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GRIDLINK INTERCONNECTOR

GRIDLINK INTERCONNECTOR LIMITED

GridLink Marine Environmental Report

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GridLink Marine Environmental Report

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0. NON-TECHNICAL SUMMARY

0.1 Introduction

0.1.1 Proposed Development

GridLink Interconnector Limited (the Applicant) is proposing to develop a 1,400 megawatt electricity interconnector, linking the existing electricity grids in the United Kingdom (UK) and France (Figure 0-1, Drawing P2172-LOC-003). The GridLink Interconnector project (GridLink) will consist of two converter stations, one close to the existing National Grid 400 kV Kingsnorth Substation, at Kingsnorth in Kent and one close to the existing RTE Warande Substation, at Dunkerque in the Nord region of France. The converter stations will be connected by a high voltage direct current (HVDC) cable system comprising 140 km of subsea cable and 13 km of underground cable in France. The UK landfall point for the submarine cables is the MedwayOne commercial area at the site of the former E.on coal-fired power station at Kingsnorth. There is no underground cable in the UK since the converter station site is located next to the shoreline.

GridLink is configured so that the power will be able to flow in either direction at different times, depending on supply and demand in each country.

The project is designated as a European Union Project of Common Interest (PCI), project number No. 2018/540, under the provisions of European Union Regulation No. 347/2013 on guidelines for Trans-European Network for Energy (TEN-E Regulations) and receives grant funding under the Connecting Europe Facility (CEF).

The Environmental Report, to which this Non-Technical Summary relates, covers the UK Marine components of GridLink from mean high-water springs (MHWS) at Kingsnorth out to the UK Exclusive Economic Zone boundary with France; a distance of 108km with an average width of 500m (the Proposed Development.

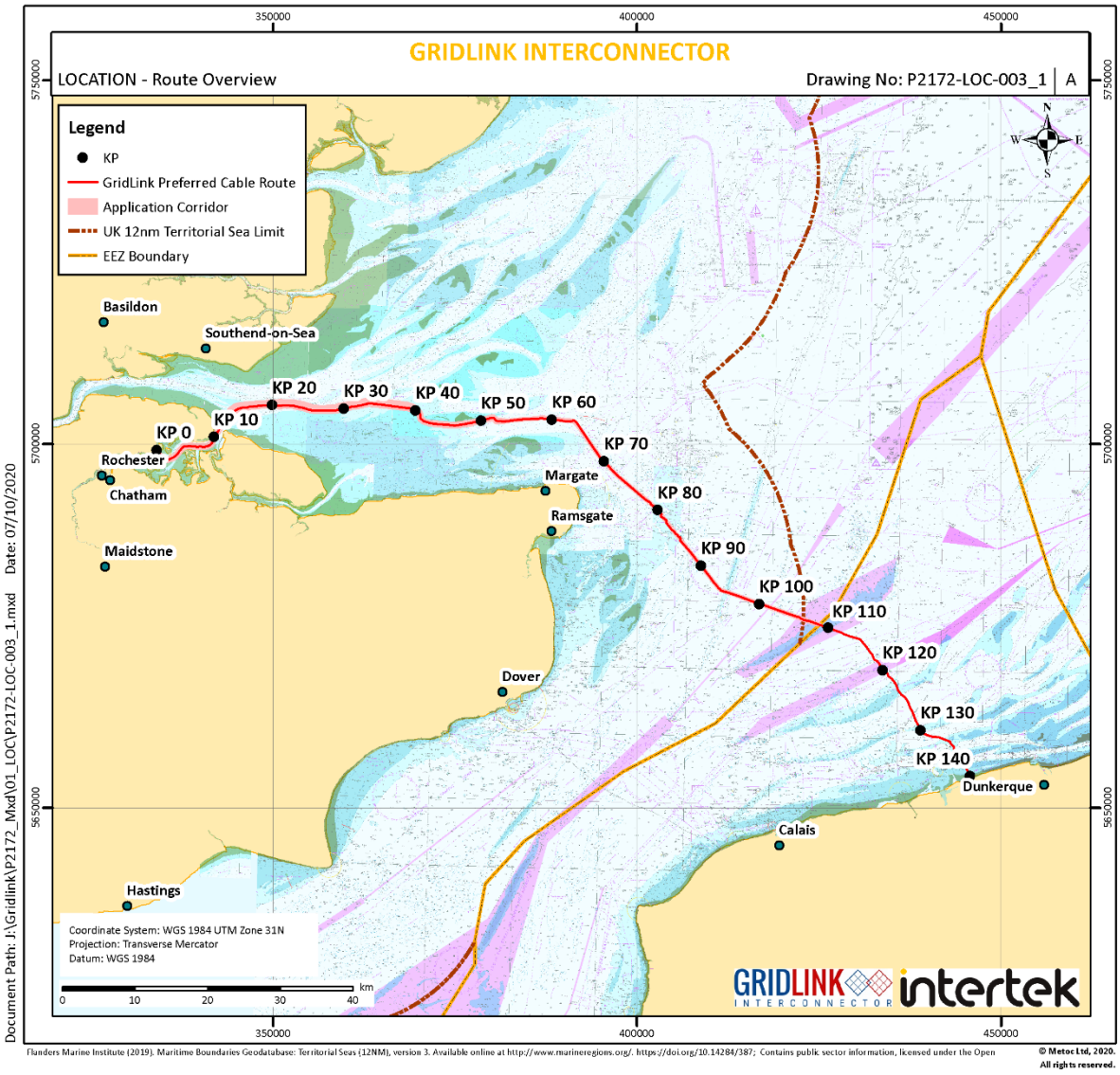
The Proposed Development comprises:

- Two high voltage direct current (HVDC) electricity power cables;
- A smaller fibre-optic cable for control and telecommunications;
- All associated works required to install test, commission and complete the aforementioned cables; and
- All associated works required to operate, maintain, repair and decommission the aforementioned cables, including three repair events .

The Environmental Report will be submitted to the Marine Management Organisation (MMO) in support of an application for a Marine License under the Marine and Coastal Access Act 2009.

Separate Environmental Reports are prepared which cover individually the UK Onshore elements; the French Marine and Onshore element (from the France / UK EEZ boundary onwards).

Figure 0-1 GridLink overview (Drawing P2172-LOC-003)



0.1.2 Submarine Cable Route Description

The **Preferred Cable Route** has been defined through an iterative process involving feasibility studies, preliminary cable route engineering, subsea bathymetric, geotechnical, and environmental surveys, consultation with stakeholders and post-survey routeing studies. The cable installation may deviate from this route i.e. to micro-route around obstacles, but only within an area defined as the **Asset Placement Corridor**. The corridor is nominal 500 m wide and has been included in the offshore bathymetric, geophysical, geotechnical and environmental survey carried out for GridLink.

Kilometre points (KPs) have been assigned to the Preferred Cable Route running from KP0 at MHWS, Kingsnorth to KP139.7 at MHWS, Dunkerque. KPs have been used in the Environmental Report to help describe specific points or sections of the Preferred Cable Route.

The **Application Corridor** – the spatial extent that the Marine Licence Application will apply to is wider than the Asset Placement Corridor from KP0 to KP55 and finishes at the UK/France EEZ boundary at KP108.1. The Application Corridor encompasses all areas where works will be undertaken in UK

waters. Due to the shallow water depths between KP0 and KP55, it is likely that anchored vessels will be required, therefore the Application Corridor has been extended wider than the Asset Placement Corridor to accommodate potential anchor positions.

There are areas within the Application Corridor where anchor placement is not favoured (i.e. due to the presence of sensitive habitats, or third-party assets), these are defined as **Areas of Constraint for Anchor Placement**. In addition, it is recognised that within the Application Corridor there are several constraints that mean installation in certain areas would not be preferred, these are defined as **Areas of Constraint for Asset Placement**.

The submarine cable system will be laid within a 30m corridor that is subject to a Marine Licence Application, a Crown Estate lease, an easement from Peel Ports (for the Medway Estuary only) and a licence from the Rochester Oyster and Floating Fishery (ROFF) (selected parts of the Medway Estuary only).

0.1.3 Project Objectives

The European energy market faces many challenges linked to aging infrastructure, environmental targets and energy transition. Meeting these challenges requires a significant shift towards a greater share of renewable energy supported by an improved transmission network capable of distributing energy and ensuring the security of supply.

The objective of the Proposed Development is to support this transformation by improving the capacity of the UK and French networks to distribute electricity to consumers, and to ensure that electricity supply is secure in the event of production uncertainty linked to renewable resources, availability of existing generation units, transmission network constraints or other reasons.

The main economic benefits of GridLink result from increasing competitiveness in the energy market through import and export trade between the UK and France and enhancement of the security of supply. According to supply and demand, which changes depending on the time of day, season, weather conditions and availability of renewable energy, GridLink will be able to either import or export electricity. This opens up commercial opportunities for energy producers, thus reducing costs for consumers.

The environmental benefits of GridLink comprise the facilitation of the efficient use of renewable energy and other low carbon sources of electricity by the UK and French networks. Surplus renewable and nuclear energy can be utilised through GridLink, whilst otherwise it's use may be constrained. In addition, GridLink provides a means to compensate for any shortfalls in electricity supply that may occur if renewable energy production is lower than expected.

The main goal of the Proposed Development is that energy producers and consumers can exploit these benefits through a state-of-the-art, high efficiency and reliable project with minimal environmental effects.

GridLink successfully qualified as a European Commission Project of Common Interest in 2018. European Commission (2020) state that "*PCIs are key cross border infrastructure projects that link the energy systems of EU countries. They are intended to help the EU achieve its energy policy and climate objectives: affordable, secure and sustainable energy for all citizens, and the long-term decarbonisation of the economy in accordance with the Paris Agreement.*" To become a PCI, "*the project must have a significant impact on energy markets and market integration in at least two EU countries, boost competition on energy markets and help the EU's energy security by diversifying sources as well as contribute to the EU's climate and energy goals by integrating renewables.*"

Its status as a European PCI means that GridLink is of strategic importance to the UK and France. It also means it is considered imperative infrastructure necessary for Europe to meet its climate objectives; a beneficial consequence of primary importance to the environment.

0.2 Development of Gridlink

0.2.1 Introduction

The primary objective of the project is to link the electricity transmission networks in the UK and France. This can only be delivered by the development of a subsea interconnector between the two countries.

However, the design of the interconnector is instrumental in determining the environmental effects. This section describes the alternatives that were considered and demonstrates that there are no feasible alternative solutions.

The configuration of any interconnector project is influenced by the location of the existing network infrastructure, its ability to accommodate the required connection capacity, any requirement for network reinforcements, and other factors such as environmental constraints.

The converter station sites and cable route have been identified through a comprehensive evaluation of alternatives, site selection and cable routeing process, incorporating environmental, technical and economic criteria. This process has included consideration of alternative sites, landfalls and onshore and offshore HVDC and high voltage alternating current cable routes.

A full description of the alternatives considered, and route development is provided in Chapter 2 of the GridLink Marine ER. The following sections summarise the key points.

0.2.2 Connection options

Seven potential substations were initially considered as potential connection points (Cleve Hill, Coryton, Grain, Kemsley, Kingsnorth, Northfleet East and Rayleigh Main). Further assessments, particularly considering technical and economic considerations, identified the Kingsnorth sub-station as the preferred connection site. Subsequently, a grid connection agreement concerning the connection at the Kingsnorth sub-station was signed by National Grid and GridLink Interconnector Ltd in October 2016.

0.2.3 Landfall selection

Following the identification of these connection sites in the UK, technical and environmental feasibility studies were carried out in 2016, to establish the precise landfall location of the routes. A total of seven potential landfall sites were selected, of which, four were discounted as less preferential on environmental and technical grounds. Three 'preferred' landfall options were recommended for further investigation; Grain, Kemsley and Kingsnorth. Kingsnorth, and specifically the MedwayOne Commercial area, was then chosen as the preferred landfall.

0.2.4 Subsea route selection

The Preferred Cable Route has been defined through an iterative process involving feasibility studies, preliminary cable route engineering, subsea surveys, consultation with stakeholders and post-survey routeing studies. The Preferred Cable Route has been designed to avoid or reduce environmental effects as far as reasonably practicable.

The cable route in the outer Thames Estuary was subject to an evaluation of two alternative routes. These alternatives were to locate the cable to either north or south of the existing BritNed interconnector cable that connects the UK to the Netherlands. Whilst both alternatives were technically and environmentally feasible, in order to avoid major shipping channels and two crossings of the BritNed cable, the cable route to the south of the BritNed interconnector was selected. This southern route was selected after consultation with navigational authorities (Port of London Authority, Peel Ports), organisations responsible for licensing installation of cables in the seabed

(Crown Estate, Peel Ports, Rochester Oystermen and Floating Fisheries), existing cable owners (BritNed Interconnector Ltd, London Array offshore wind farm) and fishermen associations.

A 500 m corridor along the proposed cable route was subject to a marine survey campaign between June to October 2019. Live routeing evaluations were undertaken as the geophysical survey progressed. This involved assessing the raw geophysical data to determine if there were obstructions or ground conditions which desk-based assessment had not previously identified and needed to be taken into account. Assessment of the survey data identified that the Pan Sands sandbank, located within the outer Thames Estuary between KP40 and KP50, has migrated further north than its mapped position as shown on Admiralty charts. The southern route had been routed to the north of the sandbanks in the available space between the sandbanks and the BritNed interconnector. As the southern route could not be moved further north to compensate for the sandbank migration without crossing the BritNed Interconnector, the route had to be changed to navigate to the south of the Pan Sands sandbank. Additional geophysical lines were acquired to provide information on the seabed conditions of the new route section and confirm that it was feasible.

The final Preferred Cable Route has been optimised by micro-routing within the 500 m corridor to take into account:

- Challenging ground conditions e.g. an escarpment feature at the mouth of the Medway Estuary, sand waves and sandbanks;
- Crossing angles at approaches to third party assets to minimise the requirement for rock protection and risk of scour;
- Geophysical anomalies that could be wrecks, unexploded ordnance (UXO) or large items of debris; and
- Sensitive environmental habitats, such as reef structures or protected species.

Further micro-routeing will be undertaken by the Installation Contractor to take into account the latest pre-installation seabed conditions (determined by the geophysical and geotechnical surveys) and the type of installation tools to be used, environmental considerations and project specific mitigation, crossing agreements with third party asset owners, the requirements of statutory authorities and consultations with fishermen's organisations.

0.3 Project Description

0.3.1 Submarine Cable Description

The subsea cable system will consist of two mass impregnated submarine HVDC cables.

The diameter of each cable will be approximately 130 mm, with a copper conductor. The cable will have a lead sheath, to ensure no moisture can penetrate the insulation, and steel wire armour to protect the cable from external damage during installation and burial/protection.

The two cables will be bundled together for cable-lay into a single trench. A smaller fibre-optic cable will be included with the bundled HVDC cables for monitoring and control purposes, with the potential to also offer commercial telecommunications. In order to protect the cables, the cables will be buried below the seabed, with the depth determined by a burial depth risk assessment. The burial depth will range from 1.7m to 3.5m, depending on the seabed geology and navigation and fishing hazards.

0.3.2 Indicative Programme

The construction programme (onshore and offshore) is expected to take approximately 36 months from start to finish. Construction is expected to commence in early 2022 with commercial operations from early 2025.

Table 0-1 presents the indicative periods when the offshore work activities are expected to take place. The duration of activity within the indicated periods depends on the final scope of works, cable installation method, vessels and equipment, and weather and operational downtime.

Table 0-1 Indicative programme for marine works

Activity	2022				2023			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Landfall HDD site preparation								
Landfall HDD drilling								
Landfall cable installation								
Pre-lay survey								
Route preparation								
Cable lay and burial								
External cable protection installation								

0.3.3 Pre-Installation Works

0.3.3.1 Geophysical survey

Although detailed marine surveys have been completed, there is the potential that further surveys will be carried out prior to the commencement of cable installation.

The objectives of these surveys are to confirm that no new obstructions have appeared on the seabed since the original marine survey was undertaken; to confirm the seabed level pre- and post-installation to demonstrate that the required burial depth for the cables has been reached; and to micro-route the Preferred Cable Route around any mobile bedforms or sensitive habitats within the Asset Placement Corridor.

The survey will involve a range of standard geophysical survey techniques such as multi-beam echosounder (MBES), side scan sonar (SSS), sub-bottom profiler (SBP) and magnetometer. Where necessary, visual inspection of seabed features, for example at third-party asset crossing locations or locations of archaeological potential, and depth of burial measurements may be carried out with a remotely operated vehicle (ROV).

0.3.3.2 Unexploded ordnance (UXO) survey and clearance

Given the nature of the Proposed Development, there is a risk that UXO may be encountered during intrusive activities e.g. cable installation and cable repair activities. A UXO desktop study was prepared by 6 Alpha Associates (2019) which concluded that it is almost certain that UXO will be found within the Application Corridor.

The offshore bathymetrical and geophysical survey completed in 2019 were designed to detect any significant seabed features and obstacles within the Asset Placement Corridor that may be UXO to allow micro-routing around such anomalies. A more detailed UXO-specific pre-construction survey using a magnetometer array will be undertaken pre-installation, to characterise and investigate anomalies that may be UXO in more detail.

If any significant UXO is identified, the decision-making hierarchy shall be:

1. Avoid by micro-routeing
2. If the UXO cannot be avoided, undertake clearance to surface or move UXO outside the Application Corridor

3. If the UXO cannot be safely moved, clearance by on-site detonation.

Following the UXO survey, the Preferred Cable Route will be micro-routed within the UXO survey corridor[1] provide a suitable safety distance between the cable installation and any UXO finds. With micro-routing, no UXO clearance is necessary.

If a potential UXO cannot be avoided for whatsoever reason, this potential UXO will be investigated by visual inspection using an ROV. If visual inspection confirms that the object is a UXO, then if it is safe to do so the UXO will be removed. Clearance works will be using an electromagnetic grab.

If it is not safe to remove the UXO, it will be detonated. It is proposed that, as Project Specific Mitigation, deflagration charges (in the region of 1.54kg) will be used on all UXO – whereby the explosive is burnt out rather than blown up. Deflagration is a much less energetic process and anecdotal evidence has suggested that it is "quieter" than traditional high-order detonation (Cheong et al. 2020). There will still be a relatively large release of impulsive sound energy, creating high amplitude shock waves, but evidence in Cheong et al. (2020) indicates the reduction in blast effects is around 97%. The size of the deflagration charge is relative to the size of UXO identified but 1.54kg is likely to the maximum size.

As a precautionary measure, the Marine Licence application includes permission to deflagrate up to ten UXO, although from experience on other power cable projects in the Thames region it is thought more likely that up to two will be required.

0.3.3.3 Route preparation

Prior to the start of marine cable installation, it is essential to ensure the Preferred Cable Route is clear of obstructions. A pre-lay grapnel will be towed along the Preferred Cable Route to clear any seabed debris and to prepare the route centreline for cable installation. Review of geophysical survey data has identified that no boulder clearance will be necessary in UK waters.

Preparations will also be required at locations where the Preferred Cable Route crosses sandwaves; and where it crosses third-party assets e.g. in service (IS) and out-of-service (OOS) telecommunications and windfarm export cables.

In areas of mobile sandwaves, discrete areas of seabed will require preparatory works known as pre-sweeping. A dredger or mass flow excavator will be used to remove a portion of the sandwave. This is to allow the cable to be buried relative to a non-mobile reference level below the lowest level of undulations; reducing the risk of the cable becoming exposed through sandwave movement. Ten discrete locations have been identified as potentially requiring pre-sweeping.

23 third-party assets have been positively identified within the Application Area comprising:

- 1 x in-service interconnector cable;
- 2 x in-service wind farm export cable arrays (comprising 2 and 4 cables respectively);
- 3 x in-service telecommunications cables;
- 1 x new telecommunications cable (which will be in-service by 2022); and
- 17 x historic/out-of-service cables.

The third-party assets have been identified by desk-top studies and the marine survey.

The Proposed Development will cross over in-service cables on a 'bridge' comprised of either aggregate (rock) or concrete mattresses. This first layer of protective material will be positioned during route preparation. This prevents the overlaid cable bundle from contacting the buried in-service cable as they settle into the sediment. Once the cable bundle is laid over the bridge, external

[1] A maximum 100m wide corridor within the Asset Placement Corridor.

cable protection will be deposited over the top to protect the cables from external aggressors (e.g. fishing gear, anchor strikes).

To cross an out-of-service cable, a de-trenching grapnel is used to retrieve the out-of-service cable from the seabed. The de-trenching grapnel typically penetrates 1.5 – 2.0m into the seabed. Once retrieved the out-of-service cable is cut and the ends secured to the seabed in accordance with International Cable Protection Committee (ICPC) recommendation No 1 (ICPC 2014). The cutting corridor is to be agreed with the asset owner but is expected to be a minimum of 50m either side of the centreline (100m wide in total).

0.3.4 Cable Installation

0.3.4.1 Cable laying techniques

There are three possible configurations for cable installation:

- **Pre-cut trenching** – A pre-cut trenching vessel will tow a plough along the seabed creating a v-shaped trench. A cable lay vessel will follow, laying the cables directly into the trench. This is typically followed by a support vessel towing a back-fill plough which pushes the spoil heaps into the trench. This method is not typically used in unconsolidated soils such as the sands present along large parts of the route.
- **Simultaneous lay and burial** – simultaneous trench excavation and cable-lay into the trench at the same time. The cable lay vessel may tow the burial equipment or it is deployed by another vessel navigating close behind, creating effectively a single large spread. The cables are fed into the burial equipment directly from above and the cables are buried as the spread progresses along the route.
- **Post-lay burial** – cable-lay on the seabed followed by post-lay trench excavation and then trench backfilling, if required. The cable lay vessel lays the cables on the seabed and a post-lay burial vessel follows later to bury the cables. As the post-lay burial is a stand-alone operation, the post-lay burial vessel may operate with a longer separation distance from the lay vessel, so there are two discrete operations separated physically and in time.

Cable lay operations will be performed on a 24-hour basis to maximise efficient use of suitable weather conditions and vessel and equipment time; and minimise the presence of the cable lay spread in navigation channels, fishing grounds or other sensitive areas.

The temporal effect of the spread will be dependent on the slowest moving element, usually the cable burial spread, which will most likely be moving at a speed of between 100 – 300m per hour, depending on the soils encountered and the type of burial equipment used. Cable laying (without simultaneous cable burial) can progress at speeds of up to around 300-500m an hour. The only interruptions to the marine installation may be for cable joints that need to be made along the route.

0.3.4.2 Installation vessels

The vessels expected to be used for cable-lay and associated activities will consist of:

- Cable lay vessel (CLV) – undertakes cable lay and burial in water depths greater than 10m;
- Cable lay barge (CLB) – undertakes cable lay and burial in water depths of less than 10m (i.e. from KP0 to KP55);
- Jack-up barge (JUB) – a small platform with four legs. It will be used at the horizontal directional drill entry/exit point to support the drilling of the HDD and pull-in of the cables;
- Small work boats e.g. anchor handling vessels, tugs and other work boats – will support the CLV, CLB and JUB during cable pull-in operations and cable lay/burial;
- Guard vessel(s) – used to protect areas of exposed cable prior to external protection being applied and may be used in support of the CLB which will have limited manoeuvrability; and

- External cable protection placement vessel(s) – used to deposit the external protection material e.g. rock berms, concrete mattresses.

0.3.4.3 Cable jointing

CLV's typically have a carrying capacity of 5,000 to 10,000 tonnes. For the cable system design, this equates to cable lengths in bundled configuration up to approximately 100km. However, this means that it may be necessary to install the cable in at least two sections, with each section connected by a cable joint.

Following consultation with the Port of London Authority, the cable joint will be made between KP50 and KP51 or between KP53 and KP55 i.e. either side of the London Array crossing location. This is in order that the two-week static cable jointing operation takes place outside of the main shipping lanes. The joint will be buried in the seabed.

0.3.4.4 Cable burial and protection

Once laid on the seabed the cables need to either be buried or otherwise protected from the threat of external damage; primarily ships anchors or fishing activity.

The choice of burial technique or protection method will vary along the Preferred Cable Route depending upon the seabed conditions. Wherever possible, the cables will be buried in the seabed as this provides the best protection for the cable and minimises potential for interference with fishing activity. Where the seabed composition is not suitable for burial, external cable protection will be provided through either rock placement or concrete mattresses.

Burial depths

The recommended target burial depths along the cable length have been determined using the Carbon Trust cable burial risk assessment (CBRA) methodology. The burial depths consider cable design, seabed composition and dynamics, sediment mobility and potential for damage from external sources (fishing gear and ship's anchors). The target depth of lowering (TDOL - the depth specified, that the cable must be buried to) is generally 1.7m but it does vary along the Preferred Cable Route up to a maximum of 3.5m due to the presence of extremely low strength clay (within which anchors will penetrate very deeply) combined with high traffic densities.

Cable burial techniques and tools

The following burial tools may be used for cable burial:

- Jet Trenching - cable installation technique which can be used to bury the cable in areas of loose non cohesive sediments such as sand and silt. It uses a powerful water-jetting tool to fluidise seabed, allowing pre-laid cables to sink to the required burial depth.
- Conventional narrow share cable plough - burial technique used in cohesive sediments such as clays through to rock and non-cohesive sediments such as loose coarse sand to fine dense sand. The plough share is pulled through the seabed and cuts and lifts a wedge of soil, the cable is then fed into the plough and guided down through the share to be placed at the base of the trench before the wedge is placed back in.
- Advanced cable plough (vertical injectors) – Required to achieve 3.5m target depth of lowering. Deep burial ploughs use water jets fitted within the plough share to fluidise material at the leading edge of the share.
- Cutting - This technique is used to install cables into hard sediments such as clay, cemented sand, sandstone and weak bedrock. This technique is unlikely to be used for the Proposed Development.
- Mass flow excavator - will not be used as a technique to bury the cables; although they may be used at select locations for pre-sweeping of sandwaves.

External cable protection

Where cable burial is not feasible due to difficult ground conditions or crossing existing subsea assets, external protections such as rock or mattressing is generally used to protect the installed cables. The following external cable protection methods are likely to be used:

- Rock placement - Rock placement is used to protect subsea cables by covering them in a continuous profiled berm of graded rock. The size of the berm will depend on the location, the site-specific anchor and fishing risks and metocean conditions.
- Concrete mattressing - Concrete mattresses are matrices of interlinked concrete blocks which form a close-fitting layer over the. Mattresses are typically used in combination with rock protection e.g. at third-party asset crossings, or in areas where the main risk to the cables is from fishing activities.
- Frond mats - Although not directly a form of external cable protection frond mats are used as an anti-scour system. The mats can either be attached to concrete mattresses or laid separately secured by gravity or anchors. The mats are proposed as mitigation to reduce scour and encourage resedimentation of the cable protection where the Proposed Development crosses the London Array Offshore Windfarm export cables.

The Environmental Report provides estimates of the total requirement for external cable protection as follows:

In-service Cable Crossings:

- Seven locations require external protection
- Total length of external protection = 755m
- Seabed footprint of external protection = 9,980m^2
- External cable protection volume = 10,710m^3

Maximum requirements due to ground conditions are estimated to be:

- Total length of external protection in UK waters = 3,944m
- Seabed footprint of external protection = 18,595m^2
- External cable protection volume = 28,263m^3

0.3.4.5 Landfall installation

The intertidal area adjacent to the converter station site is an expanse of mudflats designated as the Medway Estuary and Marshes Special Protection Area (SPA) and Ramsar site, the Medway Estuary and Marshes Site of Special Scientific Interest (SSSI) and the Medway Estuary Marine Conservation Zone (MCZ). To avoid disturbance of this habitat, the shore crossing will be made by horizontal directional drilling (HDD). The cables will come directly ashore into the compound within the converter station site (Figure 0-2, Drawing P2258-LOC-012).

HDD is a surface-launched process for boring a hole under any sensitive surface features between two points for the installation of a cable or pipeline. A duct is inserted into the drilled hole into which the cable or pipeline is installed. The process can be driven from the land to sea, or from a suitable platform such as a jack-up barge at sea to land.

The Proposed Development will require two HDDs: the bundled cables need to be separated into individual HDDs for the shore crossing. It is not possible to pull-in a bundled cable through a single HDD.

The ducts will fan out of the transition joint pit within the converter station site to achieve exit points for the marine cables in the nearshore, with a minimum separation distance between the entry and exit points of each duct of approximately 5m. The cable ducts will pass approximately 10m below the

intertidal area for an approximate length of 600m. The proposed exit/entry point is illustrated in Figure 0-2 (Drawing P2258-LOC-012).

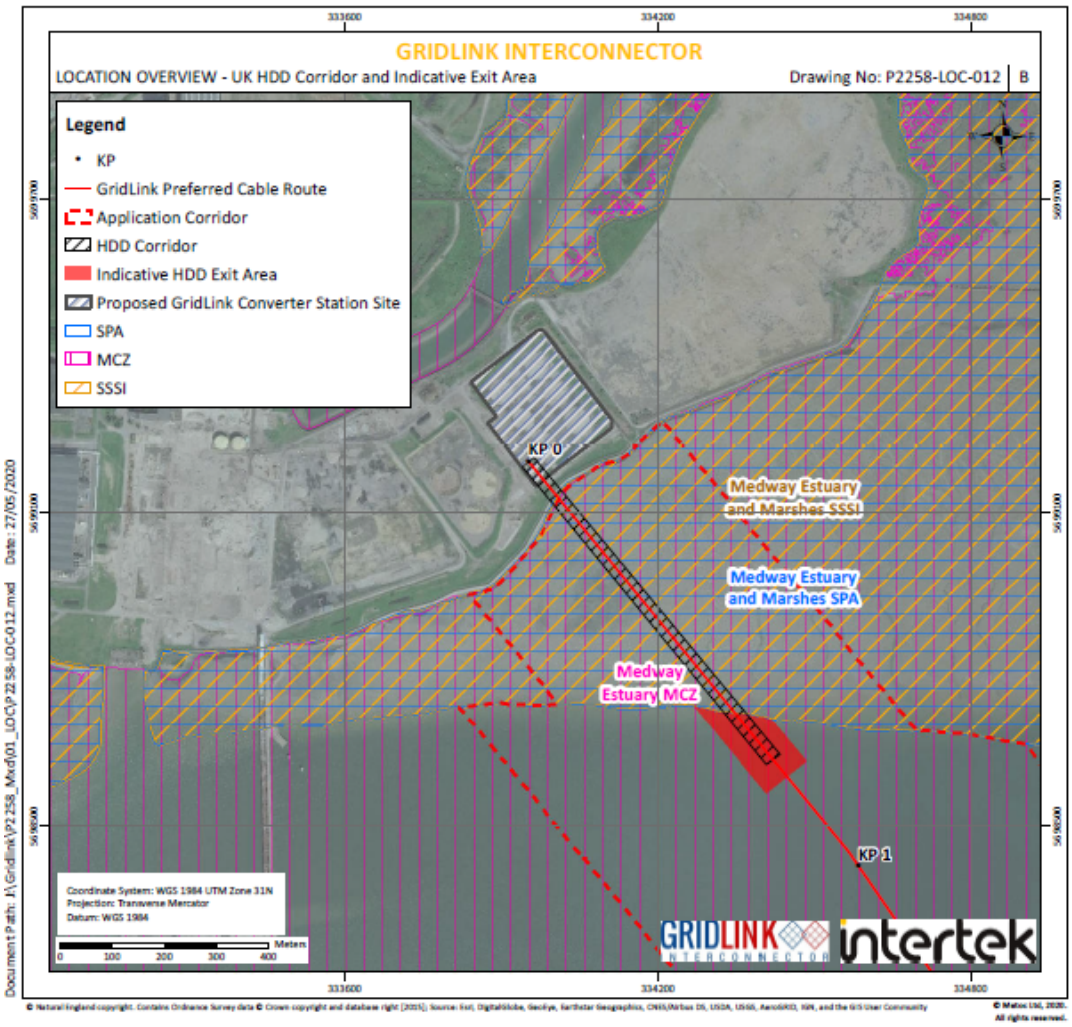
No HDD works will be required on the intertidal mudflats.

The installation sequence for each of the submarine cables and the fibre optic cable is likely to apply the indicative methodology summarised below:

- The cable pull-in will be carried out from sea to land, therefore the cables will be unbundled close to the nearshore entrance to the HDD ducts.
- The end of the duct accepting the cable will be exposed using an excavator positioned on a JUB or anchored barge.
- The submarine cable will be floated to the entry point to the duct, using small work boats and divers.
- The submarine cable will then be connected to the messenger wire pre-installed in the duct and winched through the duct.
- The submarine cable will arrive in the Transition Joint Bay, where the armouring will be removed and the cable installation continued underground into the converter station.

No cable pull-in works would be required on the intertidal mudflats.

Figure 0-2 HDD exit location (Drawing P2258-LOC-012)



0.3.5 Operation

Routine surveys using standard geophysical survey equipment and/or ROVs to monitor buried depth and integrity of external cable protection will be undertaken. The first survey will be carried out after completion of cable installation and then repeated approximately every two years or if the local environmental conditions change or are suspected as having changed.

Following installation, the submarine cables will operate without requiring any manual intervention. The control and monitoring of operations is carried out from a control room located at the converter station or a separate office.

If a cable fault is detected by the cable monitoring system, the relevant section of the cable will be located and retrieved to surface for inspection and replacement. It may be necessary to unbury the cable prior to cable recovery or remove external protection such as rock-berms or mattresses. Once unburied, measurement and testing will be conducted to establish the section of cable that needs to be replaced. A repair will typically be carried out by a single vessel.

The extra length of a repaired short cable section means it cannot be returned to its exact previous alignment on the seabed. The excess cable will be laid on the seabed in a loop off to one side of the original route, but the loop will lie within the Asset Placement Corridor. The additional joints and the extra cable length will be buried or protected by rock placement or concrete mattresses deployed from either the repair vessel itself or a separate specialised vessel.

The estimate of the number of repair operations is three:

- One operational cable fault over the operational lifetime of the cable (nominal 40 years);
- Two third party interactions with the cable over the operational lifetime of the cable (nominal 40 years), based on calculation formulas provided by Ofgem, ENTSO-E and CIGRE 379.

All repair activities will be undertaken within the Application Corridor. It has been assumed that external cable protection during repair operations will only be required where ground conditions may preclude burial.

0.3.6 Decommissioning

Decommissioning will not be required until the end of the operational lifetime of the Proposed Development (nominal 40 years). Decommissioning operations will be conducted according to the standard industry protocols and good international industry practices in force at the relevant time.

The preliminary decommissioning plan assumes recovery and removal of the subsea and onshore cables, and demolition of the converter station. However, the decommissioning plan will be flexible to adopt the least environmentally damaging option, such as leaving the cables in-situ, as may be determined at the time when decommissioning becomes necessary.

The decommissioning plan will take into account all permit requirements and contractual commitments to land-owners made on behalf of the Applicant.

0.3.7 Emissions

The emissions which may occur to varying degrees during cable installation or operation are electric and magnetic fields (EMF), heat and sound.

The influence of GridLink on the background geomagnetic field along the Preferred Cable Route has been calculated to be low, with EMF dissipating to natural background levels within 10m of the cables. Temperature increases in the upper sediments of the seabed over the cables are not calculated to change compared to the ambient temperature for buried cables and will only exceed 2°C within 5m of

the cables where cables are transitioning out of buried state to become surface laid e.g. at third-part asset crossings.

Different aspects of the Proposed Development will generate continuous or impulsive sound including geophysical survey equipment, vessel movements, HDD drilling, cable trenching, placement of cable protection, and UXO detonation (if required). The significance of the effects depends on the predicted source level (the apparent strength of a sound at a reference distance) and how the sound propagates through the water. The most significant source will be from UXO detonation.

0.3.8 Approach to Design

The design has been developed through an iterative process to avoid or reduce potential environmental effects, including:

- Review of good industry practices and guidance, including consideration of lessons learned from recent cable installation projects in the region e.g. BritNed, NEMO and installation of windfarm export cables.
- Pre-application consultation with fishing industry and nature conservation stakeholders to identify appropriate installation techniques for specific locations.
- Identification of sensitive environmental features through a desk-based assessment that used publicly available datasets and bathymetric, geophysical, geotechnical and environmental surveys of the seabed, and bird surveys of the intertidal mudflats.
- During cable route survey, acquisition of additional environmental data to investigate the extent and condition of potential reef habitats.

Assumptions which form part of the design of GridLink are outlined Table 3-13, Chapter 3 of the Environmental Report. These are referred to as embedded mitigation in the Environmental Report. These mitigation measures have then been supplemented by additional Project Specific Mitigation determined as a result of the assessment of each environmental topic.

0.4 Approach to the Assessment

0.4.1 Approach

The Marine Management Organisation (MMO) are obliged to grant a Marine Licence (within UK territorial waters) for power cable applications, however, environmental information can be requested by them to support the application and conditions can be included in any Marine Licence issued. The MMO confirmed, through an EIA Screening Opinion (reference EIA/2018/00042, dated 27 July 2018), that a statutory Environmental Impact Assessment (EIA) is not required for GridLink.

The Applicant recognises that it is required to provide environmental supporting information in support of its Marine Licence application. In addition, as an interconnector license holder, the Applicant has a duty to preserve amenity. The Applicant is committed to completing appropriate marine surveys, assessments of potential environmental effects and stakeholder consultations to fulfil this duty.

The Applicant considers it best practice to meet its obligations by undertaking a non-statutory Environmental Assessment. Whilst not a statutory EIA, the assessment has been undertaken in accordance with relevant best practice. This Environmental Report documents the assessment process, its findings and conclusions.

There are several different guidance documents available for terrestrial and marine applications which set out what an environmental assessment should include and suggested ways it can be undertaken. However, there are few prescriptive examples on how to measure the significance of an effect. The

Scottish Natural Heritage Handbook provides an example of a matrix showing effect significance related to sensitivity of the receptor and magnitude of change. This method can be applied to any marine project irrespective of its location in the UK and has been used as a guide for the assessment methodology in the Environmental Report.

The significance of the effect ranges from 'negligible' to 'major', with effects regarded as Not Significant if they are 'negligible' or 'minor' and Significant if they are 'moderate' or 'major'. The description of the assessment methodology adopted for the Proposed Development is set out in Chapter 4 of the Environmental Report.

A range of specialist studies, assessments and surveys have been carried out to inform the assessment. The data collected throughout these assessments and surveys have been used to define the baseline conditions against which effects have been measured and predicted, in turn helping to define the mitigation measures required.

