The Great Grid Upgrade

Sea Link

Sea Link

Volume 9: Examination Submissions

Document 9.13: Pegwell Bay Construction Method Technical Note

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Version History

Date	Version	Status	Description / Changes
November 2025	A	Final	Final draft for submission
December 2025	B	Final	Updated Appendix B in response to ISH1 Actions

Executive Summary

Purpose of the Document

This document has been prepared in response to relevant representations received from several stakeholders' seeking clarity regarding the construction activities proposed at the Kent landfall.

This document supports information presented in **Application Document 6.2.1.4 Part 1 Introduction Chapter 4 Description of the Proposed Project [APP-045]** providing additional detail in relation to the proposed works at the Kent landfall and activities occurring within Pegwell Bay.

This document defines the maximum design parameters associated with the use of Horizonal Directional Drill (HDD) as the worst case trenchless crossing techniques. These maximum design parameters have been used to inform the maximum design scenarios (worst-case scenarios) that form the basis of the receptor specific impact assessments. Further information on alternative trenchless techniques is provided in Appendix A.

This is not an assessment document. This document provides information that has been used to inform updates to receptor specific impact assessment chapters where key stakeholders have requested further clarity on the nature and maximum extents of construction works and activities proposed within Pegwell Bay. Where commitments have been made to minimise potential effects of landfall construction activities within Pegwell Bay, these have been captured in **Application Document 7.5.3.2 (B) CEMP Appendix B Register of Environmental Actions and Commitments (REAC) [REP1-102]**. These include for example preparation of a Pegwell Bay Landfall Construction Method Statement and HDD frac out management plan. The REAC also includes a commitment to maintaining a minimum distance of 105 m between the seaward edge of the saltmarsh and the HDD exit pits and a minimum distance of 50 m between the seaward edge of the saltmarsh and the temporary working area.

This document also focuses specifically on landfall construction activities occurring between Mean High Water Spring (MHWS) and Mean Low Water Spring (MLWS) (Pegwell Bay intertidal zone). Reference to onshore works (specifically the onshore drilling compound and onshore transition joint bays (TJBs) which are located landward of MHWS) has been included for context purposes only. Detail on all proposed onshore works (landward of MHWS) is provided in **Application Document 6.2.1.4 Part 1 Introduction Chapter 4 Description of the Proposed Project [APP-045]**.

Structure of the Document

The structure of this document is as follows:

- **Section 1:** Introduction, Landfall Overview and Overview of Landfall Construction Process including key phases (phases 1A, 1B, 2, 3, 4 and 5) involved in landfall construction
- **Section 2**: Phases 1A and 1B Landfall Access, Trenchless Crossing (HDD) Cofferdam Construction and Construction Working Area
- **Section 3:** Phase 2 Trenchless Crossing (HDD) Drilling and Duct Installation

- **Section 4:** Phases 3, 4 and 5 Marine Cable Pull-In, Marine Cable Burial and Removal of Construction Access
- **Section 5:** Construction Access
- **Section 6:** Construction Programme
- **Section 7:** Operation and Maintenance (Cable Repairs)
- **Appendix A:** Alternative Trenchless Crossing Techniques
- **Appendix B:** Schedule of Landfall Construction Plant and Equipment

1. Introduction

1.1 Introduction

1.1.1 This document has been prepared in response to relevant representations received from several stakeholders seeking clarity regarding the construction activities proposed at the Kent landfall.

1.1.2 This document supports information presented in **Application Document 6.2.1.4 Part 1 Introduction Chapter 4 Description of the Proposed Project [APP-045]** providing additional detail in relation to the proposed works at the Kent landfall and activities occurring within Pegwell Bay.

1.1.3 This document focuses specifically on landfall construction activities occurring between Mean High Water Spring (MHWS) and Mean Low Water Spring (MLWS) (Pegwell Bay intertidal zone). Reference to onshore works (specifically the onshore drilling compound and onshore transition joint bays (TJBs) which are located landward of MHWS) has been included for context purposes only. For detail on all proposed onshore works (landward of MHWS) please refer to **Application Document 6.2.1.4 Part 1 Introduction Chapter 4 Description of the Proposed Project [APP-045].**

1.1.4 A detailed Landfall Method Statement setting out the final landfall design and installation methods within the intertidal zone will be prepared pre-construction. This commitment is included in **Application Document 7.5.3.2 (B) CEMP Appendix B Register of Environmental Actions and Commitments (REAC) [REP1-102].**

Defining the worst-case scenario

1.1.5 This document describes the methods that are most likely to be used to construct and install the trenchless crossing at the Kent Landfall. The methods described are based on using Horizontal Directional Drill (HDD) technique which is the assessed worst-case trenchless technique. Other trenchless techniques are available. These include direct pipe or microtunnelling.

1.1.6 For the purpose of the Sea Link Project (hereafter referred to as the 'Proposed Project'), HDD has been assessed as the worst-case trenchless technique. This is on the basis that despite having a similar footprint to direct pipe and microtunnelling/microboring, HDD takes longer to install due to the requirement for several passes (initial drilling of the pilot bore, followed by reaming to enlarge the bore then duct installation) whereas with direct pipe, the duct (pipe) is pushed through the ground on one single pass (no prior bore drilling required). Microtunnelling/microboring is like direct pipe in terms of duration of installation. However, it is generally better suited to shorter distances.

1.1.7 Although both HDD and direct pipe are suitable for long distances, HDD offers increased flexibility to adapt to ground conditions during drilling. HDD can also be re-drilled on a parallel or deeper alignment whereas direct pipe would require the entire pipe to be withdrawn, cut into segments and new pusher position and entry port identified. Further detail on both direct pipe and microtunnelling/microboring techniques is provided in Appendix A.

1.2 Landfall Overview

1.2.1 The landfall forms the interface between the Offshore Scheme and the Kent Onshore Scheme. Marine cables are connected to the onshore cables in a Transition Joint Bay (TJB), a below ground (buried) concrete (or other material) chamber. TJBs are located onshore above Mean High Water Spring (MHWS).

1.2.2 Development of a landfall requires construction works in both the marine environment (below MHWS) and onshore (above MHWS).

1.2.3 The proposed Kent landfall is located within Pegwell Bay to the south of the settlement of Cliffsend. The onshore TJB would be located to the west of St Augustine's and Stonelees Golf Club.

1.2.4 The marine cables will access the onshore TJB via a trenchless crossing. This trenchless crossing will extend from the mudflats in Pegwell Bay to the onshore TJB, passing beneath the Pegwell Bay saltmarsh and shallow lagoon, Sandwich Road and St Augustine's Golf Course at a depth of between 15 and 20 m. This will ensure all potential interactions with the Pegwell Bay saltmarsh and shallow lagoon are avoided, minimising the potential for any adverse impacts on these sensitive features.

1.2.5 The indicative location of the onshore compound (where the onshore TJBs will be located), route of the trenchless crossing and the position of the trenchless crossing exit pits in Pegwell Bay are illustrated in **Application Document 2.13.2 Design and Layout Plans – Kent Indicative Horizontal Directional Drill Solution Pegwell Bay [APP-037]**. A copy of this figure is provided in Figure 1.1 below for ease of reference.

1.2.6 A feasibility study was completed in 2023 which confirms the suitability of using a trenchless crossing solution at Pegwell Bay. Findings from this feasibility study can be found in **Appendix A Landfall HDD Feasibility Technical Note,** part of **Application Document 7.3 Design Development Report [APP-321]**. Based on the findings from this feasibility study, no alternative non-trenchless techniques, such as open cut trenching, have been considered in the assessment documents or the Development Consent Order **Application Document 3.1 (E) draft Development Consent Order (DCO) [REP1-036]** and therefore would not be permitted as part of this application.

