width of 6 m. The overall footprint of such an effect is calculated as 0.027 km^2.

The presence of this berm will create a discrete seabed feature that has the potential to cause disruption to commercial fishing activity in this area. The main source of impact is that the 0.027 km^2 of seabed habitat covered by the berm will change from a sedimentary environment which may have been able to support certain fish species such as flatfish and other demersal species, to a rocky area where demersal fish will no longer be located. However, the design of the berm will still permit fishing over this area and there is no expectation that the presence of the berm will lead to a reduction in other, pelagic species. Therefore, fishing will be still be able to occur. The presence of the berm may also be beneficial in terms of habitat for certain species of shellfish, in particular lobster, and this may also lead to increased/varied fishing opportunities.

The key receptor for this potential impact is mobile gear. The sensitivity of this receptor to this potential impact is judged to be **Medium**. The magnitude of effect via this potential rock berm is judged to be **Medium** for trawler / dredging vessels, based on the following definition – “a change to fishing activity leading to a loss of income or opportunity beyond normal business variability / risk” – see Table 3.4.3. Therefore, without mitigation, the impact on mobile gears due to changes in seabed sediments and morphology is judged to be **Moderate**.

However, if the same mitigation measures as defined above are successfully implemented with respect this berm feature, including ensuring that the berm is clearly defined on relevant charts, then a **Minor** impact is predicted.

Table 3-26: Impact assessment: Disruption to fishing activity via Rock Berm between KP11 and KP15

Sensitivity of receptor	Medium
Magnitude of effect	Medium
Significance of impact (with mitigation)	**Moderate (Minor)**

3.4.2.4. Temporary Disturbance and Displacement of Other Shipping around CFE and / or Rock Placement Works (including CPS) and Construction of a Rock Berm

The following impact on shipping and navigation have been assessed within this updated assessment;

- Potential impact on shipping and navigation via disturbance / restrictions during the CFE and / or rock placement works (including CPS works); and
- Potential impact on compass operation due to shallow buried cables.

Disturbance/Restriction to Navigation during Installation Phase

With respect to the first impact, the change (increase) in the duration of this activity will not impact upon the sensitivity of the receptor but does have the potential to change the magnitude of effect. In terms of receptors, the CMS cable is located to the west of a main shipping lane. However, based on the effect magnitude criteria in Table 3-23, as any disturbance to shipping will still only be a "*A temporary consideration/nuisance to shipping….in the area*", the magnitude of effect is assessed as low, and the overall impact will remain as **Minor**.

Impact on Compass Operation due to Shallow Buried Cables

The presence of subsea cabling has the potential to cause interference with magnetic compasses used for navigation. This impact is only likely to affect small vessels relying on magnetic compasses as a primary means of navigation in the absence of more sophisticated equipment on board. The sensitivity of receptors to this potential effect is judged to be medium as areas of shallower burial that will now require cable protection correspond to areas of the Moray Firth where important fishing grounds occur and regionally important shipping routes exist.

However, this effect is not predicted to occur as the planned works will achieve the DOC required (either via sediment cover from CFE works or via rock placement). Therefore, **No Impact** is predicted.

Table 3-27: Impact assessment: potential disturbance impacts on shipping and navigation

Sensitivity of receptor	Disturbance / restriction to shipping/navigation**:** Low Impact on compass operation due to shallow buried cables: Medium
Magnitude of effect	Disturbance / restriction to shipping/navigation: Low Impact on compass operation due to shallow buried cables: None
Significance of impact	Disturbance / restriction to shipping/navigation: **Minor** Impact on compass operation due to shallow buried cables: **No Impact**

3.4.2.5. Risk to Navigation via presence of rock/CPS in nearshore region and rock berm between KP11-15

Once installed, the presence of rock in the nearshore region near Portgordon and also the rock berm between KP11-15 has the potential to create a navigational risk for vessels via a reduction in water depth. The key receptors that may be affected by reduced water depths include commercial ships, fishing vessels and recreational vessels.

A recent assessment of this potential impact has been undertaken by Xodus (Xodus, 2019). This report included:

- Review of the bathymetry in the nearshore Portgordon area KP1.622 to KP10.0;
- Review of proposed design rock placement and the impact on the existing bathymetry;
- Identification of areas where the proposed rock placement would reduce the water depth by more than 5%; and
- Identification of types of shipping which navigate these areas and the maximum draught.

The assessment demonstrated that the proposed rock berm designs in the nearshore region arod Portgordon are contained within the current marine licence condition with respect to maintaining water depth reductions to <5%. However, a marginal decrease (maximum ~0.6m) in water depth relative to Lowest Astronomical Tide (LAT) above the 5% is expected when considering the maximum allowable vertical installation tolerances are considered.