Of pertinence is the requirement to undertake Habitats Regulations Assessment (HRA), Marine Conservation Zone (MCZ) Assessment and Water Framework Directive (WFD) Assessment as the Proposed Development crosses European marine sites, MCZs and relevant waterbodies respectively. These reports are standalone assessments, submitted alongside the Environmental Report and provided as Technical Appendices E, F and G respectively, that have been used to inform the Environmental Report and define mitigation measures required.

The assessment of significance is undertaken prior to any mitigation. Project Specific Mitigation will generally only be proposed if effects are Significant. Project Specific Mitigation are measures to be adopted and implemented during construction and operation that are over and above legal compliance. Appropriate, feasible and cost-effective mitigation measures have been proposed as necessary in each topic Chapter. All project specific mitigation commitments made in the Environmental Report are additionally listed in a Schedule of Mitigation provided as Chapter 15.

The significance assessment is repeated taking into consideration the application of Project Specific Mitigation, to determine whether there is likely to be a residual effect.

The assessment has also considered whether the Proposed Development could have the potential for cumulative effects with other present or reasonably foreseeable projects, plans or licensed activities. Cumulative effect assessment (CEA) is not required for pressures where it is concluded that the Proposed Development will have a significant effect (as project specific mitigation will already have been proposed); instead it focuses on pressures for which the assessment has concluded that there is a minor residual effect and assesses whether other plans or projects in the region would increase the likelihood of a significant effect occurring. If a cumulative effect is identified, Project Specific Mitigation is proposed. The CEA method has been informed by guidance provided in the "MMO Strategic Framework for Scoping Effects" (MMO 2014) but has been adapted to account for the volume of proposed projects in the Thames Estuary region.

Transboundary assessment has been an integral part of the assessment process. As a linear project that crosses two maritime jurisdictions (UK and France), transboundary effects will be limited. However, they have been considered by the assessment and discussed where relevant in the assessments and topic chapters.

0.4.2 Consultation

The Applicant has taken a pro-active approach to consultation, recognising that it is a critical activity in the development or a comprehensive and balanced assessment.

Discussions started in 2017 with local planning authorities, statutory bodies and other non-statutory stakeholder groups, and have continued throughout the assessment process. Stakeholders have had

the opportunity to inform route development, environmental surveys, Environmental Report scope and content and proposed mitigation measures.

Initially, a request for a Scoping Opinion (Intertek 2018) was submitted to the Marine Management Organisation in August 2018 in support of a non-statutory Environmental Report. This was followed by a request in November 2018 to consider an Addendum to the Scoping Report proposing (as a contingency) an alternative shore crossing method. The MMO provided a Scoping Opinion (ENQ/2018/00159) on 05 February 2019 to both the requests. All comments and data received during consultation and scoping has been used in the assessment process and has helped provide direction on the topics the Environmental Report focuses on.

Wider public consultation related to the Proposed Development has been achieved through:

- Project website (www.gridlinkinterconnector.com), including regular updates on progress and provision of project documents to view and/or download;
- Virtual public exhibition on the website, including live chat session on 4 September 2020, and Feedback Forms to receive comments on the Proposed Development;
- Online public consultation meeting held on 11 September 2020;
- Newspaper notices published in both local and national newspapers, and announcements on local radio and social media platforms;
- Information points (2) for the distribution of hard copies of project literature; and
- Telephone hotline to enable questions from persons without internet access or computer literacy.

During the restrictions imposed by COVID-19, physical public exhibitions and meetings have not been possible, so a virtual/online platform has been used. The full project (onshore and offshore elements) has been presented and the public given the opportunity to ask questions in person, online or by Feedback Forms and Contact Us forms. Issues raised during the consultation process have been considered within the Environmental Report.

0.5 Summary of Environmental Effects

0.5.1 Physical Environment

Existing Baseline: The Proposed Development starts in the Medway Estuary; a macro tidal estuary with a complex arrangement of tidal channels which drain around large islands and peninsulas with large areas of mudflat. The Proposed Development follows the main channel of the River Medway into the outer reaches of the Medway Estuary and into the Thames Estuary where it transverses areas of sandbanks. The currents and movement of sediments in the outer Thames Estuary are dominated by tidal flow. The sediment mobility indicators include sand streaks and ribbons, mega ripples and sand waves. The bathymetry gradually deepens towards the English Channel, reaching a maximum of 41m along the Preferred Cable Route before it shallows again towards the UK/ France EEZ boundary where there are areas of shallow sandbanks.

Seabed sediments along the Proposed Development generally comprise of silty and sand clays, silty sand and gravelly sand. Between KP66 and the UK/France EEZ boundary, chalk bedrock is close to the seabed surface and outcrops in places. Superficial sediments are present as a thin veneer / layer over the chalk, except where the South Fall and Sandettie Sandbank intersect the Proposed Development.

Generally, suspended sediment concentrations in the Medway Estuary are low and typically range from 0.1mg/l to 30mg/l, with the suspended load mainly comprising of re-suspended fine sediments, with the highest suspended sediment concentrations occurring close to high water on spring tides. Suspended sediment concentrations within the Thames Estuary vary ranging between 10mg/l to 3000mg/l.

Sediment samples taken during the cable route survey were tested for metal, organics and polycyclic aromatic hydrocarbons (PAH) concentrations. Metal concentrations were low across all nearshore grab sample sites (KP0 – KP50) and rarely exceeded any threshold values except for Arsenic, Chromium, Nickel and Mercury. Exceedances of threshold values for Mercury were within samples taken closest to the landfall and within the Medway Estuary. The Medway Estuary has a history of mercury pollution from historic dockyards and industrial facilities such as Kingsnorth Power Station, therefore it is unsurprising that exceedances are found here and are likely to be of historic anthropogenic origin. Concentrations of PAH in UK Offshore Survey samples were all below the limits of detection.

Environmental Appraisal Conclusion: The potential pressures considered by the assessment included penetration and disturbance including abrasion; changes in suspended solids (water clarity); local water flow (tidal current) changes; and physical change (to another seabed type). The assessment concluded there is the potential for **Significant effects** where external cable protection is deposited on sandy sediments within the Margate and Long Sands Special Area of Conservation (SAC) for the London Array OWF export cable crossing. As the sandy sediments present are a sub-feature of the Primary Feature of the SAC they are highly sensitive to a change in sediment type. In addition, the deposit of cable protection could lead to scour. The Environmental Appraisal and Water Framework Directive Assessment concluded all other effects are **Not Significant**.

Project Specific Mitigation Proposed: Careful consideration has been given to how the potential for scour can be reduced at the crossing and how to encourage sediment to build up over the cable protection, returning the seabed to a sand habitat. Features have already been incorporated into the design of the crossing to reduce scour, but in addition, it is proposed (Project Specific Mitigation PS1) that the crossing design will incorporate fronded mats which aim to capture sediment around and on the external cable protection. In addition, consultation with Blue Transmission London Array Ltd has indicated that they would be amenable to discussing whether the crossing angle could be reduced from 90 degrees to align the external cable protection to tidal flow (Project Specific Mitigation PS2). Changing the crossing angle to present less of a barrier to tidal flow will reduce turbulent flow at the crossing and subsequently reduce scour.

With respect to other crossing locations and areas where ground conditions may prove challenging for cable burial, Project Specific Mitigation (PS4) requires the cable installation contractor to try and achieve target depth of lowering without the need for external cable protection. Removing the requirement for external cable protection will remove the pressure-receptor pathway entirely resulting in no effect. Although this will not be feasible at crossings, it is anticipated that at least some of the areas assessed as locations for external cable protection due to ground conditions will not be required.

Residual Effect: The Environmental Appraisal concluded that implementation of the Project Specific Mitigation will either remove the pressure-receptor pathways resulting in no effect, or reduce the significance of effects to Minor, which is **Not Significant**.

0.5.2 Protected Sites

The Proposed Development has been subject to the HRA process and the MCZ Assessment process as it crosses the following sites: Medway Estuary and Marshes Special Protection Area (SPA), Ramsar site and Site of Special Scientific Interest (SSSI); Thames Estuary and Marshes SPA and Ramsar site; Outer Thames Estuary SPA; Southern North Sea SAC; Margate and Long Sands SAC; Medway Estuary MCZ; Goodwin Sands MCZ and Foreland MCZ. In addition, it crosses Prohibited Area 4 – Pan Sand Hole, a Kent and Essex Inshore Fisheries and Conservation Authority Byelaw Area.

0.5.2.1 HRA conclusions

Detailed HRA screening assessment has been conducted on the Proposed Development which concluded that significant effects are likely or uncertain on the Qualifying Features and conservation objectives of three sites and that Appropriate Assessment (AA) is required:

- Margate and Long Sands SAC (site code: UK0030371);
- Southern North Sea SAC (site code: UK0030395); and
- Bancs des Flandres SAC (site code: FR3112006)

Further to screening, information to Inform Appropriate Assessment has been provided which concludes:

Margate and Long Sands SAC

1. With respect to the deposit of external cable protection in the Margate and Long Sands SAC there is the potential for an adverse effect on the conservation objectives for the Primary Feature 'Sandbanks which are slightly covered by sea water all the time'.
2. Project specific mitigation has been proposed; the objective of which is to encourage sediment build up over the external cable protection returning the seabed to a sand habitat.
3. Evidence has been provided to demonstrate that the project specific mitigation proposed will be an effective long-term solution in mitigating adverse effects.
4. With implementation of the proposed mitigation, the Proposed Development **will not have an adverse effect on the integrity of the Margate and Long Sands SAC** either alone or in combination with other plans or projects.

Southern North Sea SAC

1. With respect to the high order detonation of unexploded ordnance (UXO) in the Southern North Sea SAC there is the potential for an adverse effect on the conservation objectives for the Primary Feature harbour porpoise (*Phocoena phocoena*).
2. It cannot be ruled out that the Proposed Development will not have significant in-combination effects with other projects in the Southern North Sea SAC given the potential for other noisy activities (pile driving and UXO detonation) and the uncertainty surrounding construction programmes. Mitigation has been proposed in the form of coordination with the MMO and other developers to manage this risk.
3. Project specific mitigation has been proposed including low order detonation (deflagration), a seasonal restriction, acoustic deterrence and coordination with other developers in the region. The objectives of mitigation are to reduce the significance of effects by avoiding the requirement for detonation; reducing the size of the charge used; and ensuring animals are not near to the detonation.
4. The mitigation measures proposed have proven successful for similar projects in UK waters. They are proven effective at reducing the magnitude of the effect by reducing the numbers of animal exposed to the noise levels that may cause injurious effects. The sensitivity of the receptor is also reduced as the animal is encouraged to move out of an area and therefore the pathway for the effect is reduced.
5. With implementation of the proposed mitigation, the Proposed Development **will not have an adverse effect on the integrity of the Southern North Sea SAC** either alone or in combination with other plans or projects.

Bancs des Flandres

1. With respect to the detonation of UXO in UK waters and transboundary effects from underwater noise changes on the Bancs des Flandres there is the potential for an adverse effect on the conservation objectives for the Primary Feature harbour porpoise (*Phocoena phocoena*), grey seal (*Halichoerus grypus*) and harbour seal (*Phoca vitulina*).
2. Significant intra-project effects between the Proposed Development and the French Marine components of GridLink can be adequately managed through the Applicants commitment to not undertake UXO detonation in UK and French waters on the same day.
3. Significant in-combination effects with the Thanet Extension offshore windfarm are unlikely but cannot be categorically ruled out, however, mitigation has been proposed in the form of coordination with the MMO and other developers, which will avoid the two projects coinciding and remove the pathway for effect.
4. Project specific mitigation has been proposed including low order detonation (deflagration), a seasonal restriction and acoustic deterrence. The objectives of mitigation are to reduce the significance of effects by avoiding the requirement for detonation; reducing the size of the charge used; or ensuring animals are not near to the detonation.
5. The mitigation measures proposed have proven successful for similar projects in UK waters. They are proven effective at reducing the magnitude of the effect by reducing the numbers of animal exposed to the noise levels that may cause injurious effects. The sensitivity of the receptor is also reduced as the animal is encouraged to move out of an area and therefore the pathway for the effect is reduced.
6. With implementation of the proposed mitigation, the Proposed Development **will not have an adverse transboundary effect on the integrity the Bancs des Flandres SAC** either alone or in combination with other plans or projects.

0.5.2.2 MCZ Assessment conclusion

Detailed screening was undertaken on eleven MCZs initially identified as requiring consideration within the MCZ Assessment process. Screening concluded that there exists a pressure-receptor pathway between the Proposed Development and the Protected Features of the following five MCZs and that Stage 1 Assessment is required:

- Medway Estuary MCZ (site code: UKMCZ0011);
- Swale Estuary MCZ (site code: UKMCZ0041);
- Thanet Coast MCZ (site code: UKMCZ0017);
- Goodwin Sands MCZ (site code: UKMCZ0061); and
- Foreland MCZ (site code: UKMCZ0060).

The Stage 1 Assessment has concluded that for all five MCZs assessed the conditions of Section 126 of the MCAA 2009 can be met. There is **no significant risk that the Proposed Development either alone or in combination with other plans or projects will hinder the achievement of the conservation objectives** stated for the MCZs; and the MMO can exercise its functions to further the conservation objectives for the MCZs.

0.5.2.3 KEIFCA Byelaw assessment conclusion

The Proposed Development crosses the Pan Sand Hole prohibited area from KP41-KP47. Pan Sand Hole prohibited area is located within the Margate and Long Sands SAC, which is designated for the Annex I habitat 'sandbanks which are slightly covered by sea water all the time'.

The presence of the biotope 'dense *Lanice conchilega* and other polychaetes in tide-swept infralittoral sand and mixed gravelly sand' within the Margate and Long Sands SAC was a primary reason for the designation of the KEIFCA Byelaw prohibited area Pan Sand Hole. This habitat was not identified within the Asset Placement Corridor. The Environmental Appraisal concluded that potential effects from the Proposed Development will be **Not Significant.**

0.5.3 Benthic Communities

Existing Baseline: Approximately 71.5km of the Proposed Development lies within sites designated as European (SACs) or nationally protected sites (MCZs), designated to protect benthic habitats. As such, four Annex I habitats (Estuaries; Sandbanks which are slightly covered by seawater all the time; Mudflats and sandflats not covered by seawater at low tide; and Biogenic Reef), five Protected Features of an MCZ (Subtidal coarse sediment; Subtidal sands; Subtidal muds; Peat and clay exposures; and *Sabellaria spinulosa* reefs), and four Habitats of Principal Importance (Subtidal sands; Sheltered muddy gravels; Mud habitats in deep waters; and Subtidal chalk) were identified within the Asset Placement Corridor. In addition, four juvenile ocean quahog (*Arctica islandica*) were identified in a grab sample. A total of 24 habitats were identified across the Asset Placement Corridor.

Environmental Appraisal Conclusion: The GridLink Marine HRA (Technical Appendix E) and the GridLink MCZ Assessment (Technical Appendix F) provide comprehensive assessments of the potential effects on habitats of conservation importance within protected sites. The conclusions of these assessment are summarised in Section 5.2. The Environmental Appraisal focused on habitats of conservation importance found outside protected sites or within a protected site not specifically designated for that feature. The potential pressures considered by the assessment included penetration and disturbance including abrasion; siltation rate changes; and physical change (to another seabed type). **No Significant effects** were identified on habitats of conservation importance identified outside protected sites or within a protected site but which are not a Qualifying Interest/Protected Feature.

Project Specific Mitigation Proposed: Although no significant effects have been identified, additional Project Specific Mitigation has been proposed as best practice for two pressures which were assessed as Not Significant. This is to ensure the Installation Contractor takes reasonable additional measures to reduce the footprint of the Proposed Development. The objectives of these measures are to ensure the Installation Contractor respects the goals that the Applicant is seeking to achieve by minimising the use of external cable protection and minimising the displacement of the seabed (PS4); avoid deviation off the Preferred Cable Route which has been identified as the best route that balances environmental and social constraints (PS5); and avoid anchor placement on sensitive habitats (PS7).

Residual Effect: Through the implementation of project specific mitigation proposed as a means of best practice, residual effects on benthic communities have been assessed as **Not Significant**.

0.5.4 Fish & Shellfish

Existing Baseline: The Proposed Development directly interacts with spawning grounds (the location where eggs are laid) and the waters which act as nursery areas (the location where juveniles are common) for 12 commercially important fish species. Key species with demersal life stages known to spawn within the Proposed Development include Atlantic cod, Atlantic herring, lemon sole, European plaice, sandeel, common sole, whiting, and European bass. Of these species sandeel and Atlantic herring are known to be particularly sensitive to seabed disturbance because they spawn in very specific substrates. A sandeel and herring habitat assessment has been conducted to support the Environmental Appraisal process. It concluded that the Proposed Development crosses the Downs Spawning Grounds and partly overlaps the Blackwater Spawning Grounds. Review of sediment data identified two locations classified as Prime herring spawning, and three locations as Sub-Prime habitat. With respect to sandeel habitat, the Proposed Development crosses a sandeel spawning ground and

review of grab sample data has identified the presence of four Prime and three Sub-Prime spawning habitat locations within the Proposed Development.

Protected species known to occur within the Proposed Development include the Bullhead, European eel, European smelt, Atlantic cod, Atlantic herring, Atlantic mackerel, European plaice, Sandeel, Sea lamprey, Common sole, Tope, and Whiting.

Brown shrimp, crabs, cockle, lobsters, native oyster, Pacific oyster, scallop, whelk, and blue mussel are important shellfish within the area of the Proposed Development.

Environmental Appraisal Conclusion: The potential pressures considered by the assessment included penetration and/or disturbance of the substrate below the seabed; physical change (to another seabed type); siltation rate changes, including smothering (depth of vertical sediment overburden); changes in suspended solids (water clarity), transitional elements and organo-metal contamination, underwater noise changes and electromagnetic field changes. **No Significant effects** were identified on fish and shellfish.

Project Specific Mitigation Proposed: Although the assessment concluded effects will be Not significant, through consultation with the fishing industry, it has been identified that additional Project Specific Mitigation would be welcomed, as best practice. Mitigation aims to minimise SSC concentrations and provide assurance through monitoring that commercial shellfish beds (principally cockles) will not be significantly affected as per the conclusion of the Environmental Report; ensure that key shellfish grounds are not affected by UXO detonation; and minimise intrusive works within the Atlantic herring spawning grounds during key seasons.

Residual Effect: Residual effects have been assessed as **Not Significant**.

0.5.5 Marine Birds

Existing Baseline: The Medway Estuary, Outer Thames Estuary and English Channel and the adjacent coastlines are important for a wide range of nationally and internationally important estuarine and seabird populations, acting as both breeding sites and foraging areas. The Kingsnorth landfall is sited within the Medway Estuary and Marshes SPA, Ramsar site and SSSI. The intertidal area adjacent to the converter station site is an expanse of mudflats important as a feeding ground for the Qualifying Interest features of the sites. Most birds use the SPA for overwintering and the period at which the fewest species are present is May to September; in September only one designated feature is present in significant numbers (non-breeding avocet). The Proposed Development also crosses the Outer Thames Estuary SPA, designated for non-breeding Red-throated diver and breeding common and little tern.

Environmental Appraisal Conclusion: A comprehensive assessment of the potential effects on marine birds is presented in the GridLink Marine HRA (Technical Appendix E). Of the 14 sites designated to protect birds assessed during Stage 1 screening, seven of the sites were screened out because either a pathway between the Proposed Development and the Primary and Qualifying Features could not be identified or a pathway exists but there is no physical overlap of the pressure being considered and the Primary and Qualifying Feature. A possible pressure-receptor could be identified for seven sites and a more detailed assessment of the potential for likely significant effects were conducted taking into consideration the features of the sites. The sites assessed for potential likely significant effects were Medway Estuary and Marshes SPA, Ramsar and SSSI; Thames Estuary and Marshes SPA and Ramsar; Outer Thames Estuary SPA; and Foulness (mid-Essex Coast Phase 5) SPA. Stage 1 Screening concluded for each of the seven sites that there was **no potential for a likely significant effect** from the Proposed Development either alone or in-combination with other plans or projects and Appropriate Assessment is not required.

Project Specific Mitigation Proposed: Although the HRA concluded effects will be Not Significant, and without prejudice to this conclusion, the Applicant has proposed that no HDD works will be undertaken

in the Medway Estuary between 01 October to 31 April (to further mitigate effects on overwintering birds).

Residual Effect: Residual effects have been assessed as **Not Significant**

0.5.6 Marine Mammals & Marine Reptiles

Existing Baseline: Marine mammals present in the Proposed Development include cetaceans (whales, dolphins and porpoises) and pinnipeds (seals). No otters have been recorded along the Proposed Development.

Cetaceans found within the southern North Sea are low in diversity and abundance compared to other areas of UK waters. Harbour porpoise are the most abundant and commonly sighted species in the area. The Proposed Development crosses the winter grounds for the Southern North Sea SAC. In nearshore waters common bottlenose dolphin are recorded occasionally, and offshore white-beaked dolphin, short-beaked common dolphin, fin whale, minke whale and long-finned pilot whales are recorded occasionally.

Grey seal and harbour seal (also called common seal) live and breed in UK waters. Both species breed at haul out sites along the Kent coast, Thames Estuary and Norfolk coast (Reiss *et al.* 2010).

Environmental Appraisal Conclusion: The potential pressures considered by the assessment included underwater noise changes and electromagnetic changes. The Environmental Appraisal concluded that electromagnetic changes and the generation of underwater noise from continuous sources (such as vessel movements and cable trenching) and from geophysical survey (impulsive noise) will have effects assessed as not significant on marine mammals. The detonation of a UXO will cause brief, but wide-spread disturbance to marine mammals and may cause injury. Depending on the location of the UXO detonation, marine mammals in French waters could also be affected. As there are several other projects within the region which may also require UXO detonation or piling there is also the potential for cumulative effects, particularly with respect to the Southern North Sea SAC. The Environmental Appraisal concluded that the high order detonation of UXO has the potential to have a **Significant effect** on marine mammals; and that it cannot be ruled out that there will not be **Significant cumulative effects** and **Significant transboundary effects**. Effects from electromagnetic changes were assessed as **Not Significant**.

Project Specific Mitigation Proposed: The most effective mitigation is to avoid the need for detonation completely. Mitigation embedded into the design of the project seeks to do this by establishing a decision-making strategy in which UXO detonation is the last option. If detonation is required it is best practice to follow the JNCC guidelines for minimising the risk of injury to marine mammals from using explosives. However, to further reduce the significance of effect, a range of industry standard best practice mitigation has been proposed which has proven successful on similar projects across the Southern North Sea and UK. The objectives of which are to reduce the size of the charge by using low order detonation (deflagration) on all charge sizes; ensure marine mammals are not near the detonation e.g. through use of seasonal restrictions, passive acoustic monitoring to support visual observations and use of an acoustic deterrent device; and to coordinate UXO detonations within the project and with developers that have 'noisy' activities in the winter grounds of the Southern North Sea SAC to ensure that detonation will not lead to significant disturbance of marine mammals. In addition, the Application will apply for an EPS License for the UXO detonations.

Residual Effect: Implementation of the combined embedded and Project Specific Mitigation will reduce the significance of the effect from Major for injurious effects and Moderate for disturbance to Minor, which is **Not Significant** for both types of effect.

0.5.7 Navigation Risk Assessment

Existing Baseline: A Navigation Risk Assessment has been undertaken for the Proposed Development and is presented in Technical Appendix J. The Proposed Development lies within the Peel Ports authority area; and the Port of London Authority area. It runs parallel to one of the main shipping channels in the Thames Estuary, the Princes Channel; crosses the Medway Approach Channel traffic separation scheme (TSS), the Princes Channel TSS and the Dover Strait TSS in the English Channel. The total length of the Proposed Development within restricted navigational areas is 29.8km. In addition, it is within 1km of ten defined anchoring area although it does not pass through any anchoring areas. Vessel counts peak between May and August, but monthly vessel numbers are high at over 3800 unique vessels every month all year. Shipping density is therefore high for most of the Preferred Cable Route.

Navigation Risk Assessment Conclusion: The potential hazards considered by the assessment included displacement of vessels; disruption to right of passage; collision risk; accidental anchoring on unburied cable; anchor snagging and cable drag including emergency anchoring; change in water depth - affecting safe navigation; electromagnetic changes affecting magnetic compasses, project vessels blocking navigational features and anchorages; and extreme weather conditions. In the risk assessment the hazard has been ranked by expected risk, based on the estimated frequency and consequence with no mitigation measures applied creating a 'Inherent Risk' to the project. It concluded that prior to mitigation there is the potential that the Proposed Development poses a **Significant risk** to navigation, particularly with respect to displacement of shipping vessels with works within the Dover TSS and Medway; collision risk; blockage of navigational features and anchorages, especially in Port Authority Areas and from the reduction in water depth impeding safe navigation. All other potential effects were assessed as **Not Significant**.

Project Specific Mitigation Proposed: Due to the high shipping density in the region and the proximity to major shipping channels project specific mitigation has been proposed to reduce the sensitivity of shipping. This includes, but is not limited to, ensuring that the Installation contractor establishes a communications protocol with Peel Ports and Port of London Authorities (PS33, PS34, PS35, PS36 and PS37), Trinity House (PS32) and yacht clubs in the area, including Lower Halstow Yacht Club, the Medway and Swale Boating Association (PS42) and Channel Navigation Service and Dover Coastguard Operations (PS46) to ensure disruption is minimised.

To reduce the sensitivity of shipping to the water depth changes the Maritime and Coastguard Agency will be consulted once final designs for rock berms are complete to determine whether additional mitigation will be required such as aids to navigation i.e. marker buoys.

Residual Effect: All hazards have been reduced to 'As Low As Reasonably Practicable' (ALARP) through the embedded and project specific mitigation. Even with risk control measures in place to mitigate the frequency and/or consequence of a hazard, several remain with a Moderate risk classification. For displacement of vessels the residual risk remains moderate as although these additional measures will facilitate the management of disruption there will still be temporary loss of access that will require re-routing of existing shipping. For collision risk and blockage of navigation features, additional measures will facilitate the risk control and the residual risk has been reduced to moderate. The risk for a reduction in water depth remains moderate because specific requirements for and designs of external cable protection have not been confirmed. However, with respect to the residual effect of the Proposed Development on shipping and navigation in the region, the risks identified by the NRA are of short duration with limited spatial effects and therefore will be no **significant residual effects**.

0.5.8 Commercial Fisheries

Existing Baseline: Most of the Proposed Development is within the UK territorial waters 12-mile fishery limit. Around 76% of the Proposed Development is inside the UK 6-mile fishery limit and falls

within the fisheries district of Kent and Essex Inshore Fisheries and Conservation Authority (KEIFCA). The Medway Estuary is a nursery ground for commercially important fish species, including European bass. Fishing in the River Medway is limited to a small number of Freemen fisherman from the Rochester Oyster and Floating Fishery (ROFF) guild. Demersal trawling, static gear potting and oyster dredging is carried out in the Medway Estuary (between KP0 and KP10) for the purpose of training ROFF fishing apprentices.

Fishing activity in the Thames Estuary (KP10 to approximately KP80) is characterised by inshore demersal and shellfish fishing by the local Thames Estuary fishing fleet. Six key fisheries have been identified along the Proposed Development; potting for whelks; potting for lobster and crab; bottom drift netting for Dover sole; general demersal trawl, beam trawling and anchored nets targeting whitefish; trawling for shrimp; and suction dredging for cockles. Through consultation with local fishing organisations and vessels, it has been determined where each of the six fisheries spatially overlaps with the Proposed Development. Dredging for oysters is also known to occur in the region but data provided by KEIFCA indicates that it occurs south of KP30 to KP35.

The Outer Thames Estuary is classified as Shellfish Waters, being designated for the protection of shellfish growth and production. There exists a well-established cockle fishery in the region, one of the largest such fisheries in the UK. The Proposed Development overlaps areas classified as cockle beds with other commercial areas in proximity between KP0 to KP30 and KP45 to KP60.

All fisheries have key seasons and there is no one month in the year where at least one fishery is not active. The peak period is July to October (inclusive).

Environmental Appraisal Conclusion: The potential pressures considered by the assessment included temporary displacement of fishing activity (including required static gear clearance); physical change (to another seabed type); temporary habitat disturbance affecting commercial stocks; permanent habitat loss affecting commercial stocks; changes in suspended sediments (water clarity) indirectly leading to effects on commercially targeted species; snagging; underwater noise changes; change in water depth; and transition elements and organo-metal contamination. The Environmental Appraisal concluded that there is the potential for **Significant effects** from the pressures physical change (to another seabed type), snagging resulting from obstruction on the seabed and change in water depth and a change in water depth. With respect to physical changes to the seabed and snagging the Environmental Appraisal conclusion relates to the position of external cable protection in areas where bottom drift netting is practised. In these areas the presence of cable protection has the potential to close specific drift lines. External cable protection also has the potential to reduce water depth limiting safe navigation in certain areas, whilst in other areas the presence of the cable protection has the potential to cause scour. Significant scour depressions could also hinder certain fishing gear types e.g. trawling, static gear and bottom drift nets, requiring vessels to make permanent changes to established fishing areas. The potential effects from all other pressures were assessed as **Not Significant** including effects on the cockle fishery from suspended sediments.

Project Specific Mitigation Proposed: An extensive series of project specific mitigation has been developed in consultation with the local fishing industry. Much targets specific sections of the Preferred Cable Route where specific sensitivities to a certain fishery have been identified. To address potential significant effects measures have been proposed for the London Array crossing; the objective of which is to reduce scour and encourage sediment to build up on the crossing post-installation with the aim to return the seabed back to its sandy sediment. It is proposed that frond mats will be incorporated into the crossing design; frond mats locally interrupt and reduce the velocity of the near bottom currents encouraging sediment deposition and preventing scour. Over time sediment builds up to form an embankment on and around the mats. It is anticipated that once sediment builds up on the mats and crossing it will be a suitable substrate for bottom drift netting. In other locations the objective of the project specific mitigation is to reduce the footprint of the cable protection material

as far as possible. Project specific mitigation id PS4 seeks to ensure that Contractor is cognisant of this objective and makes reasonable endeavours to respect it.

With respect to the snagging hazard, fourteen project specific mitigation measures have been identified that seek to reduce the magnitude of effect by removing the hazard or removing the risk that fishing vessels will be exposed to the hazard. For example, PS16 through to PS18 are concerned with the provision of guard vessels to protect fishing from cable exposed on the seabed. PS13 through to PS15 target the risks associated with cutting out-of-service cables and propose measures to reduce snagging hazards because of this activity. Whilst PS20 through to PS23 monitors the success of the project in achieving the commitment to reduce snagging hazards by committing to undertaking bottom drift net surveys and trawl surveys at key locations across the Preferred Cable Route. These surveys commenced in September 2020. PS46 includes a commitment for the Applicant to provide a Technical Note to all fishing vessels in the region (distributed by the FLO) that outlines all the positions and dimensions of any potential snagging hazards i.e. cut ends and clump weights.

Although there may be short- to medium-term effects on the fishery in the long-term it is expected that established bottom net drift lines and trawl lines can be maintained. Project specific mitigation PS20 through to PS23 monitors the success of the project in achieving this by committing to undertaking bottom drift net surveys and trawl surveys at key locations across the Preferred Cable Route. These will establish that the Preferred Cable Route was suitable for the identified fishery prior to installation work starting and confirms at the end that the seabed has been returned to a fit state to allow the fishery to continue in future.

In addition to the above, Project Specific Mitigation has been requested by the fishing industry to be considered as best practice for the Thames Estuary region for certain pressures which the Environmental Appraisal concluded were Not Significant. The Applicant has agreed to these measures, the objectives of which are to ensure lines of communication between the Applicant and fishing organisations are clearly outlined and understood by all parties; if feasible avoid peak seasons, thereby minimising disruption to the industry; minimise suspended sediment concentrations and provide assurance through monitoring that the cockle beds will not be significantly affected. In addition deflagration will be used on all charges to provide assurance that key shellfish grounds will not be affected.

Residual Effect: As outlined above, although there may be short- to medium-term effects on the fishery in the long-term it is expected that within the implementation of the project specific mitigation established bottom net drift lines and trawl lines can be maintained. The residual effect of the pressures physical change to another seabed type and snagging resulting from obstructions on the seabed have been assessed as **Not Significant**. In line with the conclusions of the NRA, as a precaution it has been concluded that a change in water depth at selected locations associated with the deposit of cable protection could result in **Significant residual effects.**

0.5.9 Marine Archaeology

Existing Baseline: The potential to encounter sub-seabed palaeo-environmental data in the Medway Estuary, the Thames Estuary and in the southern North Sea is known to be high. Assessment of the sub-bottom profiler and geotechnical survey data collected within the Proposed Development has revealed the presence of a series of palaeo-channels along the Asset Placement Corridor, including deposits formerly associated with (semi-)terrestrial environments. Seven of the 108 vibrocores reviewed have been identified for further geo-archaeological investigation.

Thirty-one wrecks, 10 aircraft, 25 obstructions, five findspots and 12 monuments are recorded within the Asset Placement Corridor. Of these, 6 wrecks and all 10 aircraft are protected under the 'Protection of Military Remains Act 1986.' Analysis of the geophysical data collected within the Proposed Development identified 283 geophysical anomalies, 37 of which relate to known historical assets.

Environmental Appraisal Conclusion: The potential pressures considered by the assessment were direct damage to archaeological assets by intrusive seabed works; and indirect damage to archaeological assets. The assessment concluded effects on palaeo-environmental deposits will be **Not Significant.** The implementation of the GridLink Written Scheme of Investigation and Protocol for Archaeological Discoveries will mitigate risks to unidentified marine archaeology and cultural heritage that may be encountered throughout the works. The potential for **Significant effects** on archaeological assets have been identified in the Asset Placement Corridor primarily from aspects of the Proposed Development such as pre-sweeping, pre-lay grapnel run, cable burial and from the anchors of works vessels.

Project Specific Mitigation Proposed: To mitigate potential effects, Project Specific Mitigation (PS39) in the form of archaeological exclusion zones (AEZs) of between 10m and 180m radius, centred on the recorded location of each asset or anomaly, have been assigned. Where deemed necessary, the precautionary principle has been adopted and AEZs have been proposed even though the assessment concluded a negligible effect on the anomaly being assessed. The Preferred Cable Route encroaches directly on 18 proposed AEZs. Four of these are deemed to be of medium, and 14 of low, archaeological potential (or receptor significance). The possibility that these anomalies are indicative of wreckage or submerged features cannot be discounted. As the AEZs will be encroached by the Preferred Cable Route, either the cable will be routed around the AEZs or ground-truthing, by remotely-operated vehicle (ROV) or diver surveys, will be undertaken to determine the extent of the anomaly so the cable can be micro-sited around any potential archaeological asset.

Residual Effect: The implementation of Project Specific Mitigation will reduce the effect to **Not Significant**.

0.5.10 Intra-Project, Cumulative and Transboundary Effects

0.5.10.1 Intra-project effects

Typically, intra-project effects can occur between different components of the same project from activities which are geographically close to each other and have the potential for pressures they exert on receptors to overlap spatially or temporally. For a linear interconnector cable such as GridLink, the scope of intra-project effects is limited to the interfaces between onshore and offshore project components i.e. between the Proposed Development and UK Onshore. At the marine interfaces, e.g. between the Proposed Development and the French Marine component, the effects from the cable installation will move with the installation spread and therefore there is no spatial or temporal overlap; it is a continuation of the effects along the linear project. The significance of effects is therefore considered by the individual environmental assessments for each jurisdiction.

Two potential pressure-receptor pathway at the interfaces have been considered by the Environmental Appraisal process as follows:

- A pressure-receptor pathway exists relating to potential cumulative effects (PCE) on birds in the Medway Estuary and Marshes SPA and Ramsar at the interface between the between the Proposed Development and UK Onshore; and
- A pressure-receptor pathway exists relating to PCE on marine mammals and specifically harbour porpoise in the Southern North Sea SAC and Bancs des Flandres SAC at the interface between the Proposed Development and the French Marine component.

The significance of effects has been assessed in the GridLink Marine Habitats Regulations Assessment (HRA) – Technical Appendix E which concluded:

- The combination of visual disturbance and above water noise from the UK Onshore and Proposed Development will not result in significant intra-projects effects on bird species within the Medway Estuary and Marshes SPA, Ramsar and SSSI. **No Significant intra-project effects** are expected

- The Applicant is committed to ensuring that there will not be UXO detonations on the same day within the Proposed Development and French Marine component of GridLink to avoid the potential for significance adverse effects on harbour porpoise within the Southern North Sea SAC and Bancs des Flandres SAC. **No Significant intra-project effects** are expected.

0.5.10.2 Cumulative effects

Assessment of PCE on biological receptors: The assessment of in-combination effects for biological receptors has been completed following the HRA and Marine Conservation Zone (MCZ) Assessment processes; and is presented in full in Technical Appendix E – GridLink Marine HRA and Technical Appendix F – GridLink MCZ Assessment. The assessments concluded:

- For European sites where alone, the Proposed Development will not have a significant effect on the European site, **No significant in-combination effects** have been identified.
- With respect to the pressures: penetration and/or disturbance, habitat structure changes – removal of substratum (extraction), physical change to another seabed type and water flow (tidal current) changes as a result of the requirement for external cable protection and pre-sweeping within the Margate and Long Sands SAC the Stage 2 Information to Inform AA assessment of in-combination effects concluded that there will be **No significant in-combination effects** between the London Array Wind Farm and Extension, the North Edinburgh Channel (dredged material disposal site), NeuConnect Interconnector and Thames Estuary Channel Management, demersal fishing and the Proposed Development.
- With respect to the pressure underwater noise changes as a result of UXO detonation (if required) the Stage 2 Information to Inform AA assessment concluded that given the uncertainty around the other construction activities occurring within the SNS SAC, and the fact that it is unknown where, when and if UXO detonation would be required for the Proposed Development **it cannot be ruled out that in-combination effects will not occur** and mitigation measures have been proposed to manage the risk.
- With respect to MCZs, **No in-combination effects** were identified.

Assessment of PCE on socio-economic receptors: Chapter 14 presents the CEA undertaken on commercial fisheries and shipping. The assessment methodology was based on the MMO Strategic Framework for Scoping Effects (MMO 2014a). However, due to the sheer number of plans, projects and activities within the study area (195) it was not feasible to follow this process exactly and to provide an individual assessment for all plans, projects and activities. Instead, a map-based approach was used for the assessment to determine the area of sea that has been affected by other plans and projects which could act in-combination with the Proposed Development to have the following potential pressures: temporary displacement of shipping and commercial fisheries; snagging resulting from obstructions on the seabed; reduction in water depth impeding safe navigation; physical change (to another seabed type); temporary habitat disturbance; changes in suspended sediment (water clarity); and underwater noise changes. It concluded that there will be **No Significant cumulative effects** on commercial fisheries or shipping.