Overview of the Landfall Construction Process

1.2.7 For the Proposed Project, the trenchless crossing (HDD) will involve drilling a bore between the onshore temporary drilling compound (see **Application Document 6.2.1.4 Part 1 Introduction Chapter 4 Description of the Proposed Project [APP-045])** and the marine environment (HDD exit pits). The bore will be drilled from onshore to offshore (intertidal), with the drilling rig located in the onshore temporary drilling compound. Once the bore(s) are drilled, ducts will be inserted into the bore(s). The ducts can be installed in either direction (marine to onshore or vice versa). The duct ends at the intertidal HDD exit pits may then be temporarily buried while awaiting installation of the marine cable. The HDD duct ends will then be re-excavated one week prior to marine cable pull-in. The marine cable will be pulled through the trenchless crossing ducts from offshore to onshore. Once the marine cable has been pulled through the ducts and connected to the onshore cables in the onshore TJBs, the section of marine cable in the intertidal zone (between MLWS and the HDD exit pits) will be buried.

1.2.8 Due to the extent of the intertidal zone at Pegwell Bay, the trenchless crossing exit pits will be located within the intertidal zone approximately 105 m to 140 m seaward from the edge of the saltmarsh. The commitment to maintaining this distance from the saltmarsh is included in **Application Document 7.5.3.2 (B) CEMP Appendix B Register of Environmental Actions and Commitments (REAC) [REP1-102].**

1.2.9 In total, up to four separate trenchless crossings (HDD ducts) will be installed at the Kent landfall. This is one more duct than is required for the terrestrial HVDC underground cables. Should a section of cable need to be replaced at the landfall, this additional duct would allow for a new section of cable to be pulled through rather than a repair to the existing or needing to re-install ducts. For the purpose of the assessment it is assumed that the four HDD ducts will be installed sequentially, not in parallel, resulting in a maximum of four individual HDD operations.

1.2.10 Construction of the landfall will involve a number of phases. Most of the phases will occur sequentially, however, there are certain activities that may occur in parallel or temporally overlap. The key phases are listed below.

- **Phase 1A:** Establish temporary access route between the former hoverport and the HDD exit pits (located in the intertidal zone)
- **Phase 1B:** HDD exit pit cofferdam construction and working area
- **Phase 2:** HDD drilling and duct installation
- **Phase 3:** Marine cable pull-in
- **Phase 4:** Marine cable burial
- **Phase 5:** Removal of access

1.2.11 Further detail on each of these phases, including a description of the equipment that will be required for each phase is provided in the following sections.

Noise and Light Emissions

1.2.12 A summary of types of construction plant and equipment that are likely to be required for each phase and associated noise levels and lighting requirements is provided in Appendix B.

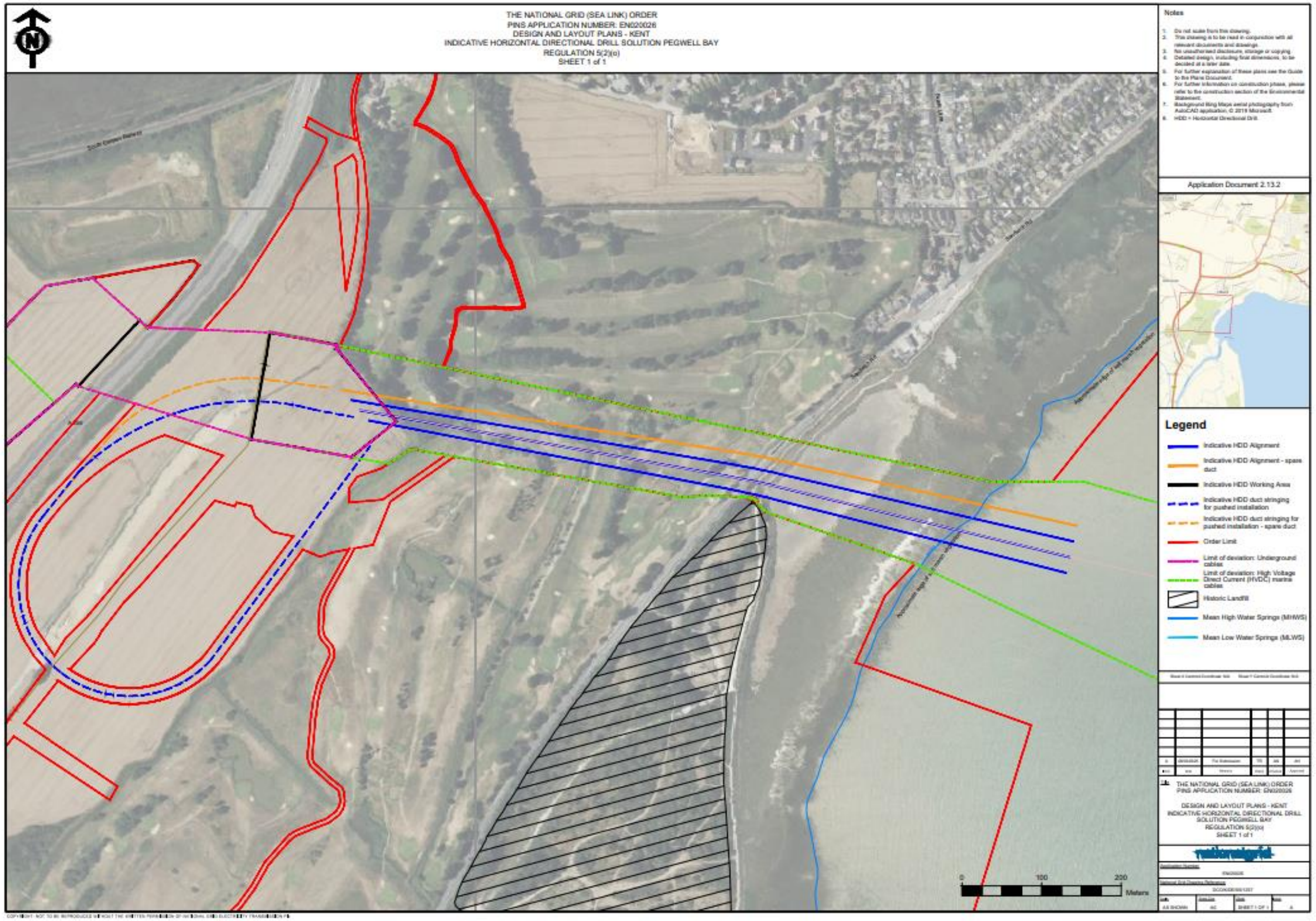

Figure 1.1 Application Document 2.13.2 Design and Layout Plans – Kent Indicative Horizontal Direction Drill Solution Pegwell Bay [APP-037].

2. Phases 1A and 1B Landfall Access, HDD Cofferdam Construction and Construction Working Area

2.1 Introduction

2.1.1 The following section provides information on the following landfall construction phases:

- Phase 1A: Establish temporary construction access route between the former hoverport and HDD exit pits; and
- Phase 1B: HDD exit pit cofferdam construction and working area.

2.1.2 Further detail on construction access, vehicle types and numbers and vehicle movements is provided in Section 5.

2.2 Phase 1A Establish Temporary Construction Access Route

2.2.1 During all stages of landfall construction and cable installation, there will be a requirement for construction plant, vehicles and personnel to gain access to the intertidal area within Pegwell Bay.

2.2.2 Two access routes onto the Pegwell Bay intertidal mudflats have been identified as being required to complete all construction activities:

- Hoverport access; and
- Transportation by sea.

2.2.3 As the HDD exit pits are located in the upper intertidal area, access during construction (and if required during operation for maintenance purposes) would be from the former hoverport, located at the northern end of Pegwell Bay, to the work area.