When considering the maximum allowable vertical installation tolerances, the proposed rock berms result in a decrease in water depth of a maximum of ~11% reduction at the shallowest water depth and 7-8% in other areas are considered above current LAT.

This review has since been issued to the MCA who responded via email dated 30.01.19. The MCA noted that even with proposed reductions in water depth in the nearshore region, all vessels in this area would still have an under keel clearance of >3m. Therefore, the MCA had no objection to the proposed works.

With respect to the berm between KP11-15, water depths in this region are such that even with a crest height of 1.7m, there will not be a reduction on water depth of >5%.

Based on this feedback, **No Impact** on navigation is predicted via these rock placement/berm creation works.

Table 3-28: Impact assessment: potential disturbance impacts on shipping and navigation

Sensitivity of receptor	Low
Magnitude of effect	None
Significance of impact	**No Impact**

3.4.2.6. Damage to Seabed Archaeological Resources via CFE and / or Rock Placement Works (Including CPS); and Construction of Rock Berm

CFE and / or rock placement works (including the construction of any berms between approximately KP 11 and KP 15) will be undertaken in areas already subject to disturbance via cable installation, or adjacent to the original cable trench. The overall sensitivity of archaeological receptors remains Low, as in the EIA (SSE, 2011).

It is unlikely that archaeology or wartime debris will be identified within the areas proposed for CFE and / or rock placement. Given that an Archaeological Finds Plan is in place, it is not considered that the magnitude of the impact will change due to an increase in rock protection tonnage, construction of a berm between approximately KP 11 and KP 15, or because of CFE. Therefore, it is concluded that the magnitude of the effect is Low. As a result, the significance level of the impact will be **Minor**.

Table 3-29: Impact assessment: potential effects on marine archaeology

Sensitivity of receptor	Low
Magnitude of effect	Low
Significance of impact	**Minor**

3.4.2.7. Works Resulting in Deterioration of Waterbody Status and Impact on Water Framework Directive (WFD)

With respect to water quality in terms of re-suspended sediments from cable works it is considered here that sensitivity of the receptor has not changed since the EIA (SSE, 2011) or previous MarineSpace assessment (2017) and for the purpose of this appraisal will remain as moderate. It is not anticipated that the current 'Good' status of the nearby Water Bodies (Portgordon to Findochty and Lossiemouth to Portgordon) will be adversely impacted by the proposed CFE and / or rock placement works, therefore, **No Impact** is predicted on the existing WFD waterbody status in the area of works.

3.4.2.8. Works Resulting in Conflict with the Scottish National Marine Plan (SNMP)

An assessment of an “impact” on key policies within the Scottish Marine Plan (Scottish Government, 2015) using the same methodology and criteria as other environmental receptors is not appropriate or relevant. An appraisal of key policies related to subsea cables and other sectors, such as commercial fishing, has been undertaken and concluded that, subject to the successful completion of these planned CFE and / or rock placement works, and implementation of appropriate mitigation measures, these key policies will be complied with.

3.5. Cumulative Effect on Range of Receptors of CFE and / or Rock Placement and CPS; and Construction of a Rock Berm, Combined with Other Nearby Projects

Since the original impact assessment was undertaken (SSE, 2011), certain projects in the Moray Firth region have progressed to full construction and / or have changed in scope / design. Notable projects in this region (Figure 3.5.1) that have the capacity to create cumulative impacts with the cable repair on the C-M cable are:

- Beatrice OWF (under construction);
- Moray East OWF (updated Scoping Report submitted 2017); and
- Moray West OWF (updated Scoping Report submitted 2017).

The export cable corridors associated with Moray East and Moray West OWF are currently expected to cross the route of the C-M proposed cable burial activities assessed within this appraisal. However, these activities will not occur during the same period and, due to the fact that any increases in suspended sediment concentration via CFE will be temporary and very localised, no cumulative impacts via this pathway are predicted.

No detailed information is currently available regarding the Moray East Offshore Wind Farm – alternate design or the Moray West Offshore Wind Farm. However, the pressures (effects) associated with the additional rock placement on the relevant MPAs and their qualifying features are unlikely to have a temporal overlap with activities likely to combine effects from construction of the wind farm. This is specifically the case for indirect effects associated with prey species, foraging activity or underwater sound emissions.