0.5.10.3 Transboundary effects

GridLink crosses two maritime jurisdictions (UK and France). An environmental assessment has been conducted for each jurisdiction, as well as the UK and French onshore components, and as such transboundary assessment has been an integral component of the environmental assessment.

It is anticipated that transboundary effects will be limited to sediment dispersion and underwater noise related to the detonation of UXO. These effects will be limited in spatial extent to <1km for sediment deposition and 26km for effects on marine mammals from the jurisdictional boundary. Consequently, the only country potentially affected by transboundary effects is France.

With respect to the deposition of sediment the scale and consequences of transboundary effects due to the Proposed Development will be less than those in UK waters and are considered Not significant.

With respect to the pressure underwater noise changes as a result of UXO detonation (if required) the Stage 2 Information to Inform AA assessment concluded that with implementation of the combined embedded and Project Specific Mitigation the Proposed Development will not have a significant adverse effect on the integrity of the Bancs des Flandres SAC. **No significant transboundary effects**

0.6 Conclusions

This Marine Environmental Report presents a comprehensive assessment of the potential effects of the installation, operation (including maintenance and repair) and decommissioning of the Proposed Development and sets out embedded mitigation and proposes project specific mitigation to avoid or reduce significant effects to an acceptable level.

The embedded mitigation and project specific mitigation, as set out in a Schedule of Mitigation in Chapter 15, will form the basis of an Environmental Management Plan to be implemented during the installation and operation of the interconnector.

Following the environmental assessment of the residual effects on the physical, biological and human environments, the following can be concluded:

- Intrusive works on the intertidal mudflats at Kingsnorth have the potential to cause significant effects on estuarine processes and protected bird species. The Applicant is proposing to employ a trenchless technique (horizontal directional drilling) whereby the sensitive intertidal area, part of the Medway Estuary and Marshes Special Protection Area (SPA), Ramsar and Site of Special Scientific Interest (SSSI) and Medway Estuary Marine Conservation Zone (MCZ) is avoided. This will ensure that there are **no significant effects** on estuarine processes or bird species.
- The main effects associated with the Proposed Development are anticipated to be localised, temporary disturbance to the seabed during installation. The cables will be buried in the seabed between 1.7m and 3.5m in depth; depth of lowering depends on the sediment conditions and external risks at specific locations. For all subtidal habitats (benthic communities) and fish species, this will result in effects which are **Not Significant**. In addition, there will be **no significant effects** on the Kent and Essex inshore Fisheries and Conservation Authority (KEIFCA) Pan Sand Hole Byelaw Area. Without prejudice to this conclusion, Project Specific Mitigation has been proposed as best practice to minimise displacement of the seabed and intrusive works in sensitive areas; avoid deviation from the GridLink Preferred Cable Route; avoid anchor placement is sensitive habitats; and minimise the use of external cable protection.
- The deposit of external cable protection for the crossing of the London Array Offshore Windfarm Export cables has the potential to result in significant effects on the seabed sediments of the Margate and Long Sands Special Area of Conservation (SAC) and commercial fisheries. As the sandy sediments present are a sub-feature of the Primary Feature of the SAC they are highly sensitive to a change in sediment type. In addition, the deposit of cable protection could lead to scour and snagging of fishing gear. The presence of cable protection has the potential to hinder certain fishing gear types e.g. trawling, requiring vessels to make permanent changes to established fishing areas. Project Specific Mitigation has been proposed, the objective of which is to reduce scour and encourage sediment to build up on the crossing post-installation, with the aim to return the seabed back to its sandy sediment. It has been proposed to incorporate frond mats into the crossing design to provide a long-term sustainable solution to encourage re-sedimentation. It is anticipated that once sediment builds up on the mats and crossing it will return the sediment feature of the SAC and still be a suitable substrate for bottom drift netting. Although there may be short-term effects on the SAC and commercial fishery, implementation of the project specific mitigation will

ensure there will be **no significant residual effects.** Post installation monitoring will also be undertaken to validate the effectiveness of the mitigation proposed.

- The Proposed Development crosses seven European Sites and three MCZs; it has therefore been subject to the Habitats Regulations Assessment process and MCZ Assessment process which concluded:
  - With respect to the deposit of external cable protection in the Margate and Long Sands SAC there is the potential for an adverse effect on the conservation objectives for the Primary Feature ''Sandbanks which are slightly covered by sea water all the time' and Appropriate Assessment is required. Therefore, Project Specific Mitigation has been proposed with the objective of encouraging sediment build up over the external cable protection to return the seabed to a sand habitat. Evidence has been provided to demonstrate that the project specific mitigation proposed will be an effective long-term solution in mitigating adverse effects. Post installation monitoring will also be undertaken to validate the effectiveness of the mitigation. With implementation of the proposed mitigation, the Proposed Development **will not have an adverse effect on the integrity of the Margate and Long Sands SAC** either alone or in combination with other plans or projects.
  - For pre-sweeping in the Margate and Long Sands SAC there is the potential for an adverse effect on the conservation objectives for the Primary Feature ''Sandbanks which are slightly covered by sea water all the time' and Appropriate Assessment is required. The Information to Inform AA concluded that pre-sweeping **will not have an adverse effect on the integrity of the Margate and Long Sands SAC** either alone or in combination with other plans or projects.
  - With respect to the high order detonation of unexploded ordnance (UXO) in the Southern North Sea SAC, there is the potential for an adverse effect on the conservation objectives for the Primary Feature harbour porpoise and Appropriate Assessment is required. A similar conclusion was reached for the potential for transboundary effects of the Primary Features harbour porpoise, grey seal and common seal of the Bancs des Flandres SAC (France). This assessment also applies more widely to all marine mammals within the Proposed Development which are European Protected Species. It cannot be ruled out that the Proposed Development will not have significant in-combination effects or significant transboundary effects with other projects in the Southern North Sea SAC and Bancs des Flandres SAC given the potential for other noisy activities (piling for new windfarms and UXO detonation for windfarms and new subsea cables). Project Specific Mitigation has been proposed to reduce the significance of effects by avoiding the requirement for detonation; reducing the size of the charge used by using low order detonation (deflagration); and ensuring animals are not near to any detonation. This includes a seasonal restriction when harbour porpoise are expected to be most abundant in the area. In addition, UXO detonation will not be carried out in UK and French waters on the same day and liaison will be implemented with the MMO and other developers to manage any conflicting schedules for windfarm piling or UXO detonation at any other simultaneous projects. With implementation of the proposed mitigation, the Proposed Development **will not have an adverse effect on the integrity of the Southern North Sea SAC or Bancs des Flandres SAC** either alone or in combination with other plans or projects.
  - The Habitats Regulation Assessment (HRA) process concluded that for all other European sites that the Proposed Development crosses or is in proximity to there will be **no likely significant effects** and Appropriate Assessment is not required.
  - The Stage 1 MCZ Assessment has concluded that for the MCZs that the Proposed Development crosses (Medway Estuary MCZ, Goodwin Sands MCZ, and Foreland MCZ) and two adjacent sites (Swale Estuary MCZ and Thanet Coast MCZ) the conditions of Section 126 of the Marine and Coastal Access Act 2009 can be met. There is **no significant risk that the Proposed**

Development either alone or in combination with other plans or projects will hinder the achievement of the conservation objectives stated for the MCZs; and the MMO can exercise its functions to further the conservation objectives for the MCZs.

- Where burial in the seabed is prevented e.g. at third-party asset crossings or where ground conditions may prevent burial to the required target depth, external cable protection will be required. The Navigation Risk Assessment (NRA) concluded that there is the potential for localised significant effects on navigation from the deposit of external cable protection. For all crossings with existing in-service cables the under-keel clearance indicates safe navigation. However, two locations have been identified where a reduction in water depth could limit or restrict navigation; the planned BT North Sea Joss crossing and an area in shallow water where ground conditions may prevent cable burial. To minimise the risk to shipping due to the water depth changes, the Maritime and Coastguard Agency will be consulted regarding the final designs for rock berms to determine requirements for aids to navigation i.e. marker buoys. Although there may be minor localised residual effects, overall there will be **no significant residual effects** on shipping and navigation.
- The presence of the cable installation vessels will cause temporary disturbance to fishing, recreation and shipping in the vicinity of the Proposed Development. Disruption will be limited to discrete sections of the Proposed Development, progressing along the Proposed Development during installation (and decommissioning) or confined to the location of the maintenance or repair activity. A communications protocol will be established with Peel Ports and Port of London Authorities, Trinity House and sailing clubs in the area to ensure disruption is minimised. Guard vessels will be used where the installation spread has restricted manoeuvrability and is near shipping channels e.g. between KP0 and KP55, and if the cable is exposed on the seabed between lay and burial / protection operations. As a result, **no significant residual or cumulative effects** are expected.
- The potential effects on commercial fisheries will be **Not Significant,** including effects on the cockle fishery from suspended sediments. However, a change in water depth at selected locations associated with the deposit of cable protection which could result in a localised significant residual effect. Without prejudice to the conclusion of no significant effects, an extensive series of Project Specific Mitigation has been developed in consultation with the local fishing industry. The objectives are to remove snagging hazards and provide assurance that fishing activities can be safely continued after cable installation; reduce the footprint of the cable protection material as far as possible; ensure lines of communication with fishing organisations are clearly outlined and understood by all parties; if feasible, avoid marine operations during peak fishing seasons, thereby minimising disruption to the fishing industry; minimise suspended sediment concentrations and provide assurance through monitoring that the cockle beds will not be significantly affected; and provide assurance that key shellfish grounds will not be affected by high order UXO detonation (if required). The Project Specific Mitigation includes monitoring the success of the mitigation by undertaking bottom drift net surveys and trawl surveys at key locations along the cable route. These will establish that the cable route was suitable for the identified fishery prior to installation work starting and confirm at the end of cable installation that the seabed has been returned to a fit state to allow the fishery to continue in the future.
- Archaeological exclusion zones will be established around potentially significant archaeological assets. A Written Scheme of Investigation (WSI) and Protocol for Archaeological Discoveries (PAD) will be implemented throughout all phases of the Proposed Development. Therefore, there will be **no significant residual effects** on marine archaeology.
- During operation, the cables will generate low electromagnetic fields that will emanate up to a maximum of 10m from the cables (depending on burial depth) before diminishing to natural background levels. There will be **no significant effects** on biological receptors (e.g. benthic

communities, fish, marine mammals) and the fields will not interfere with navigation systems for commercial shipping or recreational boating.

- The Cumulative Effects Assessment concluded that with respect to high order UXO detonation there is the potential for significant intra-project, cumulative and transboundary effects on marine mammals from the sudden, brief and significant underwater noise changes. However, with the implementation of Project Specific Mitigation, including the commitment to use low order detonation (deflagration) on all charge sizes, in relation to the Southern North Sea SAC and Bancs des Flandres SAC, the effects can be managed and **no significant residual intra-project, cumulative and transboundary effects** are expected. All other potential intra-project, cumulative and transboundary effects have been assessed as **Not Significant**.
- Any effects from decommissioning activities (cable removal) will be broadly similar to those during cable installation. The appropriate method of cable decommissioning will be determined prior to the end of the interconnector's design life. This will consider hazards presented by leaving cables in-situ and potential constraints if removed entirely. The effects of removal are predicted to be minor and temporary in nature, and not greater than the effects associated with installation which are considered to be not significant.

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GLOSSARY

AA
Appropriate Assessment

ADD
Acoustic Deterrent Device

AEZ
Archaeological Exclusion Zones

AIS
Automatic Identification Data

ALARP
As Low As Reasonably Practicable

Application Corridor
Extended area where all cable installation related works, including anchor placement and other temporary works, will take place.

Area that is covered by development consents and permits to authorise cable installation and related works.

Asset Placement Corridor
Area where micro-routeing of the GridLink Preferred Cable Route will be permitted to avoid local obstacles.

BAP
UK Biodiversity Action Plan

b field
Magnetic Field

BGS
British Geological Survey

Birds Directive
European Council Directive 2009/147/EC of the European Parliament and of the Council on the conservation of wild birds

BSA
Biologically Sensitive Area

BT
British Telecom

BTO
British Trust for Ornithology

CBRA
Cable Burial Risk Assessment

CCME
Canadian Council of Ministers of the Environment

CD
Chart Datum

CEA
Cumulative Effects Assessment

CEF
Connecting Europe Facility

Cefas
Centre for Environment, Fisheries and Aquaculture Science

CEMP
Construction Environmental Management Plan

CHSR
The Conservation of Habitats and Species Regulations 2017

CIEEM
Chartered Institute of Ecology and Environmental Management

CLB
Cable Lay Barge

CLV
Cable Lay Vessel

COLREGs
Convention on the International Regulations for Preventing Collisions at Sea, 1972

COMAH
Control of Major Accident Hazards Regulations

COMHSR
Conservation of Offshore Marine Habitats and Species Regulations 2017

Constrained Area for Anchor Placement
Area where cable installation-related works, including anchor placement and other temporary works, shall not take place, expect if critical to project feasibility

Constrained Areas for Asset Placement
Area where cable installation shall not take place except if critical for project feasibility

CNS
Central North Sea

CPT
Cone Penetrometer Testing

CRoW
Countryside & Rights of Way Act 2000

CSV
Construction Support Vessel

Cumulative Effects
The combined effect of pressures present to which a specific receptor is sensitive. Cumulative effects result from incremental changes caused by other past, present or reasonably foreseeable actions together with the Proposed Development

DAERA
Department of Agriculture, Environment and Rural Affairs

DBA
Desk-based Assessment

DC
Direct Current

DECC
Department for Energy and Climate Change

DEFRA
Department for Environment, Food and Rural Affairs

DP
Dynamic Positioning

DSV
Dive Support Vessel

DVV
Dual Van Veen

EA
Environmental Assessment

EC
European Commission

EEZ
Exclusive Economic Zone

EDR
Effective Deterrent Range

EIA
Environmental Impact Assessment

Embedded Mitigation
Refers to primary and tertiary mitigation that form part of the project description assessed for GridLink.

EMF
Electromagnetic Fields

EMP
Environmental Management Plan

EPS
European Protected Species – Species of animals or plants listed in Annex II and IV of the Habitats Directive

ERL
Effects Range Low

ER
Environmental Report

ES
Environmental Statement

EU
European Union

EUNIS
European Nature Information

EOD
Explosive Ordnance Disposal

FCP
Fisheries Co-existence Plan

FLO
Fisheries Liaison Officer

GIS
Geographical Information Systems

GPS
Global Positioning Systems

Gridlink Preferred Cable Route
The route that the GridLink Submarine Cable Bundle will be installed along. Installation Contractor will be required to robustly justify any deviation from this position.

Habitats Directive
European Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora

HD
High Definition

HDD
Horizontal Directional Drilling

HF
High Frequency

HG
Hamon Grab

HRA
Habitats Regulations Assessment

HVAC
High Voltage Alternating Current

HVDC
High Voltage Direct Current

ICPC
International Cable Protection Committee

ICG-C
Intercessional Correspondence Group on Cumulative Effects

ICES
International Council for the Exploration of the Sea

ICNIRPP
International Commission on Non-Ionizing Radiation Protection

iE
Induced Electric Fields

IEC
International Electro-Technical Commission

IEMA
Institute of Environmental Management and Assessment

IFCA
Inshore Fisheries and Conservation Authority

IHLS
International Herring Larval Survey

IMO
International Marine Organisation

In-combination Effects
Similar to Cumulative Effects but it describes the effect of a pressures present from the plan or project acting with pressures from other plans or projects

Indirect Effects
Effects, which are not a direct result of the project, often produced away from or as a result of a complex pathway

INNS
Invasive non-native species

Intertek E&W
Intertek Energy & Water

Intertidal
The area between mean high-water springs and mean low water springs

IPA
Initial Project Assessment

INS
International Navigation System

IS cables
In Service Cables

ISQC
Interim Sediment Quality Guidelines

IUCN
International Union for Conservation of Nature

JNCC
Joint Nature Conservation Committee

JUB
Jack-up Barge

KEIFCA
Kent and Essex Inshore Fisheries & Conservation Authority

KM
Kilometre

KPs
Kilometre Points

LAT
Lowest Astronomical Tide

LF
Low Frequency

Long-term Effects
Effects lasting fifteen to sixty years

LSA
Land service ammunition

LWM
Low Water Mark

M
Metre

MarESA
Marine Evidence Based Sensitivity Assessment

MarLIN
Marine Life Information Network

MARPOL
International Convention for the Prevention of Pollution from Ships

MBES
Multi-Beam Echo Sounder

MCA
Maritime and Coastguard Agency

MCAA
Marine and Coastal Access Act

MCZ
Marine Conservation Zone

Medium-term Effects
Effects lasting seven to fifteen years

MFE
Mass Flow Excavation

MHWS
Mean High Water Springs

MI
Marine Institute

Mitigation
Means primary (inherent design), secondary (foreseeable) and tertiary (inexorable) measures as defined by IEMA (2016)

MLWS
Mean Low Water Springs

MMO
Marine Management Organisation

MMObs
Marine Mammal Observer

MoD
Ministry of Defence

Momentary Effects
Effects lasting from seconds to minutes

MPA
Marine Protected Area

MPS
Marine Policy Statement

MSFD
Marine Strategy Framework Directive 2008/56/EC establishing a framework for community action in the field of marine environmental policy

MSL
Mean Sea Level

MSP
Marine Spatial Plan

MU
Management Unit

MW
Megawatt

MWR
Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended)

Natura 2000
The European network of nature conservation areas, including Special Areas of Conservation, provided for by Article 3(1) of the Habitats Directive and Special Protection Areas under the Birds Directive,

NAVAREA
The geographic areas in which various governments are responsible for navigation and weather warnings.

NAVTEX
Navigational Telex is an international automated medium frequency direct-printing service for delivery of navigational and meteorological warnings and forecasts, as well as urgent maritime safety information (MSI) to ships

NE
Natural England

Nearshore
The area between mean low water springs and the 10m depth contour

NEQ
Net Explosive Quantity

NFFO
National Federation of Fishermen's Organisations

NGET
National Grid Electricity Transmission plc

NM
Nautical miles - International measurement equivalent to 1,852 metres

NRA
Navigation Risk Assessment

NSCMS
North Sea and Channel Modelling System

NtM
Notice to Mariners

NTS
Non-Technical Summary

OD
Ordnance Datum

OESEA
Offshore Energy Strategic Environmental Assessment

Ofgem
Office of Gas and Electricity Markets

OOS
Out Of Service (cable)

OREIs
Offshore Renewable Energy Installations

OSPAR
Oslo – Paris Convention for the Protection of the Marine Environment of the North-East Atlantic

PAD
Protocol for Archaeological Discoveries

PAH
Polycyclic Aromatic Hydrocarbons

PAM
Passive Acoustic Monitoring

PCE
Potential Cumulative Effects

PEL
Probable Effect Level

PCW
Phocid Carnivores in Water

PCI
Project of Common Interest

PLB
Post Lay Burial

PLGR
Pre-lay Grapnel Run

Pressure
The mechanism through which an activity has an effect on any part of an ecosystem. Pressures can be physical, chemical or biological, and can be created by different activities or drivers. The OSPAR Intercessional Correspondence Group on Cumulative Effects (ICG-C) prepared a list of marine pressures and their descriptions (OSPAR Commission 2011) which have been used in the preparation of the ER.

Primary Mitigation
Modifications to the location or design of the development made during the pre-application phase that are an inherent part of the project, and do not require additional action to be taken. Referred to as 'Embedded Mitigation' in the EIAR.

Project Specific Mitigation
Secondary mitigation identified as a consequence of the EA process to reduce or avoid the significance or likelihood of adverse effects.

Proposed Development
The marine components of GridLink from MHWS at Kingsnorth, Kent to the boundary between the UK and French EEZ waters

PS
Project Specific

PSA
Particle Size Analysis

PTS
Permanent Threshold Shift

RBMP
River Basin Management Plans

Receptor
Any ecological or other specific feature that is sensitive to or has the potential to be affected by a pressure (IEEM 2010)

Residual Effect
The degree of environmental change that will occur after the proposed mitigation measures have taken effect

Resilience
The ability of an ecosystem to return to its original state after being disturbed (from Makins 1991) (cf. 'constancy', 'persistence', 'stability').

Resistance
The degree to which a variable is changed following perturbation (Pimm 1984). The tendency to withstand being perturbed from the equilibrium (Connell & Sousa 1983). (cf. 'Stability'; 'adjustment stability').

Reversible Effects
Effects that can be undone, for example through remediation or restoration

RMS
Root mean square

RMDOL
Recommended Minimum Depth of Lowering

RNLI
Royal National Lifeboat Institution

ROFF
Rochester Oystermen and Floating Fisheries

Routeing
The selection of the preferred cable route, having regard to engineering, environmental and other constraints

ROV
Remotely Operated Vehicle

ROTV
Remotely Operated Towed Vehicle

RSPB
Royal Society for the Protection of Birds

RTE
Réseau de Transport d'Electicité

RYA
Royal Yachting Association

SAC
Special Area of Conservation

SBP
Sub-bottom Profiler

SCOS
Special Committee on Seals

SEA
Strategic Environmental Assessment

Secondary mitigation
Actions that will require further activity in order to achieve the anticipated outcome. These may be imposed as part of the planning consent, or through inclusion in the environmental reporting. They tend to operate in the middle of the mitigation hierarchy, focusing on reducing the significance or likelihood of adverse effects. They are referred to as Project Specific Mitigation in the ER.

SEL
Sound Exposure Levels

Sensitivity
An assessment of the intolerance of a species or habitat to damage from an external factor and the time taken for its subsequent recovery. For example, a very sensitive species or habitat is one that is very adversely affected by an external factor arising from human activities or natural events (killed/destroyed, 'high' intolerance) and is expected to recover over a very long period of time, i.e. >10 or up to 25 years ('low'; recoverability). Intolerance and hence sensitivity must be assessed relative to change in a specific factor.

Short-term Effects
Effects lasting one to seven years

SL
Source level

SNH
Scotland Natural Heritage

SNS
Southern North Sea

SOPEP
Shipboard Oil Pollution Emergency Plan

SPA
Special Protection Area

SPL
Sound Pressure Levels

SPM
Suspended Particulate Matter

SR
Scoping Report

SSC
Suspended Sediment Concentrations

SSS
Side Scan Sonar

SSSI
Site of Special Scientific Interest

TAC
Total Allowable Catch

TDOL
Target Depth of Lowering

Temporary Effects
Effects lasting less than a year

TEFA
Thames Estuary Fishermen's Association

TEN-E
Regulation (EU) No 347/2013 guidelines for trans-European energy infrastructure

Territorial waters
Waters within 12 nautical miles of the coastline

Tertiary mitigation (inexorable)
Actions that would occur with or without input from the EA feeding into the design process. These include actions that will be undertaken to meet other existing legislative requirements, or actions that are considered to be standard practices used to manage commonly occurring environmental effect. This can be identified at any point during the design and EA process. They are referred to as 'Embedded Mitigation' in the ER.

Third Party Asset Crossing
Crossing of in-service or out of service third party power cables, windfarms export cables or telecommunication fibre-optic cables.

TFA
Thanet Fishermen's Association

TJP
Transition Joint Pit

TraC
Transitional and Coastal Waters

Transboundary Effects
Effects from a project that cross an international boundary.

TSHD
Trailing Suction Hopper Dredger

TSS
Traffic Separation Scheme

TTS
Temporary Threshold Shift

UAV
Unmanned autonomous vehicle

UK
United Kingdom

UKHO
UK Hydrographic Office

UNESCO
United Nations Educational, Scientific and Cultural Organisation

UXO
Unexploded Ordnance

UXBs
Unexploded Bombs

VC
Vibrocore

VHF
Very High Frequency

VMS
Vessel Monitoring Systems

WFD
Water Framework Directive 2000/60/EC establishing a framework for Community action in the field of water policy

WSI
Written Scheme of Investigation

WW1
World War 1

WWII
World War 2

XLPE
Cross-linked polythene

ZOI
Zone of Influence - The spatial extent over which an activity is predicted to have an impact on the receiving environment.

1. INTRODUCTION

This Environmental Report documents the environmental assessment process carried out to support an application for consent to install, operate, maintain and eventually decommission an electricity interconnector linking the existing electricity grids in the United Kingdom (UK) and France.

1.1 The Proposed Development

GridLink Interconnector Limited (the Applicant) is proposing to develop a 1,400 megawatt (MW) electricity interconnector, linking the existing electricity grids in the UK and France (Figure 1-1, Drawing P2172-LOC-001). The GridLink Interconnector project (GridLink) will consist of two converter stations, one close to the existing National Grid 400 kV Kingsnorth Substation, at Kingsnorth in Kent and one close to the existing RTE Warande Substation, at Dunkerque in the Nord region of France. The converter stations will be connected by a high voltage direct current (HVDC) cable system comprising 140 km of subsea cable and 13 km of underground cable in France. There is no underground cable in the UK since the converter station site is located next to the shoreline.

The project is designated as a European Union Project of Common Interest (PCI), project number No. 2018/540, under the provisions of European Union Regulation No. 347/2013 on guidelines for Trans-European Network for Energy (TEN-E Regulations) and receives grant funding under the Connecting Europe Facility (CEF).

The Applicant was granted an Interconnector Licence in Great Britain by Ofgem (the UK Government regulator for gas and electricity markets) in December 2016, and received a positive Initial Project Assessment (IPA) Status decision under Ofgem's Cap and Floor Regime in January 2018.

In the UK, a bilateral connection agreement was signed with National Grid Electricity Transmission plc in October 2016 for a grid connection at the Kingsnorth Substation.

This Environmental Report covers the UK Marine components of GridLink from mean high-water springs (MHWS) at Kingsnorth to the UK/France Exclusive Economic Zone (EEZ) boundary, a distance of 108 km with an average width of 500 m (the Proposed Development).

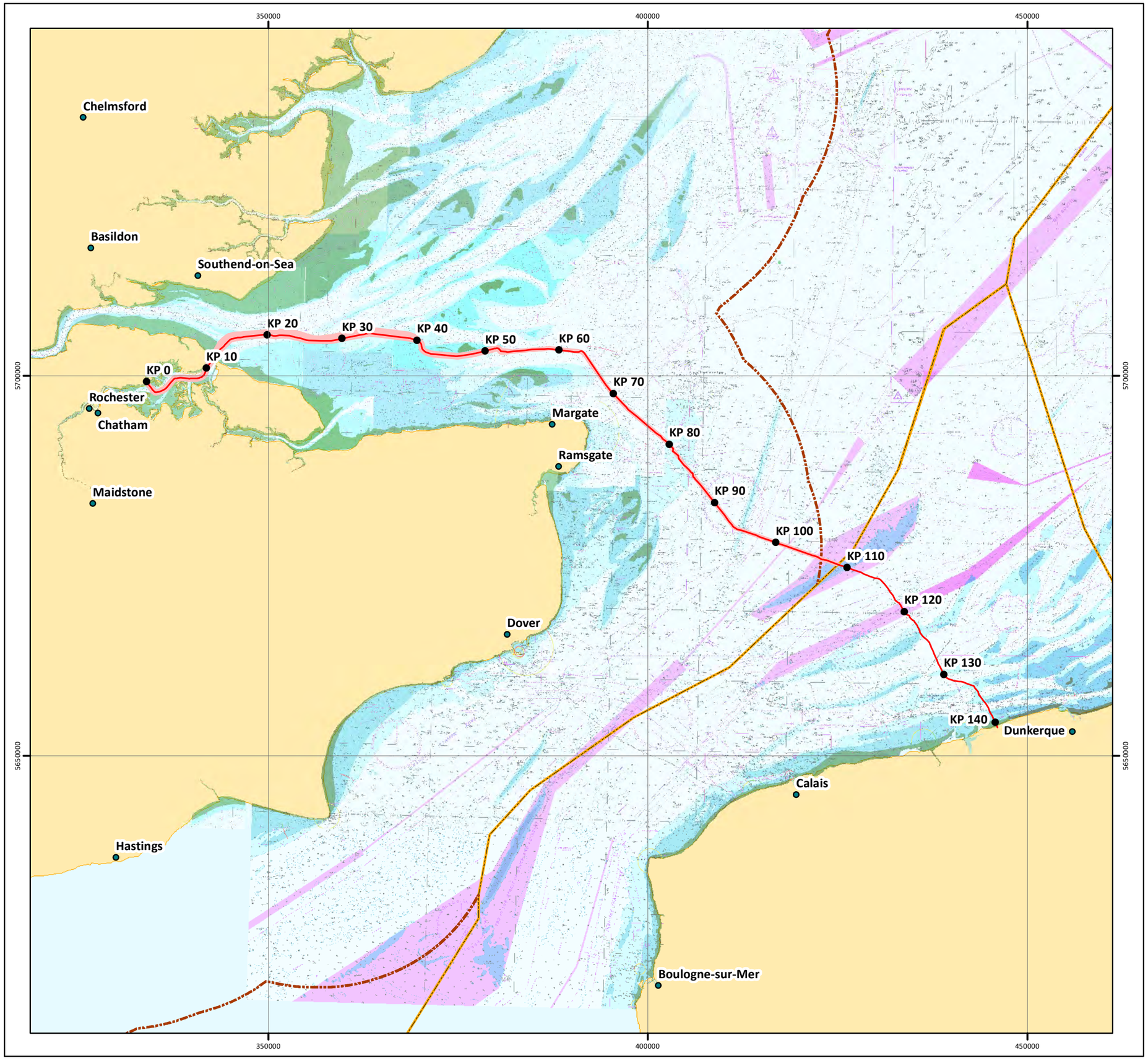
The Proposed Development comprises:

- Two high voltage direct current (HVDC) electricity power cables;
- A smaller fibre-optic cable for control and telecommunications;
- All associated works required to install test, commission and complete the aforementioned cables; and
- All associated works required to operate, maintain, repair and decommission the aforementioned cables, including three repair events.

The overall cable route is illustrated in Figure 1-1, Drawing P2172-LOC-003.

The Proposed Development is illustrated in Figure 1-2, Drawing P2172-LOC-005.

Separate Environmental Reports are prepared which cover individually the UK Onshore elements; and the French Marine and Onshore element (from the France/UK EEZ boundary onwards).



GRIDLINK INTERCONNECTOR

LOCATION OVERVIEW

Route Overview

Drawing No: P2172-LOC-003	B

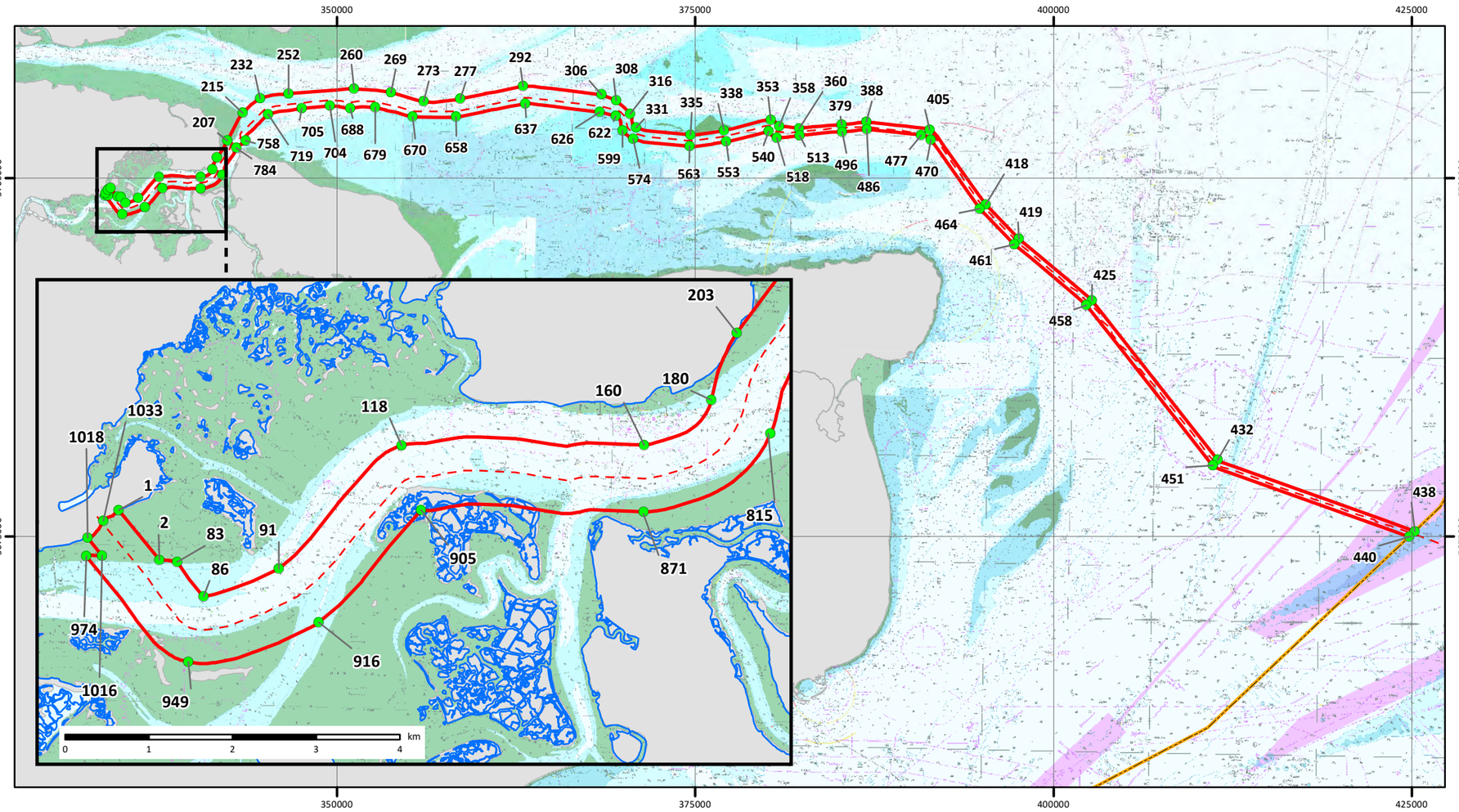
Legend

- KP
- GridLink Preferred Cable Route
- Application Corridor
- UK 12nm Territorial Sea Limit
- EEZ Boundary

NOTE: Not to be used for Navigation

Date	28 May 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	MarineRegions; UKHO; GEBCO; MarineFind; Esri; GridLink
File Reference	J:\Gridlink\P2172_Mxd\01_LOC\ P2172-LOC-003.mxd
Created By	Chris Goode
Reviewed By	Emma Langley
Approved By	Kerri Gardiner

0 5 10 15 20 km



ID	Latitude (DD)	Longitude (DD)	ID	Latitude (DD)	Longitude (DD)	ID	Latitude (DD)	Longitude (DD)
1	51.42043	0.61553	353	51.47476	1.27571	563	51.45705	1.19496
2	51.41523	0.62281	358	51.47104	1.28433	574	51.46091	1.13821
83	51.41507	0.62585	360	51.47001	1.30448	599	51.46604	1.12740
86	51.41143	0.63060	379	51.47293	1.34709	622	51.47485	1.11991
91	51.41470	0.64337	388	51.47484	1.37193	626	51.47713	1.10373
118	51.42833	0.66377	405	51.47098	1.43543	637	51.48121	1.02877
160	51.42922	0.70548	418	51.42484	1.49335	658	51.47158	0.95961
180	51.43425	0.71682	419	51.40374	1.52730	670	51.47092	0.91615
203	51.44156	0.72080	425	51.36607	1.60188	679	51.47608	0.87860
207	51.45267	0.73083	432	51.26733	1.73080	688	51.47521	0.85328
215	51.47006	0.74532	438	51.22478	1.92890	704	51.47633	0.83263
232	51.47966	0.76264	440	51.22126	1.92317	705	51.47409	0.80479
252	51.48313	0.79108	451	51.26389	1.72618	719	51.46991	0.77103
260	51.48738	0.85634	458	51.36306	1.59655	758	51.45301	0.74929
269	51.48582	0.89355	461	51.40027	1.52272	784	51.44821	0.74007
273	51.48070	0.92694	464	51.42202	1.48775	815	51.43085	0.72715
277	51.48296	0.96364	470	51.46460	1.43719	871	51.42203	0.70579
292	51.49199	1.02607	477	51.46750	1.42738	905	51.42145	0.66750
306	51.48795	1.10545	486	51.47035	1.37227	916	51.40904	0.65051
308	51.48481	1.12010	496	51.46844	1.34763	949	51.40436	0.62832
316	51.47637	1.13458	513	51.46554	1.30526	974	51.41539	0.61020
331	51.46815	1.14071	518	51.46392	1.28245	1016	51.41549	0.61291
335	51.46423	1.19561	540	51.46756	1.27383	1018	51.41732	0.61033
338	51.46755	1.22931	553	51.46050	1.23157	1033	51.41924	0.61298

*Coordinates are provided in WGS 1984 Decimal Degrees

GRIDLINK INTERCONNECTOR

LOCATION OVERVIEW

Marine Licence Application

Drawing No: P2172-LOC-005 | **B**

Legend

- Application Corridor Vertices
- GridLink Preferred Cable Route
- Application Corridor
- High Water Mark
- EEZ Boundary

N W E S

NOTE: Not to be used for Navigation

Date	29 May 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	CDA; ESRI; OSOD; MarineFind; GridLink
File Reference	J:\Gridlink\P2172_Mxd\01_LOC\ P2172-LOC-005.mxd
Created By	Chris Dawe
Reviewed By	Chris Carroll
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

km 0 5 10 15 20

1.2 Objective of the Environmental Report

The aim of the Environmental Report is to present, in a logical and comprehensive fashion, the findings and outcomes of the environmental assessment.

The environmental assessment process follows a systematic approach to assess the potential pressures and subsequent effects of a project on the environment in a robust and transparent manner. The process has been undertaken in three stages: a) screening; b) scoping; and c) assessment.

The focus of the environmental assessment was developed during the scoping phase of the process, in consultation with statutory and non-statutory stakeholders. The Environmental Report describes all aspects of the environment where it is considered there could be a potential effect, but focuses in more detail on the topics which were highlighted by stakeholders.

All scoping comments received from stakeholders throughout the assessment process up to submission of the Environmental Report are summarised at the start of each relevant topic chapter.

1.3 Project Promoter

GridLink Interconnector Limited was established for the purpose of developing, building and operating the GridLink Interconnector project.

GridLink Interconnector Ltd is 100% owned by iCON Infrastructure Partners III, L.P., advised by iCON Infrastructure LLP ("iCON"). iCON is an independent investment group with over €4.3 billion in assets under management, focusing on privately held investments in infrastructure assets in Europe and North America. iCON's investors include renowned institutions from the UK, Europe, USA, Canada, Middle East and Asia. iCON recognises the importance of integrating considerations of environmental, social and governance nature into our decision-making process and the ongoing management of our assets and became a signatory to the Principles for Responsible Investment in April 2012.