2.2.4 Access to the HDD exit pits working area will be via a designated access route across the intertidal mudflats from the former hoverport, located at the northern end of Pegwell Bay. In order to avoid the lagoon and saltmarsh, there will be no access (vehicular or pedestrian) to the intertidal mudflats from Sandwich Road or from anywhere else within the Pegwell Bay Country Park.

2.2.5 As set out in **Application Document 7.5.3.2 CEMP Appendix B Register of Environmental Actions and Commitments [APP-342]** the final location and width of access routes across the mudflats will be determined pre-construction and will be informed by a pre-construction intertidal habitat survey which will be completed to ensure the route avoids any areas of seaward encroaching saltmarsh.

2.2.6 Vehicles accessing the HDD exit pits via the former hoverport will include small excavators (15-20t), tractors, towed trailers, hovercraft and 4WD vehicles. Further details on Pegwell Bay Construction Access are provided in Section 5.

2.2.7 There may be a requirement to install temporary road plates (steel sheet piles and steel support waling and struts) or bog mats at locations where the former hoverport access corridor crosses the Nemo and Thanet cables. This would be to provide protection for these cables during construction and to minimise the potential for any disturbance to the ground around the cables. Final details of the construction access route and requirements for ground protection mats will be set out in the Landfall Construction Method Statement (**Application Document 7.5.3.2 CEMP (B) Appendix B Register of Environmental Actions and Commitments (REAC)) [REP1-102]**).

2.3 Phase 1B HDD Cofferdam Construction

2.3.1 Due to the position of the trenchless crossing (HDD) exit pits in the intertidal zone, there is likely to be a requirement to install a temporary cofferdam (or up to four smaller cofferdams – one per duct) to prevent premature backfilling of the exit pits for the trenchless crossing during receipt of the drill end and during reaming, duct installation and duct end works (see below for further detail). The cofferdam/s will also be used to capture any drilling fluids and artesian water that might be present in the chalk aquifer, which the trenchless crossing is required to pass through.

2.3.2 The cofferdams could be constructed using pre-fabricated filled tanks (normally filled with sea water, as used on the Walney Extension Offshore Wind Farm located off the coast of Cumbria which was consented in November 2014 and commenced operation in 2018 (Orsted, 2025)), a barge with moon pool grounded after positioning at high tide (as used on the DolWin grid connection cluster projects in Germany (TenneT Germany , 2023)) or piled sheeting. Where sheet piles are used, these would require 9 m piles installed to approximately 6 m depth below ground (seabed) level Where possible, silent piling techniques would be used. However, ground conditions indicate 6 m of sediments overlying chalk at exit, so vibropiles may be required if pilling is deemed necessary (no percussive piling will take place in construction of a cofferdam/s).

2.3.3 Only one cofferdam will be installed at any one time. The assessed worst-case scenario assumes the construction of smaller cofferdams (maximum length 30 m, width 5 m, with piling depth approximately 6 m below ground level and excavation depth within the cofferdams to a depth below seabed of 2 m) on four separate occasions during HDD drilling and duct installation. Based on previous works, it is anticipated it will take up to seven days to install a cofferdam around a single HDD exit pit. On that basis, the total duration of cofferdam installation (including potential vibropiling) would be 28 days. The HDD contractor is likely to construct the cofferdams with breaks of seven to 21 days between each cofferdam construction. There may be more than one cofferdam present at any one time, with each cofferdam potentially in place for 30 to 60 days during the 120-day period for HDD drilling and duct installation.

2.3.4 Within the cofferdams there may be a requirement to install temporary platforms that would be elevated above sea level to hold equipment such as mud pumps (fluid recycling), generators, and drill pipe break-out units to assist during the HDD works. These temporary platforms would be secured by legs or fixed to the cofferdams.

2.3.5 A summary of types of construction plant and equipment that are likely to be required for each phase and associated noise levels and lighting requirements is provided in Appendix B.

2.4 Temporary HDD Working Area

2.4.1 The cofferdams and HDD exit pits will be located within a designated working area of 120 m by 180 m (21,600 m^2). All construction plant and vehicles associated with the trenchless crossing works will be required to remain within this working area at all times. The exception to this would be if the HDD contractor's selected methodology for duct installation is to usesa pulled method (where the ducts are brought in by sea and installed in a marine to onshore direction (from the HDD exit pits to the temporary onshore drilling compound) as opposed to a pushed method (ducts are installed in segments that a push through the HDD bore in an onshore to offshore direction).

2.4.2 If the HDD contractor's selected methodology is to use the pulled duct installation option, access will be required along the intertidal area for placement of duct rollers on the intertidal seabed to guide the duct to the HDD exit during pull-in. The duration of these works is likely to be two to three days for each duct installation and will potentially extend 1 km seaward of the HDD exit along the line of the cable route over a 10 m width. All activities associated with the pulled duct installation would occur within the Limits of Deviation (LOD) shown in **Application Document 2.5.2 A Work Plans – Kent Sheet 5 of 6 Pegwell Bay [REP1-002].**

2.4.3 A summary of the key maximum design parameters relating to the HDD exit pits is provided in Table 2.1.

Table 2.1 Maximum Design Parameters (Worst Case) for Phases 1A and 1B: Construction Access, Cofferdam Construction and Temporary HDD Working Area (details on vehicle types and numbers are provided in Table 1.5)

Characteristic	Maximum Design Parameter
Total number of HDD exit pits	4
Distance of HDD exit pits from saltmarsh	105 m to 140 m
Total area of seabed (intertidal mudflats) directly impacted by excavation of HDD exit pits	200 m^2
Depth of lowering (excavated HDD exit pits)	0 m – 2 m depth below seabed
Temporary construction access	Laying of any required ground protection mats between hoverport and HDD working area
Maximum temporary working area around HDD exit pits	120 m by 180 m (21,600 m^2)
Minimum separation distance between temporary working area and edge of the saltmarsh	50 m
Maximum number of cofferdams	4
Size of cofferdams	Option of sheetpiled construction: Indicative 30 m length x 5 m width x 3m height above seabed x 2 m depth below seabed.

Characteristic	Maximum Design Parameter
	Option of pre-fabricated tanks construction: Indicative 25 m x 15 m width x 3 m height above seabed x 2 m depth below seabed Option of moonpool barge construction: 35 m length x 7.5 m width x 3 m height above seabed x 2 m depth below seabed
Cofferdam construction materials	Pre-fabricated filled tanks, moonpool barges, sheeted piles
Cofferdam construction methods (pre-fabricated filled tanks or moonpool barges)	Pre-fabricated filled tanks will be transported to HDD exit pit location by sea on a barge. The barge will be floated to the HDD exit pits at high tide to install the pre-fabricated filled tanks. Once installed, the barge will refloat and reposition offshore until required to reposition and remove the filled tanks Moonpool barges will be towed to site and moved or removed at high tide using a suitable tug or workboat.
Number of cofferdam repositions (filled tanks and moonpools only)	4
Cofferdam construction methods (sheet piles)	Vibropiling
Length of piles	9 m
Depth of pile installation (m below seabed)	6 m (indicative; subject to ground conditions and temporary works design)
Number of cofferdam repositions	4
Maximum duration of cofferdam construction (sheet piles)	7 days per cofferdam
Total number of days piling (vibropiles)	28 (7 days x 4 HDD exit pits) 7 to 21 days between each cofferdam repositioning
Ancillary equipment to be stored on raised platforms within cofferdams	Mud pumps (fluid recycling), generators (60 – 150 kVA), and drill pipe break-out units
Method of securing raised platforms	Legs, moorings or placed on wooden beams supported by piled sheeting

3. Phase 2 HDD Drilling and Duct Installation

3.1 Introduction

3.1.1 The following section provides information on Phase 2 trenchless crossing (HDD) drilling and duct installation.

3.2 Trenchless Crossing (HDD) Drilling

3.2.1 Delivery of the trenchless crossing (HDD) drill rig to the onshore temporary drilling compound is expected to take two days and will involve up to 20 Heavy Goods Vehicle (HGV) loads. A 150 t - 200 t crane may also be required for positioning equipment during those two days.