In addition, recovery of seabed and benthic communities within the area of the works is predicted to be relatively rapid. The ES (SSE, 2011) indicates that natural seabed sediment compositions and benthic community recovery is likely to be restored over a period of 6 months to 1 year. It seems likely, therefore, that there will be limited overlap of effects associated with the construction of the Moray East and Moray West cables, with the effects of the proposed use of CFE and / or rock placement and rock berm creation between KP11-15.

Table 3-30: Revised cumulative impact assessment – physical environment

Sensitivity of receptor	Low (Seabed features not particularly vulnerable to change / damage, often subject to existing natural / long term disturbance; features that are distributed extensively within the study area)
Magnitude of effect	Medium (a moderate shift from the baseline conditions, e.g. a change that affects 0.5 km^2 to 5 km^2 of seabed)
Significance of (cumulative) impact	**Minor**

Table 3-31: Revised cumulative impact assessment – biological environment

Sensitivity of receptor	Seabed habitat / SSC impacts: Very Low (A good example of a common or widespread habitat in the local area, Species of national or local importance, but which are only present very infrequently or in very low numbers within the subject, any other species or habitats for which there are no designations) Subsea noise impacts (marine mammals): High
Magnitude of effect	Seabed habitat / SSC impacts: Medium (Affects over 0.1% of the seabed area) Subsea noise impacts: Low "Although these additional works will result in more subsea noise effects than previously assessed, the distance of these works from other activities in the Moray Firth region makes it unlikely that the magnitude of any cumulative impact will be any greater than 'low'."
Significance of (cumulative) impact	Seabed habitat / SSC impacts: **Minor** Subsea noise impacts: **Moderate** (Residual impact = **Minor**)

Table 3-32: Revised cumulative impact assessment – human environment

Sensitivity of receptor	Medium (Site of regional (Moray Firth) commercial significance as a source of revenue and employment (e.g. important fishing ground) or lies adjacent to (within 2 km) national area; Site of commercial significance for mainstay local industry (e.g. for specific fishing port in the Moray Firth) lies adjacent to (within 2 km of) the project footprint; Areas of sea lying close to important coastal facilities / amenity areas / tourist attractions where there is a link to the sea
Magnitude of effect	Medium (Change to fishing activity leading to a loss of income or opportunity beyond normal business variability / risk)
Significance of (cumulative) impact	**Moderate** (*residual impact reduced to **Minor** if appropriate mitigation measures adopted – see below)

*Appointment of a Fisheries Liaison Officer (FLO) for the planning and duration of all CFE / rock placement activities; adherence to the project-specific FLMAP; issue of NtM's in a timely manner via Kingfisher; marking of any rock berms on relevant charts.

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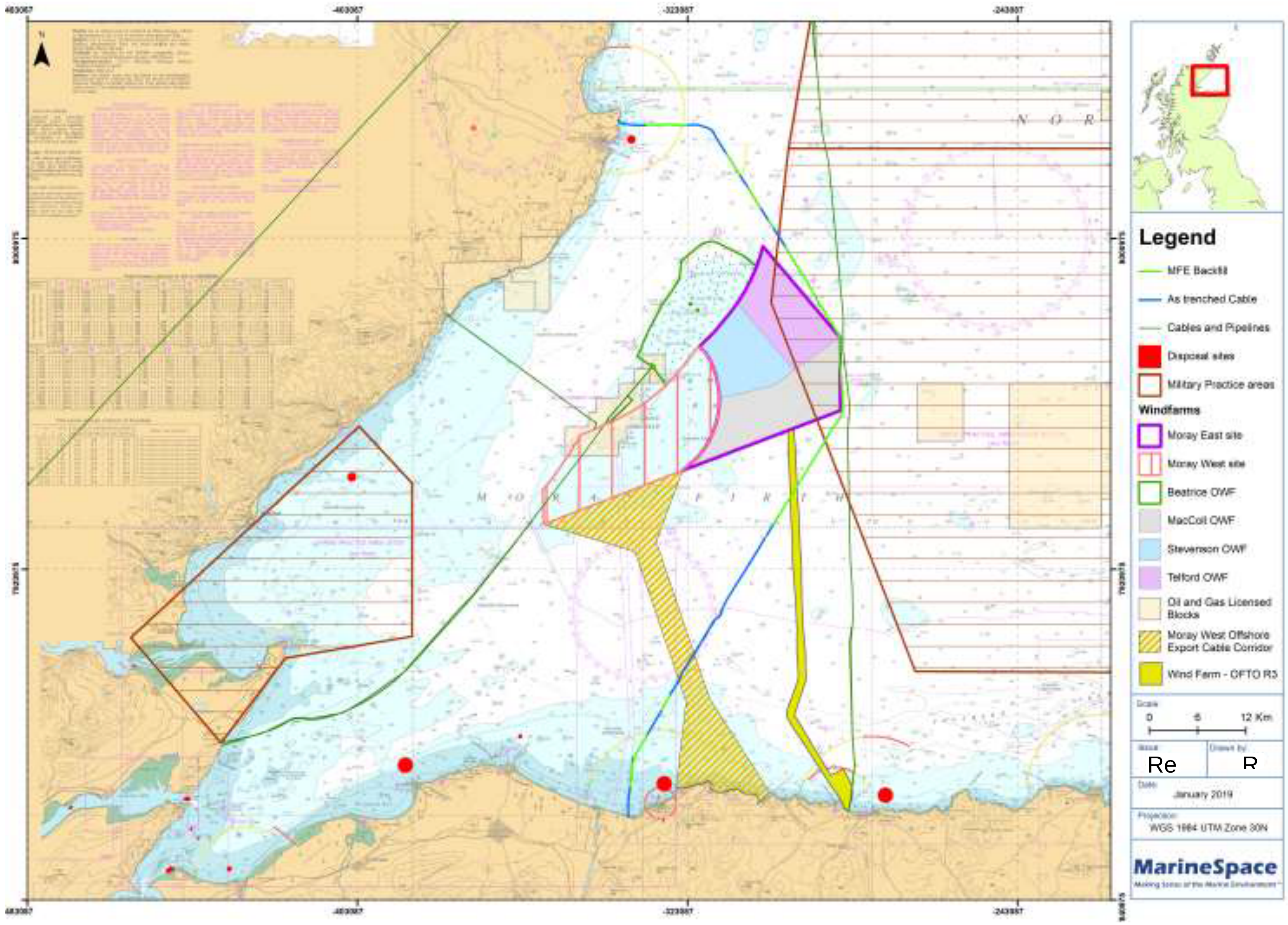
Figure 3.5.1: Current plans and projects within the vicinity of the Caithness-Moray HVDC Link