1.4 The Project Team

Intertek Energy & Water (Intertek E&W) is the Marine Environmental Consultants for the project, and assists GridLink Interconnector Ltd with data collection, analysis and interpretation to support feasibility studies, cable route development, consenting and identification of mitigation measures.

Intertek E&W is part of the part of Intertek Group plc, a FTSE 100 listed company quoted on the London Stock Exchange. Previously Metoc, Intertek E&W has been operating since 1983, providing specialist technical services in the marine, coastal and river environments. The company has considerable experience in undertaking interconnector route development, managing supporting cable route surveys and has led the environmental assessment process on eleven of the interconnectors that connect or are proposed to connect into the UK. In addition, the company has worked on two other interconnectors that are proposed to connect to France.

Specialist technical input has been provided by the following consultants:

- MMT – marine cable route survey
- Coracle Archaeology – marine archaeology

1.5 Structure of the Environmental Report

The Environmental Report comprises 16 chapters, a stand-alone Non-Technical Summary (NTS) document and 17 Technical Appendices.

The topics of the Environmental Report are evaluated within each chapter, comprising baseline description, assessment, identification of mitigation measures and conclusions. For each topic, the

baseline is described in sequence following the Proposed Development from the landfall to the EEZ boundary. Kilometer Points (KP) have been used to aid description, starting at KP0 at the landfall at Kingsnorth.

Table 1-1 Structure of the Environmental Report

Chapter	Title	Content
0	Non-Technical Summary (NTS)	The aim of the NTS is to enable communication with those unfamiliar with the assessment process and terminology by summarising the key findings of the Environmental Report in simple terms.
1	Introduction	An introduction describing the Applicant, the content of the Environmental Report and summarising the Proposed Development.
2	The Need for the Development and Alternatives	An outline of the need for the interconnector, and why the Proposed Development is preferable to alternative options.
3	Project Description	A description of the Proposed Development in terms of the activities that will be undertaken and emissions to the environment during construction and operation. The description includes the design of the Proposed Development and any embedded mitigation of environmental effects that will be deployed.
4	Assessment Scope and Methodology	A description of the process followed when conducting the assessment, including an overview of the results of the scoping consultation that focused the Environmental Report.
5	Physical Environment	Descriptions of the physical, biological and human baseline environment including identification of key receptors and their sensitivity to possible effects. The findings of the assessment process are reported, and if necessary, Project Specific Mitigation (measures to avoid, reduce or remedy the effects identified) are described. The chapters are informed by the relevant studies and surveys undertaken for the Proposed Development.
6	Protected Areas	
7	Benthic Ecology	
8	Fish and Shellfish	
9	Marine Birds	
10	Marine Mammals and Marine Reptiles	
11	Navigation Risk Assessment	
12	Commercial Fisheries	
13	Marine Archaeology	
14	Cumulative Effects Assessment	An evaluation of the possible effects of the Proposed Development in combination with other projects and plans.
15	Schedule of Mitigation	An outline of the Project Specific Mitigation proposed in the assessment.
16	Conclusions	The overall conclusions on the significance of any effects, proposed mitigation and how measures will be implemented.
Appendix A	Compliance with Marine Plan(s)	
Appendix B	Stakeholder Meetings	
Appendix C	Sediment Suspension Calculations Technical Note	

Chapter	Title	Content
Appendix D	Marine Effects of Electro-Magnetic Fields (EMF) Technical Note	
Appendix E	GridLink Marine Habitats Regulations Assessment (HRA)	
Appendix F	GridLink Marine Conservation Zone (MCZ) Assessment	
Appendix G	Water Framework Directive Assessment	
Appendix H	Atlantic Herring and Sandeel Assessment	
Appendix I	Underwater Noise Modelling	
Appendix J	Navigation Risk Assessment	
Appendix K	Marine Archaeology Technical Report	
Appendix L	Written Scheme of Investigation and Protocol for Archaeological Discoveries	
Appendix M	GridLink Draft Fisheries Co-Existence Plan	
Appendix N	GridLink Draft Marine Mammal Mitigation Plan	
Appendix O	GridLink Cable Route Survey – Integrated Geophysical and Geotechnical Report	
Appendix P	GridLink Cable Route Survey – Nearshore Environmental Report	
Appendix Q	GridLink Cable Route Survey – Offshore Environmental Report	

1.6 Sources of Data and Information

The information contained within this Environmental Report has been drawn from existing literature, project-specific data, personal communications with local experts and statutory bodies and site-specific studies and surveys commissioned for the Proposed Development. Every effort has been made to obtain data concerning the existing environment and to accurately predict the likely environmental effect of the Proposed Development. Assumptions adopted in the evaluation of the effects are reported in the relevant sections.

Key literature sources used in the environmental assessment process are listed at the beginning of each section, and referenced throughout the topic chapters. Specialist studies and surveys have also been carried out to inform the assessment process. These are listed in Table 1-2.

The data collected throughout these assessments and surveys have been used to define the baseline conditions against which effects have been measured and predicted, in turn helping to define the project-specific mitigation measures that may be required.

Table 1-2 Specialist studies

Document	Author
GridLink Cable Route Survey – Integrated Geophysical and Geotechnical Report	MMT
GridLink Cable Route Survey – Nearshore Environmental Report	MMT
GridLink Cable Route Survey – Offshore Environmental Report	MMT
GridLink Marine Archaeology Technical Report	Coracle Archaeology
GridLink Cable Burial Risk Assessment	Intertek
Wintering Bird Survey Reports	RSK Environment, AECOM
EMF – Preliminary HVDC Cable Study – Technical Note	WSP
HDD Feasibility Study	GDG
UXO Threat and Risk Assessment	6 Alpha Associates

1.7 Consultation

The Applicant has taken a pro-active approach to consultation, recognising that it is a critical activity in the development of a comprehensive and balanced assessment.

Discussions started in 2017 with local planning authorities, statutory bodies and other non-statutory stakeholder groups, and have continued throughout the assessment process. Stakeholders have had the opportunity to inform route development, environmental surveys, and Environmental Report scope and content.

A Scoping Opinion was requested from the Marine Management Organisation (MMO) on the proposed approach to, and scope of, the Environmental Report in 2018. The request for a Scoping Opinion was repeated in 2019 due to change in the location of the landfall at Kingsnorth. All comments and data received during both Scoping exercises has been used in the assessment process and has helped provide direction on the topics included in the Environmental Report. Further details of the Scoping stage are provided in Chapter 4.

The Applicant, as a promoter of a European Project of Common Interest (PCI), has conducted public consultations through a variety of means in accordance with *Regulation (EU) No 347/2013 of the European Parliament and of the Council as regards the Union list of projects of common interest* (known as the 'TEN-E Regulation'), and the associated UK Manual of Procedures.

The results of the public consultations are provided in the Stakeholder Engagement Summary Report and Statement of Community Involvement, which are available to download at www.gridlinkinterconnector.com.

Additional public information is also made available via the project web-site, including an Information Leaflet, Non-technical Summary and general information about the Proposed Development.

Comments received throughout the consultations have been considered in the preparation of the Environmental Report. Further details on the consultations are provided in Chapter 4.

1.8 Availability of the Environmental Report

The Environmental Report, including the associated Non-Technical Summary and Technical Appendices, are available in electronic copy on request or are available for download from the project website at www.gridlinkinterconnector.com.

2. THE NEED FOR THE DEVELOPMENT AND ALTERNATIVES

This Chapter summarises the development of GridLink, including the alternatives which have been considered and the rationale for the selection of the Proposed Development. It summarises the processes that were undertaken to identify a UK connection point; and sets out the alternative landfalls and marine route options which have been considered.

2.1 Objectives of the Project

The European energy market faces many challenges linked to aging infrastructure, environmental targets and energy transition. Meeting these challenges requires a significant shift towards a greater share of renewable energy supported by an improved transmission network capable of distributing energy and ensuring the security of supply.

The objective of the Proposed Development is to support this transformation by improving the capacity of the UK and French networks to distribute electricity to consumers, and to ensure that electricity supply is secure in the event of production uncertainty linked to renewable resources, availability of existing generation units, transmission network constraints or other reasons.

The advantages for the French and UK national electricity transmission networks are:

- Improvement of network stability;
- Extension and diversification of electricity supply;
- Limitation of cost management constraints;
- Improvement of capacity;
- Increasing of renewable energy integration.

The main economic benefits of GridLink result from increasing competitiveness in the energy market through import and export trade between the UK and France and enhancement of the security of supply. According to supply and demand, which changes depending on the time of day, season, weather conditions and availability of renewable energy, GridLink will be able to either import or export electricity. This opens up commercial opportunities for energy producers, thus reducing costs for consumers.

The environmental benefits of GridLink comprise the facilitation of the efficient use of renewable energy and other low carbon sources of electricity by the UK and French networks. Surplus renewable and nuclear energy can be utilised through GridLink, whilst otherwise it's use may be constrained. In addition, GridLink provides a means to compensate for any shortfalls in electricity supply that may occur if renewable energy production is lower than expected.

The main goal of the Proposed Development is that energy producers and consumers can exploit these benefits through a state-of-the-art, high efficiency and reliable project with minimal environmental effects.

2.2 European Energy Policy

The 'Energy Union' launched by the European Commission in February 2015, and endorsed by Member States in October 2015, is driving a fundamental transition towards more innovative ways to produce, transport and consume energy, and to address different approaches to design, implement and, where needed, enforce energy policy. A range of actions will be required to make this happen, including improvements to the physical interconnectedness of energy grids (both gas and electricity) to meet a

10% interconnection target by 2020 and to possibly reach 15% by 2030. The UK's expected level of interconnection in 2020 is 8% (European Commission 2017).

In 2013, the EU adopted Regulation (EU) No 347/2013 on Guidelines for Trans-European Networks for Energy (TEN-E Regulation). The TEN-E Regulation sets out guidelines to support the development of new major energy infrastructure projects that contribute to European energy networks (designated as Projects of Common Interest), including streamlining the permitting processes. GridLink achieved the status of a Project of Common Interest (PCI) in April 2018.

The TEN-E Regulation requires that PCI projects are given 'priority status' at a national level to ensure rapid administrative treatment.

2.3 Project Alternatives

The primary objective of the project is to link the electricity transmission networks in the UK and France. This can only be delivered by the development of a subsea interconnector between the two countries.

However, the design of the interconnector is instrumental in determining the environmental effects. This section describes the alternatives that were considered and demonstrates that there are no feasible alternative solutions.

2.3.1 'Do nothing' option

The 'do nothing' option dictates that generation of electricity needs to be based in the country where it is used and constrains export of electricity when generation exceeds demand.

One of the key actions identified in the European Commission Priority Interconnection Plan and the TEN-E regulations is to increase the transmission capacity between countries and improve security of supply.

GridLink has been awarded Project of Common Interest (PCI) status by the European Commission making it one of Europe's most important energy infrastructure projects and granting it the "highest national significance" possible.

The 'do nothing' option would therefore not be supported by UK government and EU policy.

2.3.2 Connection options

The configuration of any interconnector project is influenced by the location of the existing network infrastructure, its ability to accommodate the required connection capacity, any requirement for network reinforcements, and other factors such as environmental constraints.

The final route is ultimately determined by the points at which the interconnector can connect to the electricity grids in each country.

Network availability for the import and export of electricity between France and the UK was established by a study of network constraints, and initial consultations, with national transmission operators: Réseau de Transport d'Electicité (RTE) for France and National Grid Electricity Transmission (NGET) for the UK. As a result of these studies, more than 20 potential routes have been identified from existing high voltage 400 kV substations on the coast of the UK to similar facilities on the French coast.

In May 2015, the Applicant asked RTE to conduct a prospective study about the potential points of connection to the 400 kV network in northern France. In accordance with the procedure for processing applications for connection of new interconnectors to the public electricity transport network, RTE then offered the Applicant a list of the substations to which the interconnector could be connected which were evaluated according to the following criteria:

- Technical feasibility of connecting to the substation; and
- Qualitative assessment of the risk of constraints on the network and the need for reinforcements.

This study resulted in Warande (Bourbourg commune, Nord department) being chosen as the preferred connection site. Other possible connection sites were discounted because constraints on the electricity transport system in these areas meant significant strengthening work on the RTE network (new overhead transmission lines, new sub-stations, etc) may have been needed. The feasibility of connecting GridLink to the French network was confirmed by preliminary study carried out by RTE in October 2016.

Subsequently, the technical and financial proposal concerning the work required to create the connection was signed by RTE and GridLink Interconnector Ltd in May 2017.

Figure 2-1 shows the various points considered during the prospective study, which concluded that Warande is the preferred connection site.

Figure 2-1 Points studied for connection to the French electricity grid

In the UK, the Applicant commissioned a grid connection study by National Grid regarding the possibility of connecting to the 400 kV network along the south coast of England in June 2016. Preliminary feasibility studies indicated that the electricity generated by the new interconnector could not be transported to/from anywhere on the network along the south coast due to the limited capacity of existing transport links and current and future electricity production.

Based on this analysis, the preferred area with the fewest constraints was identified as located along the Thames estuary near London. Seven potential connection points were then shortlisted: Cleve Hill, Coryton, Grain, Kemsley, Kingsnorth, Northfleet East and Rayleigh Main. Further assessments, taking into account environmental, technical and economic considerations (including important archaeological sites/discoveries, environmentally sensitive areas and existing infrastructure), identified the Kingsnorth sub-station as the preferred connection site.

Subsequently, a grid connection agreement concerning the connection at the Kingsnorth sub-station was signed by National Grid and GridLink Interconnector Ltd in October 2016.

Figure 2-2 shows the various points considered during the study, which concluded that Kingsnorth is the preferred connection site.

Figure 2-2 Points studied for connection to the UK Electricity Grid

After the connection sites in France and the UK had been chosen, technical and environmental feasibility studies were carried out to select the converter station sites and locations of the landfalls of the submarine cable.

2.3.3 Landfall options

Two landfall locations for the submarine cable at Kingsnorth have been assessed: the London Medway Commercial Park (via Damhead Creek) in the Kingsnorth industrial area and the MedwayOne commercial area at the site of the former E.on coal-fired power station at Kingsnorth. Both locations are shown on Figure 2-3 (Drawing P2172-LOC-004).

In both cases, the landfall location is immediately next to a proposed converter station site so that the submarine cable can connect directly to the converter station.

The MedwayOne commercial area has been chosen as the preferred landfall as it offers a number of benefits in comparison to the London Medway Commercial Park including:

- The converter station site to which the landfall must connect is located within a former power station (now demolished), providing a larger and more flexible land plot within compatible surrounding industrial land uses;
- The onshore cable route between the converter station and the National Grid Kingsnorth sub-station is shorter (1.5 km compared to 4 km);
- One landowner is responsible for the landfall, as well as the converter station site and onshore cable route (compared to multiple land owners);
- The landfall is less constrained and construction works will be easier to implement due to the shore crossing from the Medway Estuary (compared to the narrow tidal channel of Damhead Creek).

Both landfalls had similar environmental constraints, with the intertidal area designated as a EU and national protected site for nature conservation present at both locations.

©Esri; Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

GRIDLINK INTERCONNECTOR

LOCATION OVERVIEW

Landfall Evolution

Drawing No: P2172-LOC-004 | **B**

Legend

- GridLink Preferred Cable Route
- South of BritNed Route
- Medway One Commercial Area
- London Medway Commercial Park

N W E S

NOTE: Not to be used for Navigation

Date	27 May 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	ESRI; GridLink
File Reference	J:\Gridlink\P2172_Mxd\01_LOC\ P2172-LOC-004.mxd
Created By	Chris Dawe
Reviewed By	Chris Carroll
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

0 250 500 750 1,000 m

2.3.4 Offshore route selection

The development of the submarine cable route balances the need for a technically feasible and economically viable route whilst limiting disturbance to people, existing marine users and the environment. In identifying preferred options, and determining if a route is feasible, the physical, environmental and human aspects were considered.

Route development has been an iterative process involving cycles of technical and environmental studies, surveys, consultations and refinement. The submarine cable route has been designed to avoid or reduce environmental effects as far as reasonably practicable.

Cable route options have been determined via a detailed evaluation of the characteristics of the seabed, environmental conditions (including protected sites) and marine uses. This includes the location of shipping lanes and anchorages, wrecks, seabed obstacles, restricted areas, fishing grounds, environmental sensitivities and existing third-party assets, such as windfarms, dredging areas, power cables and telecommunications cables. The cable route options avoid discrete features, optimise crossings of sensitive areas and minimise adverse effects wherever possible.

The cable route in the outer Thames Estuary was subject to an evaluation of two alternative routes. These alternatives were to locate the cable to either north or south of the existing BritNed interconnector cable that connects the UK to the Netherlands, as displayed in Figure 2-4 (Drawing P2172-LOC-001). Whilst both alternatives were technically and environmentally feasible, in order to avoid major shipping channels and two crossings of the BritNed cable, the cable route to the south of the BritNed interconnector was selected. This southern route was selected after consultation with navigational authorities (Port of London Authority, Peel Ports), organisations responsible for licensing installation of cables in the seabed (Crown Estate, Peel Ports, Rochester Oystermen and Floating Fisheries), existing cable owners (BritNed Interconnector Ltd, London Array offshore wind farm) and fishermen associations.

The selected southern route lies to the south of the existing BritNed interconnector from KP15 to KP50 with a nominal separation distance of approximately 300 m, closing to approximately 150 m at one point where the route passes near to the Great Nore anchorages.

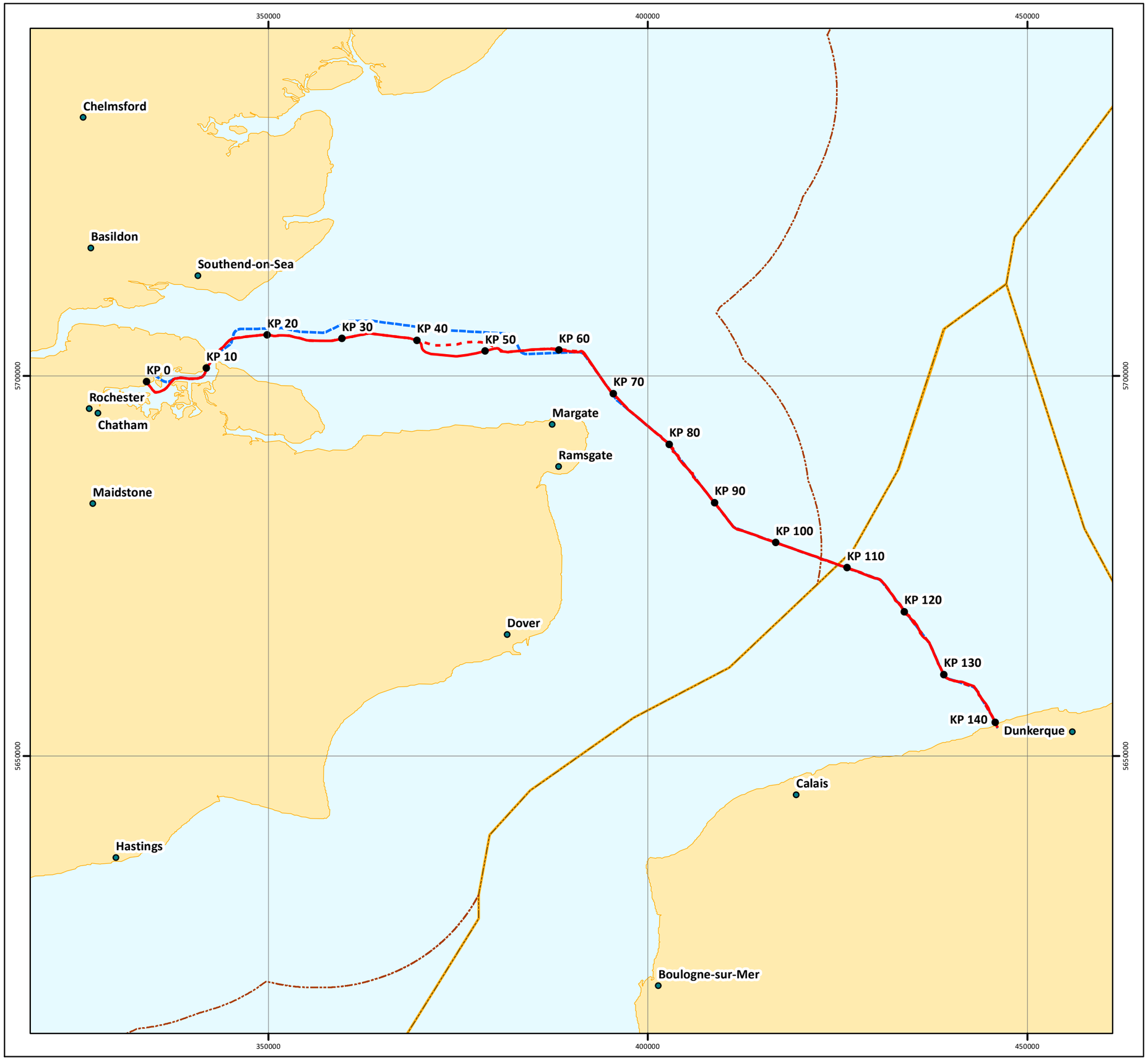
A 500 m corridor along the proposed cable route was subject to a marine survey campaign between June to October 2019. Live routeing evaluations were undertaken as the geophysical survey progressed. This involved assessing the raw geophysical data to determine if there were obstructions or ground conditions which desk-based assessment had not previously identified and needed to be taken into account. Assessment of the survey data identified that the Pan Sands sandbank, located within the outer Thames Estuary between KP40 and KP50, has migrated further north than its mapped position as shown on Admiralty charts. The southern route had been routed to the north of the sandbanks in the available space between the sandbanks and the BritNed interconnector. As the southern route could not be moved further north to compensate for the sandbank migration without crossing the BritNed Interconnector, the route had to be changed to navigate to the south of the Pan Sands sandbank. Additional geophysical lines were acquired to provide information on the seabed conditions of the new route section and confirm that it was feasible. Figure 2-4 (Drawing P2172-LOC-001) also shows the amendment to the cable route due to the Pan Sands sandbank.

In addition, based on the survey results, the cable route has been optimised by micro-routing within the 500 m corridor to take into account:

- Challenging ground conditions e.g. an escarpment feature at the mouth of the Medway Estuary, sand waves and sandbanks;
- Crossing angles at approaches to third party assets to minimise the requirement for rock protection and risk of scour;

- Geophysical anomalies that could be wrecks, unexploded ordnance (UXO) or large items of debris; and
- Sensitive environmental habitats, such as reef structures or protected species.

Further micro-routeing will be undertaken by the Installation Contractor to take into account the latest pre-installation seabed conditions (determined by the geophysical and geotechnical surveys) and the type of installation tools to be used, environmental considerations and project specific mitigation, crossing agreements with third party asset owners, the requirements of statutory authorities and consultations with fishermen's organisations.



GRIDLINK INTERCONNECTOR

LOCATION OVERVIEW

Route Development

Drawing No: P2172-LOC-001	C

Legend

- KP
- GridLink Preferred Cable Route
- South of BritNed Route
- North of BritNed Route
- 12nm Territorial Sea Limit
- EEZ Boundary

NOTE: Not to be used for Navigation

Date	22 June 2020
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Projection	Transverse Mercator
Datum	WGS 1984
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Created By	Chris Dawe
Reviewed By	Chris Carroll
Approved By	Anna Farley

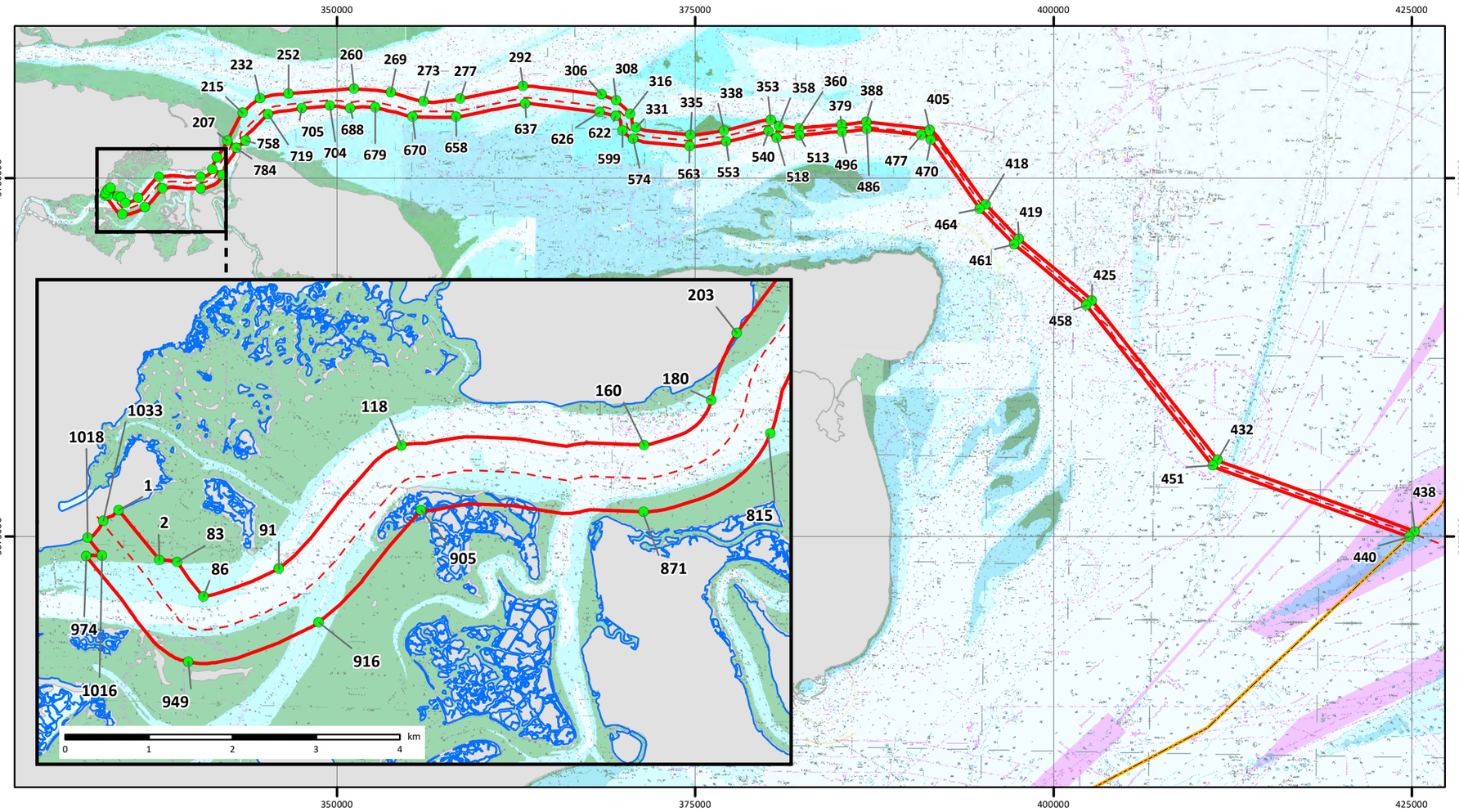
km
0 7.5 15 22.5 30

2.4 Proposed Development

The Preferred Cable Route being taken forward for development consent in the UK is shown in Figure 2-5 (Drawing P2172-LOC-005) as the cable route centreline together with an Application Corridor. The Application Corridor is the area subject to the Marine Licence application, and provides for future micro-routing to take into account any new or changes to features or installation requirements determined at the time of cable installation.

The key advantages of the Preferred Cable Route, in comparison to alternative routes considered are:

- The route represents a relatively direct crossing between the landfall locations, thus minimising the cable length (140 km).
- The route avoids main shipping channels, anchorages, and navigational features.
- The route means GridLink allows space for other projects and does not affect marine navigation to the north of the BritNed Interconnector in the future.
- The route minimises the number of third-party asset crossings required, and therefore minimises the volume of external cable protection to be deposited in the marine environment.
- The landfall facilitates the installation method at the landfall by horizontal directional drilling, which will ensure that sensitive intertidal habitats are not disturbed.



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2	51.41523	0.62281	358	51.47104	1.28433	574	51.46091	1.13821
83	51.41507	0.62585	360	51.47001	1.30448	599	51.46604	1.12740
86	51.41143	0.63060	379	51.47293	1.34709	622	51.47485	1.11991
91	51.41470	0.64337	388	51.47484	1.37193	626	51.47713	1.10373
118	51.42833	0.66377	405	51.47098	1.43543	637	51.48121	1.02877
160	51.42922	0.70548	418	51.42484	1.49335	658	51.47158	0.95961
180	51.43425	0.71682	419	51.40374	1.52730	670	51.47092	0.91615
203	51.44156	0.72080	425	51.36607	1.60188	679	51.47608	0.87860
207	51.45267	0.73083	432	51.26733	1.73080	688	51.47521	0.85328
215	51.47006	0.74532	438	51.22478	1.92890	704	51.47633	0.83263
232	51.47966	0.76264	440	51.22126	1.92317	705	51.47409	0.80479
252	51.48313	0.79108	451	51.26389	1.72618	719	51.46991	0.77103
260	51.48738	0.85634	458	51.36306	1.59655	758	51.45301	0.74929
269	51.48582	0.89355	461	51.40027	1.52272	784	51.44821	0.74007
273	51.48070	0.92694	464	51.42202	1.48775	815	51.43085	0.72715
277	51.48296	0.96364	470	51.46460	1.43719	871	51.42203	0.70579
292	51.49199	1.02607	477	51.46750	1.42738	905	51.42145	0.66750
306	51.48795	1.10545	486	51.47035	1.37227	916	51.40904	0.65051
308	51.48481	1.12010	496	51.46844	1.34763	949	51.40436	0.62832
316	51.47637	1.13458	513	51.46554	1.30526	974	51.41539	0.61020
331	51.46815	1.14071	518	51.46392	1.28245	1016	51.41549	0.61291
335	51.46423	1.19561	540	51.46756	1.27383	1018	51.41732	0.61033
338	51.46755	1.22931	553	51.46050	1.23157	1033	51.41924	0.61298

*Coordinates are provided in WGS 1984 Decimal Degrees

GRIDLINK INTERCONNECTOR

LOCATION OVERVIEW

Marine Licence Application

Drawing No: P2172-LOC-005 | **B**

Legend

- Application Corridor Vertices
- GridLink Preferred Cable Route
- Application Corridor
- High Water Mark
- EEZ Boundary

N W E S

NOTE: Not to be used for Navigation

Date	29 May 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	CDA; ESRI; OSOD; MarineFind; GridLink
File Reference	J:\Gridlink\P2172_Mxd\01_LOC\ P2172-LOC-005.mxd
Created By	Chris Dawe
Reviewed By	Chris Carroll
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

km 0 5 10 15 20

REFERENCES

1 Department for Business, Energy & Industrial Strategy (BEIS) (2019). Trading electricity if there's no Brexit deal. Updated 25 March 2019. [online] Available at: https://www.gov.uk/government/publications/trading-electricity-if-theres-no-brexit-deal/trading-electricity-if-theres-no-brexit-deal (Accessed January 2020)

2 European Commission (2017). Communication from the Commission to the European Parliament, The Council, The European Economic and Social Committee and the Committee of the Regions. Communication on strengthening Europe's energy networks. Brussels 23.11.2017. COM (2017) 718 final.

3. PROJECT DESCRIPTION

3.1 Introduction

This Chapter presents information on the Proposed Development – the marine components of GridLink from mean-high water springs (MHWS) at Kingsnorth, Kent to the median line between the UK and French Exclusive Economic Zone (EEZ) waters.

The installation, operation (including repair) and decommissioning phases of the Proposed Development are described in terms of the design of the components and their installation, including any options, as follows:

- **Installation:** The submarine cable installation process including the pre-installation surveys, the range of vessels to be used and different installation techniques which may be employed in submarine cable laying, cable jointing and burial.
- **Operation:** The physical characteristics of the submarine cable including information about its design, operation, repair and maintenance, and potential emissions produced during operation in the form of heat and electric and magnetic fields.
- **Decommissioning:** The recovery and dismantling activities involved in decommissioning at the end of its operational life.

3.2 Project Overview

GridLink is a proposed subsea and underground electricity interconnector cable between the existing electricity grids in the UK and France with a nominal rating of 1400 megawatts (MW).

GridLink will provide a new interconnector between the National Grid's Kingsnorth 400 kilovolt (kV) substation in Kent and RTE's Warande 400 kV substation to the south of Dunkerque, Nord region in France. The power will be able to flow in either direction, depending on supply and demand requirements in each country.

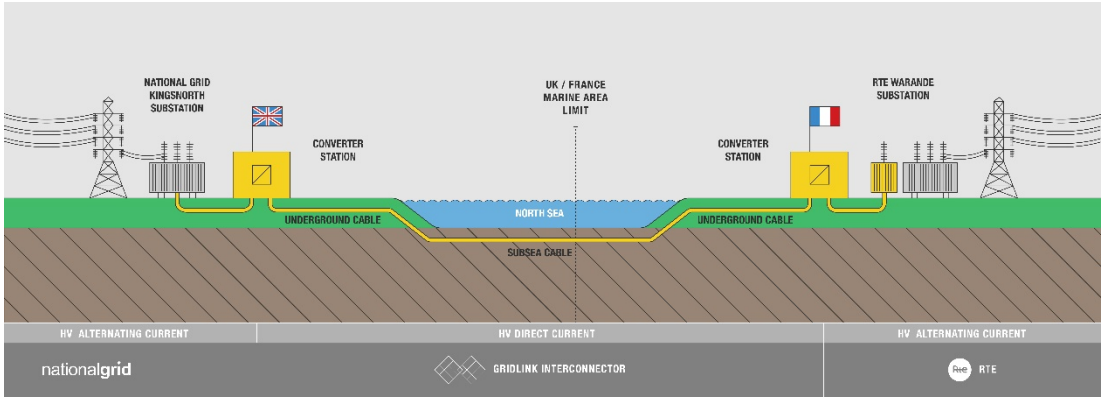
The high voltage grid systems in UK and France operate using high voltage alternating current (HVAC). To reduce energy losses during transport of electricity, HVAC is converted to high voltage direct current (HVDC) at a converter station in the exporting country before transmission by means of a submarine HVDC cable. It is then converted back from HVDC to HVAC for connection to the high voltage network in the receiving country.

The converter station in the UK will be located at the former E.On coal-fired power station site (now demolished) at Kingsnorth, approximately 1.5 km from the National Grid Kingsnorth 400 kV substation. A similar converter station will be located at the Zone de Grandes Industry (ZGI) designated by Grand Port Maritime de Dunkerque in France, approximately 3 km from the RTE Warande 400 kV substation. Each converter station will be connected to the substation by an underground HVAC cable.

The converter stations will be linked by a submarine cable system comprising two submarine HVDC cables laid together in a bundled configuration. At Kingsnorth, the submarine cable will cross the shoreline by horizontal directional drilling (HDD) to arrive in a transition joint pit (TJP) located at the converter station site. After the TJP, the cable will continue underground into the converter station.

Figure 3-1 presents a schematic of the overall GridLink project. The total length of the GridLink submarine cable is 140km; of which the Proposed Development forms 106km with UK territorial waters (i.e. between MHWS and 12 nautical miles [NM]) and 2km in the UK EEZ. The remaining 32km of submarine cable lies in French waters.

Figure 3-1 Pictorial representation of the Proposed Development



3.3 Submarine Cable Route Description

The **Preferred Cable Route** has been defined through an iterative process involving feasibility studies, preliminary cable route engineering, subsea bathymetric, geophysical, geotechnical and environmental surveys, consultation with stakeholders and post-survey routeing studies. The cable installation may deviate from this route i.e. to micro-route around obstacles, but only within an area defined as the **Asset Placement Corridor**. The corridor is nominal 500 m wide and has been included in the offshore bathymetric, geophysical, geotechnical and environmental survey carried out for GridLink.

Kilometre points (KPs) have been assigned to the Preferred Cable Route running from KP0 at MHWS, Kingsnorth to KP139.7 at MHWS, Dunkerque. KPs have been used in the Environmental Report to help describe specific points or sections of the Preferred Cable Route.

The **Application Corridor** – the spatial extent that the Marine Licence Application will apply to is wider than the Asset Placement Corridor from KP0 to KP55 and finishes at the UK/France EEZ boundary at KP108.1. The Application Corridor encompasses all areas where works will be undertaken in UK waters. Due to the shallow water depths between KP0 and KP55, it is likely that anchored vessels will be required, therefore the Application Corridor has been extended wider than the Asset Placement Corridor to accommodate potential anchor positions.

There are areas within the Application Corridor where anchor placement is not favoured (i.e. due to the presence of sensitive habitats, or third party assets), these are defined as **Areas of Constraint for Anchor Placement**. In addition, it is recognised that within the Application Corridor there are several constraints that mean installation in certain areas would not be preferred, these are defined as **Areas of Constraint for Asset Placement**.