3.2.2 Once the HDD drill rig has been set up within the temporary onshore drilling compound, the trenchless crossing (HDD) works will be as follows:

- **Installation of drill rig anchor (onshore end)**: Either poured concrete block or sheet piled.
- **Installation of Temporary Casing (onshore end)**: 20 m to 40 m length, installed by drilling or hammering.
- **Pilot Drilling**: Typically 15 m – 20 m below surface. Possibly jetted, but potentially via downhole motor drilling. Cuttings would be disposed of appropriately off site. When the pilot exits in the intertidal area, drilling fluid would be captured if practicable.
- **Reaming**: To enlarge the HDD bore, a reamer is pushed or pulled through the pilot bore. Two options exist, forward reaming where drilling fluid flows back to the entry and pull reaming where fluid flows to the exit. The use of forward reaming requires suitable geology and would be determined following ground investigations. The use of pull reaming will require capture of fluid at the exit for recycling (see section 3.4 below). A combination of the push and pull methods may be used to minimise fluid losses to the sea.

3.3 Trenchless Crossing (HDD) Duct Installation

3.3.1 Two standard duct installation methods are used for landfalls; pushed and pulled. The pushed HDD ducts will be fabricated in sections and pushed in from the onshore construction compound until it emerges within the HDD exit pit. A pulled installation uses a duct that has been fabricated elsewhere and stored at a suitable dry or wet storage location and is then floated and towed to the intertidal area as one length. The duct is transferred across any dry land in the intertidal area by supporting it on rollers at approximately 12 m intervals from offshore to the HDD exit pit. The duct is then attached to the drilling rods and pulled in along rollers from the seaward end of the HDD bore (at the HDD exit pit) towards the temporary onshore drilling compound (HDD entry pit). The pulled installation will require a tug to tow the duct from the storage location and several support vessels (e.g. workboats, Rigid Hulled Inflatable Boats (RIBs)) to control the duct length and act as guard vessels.

3.3.2 Following duct installation, a cleaning and proving tool is passed through the duct, towing a messenger wire behind it. The messenger wire will be attached to sealing flanges that are attached to the duct ends. Due to the long duration between duct installation and cable installation, the duct ends would then be stabilized and secured until cable installation. Up to five temporary rock bags/concrete mattresses would be used to stabilise the ducts and would remain in position at the HDD exit pits until approximately one week before cable pull-in. Once rock bags/concrete mattresses are installed, excavators will bury the duct and rock bags/concrete mattresses below the level of seabed at the exit.

3.3.3 HDD installation (drilling and ducting) will be a 24-hour per day operation, where viable, to minimise overall installation time, maximise the use of suitable weather windows and take advantage of vessel and construction plant and equipment availability. The total duration of the HDD drilling and duct installation works is expected to be 120 days in total. Works in the intertidal will likely begin two weeks after the commencement of HDD drilling, with cofferdams and some form of working from them likely to be in place until two weeks after the final duct is installed.

3.4 Management of Drilling Fluids

3.4.1 As discussed in **Application Document 6.2.1.4 Part 1 Introduction Chapter 4 Description of the Proposed Project [APP-045]** drilling fluids comprising bentonite and water will be used to suspend rock cuttings and carry them out of the borehole, cool the drilling equipment, clear debris from the drilling bit, seal the borehole and reduce friction on the drilling equipment. For much of the HDD process the drilling fluids will flow back to the onshore HDD entry pit, where they will be recycled. The recycling system on the site removes the cuttings from the drilling fluid for disposal off-site. The cleaned drilling fluid is then re-used for the drill in a continuous cycle. When the HDD exits to the intertidal cofferdam, the fluid will be captured in the cofferdam, preventing any losses to the sea, then returned to the entry site for recycling. Transport of the drilling fluid between the intertidal exit and the onshore entry site may be by tractor and bowser, but is more likely to be via pumping through a drill string or ducts installed on the adjacent HDDs. Contingency measures that will be put in place in the unlikely event of a surface frac out or break out of drilling fluids are described in **Application Document 6.2.1.4 Part 1 Introduction Chapter 4 Description of the Proposed Project [APP-045]** and **Application Document 7.3 Design Development Report [APP-321] Appendix A Landfall HDD Feasibility Technical Note Section 3.5.2.**

3.4.2 As set out under measure GH10 within **Application Document 7.5.3.2 (B) CEMP Appendix B Register of Environmental Actions and Commitments (REAC) [REP1-102].** the HDD contractor will produce a detailed, frac out management plan, but the essence of their plan will be as follows. During pilot hole drilling the contractor will monitor the drilling fluid pressure several metres behind the drilling bit using sensors in the downhole steering and surveying tool. This monitoring will give immediate warning of any significant change of pressure that might indicate fluid loss or surface frac out of drilling fluid. Additionally, during the pilot drilling the HDD contractor will have a “spotter” walking the drill alignment as the HDD drills from the saltmarsh to the exit monitoring for any frac out. The spotter will quickly identify any frac out, drilling will stop, and the frac out will be contained and removed. Containment is typically achieved by placing sandbags around the fluid. Removal is typically by a small hand carried pump connected to layflat hoses that are extended to either the entry pit, exit pit, or a bowser at a suitable location nearby.

3.4.3 During reaming of the bore, the fluids are contained within the cofferdam. The cofferdam will be at least 75 m from the saltmarsh (based on HDD exit pits located at 105 m from the saltmarsh and maximum length of the cofferdam of 30 m). There will be pumps and storage at the cofferdam to recover any fluid should any escape from the cofferdam. There will be personnel at the location who will be able to quickly identify any losses and take the necessary remediation action. If drilling fluid does escape from the cofferdam, the fluid is more dense than water and remains in situ on the seabed unless there are strong currents or wave action. This is also true for flocculated drilling fluid. The incoming tide at the location, even with a very strong easterly wind, is very unlikely to move drilling fluid more than 20 m from the loss location. Therefore, in the unlikely event that fluid is lost from the cofferdam and not removed, there is a very low risk of any fluid being washed 75 m inshore to the edge of the saltmarsh.

3.4.4 Potential effects of a frac-out on the saltmarsh habitat have been assessed in Application Document 6.2.3.2 (D) Part 3 Kent Chapter 2 Ecology and Biodiversity and Application Document 6.6 (B) Habitats Regulations Assessment Report. It was concluded in both assessments that any impacts on saltmarsh habitat would not be significant. The potential for any adverse effects will be further reduced through the preparation of a frac out management plan as set out in **Application Document 7.5.3.2 (B) CEMP Appendix B Register of Environmental Actions and Commitments (REAC) [REP1-102].**

3.4.5 Before removal of the cofferdam, the drilling fluid will be removed from within the cofferdam as far as practicable. Following removal of the cofferdam the duct end will be buried and a watch will be kept over the following week for any accumulations of drilling fluid, that will be removed using the same methods as used during pilot drilling.

3.4.6 It should be noted that bentonite is included on the OSPAR list of substances that Pose Little or No Risk to the Environment (PLONOR).

3.4.7 A summary of the key maximum design parameters relating to the trenchless crossing (HDD) drilling and duct installation is provided in Table 3.1.