4. Conclusions

Table 4-1 Summary of potential impacts of CFE and / or rock placement and CPS; and potential construction of a rock berm between KP11-15

Impact	Sensitivity of Receptor	Magnitude of Effect	Impact Significance (Post-mitigation)
Physical Environment			
Changes to seabed sediments as a result of CFE or excavation associated with CPS	None	Very Low	**Negligible**
Changes to seabed sediments as a result of placement of rock and CPS; and potential construction of a rock berm	Low	Low	**Minor**
Biological Environment			
Benthic Ecology Temporary, Localised Increase in Suspended Sediment Levels / Deposition and Impact to Benthic Habitats via CFE Operation and Installation of CPS	Low	Low	**Minor**
Temporary Seabed Disturbance to Benthic Habitats via CFE Operation and Installation of CPS	Very Low	Very Low	**Negligible**
Temporary Disturbance of Benthic Habitat around the Trench due to CFE Creating Secondary Depressions (as Evidenced by CFE trials)	Very Low	Medium	**Minor**
Permanent Alteration of Benthic Habitat as a Result of Berm Construction between KP11-15	Low	Very Low	**Negligible**
Fish and Shellfish Ecology: Temporary, Localised Disturbance of Fish and Shellfish via Suspended Sediment Levels due to CFE Operations and Installation of CPS	Medium to Very High	Very Low	Migratory Fish = **Minor** Scallops = **Negligible**
Potential Impact on Fish and Shellfish via Rock Berm between KP11 and KP15	Migratory Fish (barrier) = Very High Shellfish (habitat) = Low	Migratory Fish (barrier) = Very Low Shellfish (habitat) = Very Low	Migratory Fish (barrier) = **Minor** Shellfish (habitat) = **Negligible beneficial**

Impact	Sensitivity of Receptor	Magnitude of Effect	Impact Significance (Post-mitigation)
Potential Impact on Horse Mussel Bed at Noss Head via Suspended Sediment Levels from CFE	High	Very Low	**Minor**
Impact from Increase of Subsea Noise Associated with CFE Operations and / or Rock Placement and CPS; and Construction of a Rock Berm on Migratory Fish	High to Very High	Very Low	**Minor (Negligible)**
Marine Mammals: Impact from Increase of Subsea Noise due to CFE and / or Rock Placement and CPS; and Construction of a Rock Berm on Marine Mammals	Very high	Low	**Moderate (Minor)**
Ornithology: Disturbance / Displacement of Bird Populations as a Result of Vessel Presence during CFE and / or Rock Placement and CPS; and Construction of a Rock Berm	Very High	Very Low	**Minor**
Nature Conservation	See Appendix A – MPA Assessment		
Human Environment			
Commercial Fisheries: Disturbance / displacement of fishing activity around areas of CFE and / or rock placement works and CPS; and potential construction of a rock berm	Medium	Medium	**Moderate (Minor)**
Disruption to Fishing Activity via Change in Seabed Sediments and Morphology as a Result of CFE and/or Rock Placement (Including CPS)	Medium	Medium	**Moderate (Minor)**
Disruption to Fishing Activity via Rock Berm between KP11-15	Medium	Medium	**Moderate (Minor)**
Shipping and Navigation: Temporary Disturbance and Displacement of Other Shipping around CFE and / or Rock Placement Works (including CPS) and Construction of a Rock Berm	Low	Low	**Minor**
Impacts on compass operation	Medium	None	**No Impact**