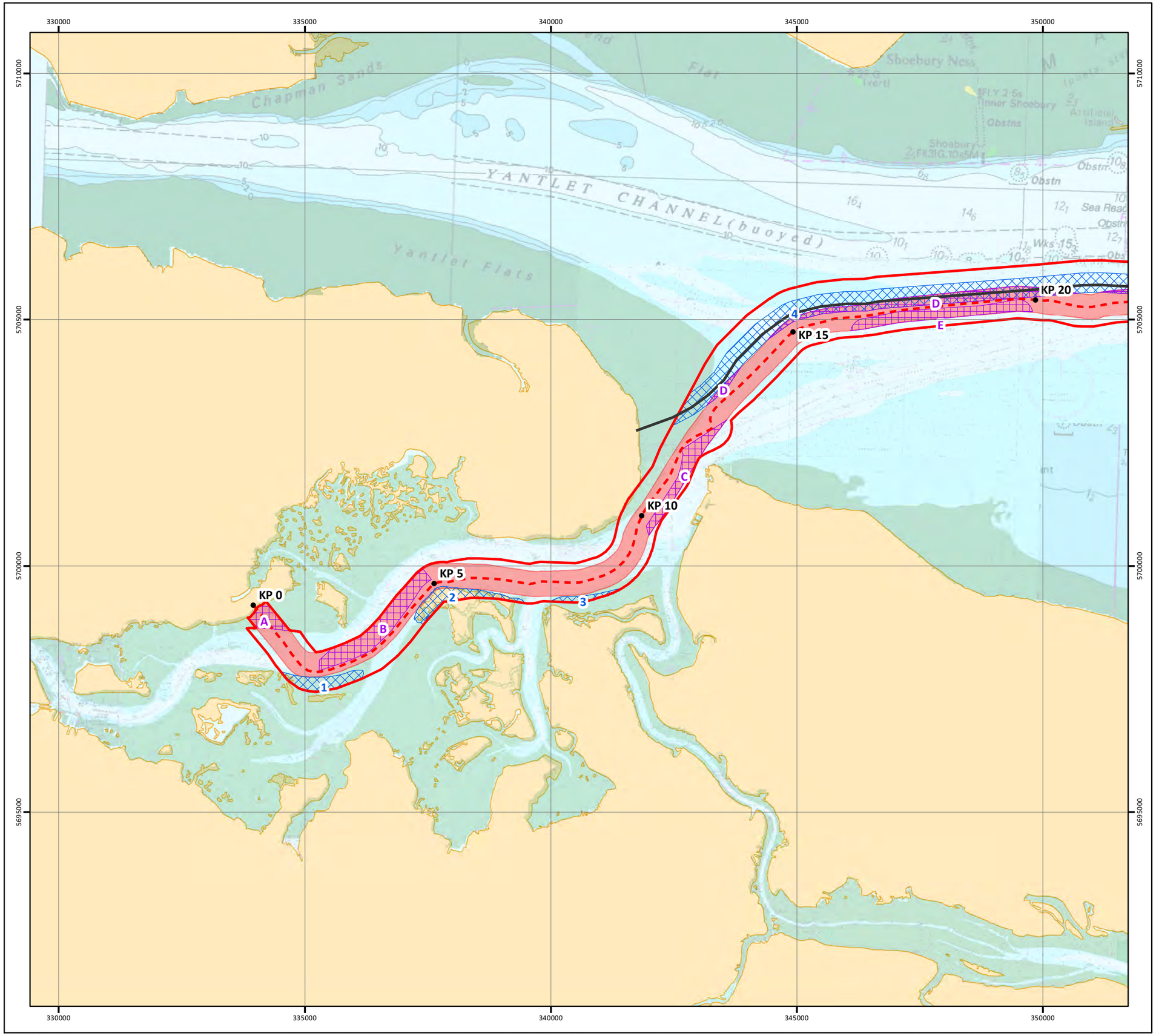
Table 3-1 lists the key project definitions described in this Section.

Figures 3-2 to 3-9 (Drawings P2172-INST-003 sheets 1-8) show the Application Corridor, Asset Placement Corridor, Preferred Cable Route, Areas of Constraint for Anchor Placement and Areas of Constraint for Asset Placement for the cable route in UK waters.

The submarine cable system will be laid within a 30m corridor that is subject to a Marine Licence Application, a Crown Estate lease, an easement from Peel Ports (for the Medway Estuary only) and a licence from the Rochester Oyster and Floating Fishery (ROFF) (selected parts of the Medway Estuary only).

Table 3-1 Project definitions

Project Area	Definition	Preliminary specification
Proposed Development	The marine components of GridLink from MHWS at Kingsnorth, Kent to the boundary between the UK and French EEZ waters	Spatial extent aligns with the Application Corridor. Temporal extent covers installation, operation and decommissioning.
Preferred Cable Route	The route where the submarine cable system will be installed. Any deviation from this position will only occur where obstacles or other constraints are identified that will affect cable installation.	Specified by feasibility studies, surveys, consultation with stakeholders and post-survey routeing studies.
Asset Placement Corridor	Area where micro-routeing of the Preferred Cable Route will be permitted to avoid local obstacles and c0nstraints.	Nominal 500 m wide corridor,
Application Corridor	Extended area where all cable installation related works, including anchor placement and other temporary works, will take place. Area that is covered by development consents and permits to authorise cable installation and related works.	Determined by potential requirement for anchored barges (not DP vessels) for shallow water operations and or cable joints
Constrained Areas for Asset Placement	Area where cable installation shall not take place except if critical for project feasibility	Determined by navigation, environmental or third party asset constraints
Constrained Area for Anchor Placement	Area where cable installation-related works, including anchor placement and other temporary works, shall not take place, expect if critical to project feasibility	Determined by navigation, environmental or third party asset constraints
Third Party Asset Crossing (UK waters)	Crossing of in-service or out-of-service third party power cables, windfarm export cables or telecommunication fibre-optic cables.	3 x in-service power cables (crossing) 3 x in-service telecommunications cables (crossing) 1 x planned new telecommunications cable (crossing) 17 x out-of-service telecommunications cables (cut-and-recover) 9 x possible out-of-service telecommunications cables, identified in public data but not identified by the geophysical survey (cut-and-recover)



GRIDLINK INTERCONNECTOR

INSTALLATION

Application Area and Constraints - Sheet 1

Drawing No: P2172-INST-003	B

Legend

- KP
- GridLink Preferred Cable Route
- BritNed Cable
- Application Corridor
- Areas of Constraint for Asset Placement
- Areas of Constraint for Anchor Placement
- Asset Placement Corridor

N W E S

NOTE: Not to be used for Navigation

Date	27 May 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	KISCA; MarineRegions; Europa; ESRI; OSOD;
File Reference	J:\Gridlink\P2172_Mxd\04_INST\ P2172-INST-003.mxd
Created By	Chris Dawe
Reviewed By	Chris Carroll
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

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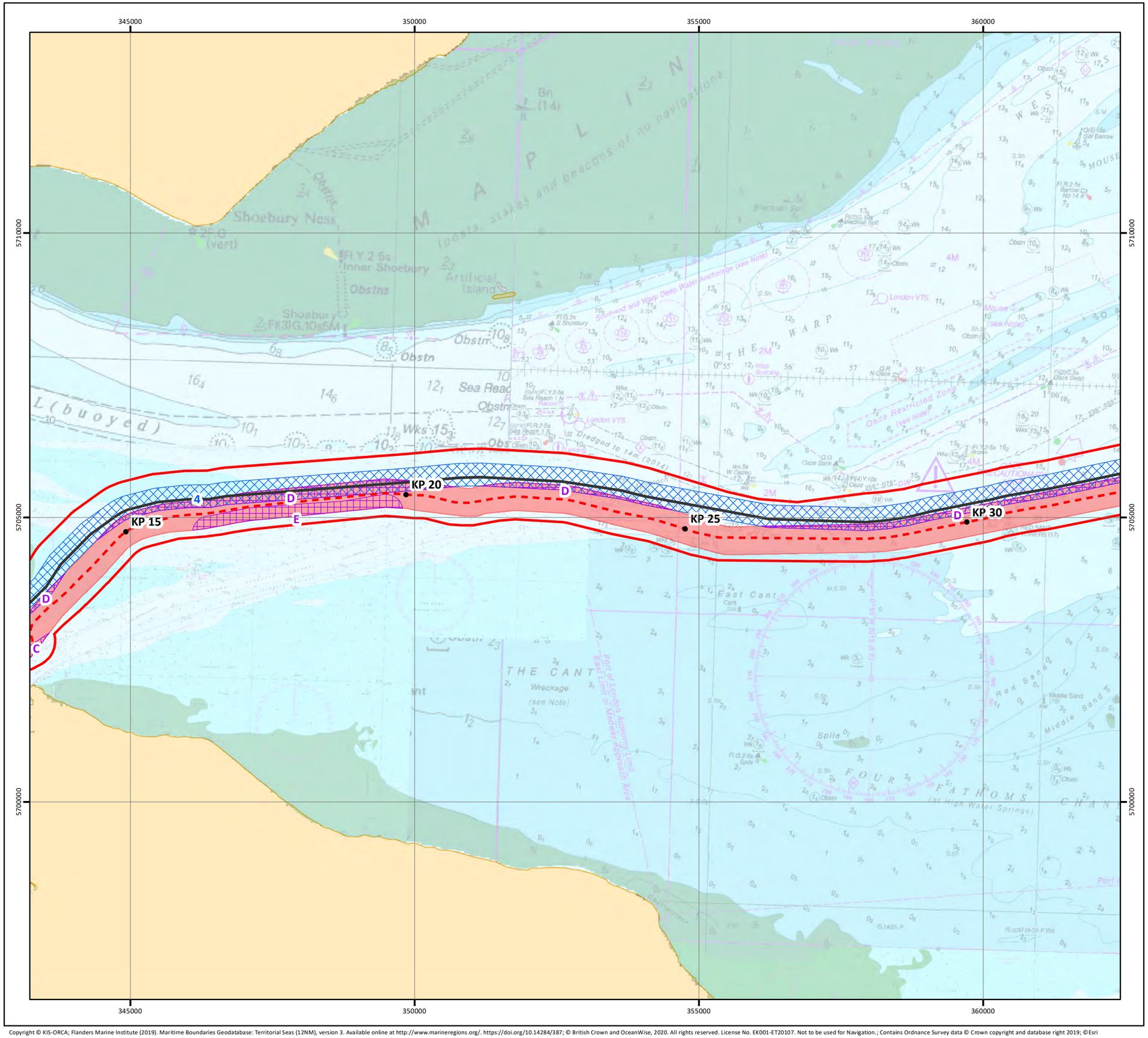

GRIDLINK INTERCONNECTOR

INSTALLATION

Application Area and Constraints - Sheet 2

Drawing No: P2172-INST-003	B

Legend

- KP
- GridLink Preferred Cable Route
- BritNed Cable
- Application Corridor
- Areas of Constraint for Asset Placement
- Areas of Constraint for Anchor Placement
- Asset Placement Corridor

N W E S

NOTE: Not to be used for Navigation

Date	27 May 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	KISCA; MarineRegions; Europa; ESRI; OSOD;
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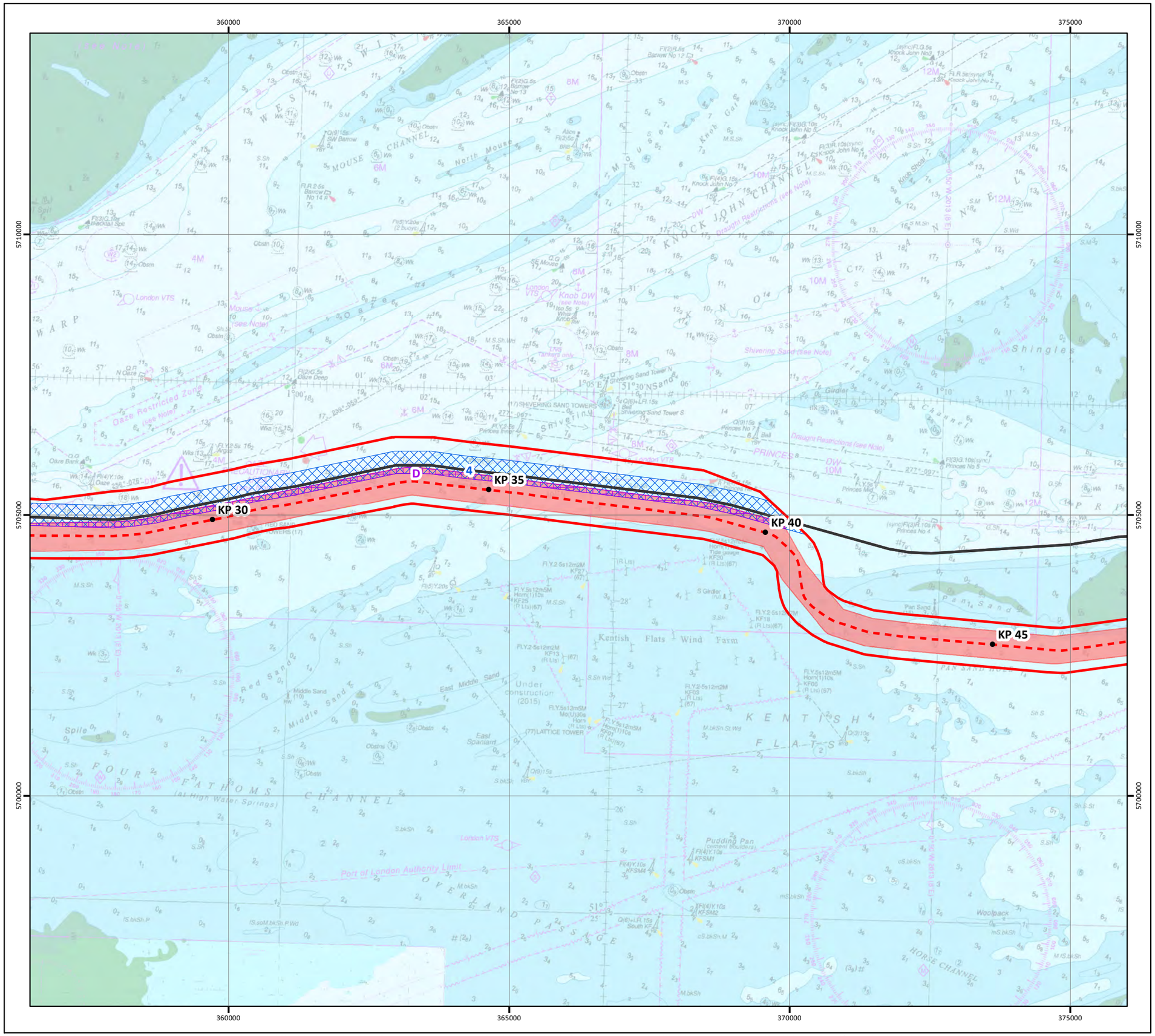
Created By	Chris Dawe
Reviewed By	Chris Carroll
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

0 1 2 3 4 km



GRIDLINK INTERCONNECTOR

INSTALLATION

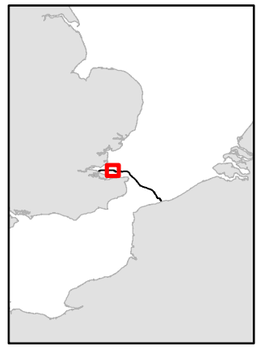
Application Area and Constraints - Sheet 3

Drawing No: P2172-INST-003	B

Legend

- KP
- GridLink Preferred Cable Route
- BritNed Cable
- Application Corridor
- Areas of Constraint for Asset Placement
- Areas of Constraint for Anchor Placement
- Asset Placement Corridor

N W E S



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Created By	Chris Dawe
Reviewed By	Chris Carroll
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

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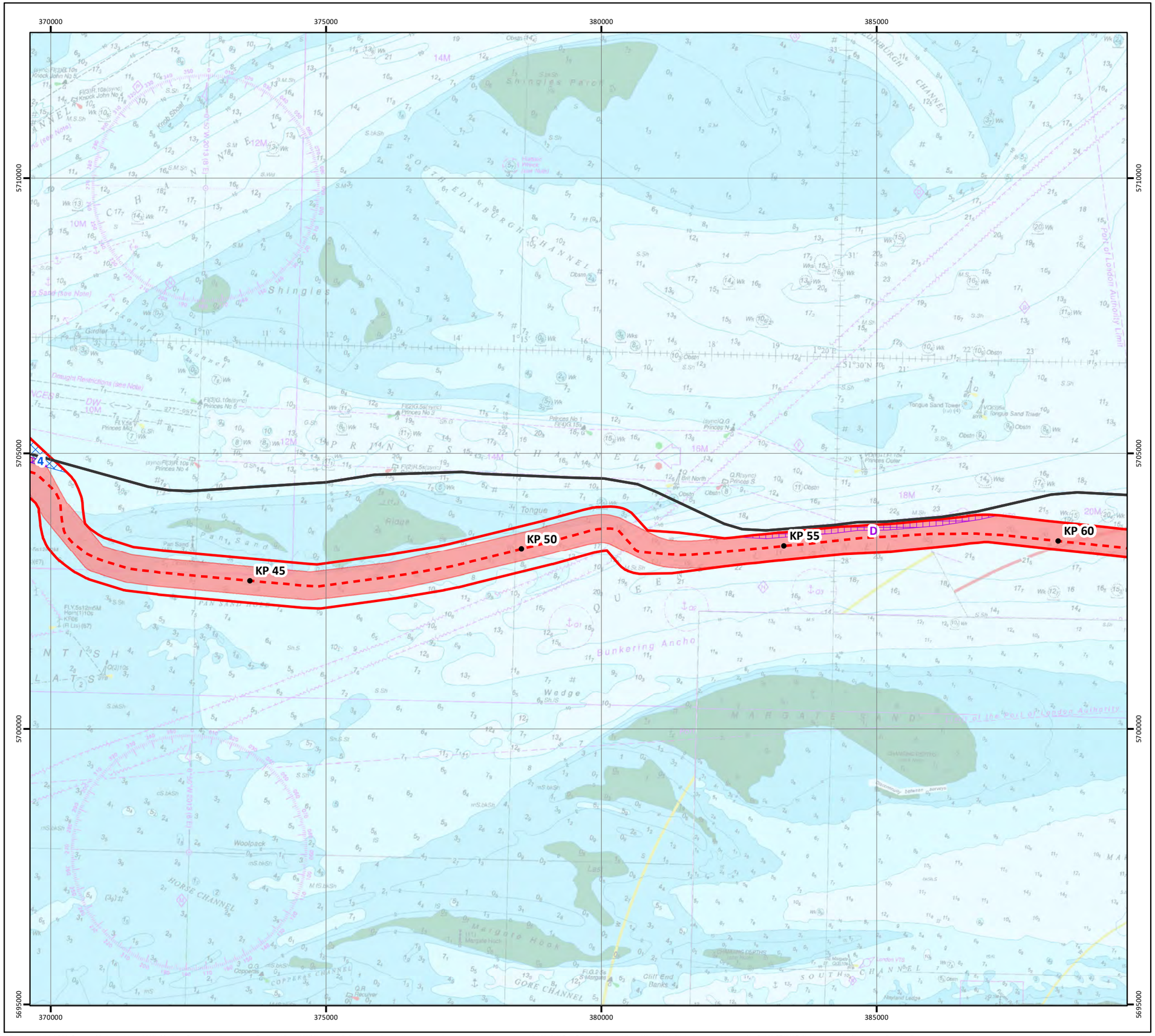

GRIDLINK INTERCONNECTOR

INSTALLATION

Application Area and Constraints - Sheet 4

Drawing No: P2172-INST-003	B

Legend

- KP
- GridLink Preferred Cable Route
- BritNed Cable
- Application Corridor
- Areas of Constraint for Asset Placement
- Areas of Constraint for Anchor Placement
- Asset Placement Corridor

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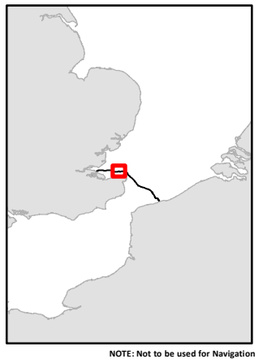

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Created By	Chris Dawe
Reviewed By	Chris Carroll
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

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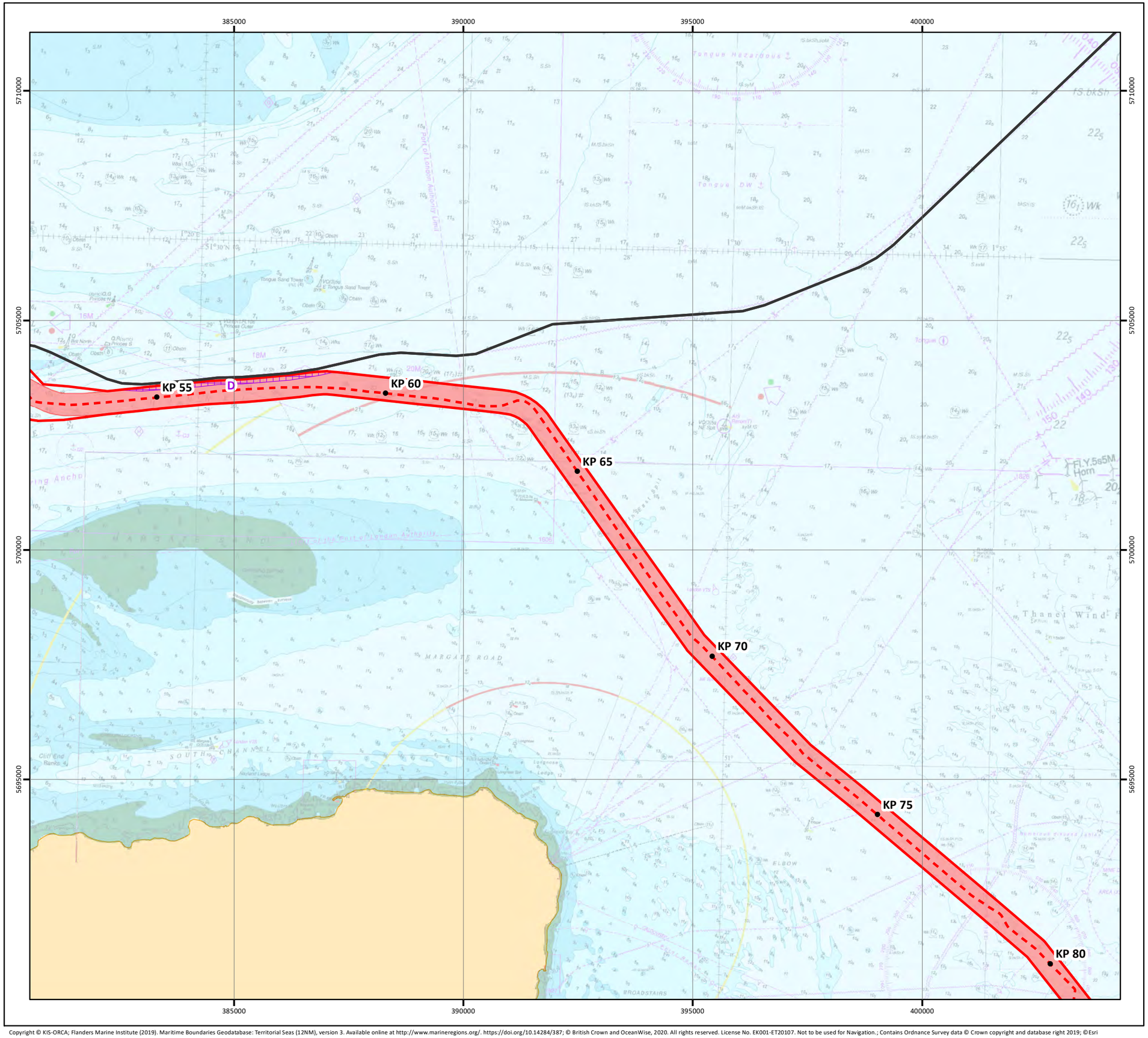

GRIDLINK INTERCONNECTOR

INSTALLATION
Application Area and Constraints - Sheet 5

Drawing No: P2172-INST-003 | **B**

Legend

- KP
- GridLink Preferred Cable Route
- BritNed Cable
- Application Corridor
- Areas of Constraint for Asset Placement
- Asset Placement Corridor

N W E S

NOTE: Not to be used for Navigation

Date	27 May 2020
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Projection	Transverse Mercator
Datum	WGS 1984
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Created By	Chris Dawe
Reviewed By	Chris Carroll
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

0 1 2 3 4 km

GRIDLINK INTERCONNECTOR

INSTALLATION

Application Area and Constraints - Sheet 6

Drawing No: P2172-INST-003	B

Legend

- KP
- GridLink Preferred Cable Route
- Application Corridor
- Asset Placement Corridor

N
W E
S

NOTE: Not to be used for Navigation

Date	27 May 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	KISCA; MarineRegions; Europa; ESRI; OSOD;
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Created By	Chris Dawe
Reviewed By	Chris Carroll
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

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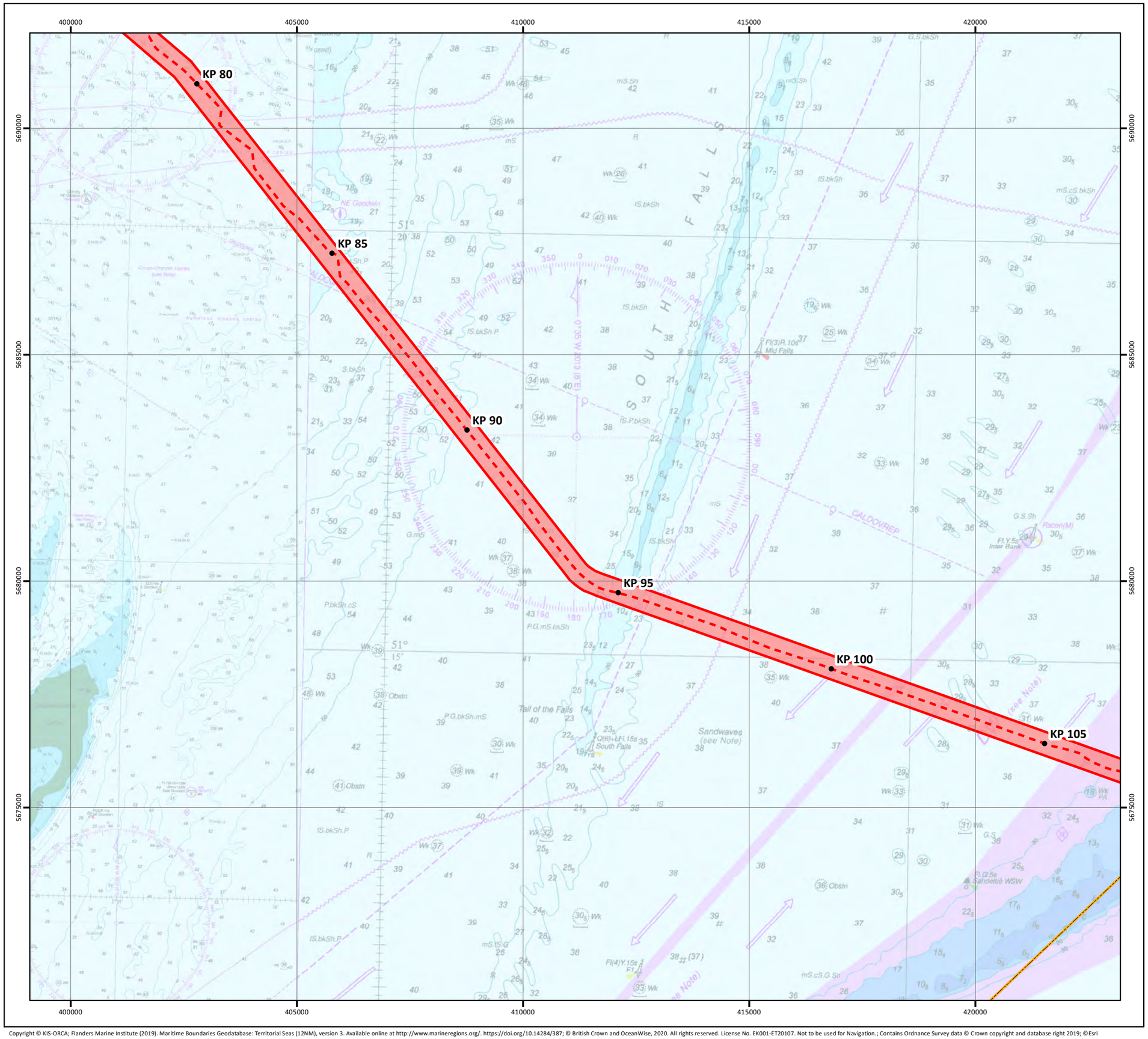


GRIDLINK INTERCONNECTOR

INSTALLATION

Application Area and Constraints - Sheet 7

Drawing No: P2172-INST-003	B

Legend

- KP
- GridLink Preferred Cable Route
- EEZ Boundary
- Application Corridor
- Asset Placement Corridor

N
W E
S

NOTE: Not to be used for Navigation

Date	27 May 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	KISCA; MarineRegions; Europa; ESRI; OSOD;
File Reference	J:\Gridlink\P2172_Mxd\04_INST\ P2172-INST-003.mxd
Created By	Chris Dawe
Reviewed By	Chris Carroll
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

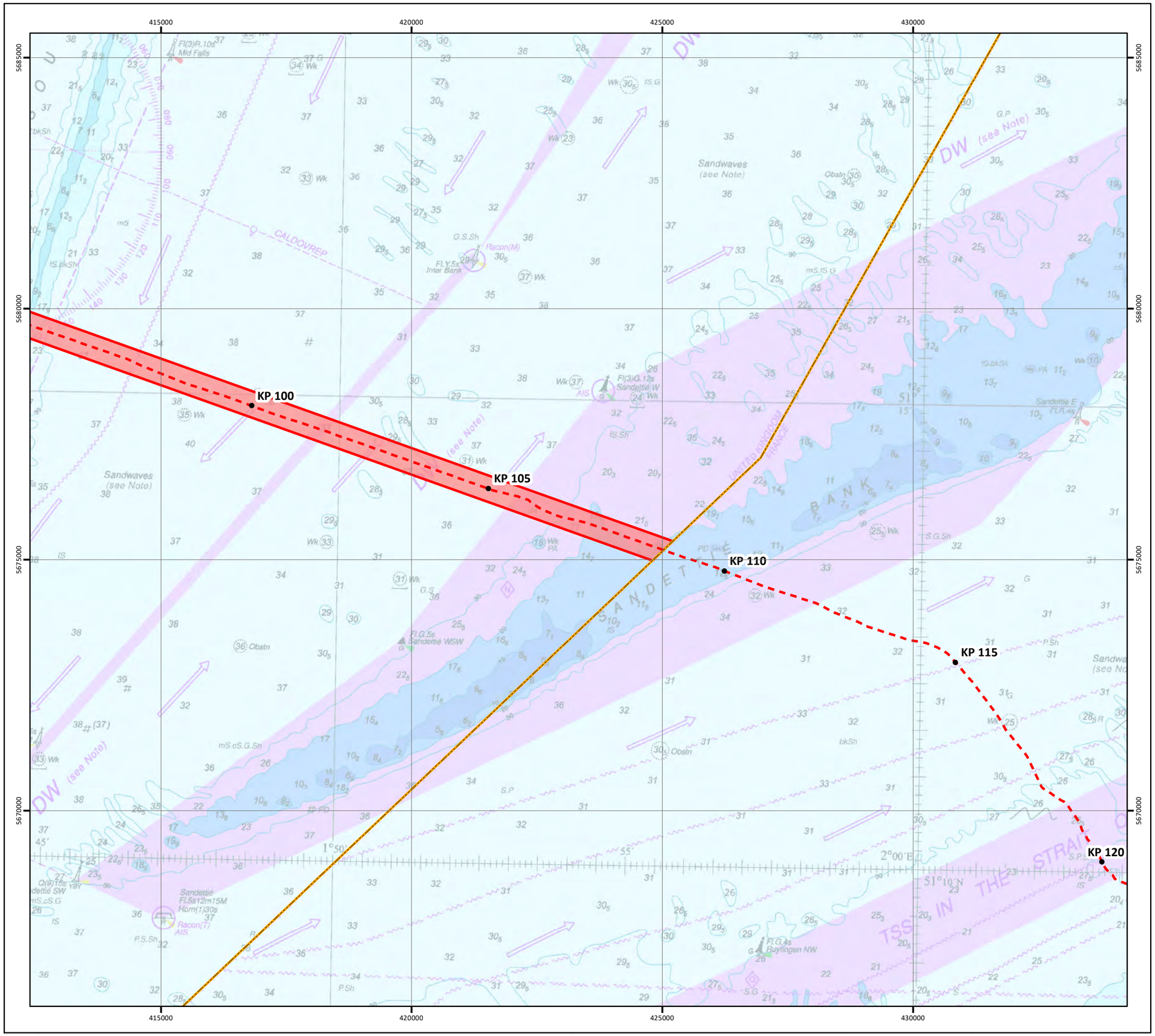
0 1 2 3 4 km

GRIDLINK INTERCONNECTOR

INSTALLATION

Application Area and Constraints - Sheet 8

Drawing No: P2172-INST-003	B



Legend

- KP
- GridLink Preferred Cable Route
- EEZ Boundary
- Application Corridor
- Asset Placement Corridor

NOTE: Not to be used for Navigation

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Projection	Transverse Mercator
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File Reference	J:\Gridlink\P2172_Mxd\04_INST\ P2172-INST-003.mxd
Created By	Chris Dawe
Reviewed By	Chris Carroll
Approved By	Anna Farley

0 1 2 3 4 km

3.4 Submarine Cable Description

The subsea cable system will consist of two mass impregnated submarine HVDC cables.

The diameter of each cable will be approximately 130 mm, with a copper conductor. The cable will have a lead sheath, to ensure no moisture can penetrate the insulation, and steel wire armour to protect the cable from external damage during installation and burial/protection. The armouring is made from round or flat steel wire wound in a helical form. A polyethylene sheath is applied over the armour wires to make the cable easier to handle and ensure the armour wires remain in place during bending.

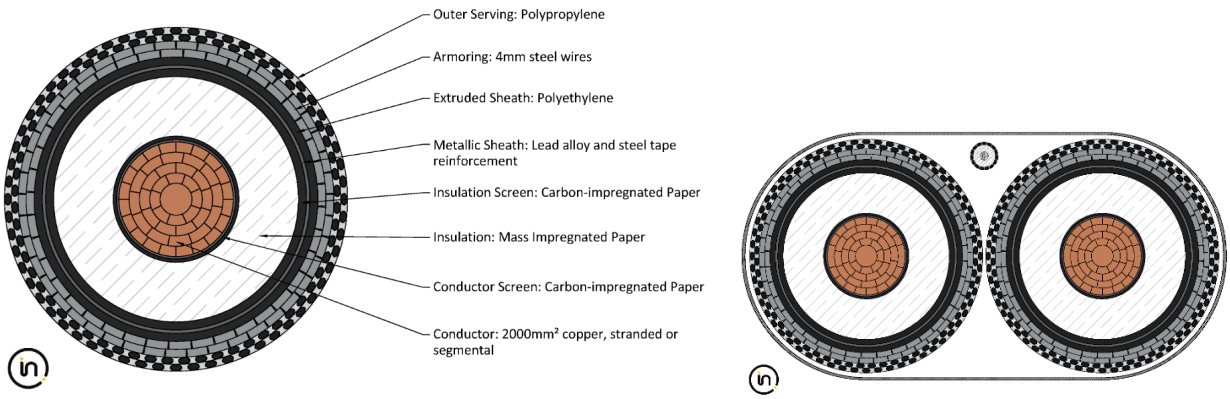
The two cables will be bundled together for cable-lay into a single trench. A smaller fibre-optic cable will be included with the bundled HVDC cables for monitoring and control purposes, with the potential to also offer commercial telecommunications. In order to protect the cables, the cables will be buried below the seabed, with the depth determined by a burial depth risk assessment. The burial depth will range from 1.7m to 3.5m, depending on the seabed geology and navigation and fishing hazards.

A summary of the cable design is below:

- Conductor: 2000mm² copper, stranded or segmental
- Conductor screen: Carbon-impregnated paper
- Insulation: Mass-impregnated paper
- Insulation screen: Carbon-impregnated paper
- Metallic sheath: Lead alloy and steel tape reinforcement
- Extruded sheath: Polyethylene
- Armour: 4mm steel wires
- Serving: Polypropylene
- Cable diameter: Approximately 128mm

An illustration of the submarine HVDC cables is shown in Figure 3-10.

Figure 3-10 Cross-sections of subsea HVDC cable and cable configuration



3.5 Indicative Programme

The construction programme (onshore and offshore) is expected to take approximately 36 months from start to finish. Construction is expected to commence in early 2022 with commercial operations from early 2025.

The exact timing of the landfall and submarine cable installation works will be dependent upon the date of the contract award for the works, time required for detailed design and cable manufacture, availability of cable installation and other vessels and any restrictions to mitigate potential effects on features of conservation interest, fisheries or other sensitive receptors.

Table 3-2 presents the indicative periods when the offshore work activities are expected to take place. The duration of activity within the indicated periods depends on the final scope of works, cable installation method, vessels and equipment, and weather and operational downtime.

Table 3-2 Indicative programme for marine works

Activity	2022				2023			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Landfall HDD site preparation								
Landfall HDD drilling								
Landfall cable installation								
Pre-lay survey								
Route preparation								
Cable lay and burial								
External cable protection installation								

3.6 Pre-installation Works

3.6.1 Unexploded ordnance (UXO) survey

Given the nature of the Proposed Development, there is a risk that UXO may be encountered during intrusive activities e.g. cable installation and cable repair activities. UXO can present a high risk to vessels, personnel and the environment if encountered within the Proposed Development and specifically within the footprint of the installation equipment.

A UXO desktop study was prepared by 6 Alpha Associates (April 2020), which describes the risk of encountering UXO's within the Application Corridor. The UXO desktop study shows the relevant military history of the area crossed by the Proposed Development, the types of UXO used, and the expected presence and distribution of these UXO. The study concluded that it is almost certain that UXO will be found within the Application Corridor. The size of the potential UXO threat sources and their likelihood of occurring are listed in Table 3-3.

Table 3-3 Potential sources of UXO

Potential source of UXO	Likelihood of presence	Highest probability UXO threat item	Net Explosive Quantity (NEQ)
Aerial bombing and military engagements	Almost certain: Aerial bombing and military engagements were identified within 500m of the Proposed Development	*Allied* and *Axis* HE bombs	125kg
Sea Minefields (WWI)	Likely: Multiple Central Powers and one Allied minefield(s) were located on cable route.	*German* E-Type Contact Mines and *Allied* sea mines	227kg
Sea Minefields (WWII)	Almost Certain: Multiple Allied and Axis minefields were located on the cable route	*German* (LMA/LMB) sea mines, *Allied* sea mines	705kg

Potential source of UXO	Likelihood of presence	Highest probability UXO threat item	Net Explosive Quantity (NEQ)
Military practice and exercise areas	Almost Certain: Three historic PEXA were located on the cable route and four modern military PEXA were identified within 2km.	*British* AAA Projectiles	67kg
Coastal armaments	Highly Likely: Both nearshore areas of the cable route were located within the firing template of numerous Allied and Axis coastal armaments	*British* and *German* AAA projectiles	67kg

The offshore bathymetrical and geophysical survey completed in 2019 was designed to detect any significant seabed features and obstacles within the Asset Placement Corridor that may be UXO to allow micro-routing around such anomalies. A more detailed UXO-specific pre-construction survey using a magnetometer array will be undertaken pre-installation, to characterise and investigate anomalies that may be UXO in more detail. Magnetometers are passive devices which detect magnetic anomalies compared to the Earth's magnetic field such as those caused by geological faults and buried metallic objects (e.g. pipelines, cables, UXO, fishing gear, anchors, chains, etc) that may not be detected by standard geophysical survey equipment.

The extent of the UXO survey will be nominally 50m either side of the Preferred Cable Route. It is typically undertaken using geophysical survey vessels.