Table 3.1 Phase 2: Trenchless crossing (HDD) drilling and duct installation

Characteristic	Maximum Design Parameter
Total number of HDD exit pits	4
Total length of HDD borehole (onshore entry point to exit pits)	1 km (each HDD bore is approx. 0.94 km length)
Diameter of HDD boreholes	400 to 660 mm
Distance of HDD exit pits from saltmarsh	105 m to 140 m
Maximum working area around HDD exit pits	120 m by 180 m (21,600 m^2)
Rollers for duct pull-in (for pulled duct installation)	Depends on length of intertidal area/mud flat requiring crossing at low tide Target to float ducts up to the HDD exit pits at high tide to minimise requirements for use of rollers. 10

Characteristic	Maximum Design Parameter
	m width x 1 km length seaward form the HDD exit is considered the maximum likely for positioning rollers.
Jack-up vessel/barge (JUB) If required will be brought in by sea for positioning at HDD exit pits at high tide	Area of seabed disturbance from JUB, as a result of spud cans: Each jack-up location: 50 m^2 4 locations (per HDD duct) = 200 m^2
1 tonne bags of stone/sand as temporary ballasting or stabilisation of equipment in intertidal area prior to cable installation	20
Rock bags/concrete mattresses for stabilising the HDD duct at exit – these will be removed approximately one week prior to cable pull-in	20 (five per exit)
Drilling fluid loss at the HDD exit pit surface	Drilling fluid discharge per borehole = 10 m^3 Solids discharged per borehole = 0.5 m^3
Maximum total duration of trenchless crossing (HDD) drilling and duct installation activities in intertidal area	120 days

4. Phases 3, 4 and 5 Marine Cable Pull-In, Cable Burial (Cable Installation) and Removal of Temporary Access

4.1 Introduction

4.1.1 Cable installation (phases 3 and 4) will occur after construction of the trenchless crossing (HDD). The time gap between completion of the HDD and cable installation will be dependent on a number of factors including cable manufacture timescales and cable lay vessel/barge availability but could be up to two years as set out in the indicative programme presented in Section 6. The rock bags/concrete mattresses placed over the HDD ducts will provide sufficient protection of the ducts until cable installation can commence.

4.1.2 The following section provides information on the following:

- **Phase 3:** Marine cable pull-in and connection to onshore cables; and
- **Phase 4**: Marine cable burial.

4.2 Phase 3 Marine Cable Pull-in

4.2.1 Cable pull-in operations will involve re-opening the offshore exit of the trenchless crossing (HDD exit pits). This will require the removal of the rock bags/concrete mattresses that were placed on the HDD exit pits following duct installation. Within the HDD exit pit, the end of the installed duct may need to be exposed using a mass flow excavator, however it is more likely that land-based excavators will be used. The HDD ends will either be raised so they are proud of the seabed, or a cofferdam will be installed around the duct ends and they will be left at their original level. A bellmouth (a device which is used to help guide the cable through the cable duct and avoid damage to both the cable and the duct) would be installed on the ends of the HDD pipe to guide the cable into the duct.

4.2.2 There may also be a requirement to install the cofferdams that were used during HDD drilling and duct installation (or similar) to prevent potential backfilling of the HDD ducts at high tide and to stop the ingress of seabed materials into the HDD pipes.

4.2.3 Alternatively, it might be possible to raise the seaward end of the HDD duct (at the HDD exit) to sit proud of the seabed This would be achieved through the installation of sheet piling possibly in a Y shape to allow the cables to feed into their respective HDD duct.

4.2.4 The marine cable will be brought to shore on a cable lay barge (CLB). The CLB will be able to beach within the Pegwell Bay intertidal area. This will enable the cable to be brought as close to the seaward end of the trenchless crossing (HDD exit pit) as possible, thereby reducing the distance over which the cable will need to be ‘pulled’ on cable rollers across the mudflats. The exact location for beaching the CLB is not known and will be subject to detailed engineering pre-construction.

4.2.5 The CLB will require the use of shallow water CLB anchors (minimum four-point mooring system) to hold position as it manoeuvres into the pre-determined location. The anchors will not penetrate more than 0.6 – 1 m in the seabed and will be positioned either by an anchor handling vessel (at high tide) or may be pre-positioned on the beach at low tide using excavators. The anchors will be placed within a 250 m – 400 m radius of the CLB. Exact locations of the CLB anchors will be determined during the engineering phase of the project, and will be designed to avoid existing infrastructure for example the NEMO and Thanet cables. When the CLB is confirmed to be in the correct location it will be secured and will be beached during cycles of the tides.

4.2.6 Cable rollers will be installed to pull-in the final section of cable between the beached CLB and the seaward end of the trenchless crossing (HDD exit pits) Plate 4.1 . The cable rollers will be stored in a compound and brought to site via tractors and trailers and positioned either by telehandler or excavator. The correct positions will be marked by surveyor with Real Time Kinematic (RTK) system or similar.

4.2.7 While it is anticipated the rollers will be on gravity bases, it may be that piled bases are required in any tidal channels as they have a tendency to be undermined by scour and lose stability. The preference would be for 'silent piling' techniques as far as practicable, unless not possible due to the prevailing conditions. However, the assessed worst case is based on the installation of piled bases using a vibropiling method of installation.

Plate 4.1 Example CLB in position using a mooring system with cable rollers in the foreground (Walney Extension Offshore Wind Farm)

4.2.8 Once the cable rollers are installed, the cable will be lowered from the beached CLB (Plate 4.2) and positioned onto the cable rollers and attached to a winch wire which is connected to the onshore end of the trenchless crossing. Once the cable is in position, the winch operator (located in the onshore drilling compound) will take up tension on the pull in wire and the CLB will start to pay out the cable This continues in a controlled manner until the marine cable reaches the HDD exit pits (seaward end of the trenchless crossing) where the winch and the cable pay out come to a controlled stop.

4.2.9 Where the cable has to travel over a long distance between the beached CLB and the seaward end of the HDD, there may be a requirement to use excavators (maximum of two on each side of the cable) to support the cable and assist with 'pulling' the cable along the rollers (see Plate 4.3).

4.2.10 Once the marine cable arrives at the HDD exit pits, excavators will be used to position the cable in the centre of the HDD bellmouth. Once in position the winch can slowly pick back up the tension on the winch wire and the CLB can continue to pay out the cable allowing it to be pulled into the trenchless crossing (HDD) duct.