Impact	Sensitivity of Receptor	Magnitude of Effect	Impact Significance (Post-mitigation)
Risk to Navigation via presence of rock/CPS in nearshore region and rock berm between KP11-15	Low	None	**No Impact**
Marine Archaeology Potential effects on marine archaeology of CFE and / or rock placement and CPS; and potential construction of a rock berm	Low	Low	**Minor**
Water Framework Directive (WFD)	**No Impact** (see Section 3.4.2.7)		
Scottish National Marine Plan (SNMP)	**N/A** (see Section 3.4.2.8)		
Cumulative Impacts: Physical Environment Biological Environment Human Environment	 Low High Medium	 Medium Low Medium	 **Minor** **Moderate (Minor)†** **Moderate (Minor)†**

† if mitigation is adopted – 'soft-start' procedure for use of CFE for underwater noise and operation of USBL systems for acoustic surveys will consist of pre-work searches prior to the use of USBL systems and beacons marine mammals receptors; appointment of a Fisheries Liaison Officer (FLO) for the planning and duration of all CFE / rock placement activities; and adherence to the project-specific FLMAP; issue of NtM's in a timely manner via Kingfisher;

While much of the C-M cable is now buried, additional methods for burial of currently exposed cable lengths are required. Therefore, the following additional works have been assessed in this environmental appraisal report:

- Controlled Flow Excavation (CFE);
- Rock placement via Fall Pipe Vessel (FPV) and / or shallow water grab placement;
    - CPS (in areas where rock placement in shallow water cannot be undertaken); and
- Remedial rock placement, creating a berm between KP11-15, associated with cable repair.

To ensure consistency, the same methodology for assessing environmental impacts has been used in this report, as in the original EIA (SSE, 2011), as well as a previous environment appraisal prepared by MarineSpace (MarineSpace, 2017) in respect of additional rock protection and cable repair works along the cable route. The potential impact of the main cable installation was also fully assessed within the marine ES produced for the Shetland HVDC Connection Marine Environmental Appraisal (SHET, 2009).

The proposed works assessed here, namely CFE and / or rock placement and CPS, and potential construction of a rock berm, are similar in nature to the main installation works, and variations of, already assessed (and consented), albeit with different spatial extent, magnitude and duration.

In summary, the majority of impacts predicted via CFE and / or rock placement and CPS; and potential construction of a rock berm were judged to result in no more than minor impacts. The only exceptions to this were a moderate impact predicted to marine mammals from disturbance via underwater noise (reduced to minor if relevant mitigation measures were implemented); and moderate impacts on commercial fisheries due to disturbance / displacement of fishing activity due to vessel presence, and disruption to fishing activity via change in seabed sediments and morphology and also creation of a rock berm between KP11-15. Both of these impacts were also reduced to minor if relevant mitigation measures are implemented.

The detailed MPA assessment undertaken in Appendix A identified associated pressures and footprints and screened the potential exposure of these footprints with MPAs in the vicinity of the cable repair works and their designated features within the study area:

- Annex I and MPA designated benthic habitats;
- Annex II marine mammals and migratory fish species designated within SACs;
- Annex I bird species classified within SPAs; and
- Where appropriate, Ramsar sites.

Where likely significant effects / risks could not be screened out, detailed assessment and determinations of any adverse effects / risk (or where no adverse effect / risk cannot be determined) is presented. **Overall, no adverse effects on the integrity of any of the MPAs was determined**. This included via potential in-combination effects between the following projects:

- Beatrice Offshore Wind Farm;
- Moray East Offshore Wind Farm;
- Moray West Offshore Wind Farm;
- Previous C-M HVDC Link additional rock placement;
- Telford Offshore Wind Farm;
- MacColl Offshore Wind Farm;
- Stevenson Offshore Wind Farm; and
- Kincardine Offshore Wind Farm.

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Appendix A