Any item detected during the survey that may be UXO will be further investigated to confirm its identity and if it poses any risk to cable installation.

3.6.2 Geophysical survey

Although detailed marine surveys have been completed, there is the potential that further surveys will be carried out prior to the commencement of cable installation.

The objectives of these surveys are to confirm that no new obstructions have appeared on the seabed since the original marine survey was undertaken; to confirm the seabed level pre- and post-installation to demonstrate that the required burial depth for the cables has been reached; and to micro-route the Preferred Cable Route around any mobile bedforms or sensitive habitats within the Asset Placement Corridor.

The geophysical survey is typically split into two elements: nearshore (<10m of water) and offshore (>10m of water), each requiring a survey vessel suitable for the different water depths.

The offshore vessel is generally larger and can conduct 24-hour operations. The towed sensors, sensor arrays and equipment are stored on the back deck, often in dedicated garages, and deployed using a crane or vessel A-frame or through a moon pool in the ships hull.

The nearshore vessel is generally smaller and due to its reduction in size can reach shallower water depths. Operations are usually kept to 12 hours (or daylight hours) with the sensors and equipment stored in pallet cases/boxes on the back deck. The equipment usually requires more manual intervention during equipment deployment and recovery.

Both vessels will acquire data to the same or very similar standard by mobilising equipment which yield high resolution results. Typical geophysical equipment and data gathering are listed below:

- **Bathymetry:** Swathe and multi-beam acoustic echo sounder systems are used to record water depth, prepare a 3D digital terrain model of the route and to describe the seabed topography along the Preferred Cable Route. The 3D terrain model built from the bathymetrical data will be used to identify mobile seabed features and, where applicable, to assess the mobility of these mobile seabed features by comparing its location relative to the previous route survey.

- **Side Scan Sonar (SSS):** The sonar signal is emitted from a towfish towed behind the survey vessel along the Preferred Cable Route. Reflections from sediments and other hard objects are received back at the towfish and processed on board the survey vessel to produce an image of the seabed. This technique enables mapping of the seabed surface and identification of sediment types, but cannot determine the thickness of sediments. Obstacles lying on the seabed, such as wrecks, trawler debris and telecommunication cables that might impede cable installation can be identified from the SSS image.
- **Sub-Bottom Profiler (SBP):** This technique involves injecting a pulse of acoustic energy into the seabed and detecting the reflections from the sub-surface geological units. From the reflections the thickness of the sediment can be assessed, but the type of sediment can only be inferred until "ground-truthing" geotechnical data is obtained.

In addition, geotechnical investigations may be undertaken to verify ground conditions to inform cable burial as well as to assess the bearing capacity of the soil with regards to the trenching equipment intended to be used. Sample positions will be determined by analysis of geophysical data. Therefore, the geotechnical investigations will be done on a separate vessel (from the geophysical campaign) and completed once the geophysical data has been acquired.

Where necessary, visual inspection of seabed features, for example at third party asset crossing locations or locations of archaeological potential, and depth of burial measurements may be carried out with a remotely operated vehicle (ROV).

3.6.3 Route preparation

Prior to the start of marine cable installation, it is essential to ensure the Preferred Cable Route is clear of obstructions.

A pre-lay grapnel will be towed along the Preferred Cable Route to clear any seabed debris and to prepare the route centreline for cable installation.

The review of geophysical survey data has identified that no boulder clearance will be necessary in UK waters. However, other types of seabed preparation that may be required in certain areas are:

- UXO clearance;
- Route preparation in sand waves (pre-sweeping); and
- Route preparation at third party cable crossing locations.

3.6.3.1 Pre-lay grapnel

Seabed debris that may have been jettisoned by vessels onto the seabed and other debris can be detrimental to the installation process. To clear the route of detected and any undetected debris, a 'pre-lay grapnel run' (PLGR) will be carried out.

The PLGR vessel tows a wire with a string of specially designed hooks, or grapnels, along the centreline of the cable route until it encounters debris. The tow winch is fitted with a strain gauge which will detect the rise in tension as an object is hooked. The PLGR grapnel will be designed to snatch debris on the surface and just below the surface.

Debris caught with the grapnel will be recovered to the deck of the vessel for appropriate licensed disposal onshore.

Cable installation will be carried out in several campaigns, the length of which is related to the cable carrying capacity of the main lay vessel. The PLGR operation may therefore be phased to ensure that the route is clear of any recent debris before each campaign, typically a few days before cable installation.

Due to the tension generated by the pre-lay grapnel as it is towed along the seabed, a robust, large vessel will be utilised for the operation.

3.6.3.2 UXO clearance

If any significant UXO is identified, the decision-making hierarchy shall be:

1. Avoid by micro-routeing.
2. If the UXO cannot be avoided, undertake clearance to surface or move UXO outside the UXO survey corridor.
3. If the UXO cannot be safely moved, clearance by on-site detonation.

Following the UXO survey, the Preferred Cable Route will be micro-routed within the UXO survey corridor[1] provide a suitable safety distance between the cable installation and any UXO finds. With micro-routing, no UXO clearance is necessary.

If a potential UXO cannot be avoided for whatsoever reason, this potential UXO will be investigated by visual inspection using an ROV. If visual inspection confirms that the object is a UXO, then if it is safe to do so the UXO will be removed. Clearance works will be using an electromagnetic grab.

If it is not safe to remove the UXO, it will be detonated. It is proposed that, as Project Specific Mitigation, deflagration charges (in the region of 1.54kg) will be used on all UXO – whereby the explosive is burnt out rather than blown up. Deflagration is a much less energetic process and anecdotal evidence has suggested that it is "quieter" than traditional high-order detonation (Cheong et al. 2020). There will still be a relatively large release of impulsive sound energy, creating high amplitude shock waves, but evidence in Cheong et al. (2020) indicates the reduction in blast effects is around 97%. The size of the deflagration charge is relative to the size of UXO identified but 1.54kg is likely to the maximum size.

UXO clearance and deflagration requires the use of a specialised UXO expert. Up to two vessels may be used: one for identification and a second for retrieval / clearance or deflagration. During deflagration, the vessel undertaking the deflagration will standoff at a specified distance. The distance depends on factors such as water depth, vessel type, activity and the predicted UXO Net Explosive Quality. A vessel standoff distance of 150m is considered a minimum safe requirement for the largest UXO identified as potentially present within the Application Corridor.

As a precautionary measure, the Marine Licence application includes permission to deflagrate up to ten UXO, although from experience on other power cable projects in the Thames region it is thought more likely that up to two will be required.

3.6.3.3 Route preparation in sand waves (pre-sweeping)

In areas of high mobility sediments and sand waves, pre-sweeping may be carried out prior to cable installation to create a path to enable trenching to the required depth.

Sandwaves can present a major challenge for both towed and self-propelled installation equipment. Installation equipment can generally work on long inclines of up to 10-15°. However, for commonly available machines, the practical limit for burial depth is 3m. By removing a proportion of the sandwave prior to installation, a burial machine can reach further down and place the cables below the level at which they may be affected by the mobility of the bedform feature; a technique referred to as pre-sweeping.

Once an area has been pre-swept cables can be buried relative to a non-mobile reference level below the lowest point of the seabed undulations. This ensures that the burial depth of the cables is unlikely to be compromised by seabed mobility (see Figures 3-11 and 3-12). The area to be pre-swept will be

[1] A maximum 100m wide corridor within the Asset Placement Corridor.

wide enough for the passage of the trenching equipment at the base of the sandwave and is typically 10-20m wide. Depending on the height of the sandwave, the corridor at the crest may be wider to ensure the sides of the trench do not collapse.

If required, pre-sweeping will be undertaken several days to a few weeks in advance of cable laying operations to ensure the path remains open for cable installation to take place.

Figure 3-11 Non-mobile reference level below mobile seabed features

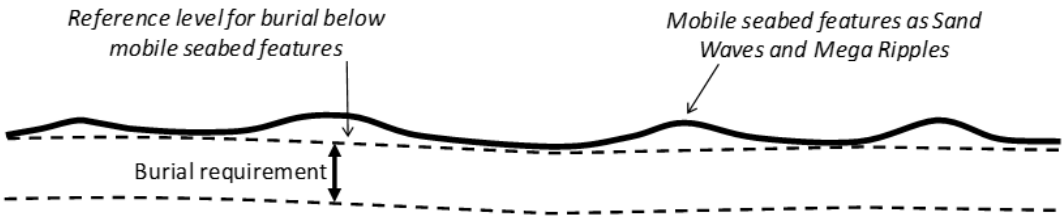
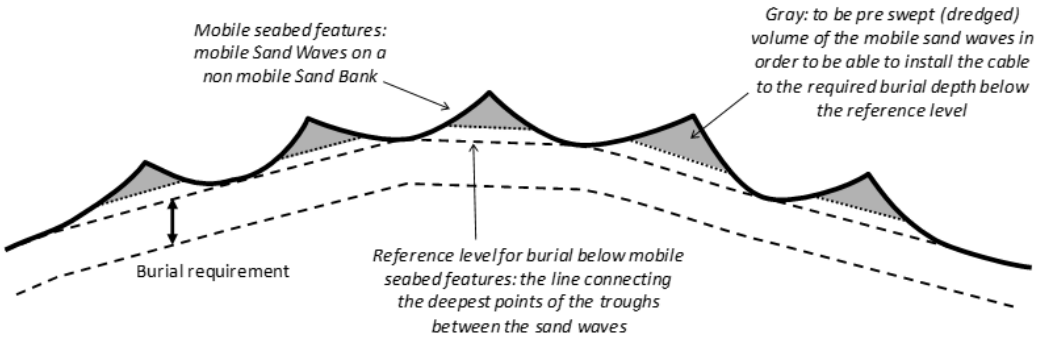


Figure 3-12 Non-mobile reference level for cable burial below sandwave and dredge profiles



Review of the geophysical and geotechnical survey data for the Application Corridor has identified preliminary (indicative) locations at which pre-sweeping may be required. These are illustrated in Figure 3-13 (Drawing P2172-LOC-006) with further detail provided in Table 3-4.

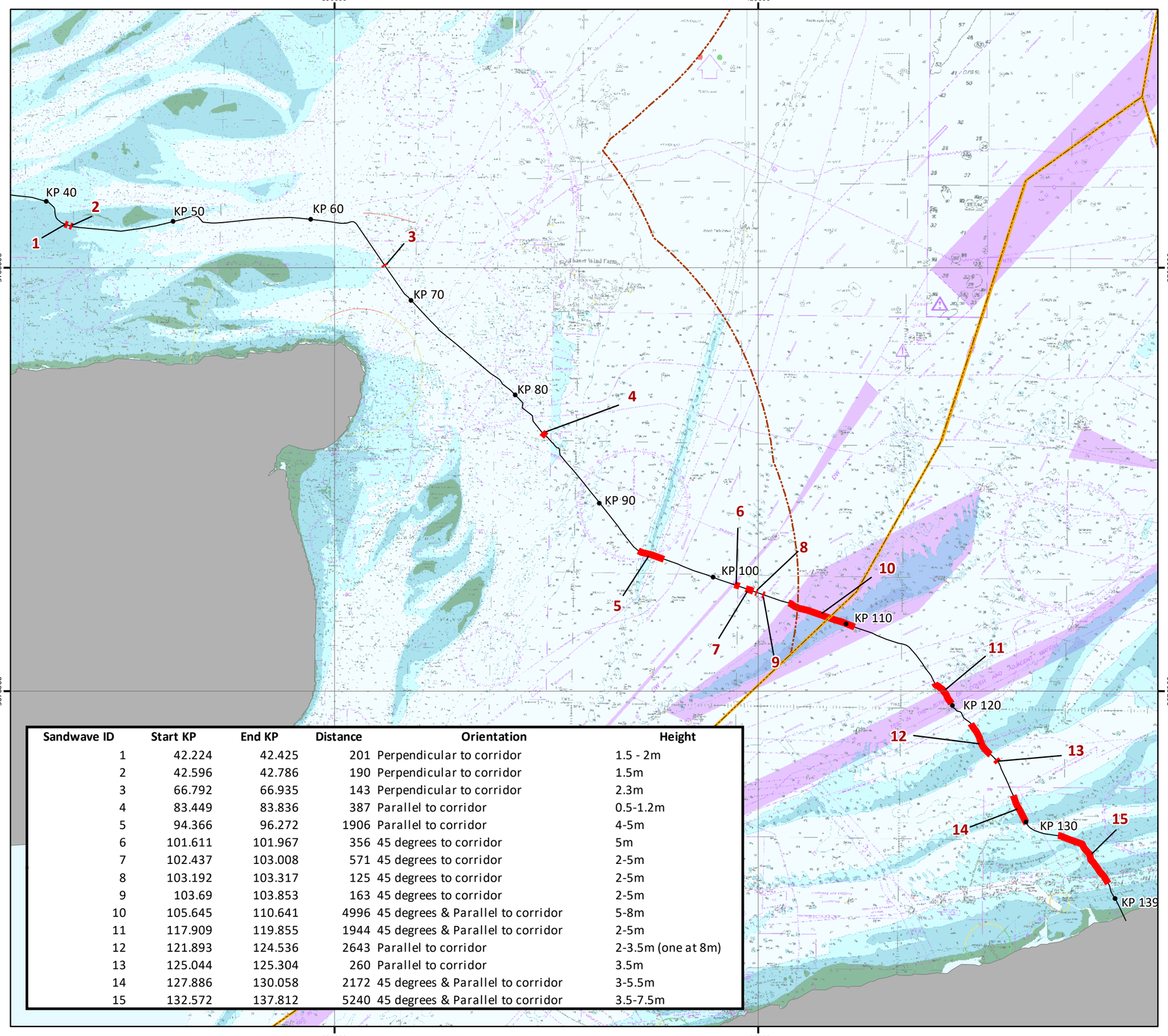
Table 3-4 Indicative pre-sweeping requirements (UK)

KP start	KP end	Maximum height of sandwave (m)	Distance to be cleared (m)	Maximum clearance width (m)*	Maximum seabed footprint (m^2)	Maximum volume of sediment removed and re-deposited (m^3)**
42.15	42.35	2.0	201	27	5427	8442
42.527	42.717	1.5	190	24	4560	5557.5
66.57	66.71	2.3	140	28.8	4032	7051.8
83	83.39	1.2	390	22.2	8658	8704.8
93.77	95.67	5.0	1900	45	85500	285000
101	101.356	5.0	356	45	16020	53400
101.83	102.4	5.0	570	45	25650	85500
102.58	102.7	5.0	120	45	5400	18000
103.08	103.24	5.0	201	45	7200	24000

KP start	KP end	Maximum height of sandwave (m)	Distance to be cleared (m)	Maximum clearance width (m)*	Maximum seabed footprint (m^2)	Maximum volume of sediment removed and re-deposited (m^3)**
105	108	8.0	3000	63	315000	1560000

*Assumes base trench width of 15m and 1:3 side slope.

**Maximum volumes based on maximum height of sand wave, noting that this will typically be a one-off spot height with the remainder of the sandwave lower. These values are therefore worst-case.



Sandwave ID	Start KP	End KP	Distance	Orientation	Height
1	42.224	42.425	201	Perpendicular to corridor	1.5 - 2m
2	42.596	42.786	190	Perpendicular to corridor	1.5m
3	66.792	66.935	143	Perpendicular to corridor	2.3m
4	83.449	83.836	387	Parallel to corridor	0.5-1.2m
5	94.366	96.272	1906	Parallel to corridor	4-5m
6	101.611	101.967	356	45 degrees to corridor	5m
7	102.437	103.008	571	45 degrees to corridor	2-5m
8	103.192	103.317	125	45 degrees to corridor	2-5m
9	103.69	103.853	163	45 degrees to corridor	2-5m
10	105.645	110.641	4996	45 degrees & Parallel to corridor	5-8m
11	117.909	119.855	1944	45 degrees & Parallel to corridor	2-5m
12	121.893	124.536	2643	Parallel to corridor	2-3.5m (one at 8m)
13	125.044	125.304	260	Parallel to corridor	3.5m
14	127.886	130.058	2172	45 degrees & Parallel to corridor	3-5.5m
15	132.572	137.812	5240	45 degrees & Parallel to corridor	3.5-7.5m

GRIDLINK INTERCONNECTOR

ROUTE OVERVIEW
Indicative Areas of Sandwave Pre-Sweeping

Drawing No: P2172-LOC-006 | **B**

Legend

- KP
- GridLink Preferred Cable Route
- Indicative Areas of Pre-Sweeping
- 12nm Territorial Sea Limit
- EEZ Boundary

N W E S

NOTE: Not to be used for Navigation

Date	22 June 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	MarineRegions; UKHO; GEBCO; EUROPA; GridLink
File Reference	J:\Gridlink\P2172_Mxd\01_LOC\ P2172-LOC-006.mxd
Created By	Chris Carroll
Reviewed By	Chris Dawe
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR intertek

0 5 10 15 km

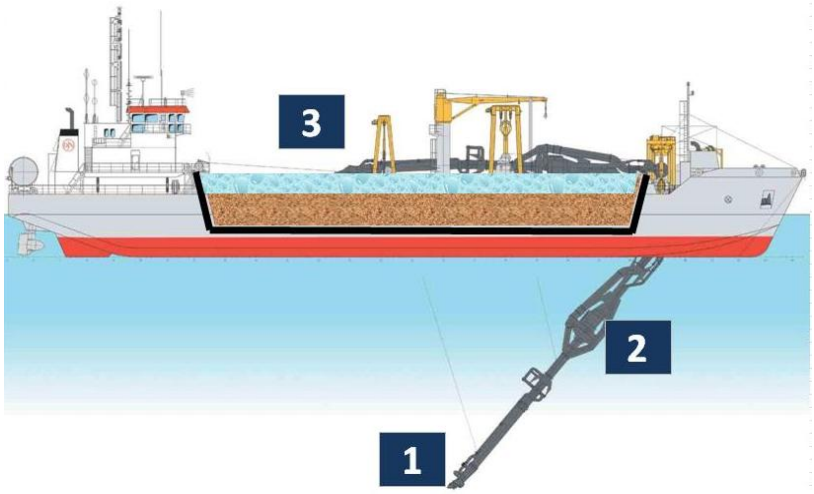
There are two techniques used for pre-sweeping; dredging and mass flow excavation.

Dredging

This technique uses a trailing suction hopper dredger (TSHD) (Figure 3-14) to remove the crest lines of sandwaves and create a flatter path for a burial machine to move along. The TSHD would operate as a discrete vessel (i.e. detached from the cable laying spread) and is generally agile and not restricted in its ability to manoeuvre.

The spoil volumes resulting from pre-sweeping are typical of dredging operations for channel or port maintenance and therefore are relatively small. The spoil would be deposited back on the seabed in the immediate vicinity of the pre-sweeping activity, thus keeping the dredged soil in the mobile seabed system and within the Application Corridor. The dredged soil will be dispersed equally by sailing slowly whilst opening the bottom doors at a slow pace.

Figure 3-14 Trailing suction hopper dredger

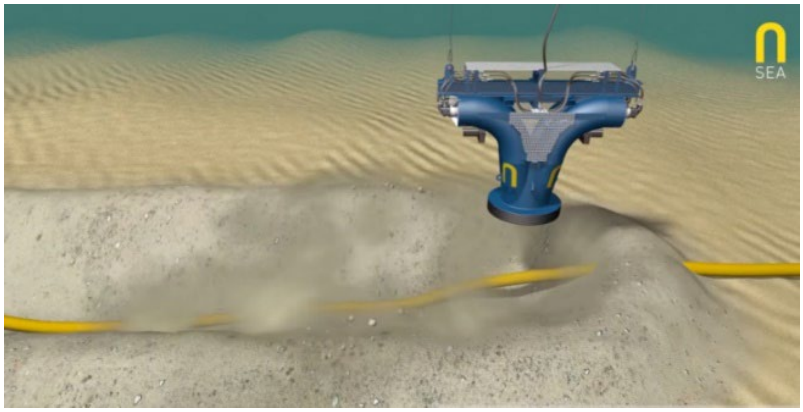


Source: http://www.theartofdredging.com/tshd3comp.htm

Mass flow excavation (MFE)

The MFE produces a downwards flow from a nozzle suspended 1m above the seabed. This fluidises the sediment, creating a trench suitable for cable installation. Sediment is either pushed to either side of the cable trench (as illustrated in Figure 3-15) by the downward thrust or settles out of suspension.

Figure 3-15 Mass flow excavator



Source: Quad-prop Mass Flow Excavating Tool by N-Sea (2014).

3.6.3.4 Route preparation at third party asset crossings

Third party asset crossings

The Proposed Development crosses three types of cables: in-service (IS) power cables, in-service (IS) telecommunication cables and out-of-service (OOS) telecommunication cables. It does not cross any oil or gas pipelines.

23 third party assets have been positively identified within the Application Area comprising:

- 1 x in-service interconnector cable;
- 2 x in-service wind farm export cable arrays (comprising 2 and 4 cables respectively);
- 3 x in-service telecommunications cables;
- 1 x new telecommunications cable (which will be in-service by 2022); and
- 17 x historic/out-of-service cables.

The third party assets have been identified by desk-top studies and the marine survey.

There are also a further 9 third party assets identified by desk-top studies that have not been found by the survey. It is assumed that these assets are out-of-service cables that, as a conservative assumption, may remain in place and require cut and recovery operations to facilitate the Proposed Development. It is also possible that these assets have already been recovered or do not exist due to inaccurate information from asset owners.

In addition, two or four new windfarm export cables are planned associated with the Thanet Windfarm Extension. The number of cables depends on the cable system design and voltage level. Depending on the timetable for implementation of the windfarm, the Proposed Development may require a crossing of the new cables.

Two third party assets also have been positively identified within 500m of the Preferred Cable Route:

1. BritNed Interconnector: 300m reducing to minimum of 150m separation north of the Preferred Cable Route, for approximately 40km from KP15 to KP55 where the Preferred Cable Route is parallel with the BritNed Interconnector cable system;
2. Kentish Flats 1 wind farm: 800m south of the Preferred Cable Route.

These assets may potentially be affected by cable installation and related activities, for example anchor placement.

In-service cables

A summary of the in-service third party asset crossings are listed in Table 3-5. Table 3-6 presents indicative locations for the planned telecom and export cables which may also require a crossing; although it is believed that the Thanet Offshore Wind Farm extension export cables will be installed after the Proposed Development.

The physical crossing design will vary according to, among other things, the size, type, location and burial state of the crossed asset. Generally, the Proposed Development will cross over the IS cables on a 'bridge' comprised of either aggregate (rock) or concrete mattresses. It is this first layer of protective material that will be positioned during route preparation by a pre-construction vessel using either a crane (for mattresses) or a fall pipe (for rock).

Table 3-5 In-service crossing locations

Asset Name	Operator	Type	KP	WG84 UTM31N			
				Easting	Northing	Lat (dd)	Long (dd)
London Array Wind Farm Export Cable (x4)	Blue Transmission London Array Ltd	Power	1) 51.89 2) 51.93 3) 51.94 4) 52.08	1) 380415 2) 380442.6 3) 380477.4 4) 380529.2	5703482.1 5703450.6 5703410.7 5703351.5	51.469853N 51.469575N 51.469224N 51.468703N	1.278267E 1.278675E 1.27919E 1.279955E
Thanet Wind Farm Export Cable (x2)	Balfour Beatty	Power	1) 77.61 2) 77.66	1) 401232.2 2) 401270.8	5692365.2 5692339.4	51.373956N 51.373734N	1.580999E 1.581553E
Nemo Link Interconnector	Nemo Link Ltd	Power	84.84	405932.6	5686912	51.325716N	1.649928E
Pan European Crossing	Century Link	Telecom	80.58	403309.9	5690251.2	51.355293N	1.611391E
Tangerine	Century Link	Telecom	81.76	404031.5	5689329.0	51.347126N	1.621999E
Atlantic Crossing 1 - Seg B1	Century Link	Telecom	96.89	414476.7	5678925.7	51.255268N	1.774435E

Table 3-6 Indicative locations for planned in-service crossings

Asset Name	Operator	Type	KP	WG84 UTM31N			
				Easting	Northing	Lat (dd)	Long (dd)
Thanet Windfarm Extension Export Cable Corridor	Vatenfall	Power	76.95 to 77.3	400709.8 400978.2	5692781.1 5692550.6	51.3775865N 51.3755610N	1.5733543E 1.5772739E
Mercator / Joss	BT	Telecom	71.32	396513.3	5696509.6	51.4103516N	1.5119920E

Out-of-service cables

The Proposed Development potentially crosses 26 out-of-service (OOS) telecommunications cables in UK waters. Of these, the cable route survey confirmed the presence of 17 assets. As a precaution, it is assumed that the other cables are still present and will need cutting before cable installation.

To cross an OOS cable, a de-trenching grapnel is used to retrieve the OOS cable from the seabed. The de-trenching grapnel typically penetrates 1.5 – 2.0m into the seabed. Once retrieved the OOS cable is cut and the ends secured to the seabed in accordance with International Cable Protection Committee (ICPC) recommendation No 1 (ICPC 2014). This recommends that "any cable segments left on the seabed are carefully documented and properly capped or terminated with a clump weight attached". This ensures that the risk of fishing gear snagging the cut cable ends is reduced. Clump weights are small disc-shaped weights that sit on the seabed surface (typically 0.5m round by 0.2m thick). The cutting corridor is to be agreed with the asset owner but it is expected to be a minimum of 50m either side of the centreline (100m wide in total).

The clearance of OOS cables will be undertaken by the installation vessels during the seabed clearance campaign. They will be equipped with a ROV for subsea intervention in case the grapnel run does not retrieve the OOS cable.

Table 3-7 provides the locations of each OOS cable.

Table 3-7 Location of Out-of-service Cables

Asset Name	Operator	Type	KP	WG84 UTM31N			
				Easting	Northing	Lat (dd)	Long (dd)
Unknown (found in MMT Geophys Survey) #1	Unknown	Assumed Telecom	9.38	341669.5	5700428.5	51.432904N	0.72221E
BT Master Wayleave Agreement (#1)	BT	Telecom	11.32	342542.8	5702123.1	51.448373N	0.734009E
BT Master Wayleave Agreement (#2)	BT	Telecom	11.24	342512.5	5702050.5	51.447712N	0.733605E
BT Master Wayleave Agreement (#3)	BT	Telecom	15.94	345825.4	5705023.3	51.475335N	0.779946E
Unknown (found in MMT Geophys Survey) #2	Unknown	Assumed Telecom	24.67	354424.0	5704899.0	51.476495N	0.903723E
Unknown (found in MMT Geophys Survey) #3	Unknown	Assumed Telecom	46.7	375365.3	5702653.9	51.46132N	1.205894E
Unknown (found in MMT Geophys Survey) #4	Unknown	Assumed Telecom	46.8	375446.1	5702664.9	51.461436N	1.207053E
North Foreland No3 - Fort No1 and No2 (Crossing #1)	Unknown	Telecom	62.15	390578.4	5703130.2	51.468746N	1.424643E
Unknown Cable - MMT_009	Unknown	Telecom	62.27	390748.2	5703134.6	51.468819N	1.427086
Unknown Cable - MMT_006	Unknown	Telecom	62.763	391119.2	5703233.1	51.469776N	1.432394E
North Foreland No3 - Fort No2 (crossing#3)	Unknown	Telecom	64.389	392289.41	5701991.1	51.458836N	1.449613E
Kentish Knock Lightship - Kingsgate	Kingsgate Telecommun ication	Telecom	69.004	394913.7	5698188.6	51.42515N	1.488503E
North Foreland No3 - Fort No2 (crossing #2)	Unknown	Telecom	69.457	395181.6	5697933	51.422902N	1.492431E
Rembrandt 2	Unknown	Telecom	71.471	396615.4	5696400.4	51.409389N	1.513492E
UK - Netherlands 9	Unknown	Telecom	71.57	396684.1	5696327	51.408741N	1.514500E
Hermes South	Global Telesystems	Telecom	72.572	397364.2	5695599.0	51.402321N	1.524486E
UK - Belgium 5	BT	Telecom	75.965	399966.4	5693421.5	51.383213N	1.562496E
Unknown (found by Thanet Wind Farm Extension survey)	Unknown	Assumed Telecom	77.257	400954.6	5692570.8	51.375739N	1.57693E
UK - Belgium 1	BT	Telecom	79.47	402730.0	5691044.4	51.362324N	1.602848E
Dumpton Gap - Middelkerke	BT	Telecom	79.748	402838.3	5690932.6	51.361338N	1.604434E
Unknown (found in MMT Geophys Survey) #5	Unknown	Assumed Telecom	80.08	403069.8	5690693.9	51.359232N	1.607823E
Dumpton Gap - La Panne 2	BT	Telecom	81.79	404034.5	5689300.7	51.346871N	1.62205E
Unknown Cable - MMT_002	Unknown	Telecom	82.998	404678.7	5688312.7	51.338099N	1.631561E
Dumpton Gap - La Panne 1	BT	Telecom	83.94	405384.6	5687631.2	51.33209N	1.641873E

Asset Name	Operator	Type	KP	WG84 UTM31N			
				Easting	Northing	Lat (dd)	Long (dd)
Dumpton Gap - Borkum (1896)	BT	Telecom	100.68	418036.8	5677645.3	51.24428N	1.825733E
Borkum - Fayal	BT	Telecom	105	422112.0	5676205.1	51.232269N	1.885055E

3.7 Cable Installation

3.7.1 Cable laying techniques

There are three possible configurations for cable installation:

1. Pre-cut trenching – A pre-cut trenching vessel will tow a plough along the seabed creating a v-shaped trench. A cable lay vessel will follow, laying the cables directly into the trench. This is typically followed by a support vessel towing a back-fill plough which pushes the spoil heaps into the trench. This method is not typically used in unconsolidated soils such as the sands present along large parts of the route.
2. Simultaneous lay and burial – simultaneous trench excavation and cable-lay into the trench at the same time. The cable lay vessel may tow the burial equipment or it is deployed by another vessel navigating close behind, creating effectively a single large spread. The cables are fed into the burial equipment directly from above and the cables are buried as the spread progresses along the route.
3. Post-lay burial – cable-lay on the seabed followed by post-lay trench excavation and then trench backfilling, if required. The cable lay vessel lays the cables on the seabed and a post-lay burial vessel follows later to bury the cables. As the post-lay burial is a stand-alone operation, the post-lay burial vessel may operate with a longer separation distance from the lay vessel, so there are two discrete operations separated physically and in time.

The sea surface footprint of a cable installation spread will depend on the technique to be used. It will incorporate that of the vessel, or vessels if working in concert, and the surrounding area, commensurate with being a “vessel restricted in its ability to manoeuvre”. Typically, a large cable-lay vessel/barge will be up to 150m in length and other vessels will be requested to remain a “safe” distance from the operation, typically 500m radius or potentially up to 1000m longitudinally if it has anchors.

The temporal effect of the spread will be dependent on the slowest moving element, usually the cable burial spread, which will most likely be moving at a speed of between 100 – 300m per hour, depending on the soils encountered and the type of burial equipment used. Cable laying (without simultaneous cable burial) can progress at speeds of up to around 300-500m an hour. The only interruptions to the marine installation may be for any cable joints that need to be made along the route.

Cable laying operations can typically continue in weather conditions up to Force 7 winds and a wave height of 3m. The vessel can stay on station typically in Force 8 or 9 winds. In the most severe weather, the vessel may have to cut and cap the cable and leave the work site. In this case, the vessel will return when the weather has improved, recover the end of the cable, make a joint and continue the laying operation.

In shallow waters the sea surface footprint of the spread will also be dependent on whether anchors are used. The anchors may be placed up to 500 to 1000m from the vessel, depending on the amount of wire present on the vessel winches and on the space available for placing the anchors with the support of anchor handling tugs. In this case, the anchor handling tugs may also act as guard vessels for the spread.

Cable lay operations will be performed on a 24-hour basis to maximise efficient use of suitable weather conditions and vessel and equipment time; and minimise the presence of the cable lay spread in navigation channels, fishing grounds or other sensitive areas.

The indicative specifications and operations of the vessels used for the cable installation and associated activities are described below.

3.7.2 Installation vessels

3.7.2.1 Types of installation vessels

The vessels expected to be used for cable-lay and associated activities will consist of:

- Cable lay vessel (CLV) – to undertake cable lay and burial in water depths greater than 10m;
- Cable lay barge (CLB) – to undertake cable lay and burial in water depths of less than 10m (i.e. from KP0 to KP55);
- Jack-up barge (JUB) – a small platform with four legs, to be used at the HDD entry/exit point to support the drilling and pull-in of the cables.
- Small work boats e.g. anchor handling vessels, tugs and other work boats – to support the CLV, CLB and JUB during cable pull-in operations and cable lay/burial;
- Guard vessel(s) –to protect areas of exposed cable prior to burial or external protection being applied and may be used in support of the CLB which will have limited manoeuvrability; and
- External cable protection placement vessel(s) –to deposit the external protection material e.g. rock berms, concrete mattresses.

3.7.2.2 Cable lay vessel (CLV)

The cable lay vessel (CLV) is a specialist ship designed specifically to carry and handle long lengths of heavy cables. Two examples of a typical cable lay vessel are provided in Figure 3-16 below. CLV's are equipped with dynamic positioning (DP) systems, which enable the ship to be held very accurately in position despite the effects of currents and wind.

Figure 3-16 Example cable lay vessels

The cable will be loaded onto powered turntables (Figure 3-17) on the back of the CLV at the cable factory. Transporting the cable in this manner prevents it kinking or twisting. The vessels can carry long lengths of cable, up to nominal 100km, depending on the vessel used and the final design of the cable.

Prior to heading to the work site, the vessel will transit to a port close to the worksite for final mobilisation of equipmen, cable handling crew, and client's representatives.

Figure 3-17 Typical cable laying vessel turntable

3.7.2.3 Cable lay barge (CLB)

The main CLV cannot typically operate in water depths of less than 10m so cannot operate in the shallow waters associated with the Medway Estuary and waters adjacent to the Princes Channel. Therefore, a separate shallow water spread, such as a CLB, will also be needed. It is likely that a CLB will be required from KP0 to approximately KP55. A typical cable lay barge is shown in Figure 3-18.

Shallow water spreads are normally based upon flat-top pontoon barges that are mobilised on an ad-hoc basis for cable work. They will be fitted with all the necessary cable storage and working gear and a four to six-point mooring system (anchors), which is used to manoeuvre the barge during cable work. Occasionally two barges are combined into a single spread, with one providing storage and deck working space and another providing motive power by use of anchors or thrusters.

The CLB will be assisted by a team of small boats and possibly divers, depending on the installation technique selected by the contractor. Small boats will be used to move anchors, monitor traffic and guard the vessel spread. Anchors will be positioned within the Application Corridor.

An anchor plan will be prepared prior to the installation works. Planned anchor positions will be surveyed before cable installation and, if necessary, anchor positions will be adjusted to avoid potential UXO, archaeological finds or Annex I habitats. Areas of Constraint for Anchor Placement have been marked on Figures 3-2 to 3-6 (Drawings P2258-INST-001 sheets 1-5), where any anchors to be positioned in these areas will require robust justification that alternative locations are not suitable.

Figure 3-18 Typical cable lay barge

3.7.2.4 Anchor handing tug

Dedicated anchor handling tugs, as shown in Figure 3-19, will support the CLB, moving the anchors that the CLB uses to propel itself along. The tugs are specialised support vessels in the region of 30m long with the ability to work in shallow water depths.

3.7.2.5 Jack-up barge (JUB)

The shore crossing where the submarine cables come ashore and connect to the land cables, will be made by horizontal directional drilling (HDD).

A jack-up barge (JUB) will be used at the HDD exit to either excavate the end of the drilling and/or support the cable pull-in through the HDD. A typical cable JUB is shown in Figure 3-20.

A JUB is a small platform that typically has four to eight legs. The number of legs used for the operation is dependent on seabed conditions, current strength and wave action. The JUB would be towed into position by a tug, which is likely to remain close by, in a support capacity, through-out the operation.

Figure 3-19 Typical anchor handling tugs

Figure 3-20 Typical Jack-up Barge (JUB)

3.7.2.6 Guard vessel

Where deemed necessary, the CLV, CLB or other vessel operations with restricted vessel manoeuvrability will be accompanied by a guard vessel(s). The guard vessel(s) will maintain surveillance around the main vessel to monitor traffic and advise other vessels to keep clear of the installation spread to avoid the threat of collision. A guard vessel may also be used to warn fishing vessels of temporarily unprotected sections of cable e.g. between cable lay and burial/installation of external cable protection.

The vessels used for guarding the CLV and CLB will be suitable for working around the cable laying operation, with crews who have experience in the local area and communications to redirect both commercial and leisure traffic away from marine operations. The vessels are typically quite small to increase manoeuvrability around the larger vessels during sensitive operations. Suitably experienced fishing vessels (locally based or sourced through the National Federation of Fishermen's Organisations (NFFO)) can be used in this role.

3.7.2.7 Construction support vessels

A variety of other vessels will be required to support the installation works, as illustrated in Figure 3-21. These will likely include crew transfer vessels, dive support vessels (DSV), general construction support vessels (CSV) and rock placement vessels. DSVs and CSVs come in a variety of sizes to fit the working conditions and activity and can be adapted to undertake several different roles e.g. archaeological or UXO inspections, PLGR, deposition of concrete mattresses or frond mattresses at

crossing locations. Rock-placement vessels are specialised vessels that feature a large hopper to transport the rock, and a mechanism for deployment of the rock at the desired location by:

- Side dumping, where the rock is pushed or tipped over the side of the vessel;
- Split hopper, where the hopper separates to allow the rock to fall through the vessel; and
- Flexible fall pipe, where a retractable chute is used to control the flow of rock to the seabed.

Fall-pipe vessels (Figure 3-21) provide the greatest accuracy as ROVs can be used to monitor the position of the fall pipe, allowing rock to be more accurately placed, but can only be used in water depths greater than 10m.

Figure 3-21 Illustrative construction support vessels

Clockwise from left: Fall pipe vessel, construction support vessel, dive support vessel, crew tranfer vessel

3.7.3 Cable jointing

CLV's typically have a carrying capacity of 5,000 to 10,000 tonnes. For the cable system design, this equates to cable lengths in bundled configuration up to approximately 100km. However, this means that it will be necessary to install the cable in at least two sections, with each section connected together by a cable joint.

At the cable joint, the end of the installed cable section will be temporarily left on the seabed whilst the CLV returns to port to pick up a new cable length. A ground wire will be attached to the end of the cable to enable retrieval of the end of the cable to allow cable laying to continue. The cable may be temporarily buried into the seabed or guarded by a guard vessel whilst the CLV is off-site to ensure it is not damaged.