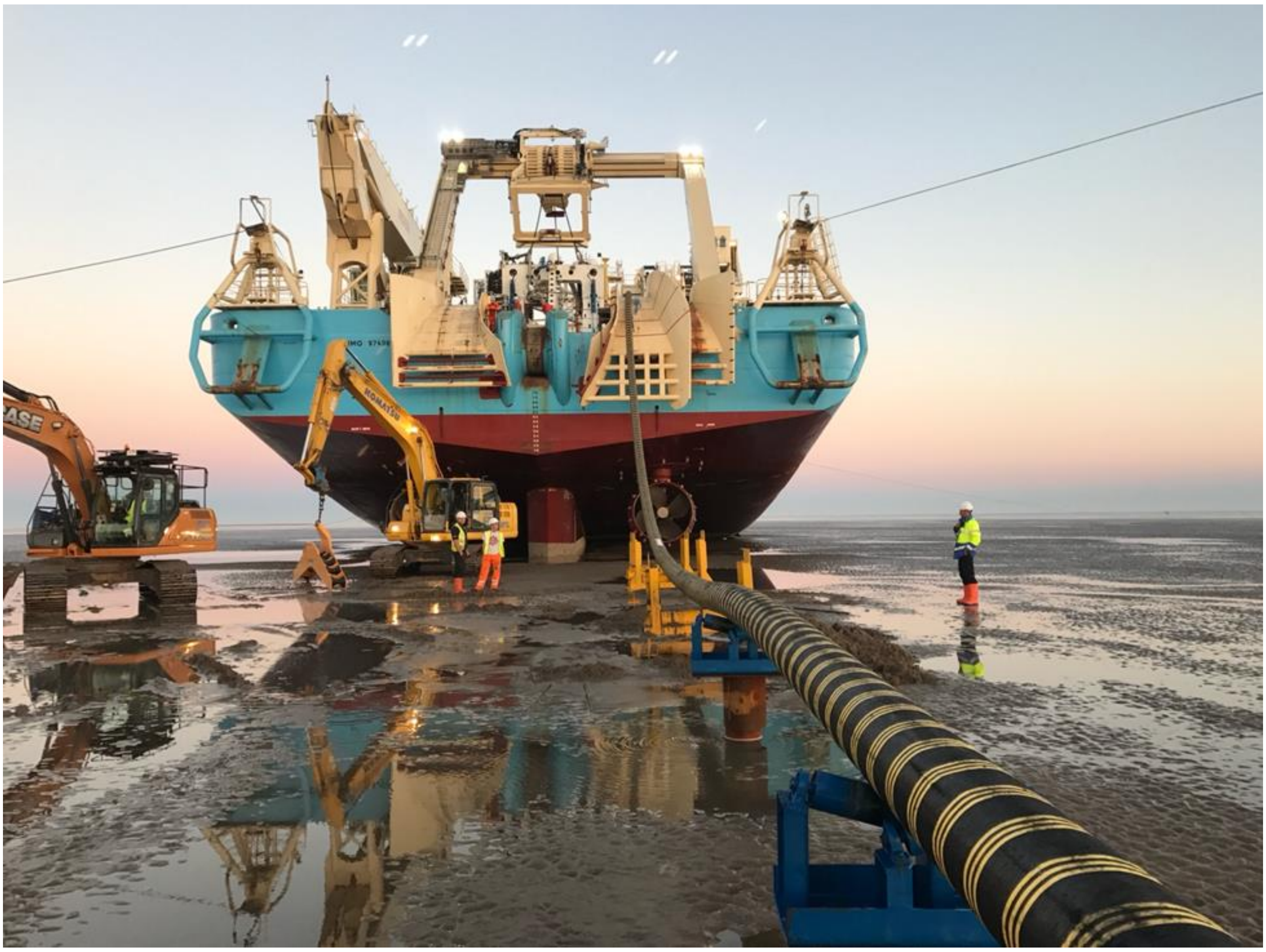

Plate 4.2 Example of cable being pulled ashore from a beached CLB (Walney Extension Offshore Wind Farm)

Plate 4.3 Example of cable being pulled ashore by winch supported by excavators

4.2.11 Once the cable end and associated rigging is confirmed to be safely in the HDD exit duct, the excavators will remove any associated rigging, and pull-in can continue through the trenchless crossing (HDD). When the cable exits the onshore end of the HDD, it will continue to be pulled up to the pre-determined over-pull location (to allow for cable jointing operations in the TJB). The cable pull-in will be brought to a controlled stop. The cable will then be stoppered off at the TJB and pull-in operations will be completed.

4.2.12 The bellmouth would then be removed and the duct sealed. A sealing plate will be installed over both ends of the HDD (see Plate 4.4 for an example).

Plate 4.4 Example of an HDD sealing plate at onshore end (Walney Extension Offshore Wind Farm)

4.2.13 The cable may be fixed in the duct using an appropriate material, such as grout, bentonite or similar which would be pumped into the duct from the landward end, with a small amount of material lost from the bleed valve at the seaward end, although this loss would be minimised as far as practicable.

4.2.14 It is not currently known whether the cables will be pulled ashore as a bundle (two HVDC cables and one fibre optic cable) and separated at the HDDs or pulled ashore individually. One power cable will be pulled into one HDD and the other power cable bundled with the fibre-optic cable will be pulled into the second HDD. It is not currently known which HDDs will be selected for use, and which will be kept as spare. Where cables are pulled in separately, cable pull-in operations could be up to 30 days apart per cable.

4.2.15 Post-installation protection such as rock bags/concrete mattresses would then be added to stabilize the HDD exits, replacing the existing temporary protection. This protection would be buried. The top of the duct would be approximately 1.1 m below the seabed and the top of the rock bags/mattresses laid on top approximately 0.5 m below the seabed.

4.2.16 Once cable pull-in is complete, the section of cable on rollers will be lifted and placed to the side of the rollers to await burial.

4.2.17 A summary of the key maximum design parameters relating to the marine cable pull-in is provided in Table 4.1.

Table 4.1 Phase 3: Marine cable pull-in

Characteristic	Maximum Design Parameter
Total number of HDD exit pits	4
Cable Lay Barge (CLB) (beached during low tide)	1
Number of CLB anchors (low seabed penetration)	8
Maximum number of cables	1 bundled (comprising 2 power cables and one fibre optic) or 2 separate pull-ins (1 power cable along and one power cable bundled with the fibre optic) if the cable is unbundled at this stage
CLB anchor footprint (per anchor)	32 m^2
Radius of 4-point anchor spread	Each anchor line 250 m – 400 m from the CLB
Cofferdam or raising HDD exit ducts to prevent sediment backfilling	4 (one per HDD duct)
Pile length	9 m
Depth of burial (piles)	6 m
Piling method	Silent piling or localised vibro-piling, if localised conditions require
Rollers for marine cable pull-in	Depends on length of intertidal area/mud flat requiring crossing at low tide Target to bring CLB in at high tide to get as close to the HDD exit pits as possible to minimise requirements for use of rollers across the intertidal area
Cable roller stability system	Gravity base or piled bases (based on vibropiling as assessed worst case) (for tidal areas / areas with high scour risk only)
Duration of cable pull-in	16 days (including recovery of the HDD duct ends and checking the cable ducts, placement of rollers / CLB anchors, cable pull in, cable burial (seven days) and beach reinstatement) based on 24 hour working
Duration between separate cable pull-in operations	Up to 30 days

4.3 Phase 4 Marine Cable Burial

4.3.1 On completion of cable pull-in operations, cable burial operations will commence.

4.3.2 Burial will commence at the HDD exit pits, with the bundled cables or two cables (if unbundled) being buried in a seaward direction. Both the HDD exit and cable will be placed into the cable trench and backfilled, if being buried by land-based excavator. In areas where the cable is lowered by a trencher, the trench will naturally backfill over the following tidal cycles, until it is back to current seabed level. In periods where the tide is out, the trench will be monitored to ensure there are no soft spots in order for public safety. If required any soft spots may have remedial work undertaken. The target depth of lowering for both the cable and HDD exit in the intertidal zone is 1.5 m below mean seabed level.

4.3.3 The section of marine cable between the HDD exit pits and MLWS will be buried in a trench. There are a number of potential methods for cable burial including trenching by excavator (Plate 4.5), installation by a terrestrial plough mounted on an excavator (Plate 4.6) or installation using an offshore cable trencher that is operated by the CLB.

4.3.4 Depending on the location of the CLB within the intertidal area, a combination of cable burial methods may be required, with the section of cable between the CLB and the HDD exit pits installed using an excavator or terrestrial plough and the remaining section of cable between the CLB and MLWS installed by the offshore cable trencher.

Plate 4.5 Cable being placed in an excavated trench (Walney Extension Offshore Wind Farm)

Plate 4.6 Cable being buried using a plough with excavators (Thanet Offshore Wind Farm)

4.3.5 The total length of cable across the intertidal area requiring burial with an excavator or terrestrial plough will depend on how close the CLB and offshore cable trencher can get to the HDD exit pits There is potential that, by bringing the CLB as close to the HDD exit pits as possible at high tide that the majority of the marine cable between the HDD exit pits and MLWS can be buried using the offshore cable trencher.