The cable joint will be made on board the CLV and will take up to approximately 14 days to complete per joint location. In this time, the vessel is likely to anchor to maintain position. Once the cable joint has been made, the vessel will continue with laying of the new cable length.

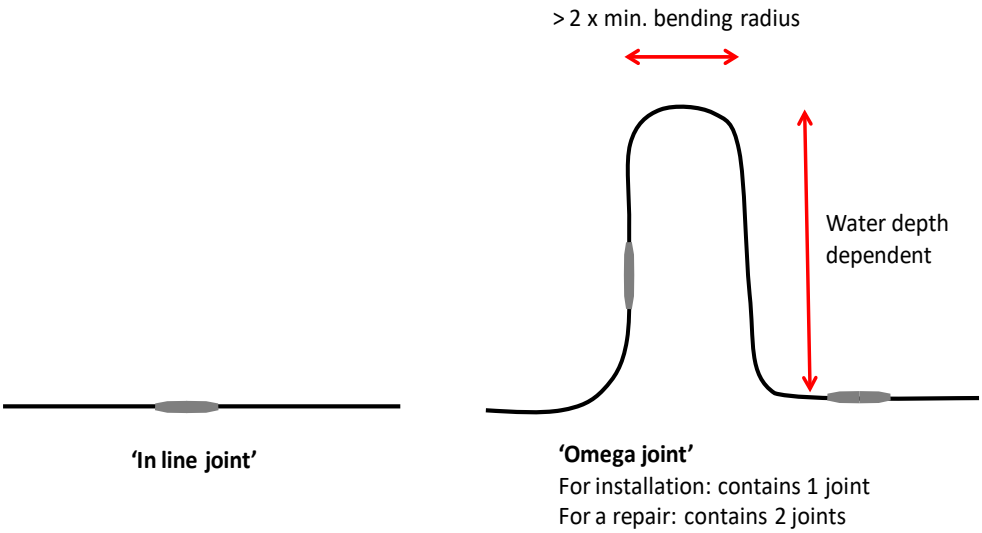
There are two types of cable joints; in line joints and omega (or hairpin) joints (as illustrated in Figure 3-22). An 'in line' joint is when cable laying is continued after picking up a cable end. An 'omega' joint is made between a cable which has been laid towards another cable, or when a repair is required in an existing cable.

The jointing process for an omega joint requires extra cable approximately equal to twice the depth of water to be introduced into each of the two cable lengths to allow for the jointing operation to take place. When the cables are deployed onto the seabed they are laid down in a loop formation, referred to as an "omega" (or "hairpin") owing to its shape. The loop size and shape are controlled as the cables are deployed onto the seabed to ensure the cable minimum bend radius requirements are met.

The joint and the short section of adjacent cables left on the seabed will be buried or protected by concrete mattresses or rock protection.

Following consultation with the Port of London Authority, it is the Applicants preference that the cable joint is made between KP50 and KP51 or between KP53 and KP55 i.e. either side of the London Array crossing location. This is in order that the two-week static cable jointing operation takes place outside of the main shipping lanes. The joint will be buried in the seabed.

Figure 3-22 Examples of subsea cable joints



3.7.4 Cable burial and protection

Once laid on the seabed the cables need to either be buried or otherwise protected from the threat of external damage; primarily ships anchors or fishing activity.

The choice of burial technique or protection method will vary along the Preferred Cable Route depending upon the seabed conditions. Wherever possible, the cables will be buried in the seabed as this provides the best protection for the cable and minimises potential for interference with fishing activity. Where the seabed composition is not suitable for burial, external protection will be provided through either rock placement or concrete mattresses.

3.7.4.1 Burial depths

The recommended target burial depths along the cable length have been determined using the Carbon Trust cable burial risk assessment (CBRA) methodology. For the purposes of assessment, the CBRA split the Preferred Cable Route into zones based on geotechnical similarities. The burial depths consider cable design, seabed composition and dynamics, sediment mobility and potential for damage from external sources (fishing gear and ship's anchors).

Two depths are calculated:

- Recommended Minimum Depth of Lowering (RMDOL) – this is the minimum depth of lowering recommended for protection from external threats. It is a direct output of the fishing risk assessment and the probabilistic anchor risk assessment and includes a safety factor.
- Target Depth of Lowering (TDOL) – this is the depth that will be specified based on best use of what is achievable by industry standard burial tools to gain an additional depth beyond RMDOL without incurring a step change in costs.

As illustrated in Table 3-8 and Figures 3-23 to 3-26 (Drawing P2258-LOC-014 sheets 1-4) the TDOL is generally 1.7m but it does vary along the Preferred Cable Route due to the presence of extremely low strength clay (within which anchors will penetrate very deeply) combined with high traffic densities.

Table 3-8 Target depth of lowering

KP Start	KP End	Section length (km)	TDOL (m)
0.41	7.099	6.689	3.5
7.099	14.899	7.8	1.7
14.899	16.099	1.2	2.05
16.099	23.999	7.9	1.7
23.999	25.599	1.6	2.2
25.599	30.999	5.4	2.5
30.999	33.799	2.8	2.2
33.799	53.999	20.2	1.7
53.999	55.199	1.2	1.9
55.199	57.099	1.9	1.7
57.099	61.736	4.637	2.5
61.736	70.799	9.063	1.7
70.799	72.869	2.07	1.85
72.869	74.499	1.63	1.7
74.499	75.799	1.3	1.8
75.799	108.500	32.701	1.7

Source: Intertek (2020)

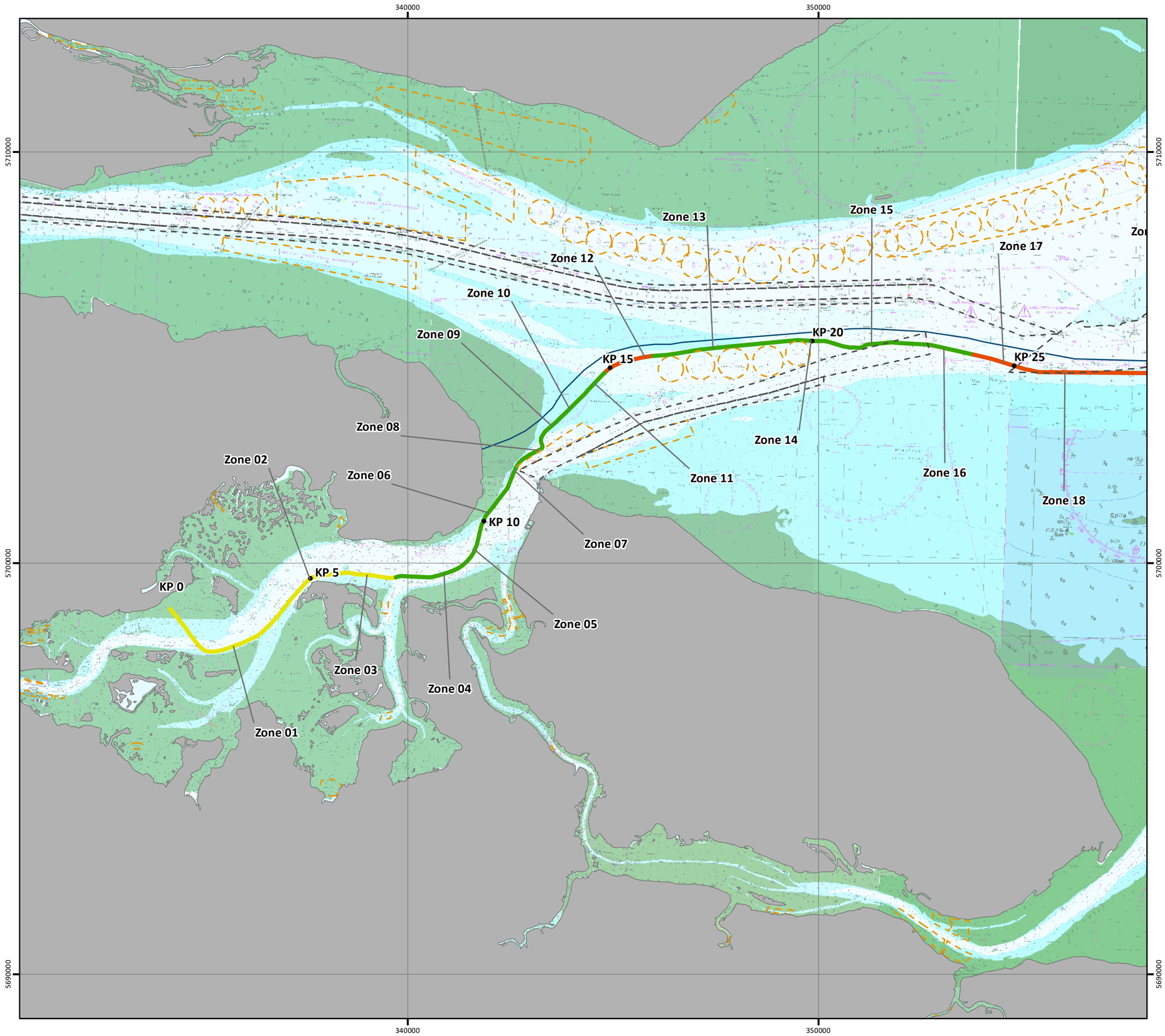
GRIDLINK INTERCONNECTOR

ROUTE OVERVIEW

GridLink Cable Burial Risk Assessment TDOL Zones

Sheet 1 of 5

Drawing No: P2258-LOC-014 | **B**



Legend

- GridLink Preferred Cable Route KP
- Navigation Channel (Designated)
- Anchorage Area (Designated)

Constrained Features

- BritNed Cable

GridLink Route TDOL Zones

- TDOL = 1.70m
- TDOL = >1.70m to 2.50m
- TDOL = 3.50m

N W E S

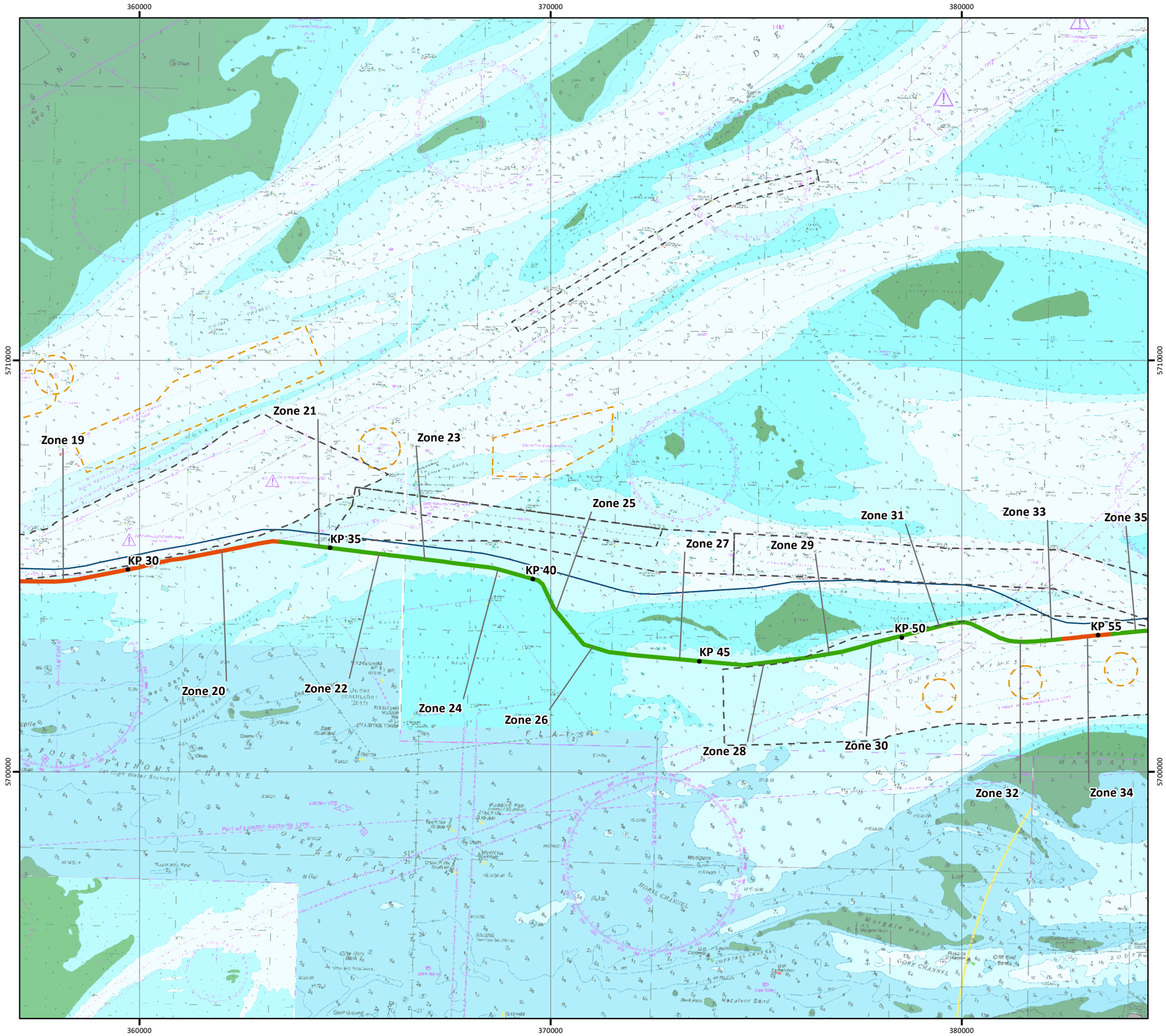
* Target Depth of Lowering (TDOL)

NOTE: Not to be used for Navigation

Date	28 May 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	MarineRegions; GEBCO; OSOD; EUROPA
File Reference	J:\Gridlink\P2258_Mxd\01_LOC\ P2258-LOC-014.mxd
Created By	Chris Dawe
Reviewed By	Emma Langley
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR intertek

0 1 2 3 4 km



GRIDLINK INTERCONNECTOR

ROUTE OVERVIEW

GridLink Cable Burial Risk Assessment TDOL Zones

Sheet 2 of 5

Drawing No: P2258-LOC-014	B

Legend

- GridLink Preferred Cable Route KP
- Navigation Channel (Designated)
- Anchorage Area (Designated)

Constrained Features

- BritNed Cable

GridLink Route TDOL Zones

- TDOL = 1.70m
- TDOL = >1.70m to 2.50m

N W E S

* Target Depth of Lowering (TDOL)

NOTE: Not to be used for Navigation

Date	28 May 2020
Coordinate System	WGS 1984 UTM Zone 31N
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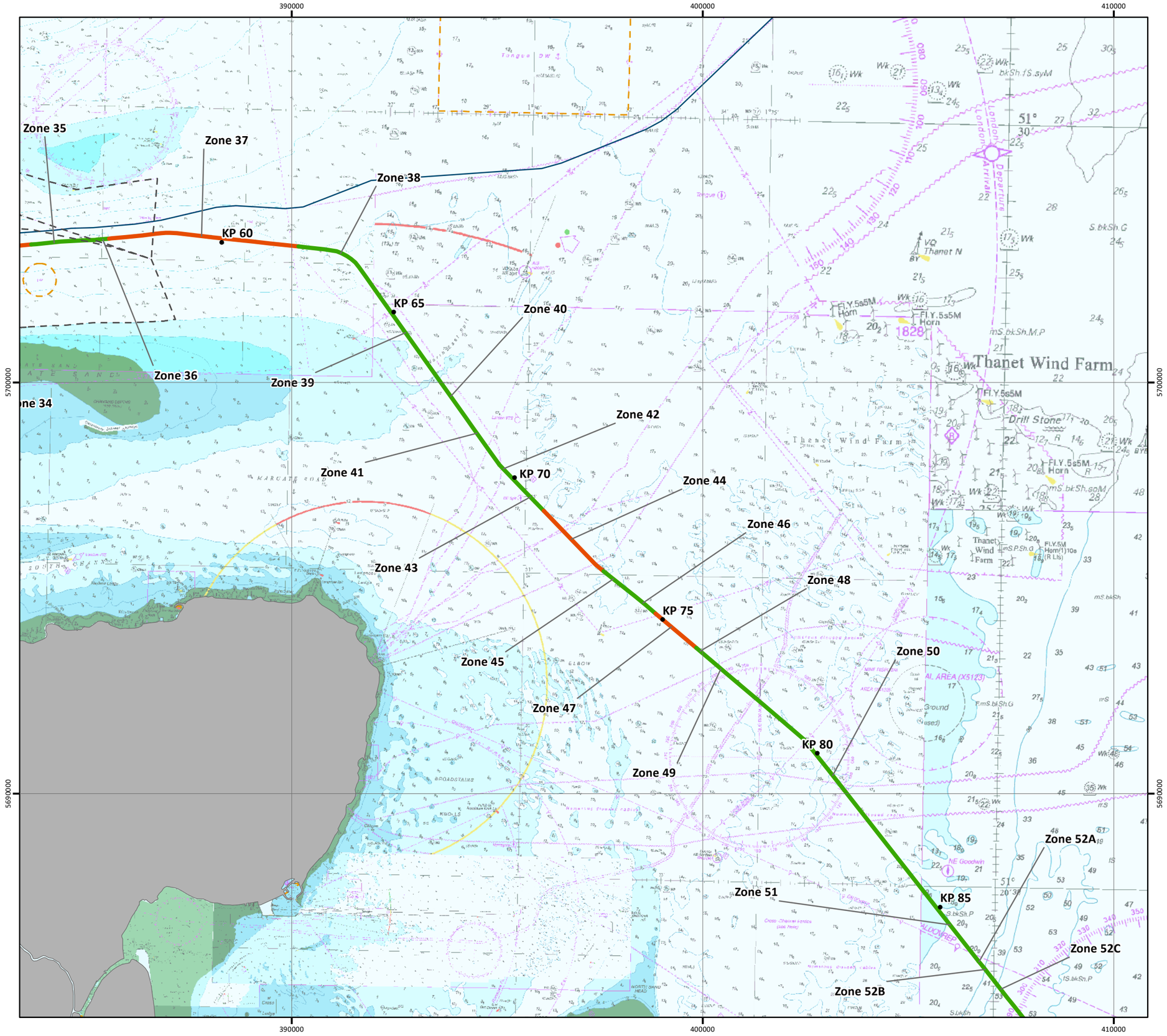
GRIDLINK INTERCONNECTOR intertek

0 1 2 3 4 km



GRIDLINK INTERCONNECTOR

ROUTE OVERVIEW

GridLink Cable Burial Risk Assessment TDOL Zones

Sheet 3 of 5

Drawing No: P2258-LOC-014	B

Legend

- GridLink Preferred Cable Route KP
- Anchorage Area (Designated)

Constrained Features

- BritNed Cable

GridLink Route TDOL Zones

- TDOL = 1.70m
- TDOL = >1.70m to 2.50m

N W E S

* Target Depth of Lowering (TDOL)

NOTE: Not to be used for Navigation

Date	28 May 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
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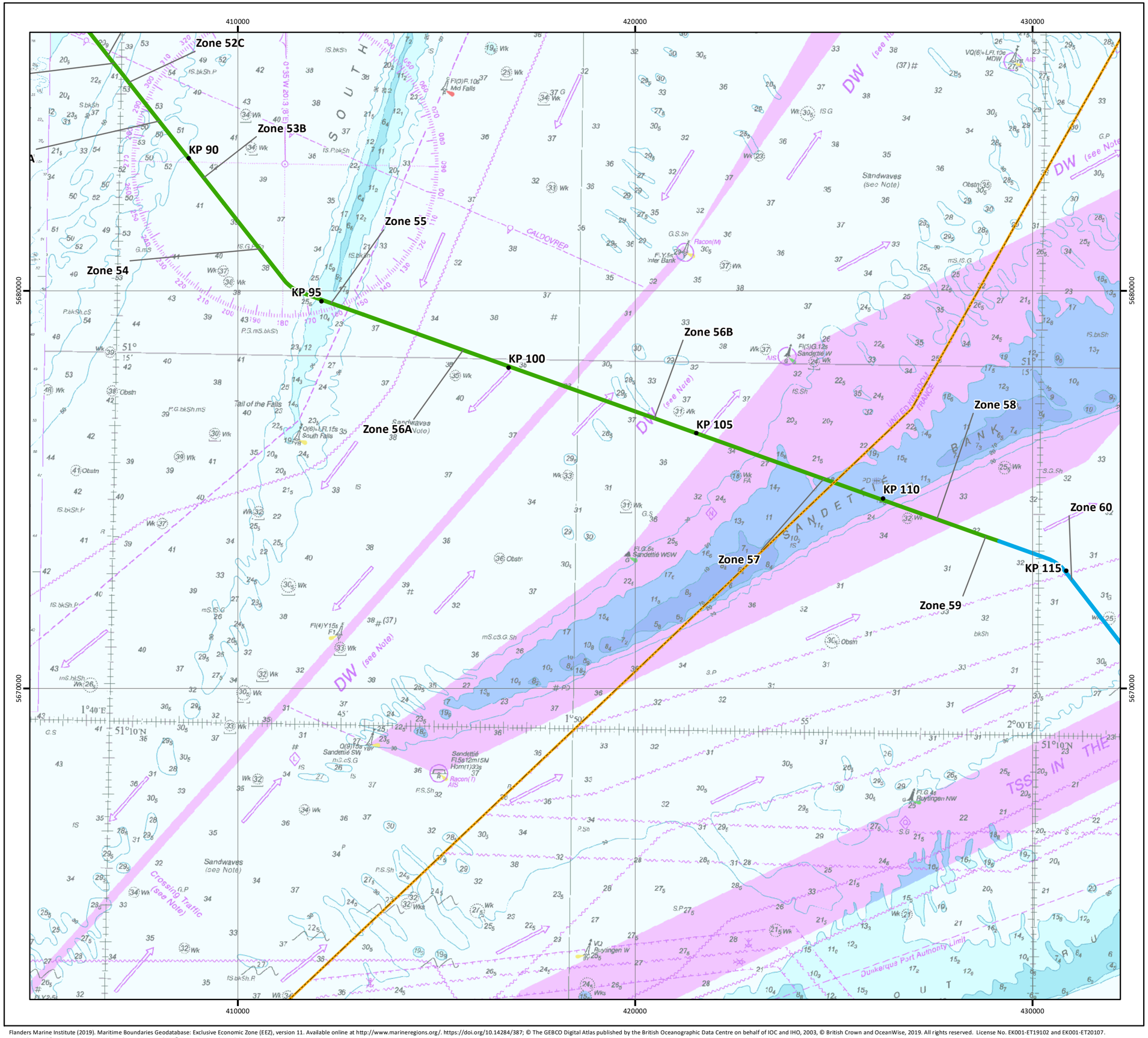
0 1 2 3 4 km



GRIDLINK INTERCONNECTOR

ROUTE OVERVIEW

GridLink Cable Burial Risk Assessment TDOL Zones

Sheet 4 of 5

Drawing No: P2258-LOC-014	B

Legend

- GridLink Preferred Cable Route KP
- EEZ Boundary

GridLink Route TDOL Zones

- TDOL = 1.25m
- TDOL = 1.70m

N W E S

* Target Depth of Lowering (TDOL)

NOTE: Not to be used for Navigation

Date	28 May 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	MarineRegions; GEBCO; OSOD; EUROPA
File Reference	J:\Gridlink\P2258_Mxd\01_LOC\ P2258-LOC-014.mxd
Created By	Chris Dawe
Reviewed By	Emma Langley
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR intertek

0 1 2 3 4 km

3.7.4.2 Cable burial techniques and tools

There are a range of techniques and tools that can be used to bury and/or protect the cables. The selection of the techniques and tool is based on:

- Seabed geology;
- Sediment mobility;
- Target depth of lowering (TDOL);
- Cable-lay speed and spread requirements;
- Proximity to third party assets;
- Environmental sensitivities e.g. presence of protected habitats, navigation and anchorages, fishing grounds, generation of sediment suspension, post-burial seabed profile, etc; and
- Environmental mitigation defined during the assessment process.

The appropriate technique and tool will be selected considering environmental sensitivities and any constraints or mitigation identified during the assessment process. Techniques and tools that minimise environmental effects will be preferred, and certain techniques and tools will be excluded if it is identified that their use poses significant risks to sensitive areas.

For all burial techniques, machine function is controlled from the surface vessel via an umbilical cable. However, in shallow water less than 5m deep, some trenchers require the assistance of divers to load the cable to the cable depressor. This operation is relatively slow and typically requires frequent maintenance.

The nature of the seabed and the TDOL influences which installation tool is selected. The seabed varies along the Proposed Development with clayey silt in the very nearshore at the landfall location, and silty and sandy clays, silty sand, and gravelly silty sand in the nearshore and offshore sections. The presence of extremely low strength clays will require tools e.g. vertical injectors, additional passes (i.e. where the burial equipment makes a number of attempts at burying the cable to get it deeper each time) and/or high specification configurations to achieve the required TDOL.

The following sub-sections describe the burial tools likely to be used.

Jet Trenching

Jet trenching is a cable installation technique which can be used to bury the cable in areas of loose non cohesive sediments such as sand and silt. It uses a powerful water-jetting tool to fluidise seabed, allowing pre-laid cables to sink to the required burial depth.

Most jetting trenchers are a self-propelling ROV on the seabed which is powered and controlled from the CLV or another support vessel. Some are towed rather than self-propelled.

The jetting trencher will sit on the seabed and follow the pre-laid cables. High powered pumps inject sea-water into the seabed either side of the cables through jetting 'swords' (Figure 3-27). This fluidises the seabed beneath the cables allowing them to naturally sink to the required burial depth. The seabed sediments naturally re-form and 'back-fill' the trench covering the cables, only creating localised and temporary (less than one tidal cycle) turbidity plumes. If the required burial depth is not achieved, several passes can be made. The system does not remove any seabed sediments from the area.

Whilst jetting is considered to have the least impact on the environment because the footprint of the tool is smaller than other installation tools such as ploughs, the use of jetting tools does result in higher suspended sediment concentrations. However, in a review of seabed disturbance from various activities it was observed that disturbance resulting from jetting was largely restricted to fines and remained low in comparison with dredging and some fishing techniques (BERR 2008).

Figure 3-27 Typical water-jetting machines

Conventional narrow share cable plough

This type of cable burial technique can be used in cohesive sediments such as clays through to rock and non-cohesive sediments such as loose coarse sand to fine dense sand.

A cable plough can either be towed by the CLV to simultaneous lay and bury the cables or more usually is towed by a separate vessel to bury the cables post-lay. As the plough share is pulled through the seabed it cuts and lifts a wedge of soil. The cable is fed into the plough and guided down through the share to be placed at the base of the trench before the wedge is placed back in, backfilling the trench.

The overall body of the plough (Figure 3-28) is approximately 15m wide and rides on hydraulically adjustable skids which are used to control the depth of protrusion of the share, and therefore the burial depth of the cable. The trench created by the plough is typically up to 1m wide for power cable installation.

The action of the plough causes a small amount of seabed disturbance, with disturbed mounds adjacent to the cut trench ranging from 0.3m – 0.5m high depending on the burial depth, tow speed etc. In addition, cable ploughing suspends finer bottom sediments into the water column creating a brief localised sediment plume (for less than one tidal cycle).

Figure 3-28 Typical plough

Advanced cable plough (vertical injectors)

Between KP0.4 and KP7.1 it is likely that an advanced cable plough with vertical injectors will be required to achieve the 3.5m TDOL. Deep burial ploughs use water jets fitted within the plough share

to fluidise material at the leading edge of the share. This reduces the required tow force allowing the plough share to penetrate deeper into the seabed.

Cutting

This technique is used to install cables into hard sediments such as clay, cemented sand, sandstone and weak bedrock. It can be used either pre-lay (so the cable can be laid into the trench) or post-lay. Although it is not thought that this technique will be appropriate for the seabed encountered within the Proposed Development, it cannot currently be discounted.

The cutting machine is usually mounted on tracked vehicles and use chain saws or wheels armed with tungsten carbon steel teeth to cut a defined trench. The operation is relatively slow and typically requires frequent maintenance. Most spoil is ejected from the trench by the cutting action and the cable is guided into the trench base by a depressor. The mechanical action may be augmented in some cases by eductors that suck disrupted material out of the trench and deposit it to the side. The open trench can be back-filled or left to refill naturally.

A typical mechanical trencher can make a trench of 0.3-0.7m in width, with the overall width of the machine in the range of 5-15m.

Mass flow excavator

Mass flow excavators will not be used as a technique to bury the cables; although they may be used at select locations for pre-sweeping of sandwaves.

3.7.4.3 External cable protection

Where cable burial is not feasible due to difficult ground conditions or crossing existing third party assets, external protections such as rock or mattressing is generally used to protect the installed cables. This section describes the different protection methods and provides indicative locations and volumes to be deposited within the Proposed Development. The figures presented are conservative worst-case estimates assuming the maximum design envelope for each scenario. Rock berm heights, widths and lengths will not exceed that proposed in this assessment.

Rock placement

Rock placement is used to protect subsea cables by covering them in a continuous profiled berm of graded rock. The berm provides a strong protective cover to prevent potential impact and snagging by fishing gear or anchors, and also ensures stability by shielding the cable from the current flow.

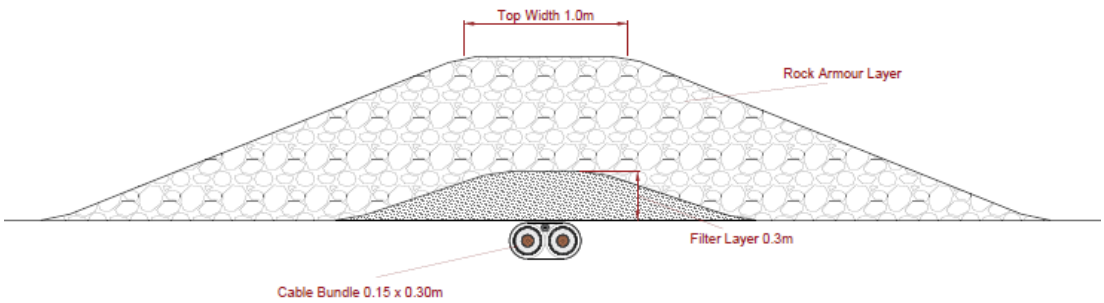
Figure 3-29 illustrates the conceptual design of a rock berm. It typically comprises two layers; a filter layer and armouring. A filter layer may be added either to provide a stable base in soft sediment for the armour layer to be installed on and/or provide protection to the cable bundle from the impact of the installation of the armour layer. If used, the filter layer would be laid first comprising of smaller particle sizes, followed by larger layer designed to prevent segregation of sediments during placement. The final layer (i.e. the armour layer) covers the other two layers and is designed to provide protection against identified external threats (e.g. anchors and fishing gear) whilst also withstanding severe metocean events.

The rock grade (particle size) of the rock used will be determined by an assessment of the local seabed geology, metocean conditions, water depth and the nature of the external threat which is being protected against. The rock grading needed for a dynamically stable rock berm decreases with increasing water depths. In shallower waters, the wave induced water action at the seabed is larger than in deeper waters and therefore a larger rock grading is needed. Rock sizes are likely to be in the range of 2cm to 22cm.

The size of the berm will depend on the location, the site-specific anchor and fishing risks and metocean conditions.

Where required, rock berms will be designed to ensure long-term stability, however it is likely that maintenance (periodic inspections and replacement of disturbed rock) will be required.

Figure 3-29 Conceptual rock placement design



Concrete mattressing

Concrete mattresses are matrices of interlinked concrete blocks which form a close-fitting layer over the cable to provide a strong protective cover to prevent potential impact and snagging by fishing gear or anchors. Typically, concrete mattresses are 6m long by 3m wide.

The mattresses are installed via a crane from either a dive support vessel or a construction support vessel, which lowers them one at a time or in batches using a special frame (Figure 3-30).

Mattresses are typically used in combination with rock protection e.g. at third party asset crossings, or in areas where the main risk to cables is from fishing activities. They do not afford the same level of protection as rock berm for protection against anchor damage as the mats can be caught and dragged by an anchor.

Figure 3-30 Concrete mattress deployment (courtesy of FoundOcean)

Frond mats

Although not directly a form of external cable protection, frond mats are used as an anti-scour system. The mats can either be attached to concrete mattresses or laid separately secured by gravity or anchors.

Frond mats are constructed from UV stabilised polypropylene fronds secured to polyester webbing (Figure 3-31). When these mats are laid the fronds float and resemble natural seaweed. As local currents transport sediment through the fronds, the fronds locally interrupt and reduce the velocity of the near bottom currents. Transported sediment drops out of suspension due to the velocity change and builds up to form an embankment on and around the mats.

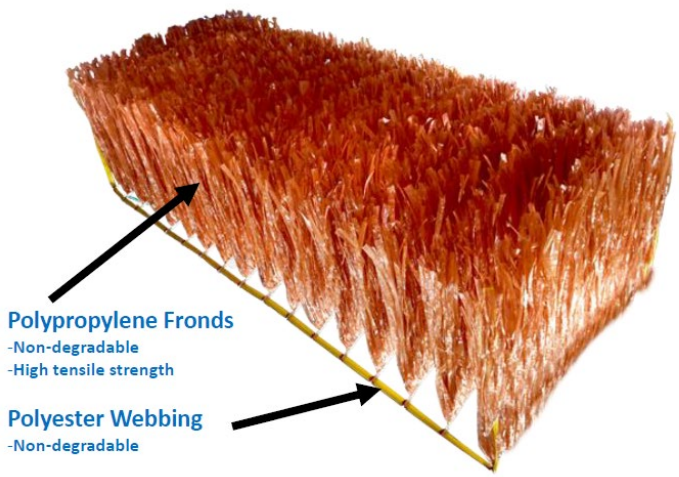
It is planned to incorporate fronded mats into the London Array crossing design to prevent scour and to encourage re-sedimentation of the crossing as environmental mitigation. The key objectives for the design shall be:

1. Prevent scour around the crossing.
2. Encourage re-sedimentation of the crossing such that the rock protection is covered by sand to minimise fishing disruption to bottom drift netting and trawling and return the seabed to a sand habitat within the Margate and Long Sands Special Area of Conservation.

Discussions with a frond manufacturer have confirmed that the mats can be used in conjunction with a rock berm either positioned around the base of the berm, and if appropriate, draped over the top subject to a suitable slope angle. In both configurations it is likely that the gravity system will be used whereby the perimeter of the mat will consist of a hollow tube filled with shingle (small particle sized sand and gravel). The weight of the tube anchors the mat to the ground. Due to the flexibility of the tube it would also anchor the mat to an irregular surface as encountered on the rock berm.

Mats can be custom made to any size, but the standard size is 5m x 2.5m. The standard length of the fronds is 1.25m. This would allow up to 1m of sediment to be captured in the mats, completely burying them. However, the fronds can be reduced to 0.5m long in areas where a 1m build of sediment is not required i.e. due to navigational concerns.

Figure 3-31 Fronded mats



Indicative locations for external cable protection

External cable protection will be required for crossing existing in-service cables and may be required where ground conditions are not suitable for burial in sediment.

A rock berm design concept study was undertaken to determine the maximum design envelope (with respect to height, width and length) for external cable protection at in-service subsea cable crossings. For each location where cable protection may be required, the study identified the maximum anchor size that could be deployed; using AIS data and the dead weight tonnage of vessels crossing the location. The berm is then designed to protect the cables against a dropped or dragged anchor of this size.

For crossings, four different design scenarios were considered which varied the number of internal layers and combinations of layers within the berm e.g. pre-lay mattresses, cable protection sleeve and post-lay rock. The maximum design envelope assumes all layers are required and then adds an additional installation tolerance to allow for imprecisions in the deposit. This maximum design envelope will not be exceeded.

Where ground conditions could prevent full burial the maximum design envelope assumes the protection provided by the target depth of lowering must be achieved by external means. For example, if the cable burial risk assessment concluded that a TDOL in sediment of 1.0m is necessary to protect the cables from anchors then consequently 1.0m of external cable protection will be deposited. However, consideration was also given to whether any burial may be achieved by analysing the geotechnical data. For the example of 1.0m of protection, if the surficial sediment unit is 0.2m deep then it is assumed only 0.8m of external cable protection would be required.

During installation, burial in sediment will be attempted along the entire cable route. Where the required TDOL is not achieved, remedial passes could be made to achieve the required depth of lowering. If remedial passes still fail to achieve TDOL, then the probabilistic risk assessment for the specific section (with respect to anchor risk) will be reviewed, a decision taken on the risk profile that can be accepted for the section and a final decision taken on whether external cable protection is required and to what height.

Pre-application consultation identified that external protection at third party asset crossings is a sensitive issue for the local fishing industry. In certain locations, there is a preference for a certain type of external cable protection to minimise potential impacts on future fishing activities. These preferences have been taken into account wherever practicable providing the required level of protection of the cable can be achieved.

Table 3-9 provides details of where external cable protection will be required for crossing existing in-service subsea cables. Where the fishing industry has indicated a preference for the type of external cable protection this is acknowledged. In summary, the total requirement for external protection at third party asset crossings (based on the maximum design envelope) is estimated to be:

- Seven locations require external protection
- Total length of external protection = 755m
- Seabed footprint of external protection = 9,980m^2
- External cable protection volume = 10,710m^3

There are several sections of the Proposed Development where ground conditions will potentially be more challenging to the cable burial campaign. This is because the geology is not practical for the typical tools used for cable burial and therefore the tools may not reach the TDOL. Table 3-10 identifies the high and medium risk areas, which are visually represented in Figure 3-32 (Drawing P2258-LOC-009). Table 3-11 details reasonable worst-case scenario estimates for external cable protection (rock berm) in the areas of high and medium risk. In summary, the maximum requirements for external protection due to ground conditions are estimated to be:

- Total length of external protection in UK waters = 3,944m
- Seabed footprint of external protection = 18,595m^2
- External cable protection volume = 28,263m^3

Table 3-9 Indicative external cable protection locations

KP Start	KP End	Length (m)*	Crossing Description	Stakeholder preference	Rock berm design envelope				Biotope present	Environmental sensitivity
					Maximum berm height (m)	Maximum berm width (m)	Estimated seabed footprint (m^2)*	Estimated external protection volume (m^3)		
51.85	52.12	225	London Array Wind Farm export cables (4 cables as one continuous external protection)	Fronded concrete mattresses	1.76	9.76	2948	2819	*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment Infralittoral mixed sediments	Margate and Long Sands SAC Outer Thames Estuary SPA
71.28	71.36	80	Mercator / JOSS (new)	Low level rock berm	2.21	12.46	1141	1349	Circalittoral mixed sediments	Not within a Protected area
77.57	77.7	120	Thanet Wind Farm North & South export cables (2 cables as one continuous external protection)	Low level rock berm	2.11	11.86	1639	1856	Circalittoral mixed sediments	**Not within a Protected area**
80.5	80.63	80	PEC telecommunication cable	Tapered concrete mattressing (but low level rock berm not excluded)	2.11	11.86	1093	1238	*Sabellaria spinulosa* on stable circalittoral mixed sediment	**Not within a Protected area.** Biogenic *S. spinulosa* Reefs, Low Grade
81.72	81.8	80	Tangerine telecommunication cable	Tapered concrete mattressing (but low level rock berm not excluded)	2.11	11.86	1093	1238	*Sabellaria spinulosa* on stable circalittoral mixed sediment	Goodwin Sands MCZ Biogenic *S. spinulosa* Reefs, Medium Grade
84.8	84.88	80	NEMO Interconnector	Concrete mattress	1.96	10.96	1021	1079	*Sabellaria spinulosa* on stable circalittoral mixed sediment	Goodwin Sands MCZ Biogenic *S. spinulosa* Reefs, Medium Grade
96.85	97.03	80	Atlantic Crossing - Seg B1 telecommunication cable	Tapered concrete mattressing (but low level rock berm not excluded)	2.01	11.26	1045	1131	*Sabellaria spinulosa* on stable circalittoral mixed sediment	Southern North Sea SAC Biogenic *S. spinulosa* Reefs, Low Grade

*Assumes +/-40m either side of crossing point.