4.3.6 Based on standard practice cable installation using the offshore cable trencher should be completed in one tidal cycle, however this will be subject to finalised engineering by the installation contractor. The assessed worst case assumes up to seven days based on an open cut trench technique using an excavator.

4.3.7 A summary of the key maximum design parameters relating to marine cable burial between the HDD exit pits and Mean Low Water Spring (MLWS) is provided in Table 4.2.

Table 4.2 Phase 4: Marine Cable Burial

Characteristic	Maximum Design Parameter
Total number of HDD exit pits	4
Cable Lay Barge (CLB) (beached during low tide)	1
Number of CLB anchors (low seabed penetration)	8
Maximum number of cables	1 (bundled) or 2 (unbundled)
CLB anchor footprint (per anchor)	32 m^2
Radius of 4-point anchor spread	250 m – 400 m from the CLB
Offshore Cable Trencher (deployed from the CLB and operated at high tide)	1
Terrestrial cable burial plough	1
Excavator (for cable trenching)	2
Bulldozer (for backfilling)	1
Cable trench width for plough with excavator (for bundled cables)	Up to 2.5 m width 1.5 m depth (DOL)
Construction swathe (working corridor) for plough with excavators assuming bundled cables	20 m
Construction swathe (working corridor) for plough with excavators unbundled (two separate cable trenches)	40 m
Cable trenching corridor for offshore cable trencher (jet trencher, jet plough, mass flow excavator (MFE))	5 m to 20 m width 1.5 m depth (DOL)
Duration of cable burial in intertidal	Up to seven days based on open cut trenching with excavators This includes re-burial of the HDD ends.

4.4 Phase 5 Removal of Temporary Access Tracks

4.4.1 Once all works at the landfall are completed (including cable pull in), the temporary drilling compound/landfall works compound and access tracks will be removed. Demobilisation is expected to take 10 days.

5. Construction Access

5.1 Introduction

5.1.1 During all stages of landfall construction and cable installation, there will be a requirement for construction plant, vehicles and personnel to gain access to the intertidal area within Pegwell Bay.

5.1.2 Two access routes onto the Pegwell Bay intertidal mudflats have been identified as being required to complete all construction activities:

- Hoverport access; and
- Transportation by sea.

5.1.3 As the HDD exit pits are located in the upper intertidal area, access during construction (and if required during operation for maintenance purposes) would be from the former hoverport, located at the northern end of Pegwell Bay, to the work area.

5.1.4 The final location and width of access routes across the mudflats will be determined pre-construction and will be informed by a pre-construction intertidal habitat survey which will be completed to ensure the route avoids any areas of seaward encroaching saltmarsh.

5.1.5 The former hoverport would also be used to access the lower intertidal area during cable pull-in and cable burial. All construction plant and vehicles will be required to use defined access routes, the locations and widths of which will be determined following a pre-construction intertidal habitat survey.

5.1.6 Transportation of construction plant by sea at the top of the tide will be limited to marine vessels and marine construction plant only.

5.2 Construction Plant and Vehicles requiring access via the Former Hoverport

5.2.1 Various types of construction plant and vehicles will be required to access the intertidal area during construction of the landfall, cable pull-in and burial. These are summarised in Table 5.1 below.

Table 5.1 Construction plant and vehicles requiring access across the mudflats via the former hoverport

Construction Plant and Vehicles	Quantity (max): HDD enabling works, drilling and ducting	Quantity (max): Landfall Cable Pull-In	Quantity (max): Cable Burial
Vibropiling rig	1	1	0

Construction Plant and Vehicles	Quantity (max): HDD enabling works, drilling and ducting	Quantity (max): Landfall Cable Pull-In	Quantity (max): Cable Burial
Excavators	4	4	4
Tractors	2	2	2
Trailers for transporting equipment (towed by tractor)	2	2	2
4WD vehicles	5	5	5
Bulldozer	0	1	1
Telehandlers	2	2	2
Argocat	3	3	3
Mass Flow Excavator	0	1	0
Hovercraft (for safety use only)	3	3	3

5.2.2 For the purpose of assessing potential impact associated with construction access, it has been assumed that for all construction activities occurring in the intertidal area, construction plant and vehicles would use the construction access, from the hoverport, up to four times a day (depending on tides). However, there may be a requirement for up to 40 movements per day at peak times of certain vehicles involved in the transportation of equipment and personnel across the mudflats.

5.2.3 Equipment requiring transportation via towed trailers includes: generators, mud transfer pumps, temporary working platforms, sheet piles and piles, rock bags and concrete mattresses, rollers for duct and cable pull in, welding machine (for sealing HDD), HDD bellmouths, and all other ancillary equipment. This equipment will be delivered to the main onshore construction compound via low loaders and HGVs and transferred to trailers for transport onto the intertidal mudflats via the former hoverport.

5.2.4 No construction plant or vehicles will be stored on the former hoverport. This will be used for access only. There will also be no access (construction plant, vehicular or pedestrian) to the intertidal mudflats from Sandwich Road or from anywhere else within the Pegwell Bay Country Park.

Construction Plant and Vehicles Transported by Sea

5.2.5 The construction plant, equipment and vehicles that are expected to access the Kent landfall from the sea are summarised in Table 5.2.

Table 5.2 Construction plant and vehicles transported by sea

Construction Plant / Vessels	Quantity: HDD enabling works, drilling and ducting	Quantity: Cable Pull-In	Quantity: Cable Burial
Cable Lay Barge (2 movements per cable landing)		1	1
Jack-up Barge	1		
Anchor Handler Vessel		2	2
Rigid Hulled Inflatable Boats (RIBS)		4	4
Work Boats (to transport equipment)		3	3
Moonpool barge, or barge to transport pre-fabricated filled tanks (for cofferdams)	1		

6. Construction Programme

6.1.1 As set out in **Application Document 6.2.1.4 Part 1 Introduction Chapter 4 Description of the Proposed Project [APP-045]** subject to gaining development consent, construction works would be expected to start in 2027 and be functionally completed by the end of 2031 with reinstatement potentially continuing into 2032. Certain advance works (such as archaeological trial trenching or protected species mitigation) may take place in advance of the main construction period.

Indicative Programme of Works at Kent Landfall

6.1.2 As presented in **Application Document 6.2.1.4 Part 1 Introduction Chapter 4 Description of the Proposed Project [APP-045] Table 4.10** works at the Kent landfall will be completed in three phases (enabling works; installation and offshore works):

- **Enabling works (2/3 months Q1/Q2 2027)** – construction of the temporary onshore drilling compound, intertidal construction access route (former hoverport to the location of the trenchless crossing (HDD) exit pits), intertidal working area and installation of the first HDD exit pit cofferdam.
- **HDD installation (approx. 5 months Q2 to Q3 2027)** – trenchless crossing (HDD) drilling and ducting, including duct end works and installation of temporary rock bags/concrete mattresses in intertidal area to stabilise duct ends.
- **HDD marine cable pull-in and burial (6 months Q2 to Q3 2029)** – marine cable pull in followed by cable burial.

7. Operation and Maintenance (Cable Repairs)

7.1.1 There may be requirement during the operation and maintenance phase of the Proposed Project to carry out a cable repair at the HDD exit or along the section of cable buried in the intertidal area.

7.1.2 Where a cable repair is required, this would involve similar equipment to that used during construction of the trenchless crossing (HDD) and cable installation.

7.1.3 The precise nature of operational cable repairs is difficult to predict as it depends on the nature and extent of the cable repair required. For the purpose of the assessment, the worst-case scenario assumes that there would be a requirement to replace the entire landfall cable. This would require similar equipment and methodology as the landfall construction and cable installation operations described in the previous sections of this Technical Note.

7.1.4 Replacement of the entire landfall cable would require the use of the spare HDD duct. A cable joint would be made at the offshore end of the repair section of the marine cable.

7.1.5 If both marine cables are damaged there will be a requirement to use both the spare duct and one of the existing ducts. This would require the removal of the old cable from the HDD duct to allow replacement with the repair section of cable. Removal of the old section of cable is most likely be done at the offshore end of the HDD in the intertidal area, with the old damaged cable section being removed by an offshore vessel.

7.1.6 Should a cable fail in the HDD, the spare HDD would be used. The offshore end of the damaged cable would be cut and sealed. A spare section of cable would be brought to site by sea, and pulled into the HDD in a similar manner as described for the pull-in operations. The cable would then subsequently be jointed on a Jack-up vessel or similar, the repair deployed onto the beach and then buried by excavators.

7.1.7 Should a cable fault occur in the intertidal area, the cable bundle will be uncovered, the location of the fault would be cut, capped and sealed. Either jack-up vessels or a cable lay barge would transit to site and set up at the fault location. The capped cable end will be jointed on board, a new cable section would be installed and then a second joint would be made. The repaired section would be lowered to the beach where it would be buried by excavators.

7.1.8 There would also be a requirement for support at the onshore end of the HDD with the construction of a temporary compound at the onshore TJBs to assist with excavation of the buried spare duct and to assist with pull in and jointing for replacement sections of cable.

Appendix A Appendix A Alternative Trenchless Crossing Techniques

A.1 Direct Pipe

A.1.1 Direct Pipe is a method that utilises a Microtunnel Boring Machine (MTBM) head attached to a prefabricated steel pipeline. Control lines and fluid circulation lines for the MTBM are installed within the pipeline. A pipe thruster installed at the onshore launch pit applies thrust to the pipe that is transferred to the MTBM. Electrical power supplied through the control lines powers the MTBM, the rotating head and cutters to excavate the ground at the face of the bore. Bentonite fluid carries the cuttings along the fluid circulation lines to the surface where the cuttings are removed and the fluid is then recycled. The pressure of the fluid at the excavation face is controlled so that it is only slightly greater than the in-situ pressure, allowing Direct Pipe to install at shallow depths while avoiding drilling fluid surface frac out.

A.1.2 The launch pit will be located in a similar position to that for the HDD option, and is an inclined ramp approximately 30m length and 5m width with a 2m to 3m sheetpiled face through which the MTBM enters the ground. Sheetpiled anchor walls will also be installed to act as thrust blocks for the pipe thruster. Following installation of the pipeline, the sheet piles will be removed and the pit backfilled to the original ground level.

A.1.3 The MTBM will exit at surface in the intertidal area, at the same location as the HDD option, and the MTBM will then be removed from the steel pipeline. Due to the size and weight (>11t) of the MTB it will probably need to be recovered to a barge at high tide for removal from the exit. The internal supply and control lines within the pipeline will be pulled back through the pipeline to the entry side, and any required internal ducts and messenger wires installed in the pipeline. The pipe thruster might then pull the offshore end of the pipeline back towards the entry by perhaps 10m so that the pipeline end is sufficiently buried below seabed level. Alternatively, the exit position may be excavated and excess pipeline cut off and replaced by a sealing flange before burial at a suitable depth below the seabed.

A.2 Micro-tunnelling

A.2.1 This method utilises a steerable tunnel boring machine (TBM) to tunnel between a launch pit and a reception pit. Lengths of jacking pipe, typically made of concrete or steel, are inserted behind the TBM as it progresses, and a hydraulic jack is used to drive the pipe forward. Water or mud mix is utilised to fluidise excavated material which is pumped to the launch pit. Cable ducting is pulled through the pipe tunnel following tunnelling through to the reception pit. The launch pit and reception pit require concrete bases to ensure a clean working environment and prevent water entering the working area.

A.2.2 The launch and reception pits also require a concrete back wall for the hydraulic jack to work against. The launch and reception pits would be backfilled on completion of the crossing and the area reinstated. Topsoil would be reinstated to the original soil profile.

Appendix B Summary of Construction Plant and Equipment

Equipment	Max number at any one time	Sound source[1]	Phase 1A Temporary Construction Access (ground mats)	Phase 1B Cofferdam Construction	Phase 2 HDD Drilling and Duct Installation	Phase 3: Marine Cable Pull-In	Phase 4: Marine Cable Burial (MLWS to HDD Exit Pits)	Phase 5: Removal of Temporary Access
Vibratory piling rig – 52 t / 14 m length / soft clay	1	88 L_{pA} at 10 m (dB) (used for M-weighted seal modelling[2]) 91 L_{AFmax} (used for modelling impact on ornithology[3])		✓		✓		
Large excavators (40t) for HDD exit pits and lifting/ unloading of equipment)	4	79 L_{pA} at 10 m (dB) 99 dB(A) (provided by contractor)		✓	✓	✓	✓	
Small excavator	2	65 at 10 m L_{Aeq} dB	✓					✓
Tractor and trailer	2	79 Drive-by maximum 10 m $L_{A(max)}$ dB	✓	✓	✓			✓
4WD vehicles	5	-	✓	✓	✓	✓	✓	✓

Equipment	Max number at any one time	Sound source[1]	Phase 1A Temporary Construction Access (ground mats)	Phase 1B Cofferdam Construction	Phase 2 HDD Drilling and Duct Installation	Phase 3: Marine Cable Pull-In	Phase 4: Marine Cable Burial (MLWS to HDD Exit Pits)	Phase 5: Removal of Temporary Access
Bulldozer	1	80 at 10 m L_{Aeq} dB				✓	✓	
Telehandler	2	70 at 10 m L_{Aeq} dB		✓	✓	✓	✓	
Argocat	3	Not available	✓	✓	✓	✓	✓	✓
Mass flow excavator	1	Not available				✓		
Equipment in the cofferdams (mud pumps etc.)	Not defined – contractor specific	Mud pumps at 77 dB at 2.5 m Generator 71 dB at 1 m both will be contained in super silencer unit.		✓	✓			
Anchor handler vessel	1	81-85 dB(A) (Bernardini *et al.*, 2024)	✓					✓
Cable Lay Barge (BLB)	1	84-86 dB(A) based on ferries		*Possible*		✓	✓	

Equipment	Max number at any one time	Sound source[1]	Phase 1A Temporary Construction Access (ground mats)	Phase 1B Cofferdam Construction		Phase 2 HDD Drilling and Duct Installation	Phase 3: Marine Cable Pull-In	Phase 4: Marine Cable Burial (MLWS to HDD Exit Pits)	Phase 5: Removal of Temporary Access
		(Bernardini *et al.*, 2024)							
Offshore Trencher	1	Not available						✓	
Hovercraft	3	N/A	*Safety use only*	*Safety use only*		*Safety use only*	*Safety use only*	*Safety use only*	*Safety use only*
Lighting			*Day working - not required*	*Potential navigation lights on cofferdams*	*24 hours lighting on cofferdams plus navigation lights on access route (on poles)*	*Navigational lights on CLB and access route*	*Navigational lights on CLB and access route*	*Day working - not required*	

Notes:

1 Noise levels based on British Standards BS 5228 - 1:2009+A1:2014 unless stated otherwise

2 Noise levels used in Application Document 9.49 Seals and Airborne Sound Disturbance Technical Note [REP1-122]

3 Noise Levels used in Application Document 6.2.4.5 (B) Part 4 Marine Chapter 5 Marine Ornithology submitted at Deadline 2

The winches used to pull the marine cable through the HDD ducts will be located in the onshore compound.

The HDD drill rig will also be located in the onshore compound. The HDD bores will be drilled from onshore to offshore.

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