** Includes a 0.3m installation tolerance, Assumes 1m top width and slope angle of 1:3

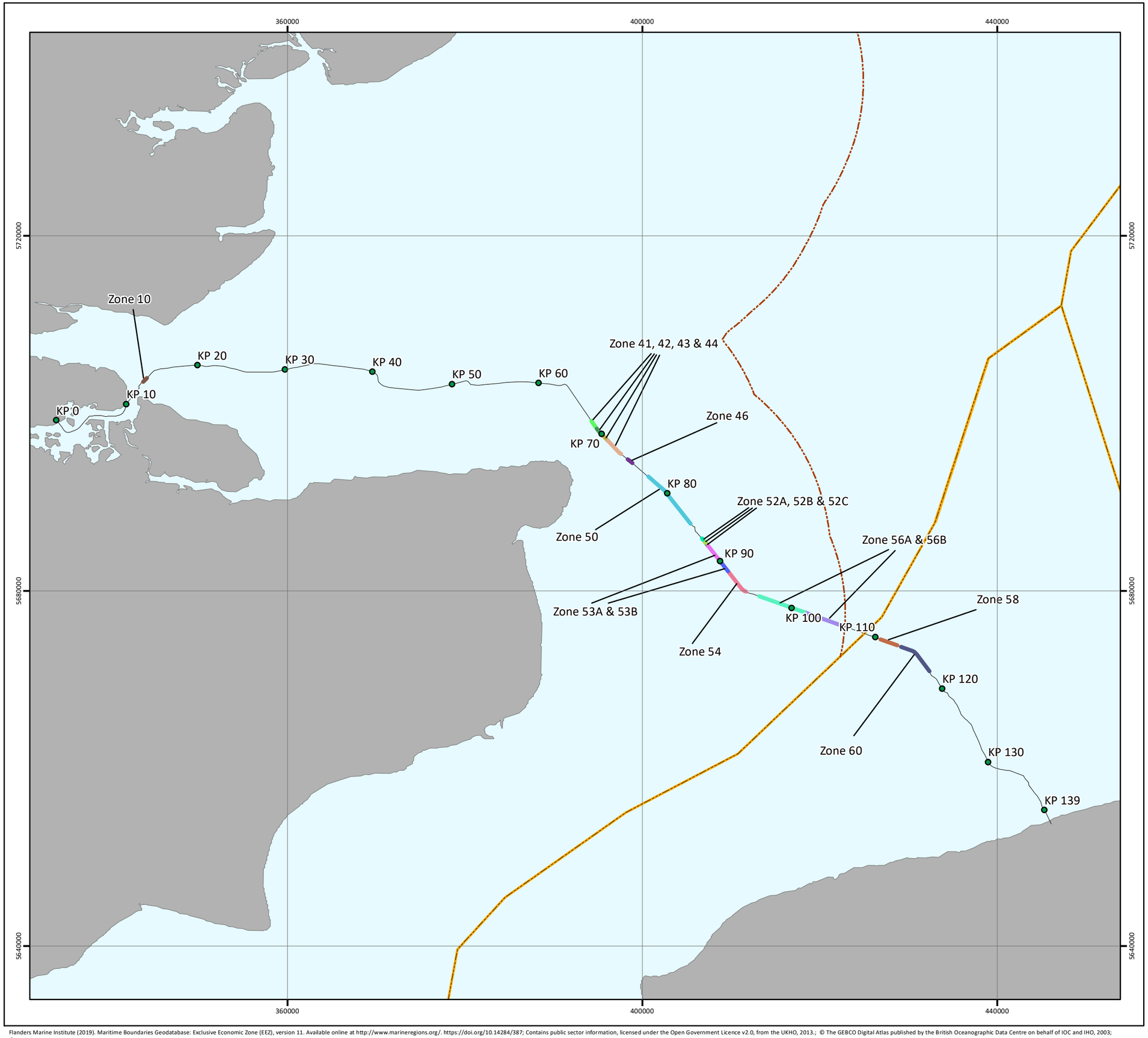
Table 3-10 Identified areas of challenging sediments (high-strength clay and chalk)

CBRA Zone	KP Start (rev2)	KP End (rev2)	Distance (km)	Layer 1 geology	Layer 2 geology	Potential for Difficulty in Reaching RMDOL (Low/ Medium / High)
10	13.304	13.899	0.595	0.5m Very Loose Sand	High Strength Clay	High – High Strength clay underlying sand
41	67.840	68.899	1.059	1.6m Loose Sand	High Strength Clay	Low – High strength clay is deeper than RMDOL
42	68.899	69.999	1.100	0.7m Loose Sand	High Strength Clay	High – High Strength clay underlying sand
43	69.999	70.799	0.800	1m Loose Silt	Medium Dense Structureless Chalk (Dm)	Medium – RMDOL requires 1.70m of burial to be reached into the Chalk layer
44	70.799	72.869	2.070	0.2m Extremely Low Strength Clay	Medium Dense Structureless Chalk (Dm)	Medium - RMDOL requires 1.85m of burial to be reached into the Chalk layer
46	73.841	74.499	0.658	0.2m Very Loose Sand	Loose Structureless Chalk (Dm)	Medium - RMDOL requires 1.55m of burial to be reached into the Chalk layer
50	76.840	83.999	7.159	0.5m Very Loose Gravel	Medium Dense Structureless Chalk (Dm)	Medium - RMDOL requires 1.65m of burial to be reached into the Chalk layer
52A	86.099	86.279	0.180	0.5m Very Loose Gravel	Medium Dense Structureless Chalk (Dm)	Low – RMDOL is not deep
52B	86.279	86.741	0.462	0.5m Very Loose Gravel	Medium Dense Structureless Chalk (Dm)	Low – RMDOL is not deep
52C	86.741	87.223	0.482	0.5m Very Loose Gravel	Medium Dense Structureless Chalk (Dm)	Low – RMDOL is not deep
53A	87.223	89.347	2.124	0.1m Very Loose Sand	Medium Dense Structureless Chalk (Dc)	Low – RMDOL is not deep
53B	89.347	90.839	1.492	0.1m Very Loose Sand	Medium Dense Structureless Chalk (Dc)	Low – RMDOL is not deep
54	90.839	93.900	3.061	0.6m Medium Dense Gravel	Medium Dense Structureless Chalk (Dc)	Low – RMDOL is not deep
56A	95.500	100.891	5.391	0.6m Medium Dense Gravel	Medium Dense Structureless Chalk (Dc)	Low – RMDOL is not deep
56B	100.891	105.720	4.829	0.6m Medium Dense Gravel	Medium Dense Structureless Chalk (Dc)	Low – RMDOL is not deep
58	110.003	112.000	1.997	0.5m Medium Dense Gravel	Medium Dense Structureless Chalk (Dc)	Low – RMDOL is not deep
60	112.478	116.842	4.364	0.5m Loose Sand	High Strength Clay	High – High Strength clay underlying sand

Table 3-11 Worse case scenarios for external cable protection due to ground conditions

Zone	Potential Difficulty	Zone Length (km)	% Zone Length with Berms	Estimated Length of Berms within Zone (km)	Berm Design Parameters								Installation Tolerance			Total Rock Volume (m^3)	Total seabed footprint (m^2)
					Filter Layer Height (m)	Armour Layer Height (m)	Berm Top Width (m)	Berm Height (m)	Berm Width (m)	Filter Volume/m of berm (m^3)	Armour Volume/m of berm (m^3)	Total Volume/ m (m^3)	Max Berm Height (m)	Max Berm Width (m)	Total Volume/ m (m^3)		
10	High	0.595	0.75	0.446	0.3	0.6	1	0.9	6.4	0.795	2.76	3.555	1.2	8.2	5.745	2564	3659
42	High	1.100	0.75	0.825	0.3	0.45	1	0.75	5.5	0.913	1.8675	2.7805	1.05	7.3	4.7005	3878	6023
43	Medium	0.800	0.25	0.200	0.3	0.4	1	0.7	5.2	1.201	1.6	2.801	1.0	7	4.631	926	1400
44	Medium	2.070	0.25	0.518	0	0.85	1	0.85	6.1	0	3.6615	3.6615	1.15	7.9	5.7615	2982	4088
46	Medium	0.658	0.25	0.165	0.3	0.35	1	0.65	4.9	1.108	1.3475	2.4555	0.95	6.7	4.1955	690	1102
50	Medium	7.159	0.25	1.790	0	0.65	1	0.65	4.9	0	2.4815	2.4815	0.95	6.7	4.2215	7555	11991
Sub-Total	-	-	-	**3.944**	-	-	-	-	-	-	-	-	-	-	-	**18595**	**28263**
French waters																	
60	High	4.364	0.75	3.273	0.3	0.75	1	1.05	7.3	0.804	3.7875	4.3575	1.35	9.1	7.0515	23080	29784
Total	-	-	-	**7.216**	-	-	-	-	-	-	-	-	-	-	-	**41675**	**58047**

Assumptions:
- Low: Assumed that RMDOL will be reached and no rock placement will be required
- Medium: Assumed that up to 25% of the zone length may require rock placement
- High: Assumed that up to 75% of the zone length may require rock placement



GRIDLINK INTERCONNECTOR

ROUTE OVERVIEW
GridLink Cable Burial Risk Assessment Zones for Rock Placement Study

Drawing No: P2258-LOC-009 | **B**

Legend

- KP
- GridLink Preferred Cable Route
- 12nm Territorial Sea Limit
- EEZ Boundary

GridLink Route Assessment Zones

- 10
- 41
- 42
- 43
- 44
- 46
- 50
- 52A
- 52B
- 52C
- 53A
- 53B
- 54
- 56A
- 56B
- 58
- 60

N W E S

NOTE: Not to be used for Navigation

Date	27 May 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	MarineRegions; UKHO; GEBCO; ESRI
File Reference	J:\Gridlink\P2258_Mxd\01_LOC\ P2258-LOC-009.mxd
Created By	Chris Dawe
Reviewed By	Chris Dawe
Approved By	Alan Redman

GRIDLINK INTERCONNECTOR intertek

0 5 10 15 20 km

3.7.5 In-service cable crossings

The Proposed Development will make seven crossings of existing in-service (IS) third party assets:

- 1 x interconnector cable;
- 2 x windfarm arrays, comprising 2 and 4 export cables respectively;
- 3 x telecommunications cables; and
- 1 x new telecommunications cables (which will be in-service by 2022).

It is essential to maintain a vertical separation distance between the existing IS cable and the GridLink cables due to the effect on thermal rating[2] caused by two cables in close proximity. A minimum separation distance will be agreed with the IS cable owner and the crossing engineered to achieve the required vertical separation distance.

Typically, the separation is achieved by installing a layer of aggregate or concrete mattresses over the existing (buried) IS cable to create a 'bridge' during the route preparation phase. The bridge will be positioned to either side of the cable and will prevent the overlaid cable bundle from contacting the buried IS cable as it settles into the sediment.

At the London Array crossing, a cable separation system e.g. URADUCT or similar, will be used instead of the aggregate layer. This will be fitted to the GridLink cables to provide the necessary depth of separation between the two cable systems, ensuring no metallic contact, but allowing a lower profile crossing. The cable protection system is rigid plastic casings attached to the cables on the installation vessel and bound together with bands of stainless steel or titanium.

The GridLink cable bundle will be buried in the sediment to within approximately 50m of the IS cable by the CLV/CLB, with the exact distance to be agreed with cable owner. From this point onwards the GridLink cable bundle will be surface-laid by the CLV/CLB across the separation layer up to the IS cable and to a similar distance the other side of the asset, whereupon burial will continue. All surface-laid sections of the cable will be covered by external cable protection (rock berm, concrete mattresses or a combination of the two).

If the cable is exposed for any period e.g. between cable lay and deposition of external cable protection, a guard vessel will be deployed.

For the purposes of assessment, it has been assumed that cable protection will be required up to 40m either side of the third-party asset.

3.7.6 Landfall installation

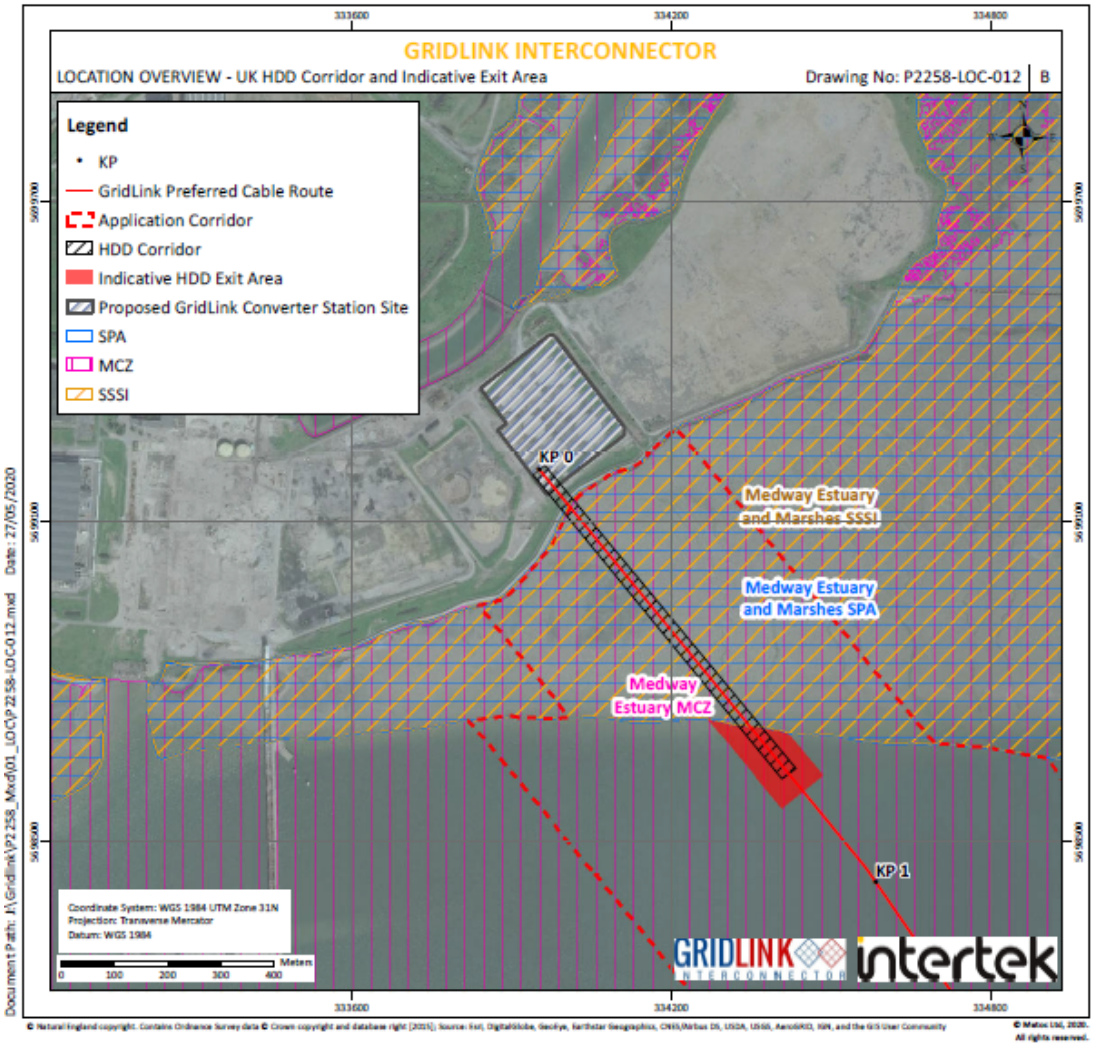
3.7.6.1 Horizontal directional drilling (HDD)

The landfall is where the marine cables come ashore and are connected to the land cables in a transition joint pit (TJP). The Proposed Development will come ashore at the site of the former E.On coal-fired power station (now demolished) at the Kingsnorth industrial estate on the Medway Estuary. The cables will come directly ashore into the compound within the converter station site (Figure 3-33, Drawing P2258-LOC-012).

The intertidal area adjacent to the converter station site is an expanse of mudflats designated as the Medway Estuary and Marshes Special Protection Area (SPA) and Ramsar site, the Medway Estuary and Marshes Site of Special Scientific Interest (SSSI) and the Medway Estuary Marine Conservation Zone (MCZ). To avoid disturbance of this habitat, the shore crossing will be made by horizontal directional drilling (HDD) between the points illustrated in Figure 3-33 (Drawing P2258-LOC-012).

[2] Thermal rating refers to the maximum amount of electrical current that a electricity cable can conduct over a specified period before it sustains permanent damage by overheating.

Figure 3-33 HDD exit location (Drawing P2258-LOC-012)



HDD is a surface-launched process for boring a hole under any sensitive surface features between two points for the installation of a cable or pipeline. A duct is inserted into the drilled hole into which the cable or pipeline is installed. The process can be driven from the land to sea, or from a suitable platform such as a JUB at sea to land. Figure 3-35 shows a typical offshore HDD setup on a JUB.

The Proposed Development will require two HDDs: the bundled cables need to be separated into individual HDDs for the shore crossing. It is not possible to pull-in a bundled cable through a single HDD.

Each HDD is accomplished in four to five stages, as illustrated in Figure 3-34, depending on the location of the entry point:

- Steel casing installation (offshore drilling only)
- Pilot hole drilling;
- Hole opening (raming);
- Duct installation; and
- Pre-lay messenger (draw) wire insertion.

When drilling from the sea to land, the entry point of the HDD drill into the seabed is where there is greatest risk of a release of drilling fluid. Therefore, before drilling commences, a steel casing will be installed. Steel casing will be 750mm in diameter and will be pushed into the seabed to depth of 5-6m at the nominal drill entry angle of 12°. The casing will provide a rigid and safeguarded path for the start of the drill bore to ensure the integrity of the bore and will prevent the inadvertent release of drilling fluid from the drill bore into the marine environment.

A small diameter pilot bore then will be drilled within the casing, or directly into the ground if the entry point is onshore. Drill pipes (approximately 9.0m in length) are added to the end of the drill string on the drilling rig one at a time and drilled down into the ground in succession. Pilot hole drilling continues until the drill bit exits the ground at the required exit point.

Drilling fluid is pumped through the hollow drill rods throughout the process. The fluid supports the bore wall, lubricates the drill head and drill pipe, and flushes cuttings generated by drilling back to the entry point for removal and disposal. The drilling mud is made up of water and other additives, principally bentonite clay. The returned drilling mud will be monitored throughout the works and modifications may be required (e.g. addition of other minor additive such as soda ash to control pH and fluid chemistry) as the drill passes through different substrates to ensure proper bore stabilisation and formation. Bentonite is a naturally occurring clay and all other additives will be biodegradable and environmentally safe.

If the HDD is driven from the Medway Estuary, a steel casing will be installed from the JUB to the seabed, through which the pilot hole will be drilled. This contains the drilling fluids minimising the risk of them entering the marine environment and causing turbidity in the receiving water. The drill fluid and cuttings will return to the JUB through the steel casing to be directed to a mud recycling unit.

A mud recycling unit will be based at the HDD drill point and will recycle the drilling mud as it returns from the bore, separating out the cuttings. The mud recycling unit minimises drilling mud quantities and mitigates the risk of excess fluid escaping from the drill exit point. The separated cuttings will require disposal as waste, and will be classified depending on their chemical characteristics. If the HDD entry point is on a JUB, the cuttings may be removed from the JUB and stockpiled onshore for testing prior to disposal.

The next stage of the HDD involves enlarging the drilled hole to the required diameter for installation of the cable via a process known as reaming. At the exit point, a back reamer replaces a drill bit and is pulled back towards the pilot hole entry. The bore hole is widened by successive reamer passes.

Following completion of the drill bore, a duct string will be pulled through into the bore in one continuous pull. The duct string is made out of high-density polyethylene (HDPE) pipe sections that are welded together just before they are inserted into the drill bore. The duct provides the conduit into which the cable can be pulled in.

The final stage involves inserting a messenger wire within the duct to enable future cable pull-in operations. Ducts may then be capped prior to cable installation to ensure that no sediment / debris can enter the duct.

Two ducts will be drilled at the landfall, one for each cable which will be unbundled to facilitate pulling through the HDD ducts. The fibre optic cable will be installed in a duct with one of the power cables. The ducts will fan out to achieve exit points for the marine cables in the nearshore zone outside of the Medway Estuary and Marshes SPA, Ramsar, SSSI and MCZ, with a minimum separation distance between the entry and exit points of each duct of approximately 5m. The cable ducts will pass approximately 10m below the intertidal area and flood defence wall for an approximate length of 600m.

No HDD works will be required on the intertidal mudflats.

Figure 3-34 Illustration of the HDD process

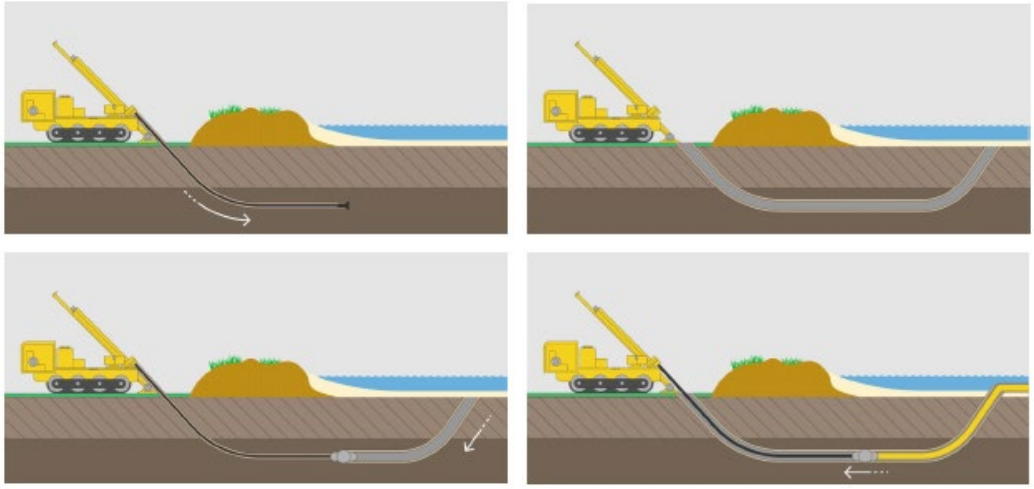
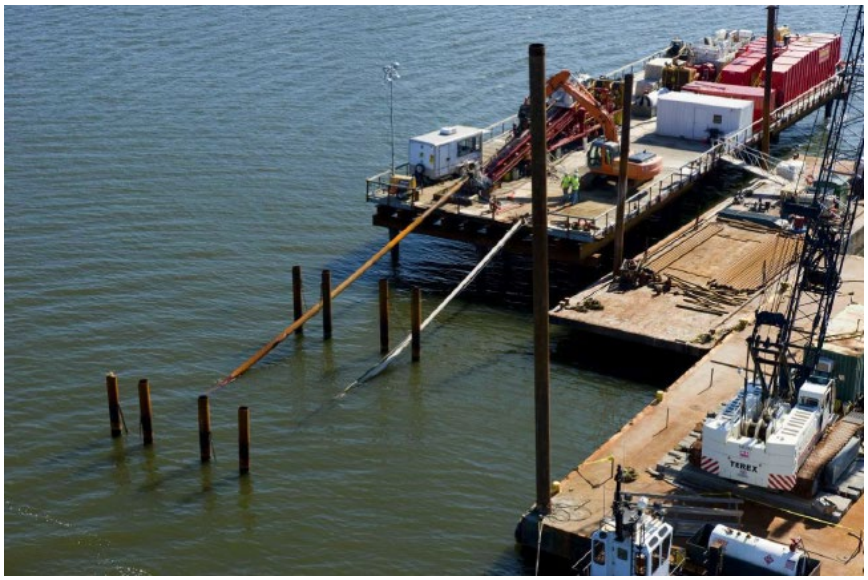


Figure 3-35 Illustrative example of offshore HDD set-up on JUB



3.7.6.2 Marine cable installation at landfall

The installation sequence for each of the submarine cables and the fibre optic cable is likely to apply the indicative methodology summarised below:

- The cable pull-in will be carried out from sea to land, therefore the cables will be unbundled close to the nearshore entrance to the HDD ducts.
- The end of the duct accepting the cable will be exposed using an excavator positioned on a JUB or anchored barge.
- The submarine cable will be floated to the entry point to the duct, using small work boats and divers.
- The submarine cable will then be connected to the messenger wire pre-installed in the duct and winched through the duct.
- The submarine cable will arrive in the Transition Joint Bay, where the armouring will be removed and the cable installation continued underground into the converter station.

No cable pull-in works would be required on the intertidal mudflats.

3.7.6.3 HDD feasibility and alternative solutions

The MMO Scoping Opinion strongly supported the use of HDD but advised inclusion of "the assessment of an alternative methodology, e.g. trenching as a highly pragmatic approach in the event that HDD is not possible".

The Applicant has not included the assessment of an alternative method for the following reasons:

1. The Applicant is confident that HDD is feasible and that there is low risk of hydrofractures;
2. The mudflats are a protected feature and it is likely that trenching may have a significant environmental effect; and
3. Trenching would require the flood defence to be temporarily breached.

The main concern surrounding the use of HDD is the unintentional return of drilling fluids to the surface during drilling operations. This process is called hydrofracture and occurs when the downhole mud pressure exceeds the overburden pressure allowing drilling muds to seep out of the borehole (i.e. in areas where the bore is shallow or the overlying sediments are loose) or the fluids find a preferential seepage pathway such as fault lines and fractures or loose material. Hydrofractures can lead to releases of drilling fluids e.g. into the marine environment, and the failure of the HDD borehole.

The Applicant has commissioned a feasibility study by a specialist HDD expert (GDG) to determine if soil conditions at Kingsnorth are suitable for HDD. The study analysed the geotechnical information collected from trial pits and onshore and offshore boreholes to determine if the ground conditions would support drilling and the potential for hydrofractures. GDG (2020) concluded that HDD is feasible and that there is a low risk of hydrofractures. There is no indication of any ground conditions that would cause significant risk of non-completion of the HDD.

The alternative to HDD would be to trench across the intertidal zone and either HDD under the coastal flood defence or cut through the flood defence and replace it post-installation. The mudflats within the intertidal zone are designated as the Medway Estuary and Marshes SPA and Ramsar site, the Medway Estuary and Marshes SSSI and the Medway Estuary MCZ. There is a concern that the trench may scour and will not naturally backfill, or if re-filled may still leave a depression leaving the cables exposed or creating an erosional feature on the mudflats.

In addition, trenching would require the flood defence to be temporarily breached to install the cable and then reinstated. Such interaction with coastal flood defences, and risk that a permanent weakness is generated by the works, means that it should only be considered as a last resort.

Given the above reasons, should the HDD shore crossing fail then the Applicant will review the available trenchless installation method and landfall location and seek alternatives to remedy the reasons for the failure without changing to a trenching solution. The landfall at Kingsnorth has been selected because HDD has been evaluated as feasible, therefore this method is the basis for the assessment. Any change to an alternative landfall location and/or method would be subject to an additional assessment and Marine Licence application.

3.8 Operation

Following installation, the submarine cable will operate without requiring any manual intervention. The control and monitoring of operations is carried out from a control room located at the converter station or a separate office.

Routine maintenance work on the submarine cables is not required. However, some work may be required to maintain the burial of the cable if the burial depth is affected by sediment mobility or third party interactions.

3.8.1 In-service survey operations

Routine surveys using standard geophysical survey equipment and/or ROVs to monitor buried depth and integrity of external cable protection will be undertaken. The first survey will be carried out after completion of cable installation and then repeated approximately every two years or if the local environmental conditions change or are suspected as having changed.

Survey techniques used will be similar to those employed for pre-installation surveys, including multi-beam echosounder, side scan sonar, magnetometer and visual inspection by ROV. In addition, shallow sub-bottom profiling and cable tracking may be used.

3.8.2 Marine cable repairs

The most common reason for repair of a marine cable is damage caused by external interaction, typically by fishing gear and commercial ships' anchors. Globally, around 70% of cable faults can be attributed to man-made activities and about 12% are caused by natural hazards e.g. induced abrasion or earthquakes (KIS-ORCA – Seafish 2019).

Faults caused by man-made activities are usually localised depending on the kinetic energy of the interaction and whether the cable is impacted, mauled (where something is dragged with force along the cable for a distance) or dragged from the seabed.

The requirement for repair operations during the lifetime of the Proposed Development will depend on the number of faults, location of the faults, and the burial / protection method used for the original installation.

The estimate of the number of repair operations is three:

- One operational cable fault over the operational lifetime of the cable (nominal 40 years);
- Two third party interactions with the cable over the operational lifetime of the cable (nominal 40 years), based on calculation formulas provided by Ofgem, ENTSO-E and CIGRE 379[3].

All repair activities will be undertaken within the Application Corridor and the effects of each cable repair is assumed to be the following:

- Repair to 500m length of each cable (i.e. two power cables and the fibre optic cable);
- Cables can be re-buried;
- Cable removal and re-burial footprints will not overlap (as a worst case, as in reality they may occur within overlapping areas);

[3] Design lifetime is 40 years but GridLink assume 25 years for commercial lifetime in-line with the period covered by the Ofgem/CRE regulatory scheme. Using the calculation formulas, GridLink has calculated the failure rates as 1.69 (Ofgem), 2.45 (ENTSO-E) and 3.5 (CIGRE 379). Ofgem indicates that the ENTSO-E and CIGRE 379 formulas exacerbate the failure rate due to lack of proper protection / burial giving rise to higher historical risks in older cables. Given the modern cable design, testing and installation procedures to be adopted for GridLink, the Ofgem calculation of 2 failures during the project lifetime is appropriate.

Should re-burial not be feasible, an alternative protection method, e.g. rock placement or concrete mattresses, up to 7m wide may be used. It has been assumed that external cable protection during repair operations will only be required where ground conditions may preclude burial.

If a cable fault is detected by the cable monitoring system, the relevant section of the cable will be located and retrieved to surface for inspection and replacement. It may be necessary to unbury the cable prior to cable recovery or remove external protection such as rock-berms or mattresses. Once unburied, measurement and testing will be conducted to establish the section of cable that needs to be replaced.

A repair will typically be carried out by a single vessel. A shallow water repair, in less than 10m of water, will typically be made using an anchored barge. In deeper water a dynamically positioned (DP) cable vessel will be used. Vessels carrying out cable repair operations are restricted in their ability to manoeuvre and divers and/or ROV are expected to be used with associated vessels.

The actual operational details and the exact configuration of a repair spread will depend on the type of repair. The typical steps will comprise:

- Loading of spare cable to the repair vessel;
- Survey to locate the damaged cable;
- Cable de-burial;
- Cable cutting and recovery to the surface;
- Splicing in the replacement section of cable; and
- Re-deployment of cable onto the seabed and re-burial.

A cable repair invariably requires the insertion of additional cables and two additional cable joints, the initial and the final at each end of the replaced cable section. The additional cable length in the case of point damage may be equal to approximately three times the depth of water at the site, and this is increased if the cables have been damaged over a distance or if the fault is difficult to locate. The greatest water depth is 51m indicating that for a point repair at this depth approximately 150m of cable would be replaced. As the fault location may be uncertain, up to 500m has been allowed for as a nominal replacement length.

For the repair of a single cable in a bundled pair, the pair of cables will need to be cut and both brought to the surface. However, it is possible that both cables might be repaired as a precaution against undetected damage.

The extra length of a repaired short cable section means it cannot be returned to its exact previous alignment on the seabed. The excess cable will be laid on the seabed in an 'omega' loop off to one side of the original route, but the loop will lie within the Asset Placement Corridor. The excess cable and first joint of a repair section will be laid 'in-line' along the original route whilst the final joint will complete the repair with the cable in the form of an 'omega' loop on the seabed.

After a cable repair, the additional joints and the extra cable length will be buried or protected by rock placement or concrete mattresses deployed from either the repair vessel itself or a separate specialised vessel.

A cable repair operation is expected to take between two and six weeks depending on the type and extent of the damage, burial requirements and operational constraints such as weather.

3.9 Decommissioning

3.9.1 Introduction

Decommissioning will not be required until the end of the operational lifetime of the Proposed Development (nominal 40 years). Decommissioning operations will be conducted according to the standard industry protocols and good international industry practices in force at the relevant time.

The preliminary decommissioning plan assumes recovery and removal of the subsea and onshore cables, and demolition of the converter station. However, the decommissioning plan will be flexible to adopt the least environmentally damaging option, such as leaving the cables in-situ, as may be determined at the time when decommissioning becomes necessary.

The decommissioning plan will take into account all permit requirements and contractual commitments to land-owners made on behalf of the Applicant.

3.9.2 Extent of decommissioning

The objectives during the decommissioning process will be to minimise both the short- and long- term effects on the environment whilst making the sea safe for navigation. Based on current regulations and available technology, the following level of decommissioning is proposed:

- Cables - to be retrieved or to be left safely in-situ, buried to below the natural seabed level.
- External cable protection – to be retrieved or to be left in-situ.

3.9.3 Retrieval of buried cables

Should cables be required to be removed from the seabed, the following operation is expected to be performed.

The first stage of the operation will be to expose a section of buried cable to either attach a gripper directly onto the cable or to install a cable "under roller" to de-bury the full length of the cable. This local cable de-burial operation would be undertaken using either a jetting device to expose a short section of cable or a grapnel tool to raise the cable to the surface.

Once a section of the cable is exposed, there are then two alternative methods to de-bury the full length of cable. If cable "peel out" forces are not excessive, a gripper could be attached to the cable to lift a cable end back to the cable recovery vessel. Alternatively, a cable under roller could be used to run the full length of the buried cable. This device would be connected back to a vessel by a steel wire and raises the cable back to seabed level. Both schemes would ensure that a cable end is recovered back onto the cable recovery vessel and retrieval would then commence for the full cable length. When the capacity of the cable recovery vessel is reached, the cable would be cut. The cable recovery process would then be repeated for the next cable section.

The cable recovery process would essentially be the reverse of a cable laying operation, with the cable handling equipment working in reverse and the cable either being coiled into tanks on the vessel or guillotined into sections approximately 1.5m long immediately as it is recovered. These short sections of cable would be then stored in skips or open containers on board the vessel and unloaded at port for later material reuse, recycling or disposal.

The submarine cable route would be surveyed to ensure that all cable had been removed and any obstructions had been removed or made safe.

3.9.4 Disposal / re-use of components

During decommissioning, the wastes will be handled, stored and disposed of according to the waste management hierarchy, with priority given to re-use, materials recycling and then treatment and disposal.

At the time of decommissioning, a waste management plan will be prepared to define the transport methods and destinations for the decommissioning wastes, environmental mitigation measures and health and safety procedures during handling, transport and disposal.

3.9.5 Decommissioning programme

The decommissioning programme is expected to be similar to that during installation, although without the need for cable jointing. Similar vessels will be involved but the expected rate for decommissioning the cable will be slower, at 100-200m per hour and will take up to 60 days.

3.10 Emissions

3.10.1 Introduction

The emissions which may occur during cable installation or operation are:

- Electric and magnetic fields
- Heat
- Sound

3.10.2 Electromagnetic fields (EMF)

Electromagnetic fields (EMF) are generated by submarine power cables due to the electric current flowing along the cables. The movement of electricity induces both an electric field (E field) and a magnetic field (B field), which are collectively referred to as EMF. The distance over which the EMF persists is dependent on the strength of the electric current and the density of the surrounding material (Tethys 2019).

The electric (E) field exists between the high voltage conductor of a cable and the grounded screen and armour, and since the armour is at the same electric potential as the ambient outside, there is no electric (E) field outside the cable. However, these materials are permeable to magnetic (B) fields, which therefore emanate into the surrounding environment. These magnetic (B) fields attenuate with distance (both horizontally and vertically) from the cable conductor. Movement through the generated magnetic field creates induced electric fields (iE field). This can occur as a result of water current movement or from an organism swimming through the field (Normandeau et al 2011). Owing to the dependence of iE field magnitude upon B field magnitude, iE fields will attenuate with both horizontal and vertical distance from the cables.

The submarine cables are high voltage direct current and will be installed in direct contact with each other (bundled configuration), with currents flowing in opposite directions. As a result, the magnetic field produced by one power cable is equal and opposite to the other cable and they tend to almost cancel each other out. Therefore, the residual magnetic field is very small.

WSP (2020) has calculated the predicted B fields from the submarine cables assuming a nominal capacity of 1.4 MW, 525 kV voltage and 1.5m burial depth in a bundled configuration with the cables touching[4]. The study concludes that at the seabed the maximum magnetic field strength will be 14µT, reducing to background values within 10m of the cable centreline.

[4] The minimum depth of lowering will be 1.7m increasing to up to 3.5m in the Medway Estuary.

Taking into account a natural background of 50µT the total magnetic field strength of 64µT is within the range of the Earth's natural geomagnetic field (which is between 25 and 65µT) and less than 0.16% and 0.016% of the exposure limits that ensure human health is protected specified by the EU and the International Commission on Non-Ionizing Radiation Protection (ICNIRPP) respectively.

3.10.2.1 Magnetic compass deviations

Electromagnetic fields have the potential to interfere with navigational compasses of fishing and recreational vessels. In addition to the depth of burial of the cable, compass deviation is also affected by the spacing between the cables, water depth and angle of the cable route to magnetic North.

WSP (2020) calculates the predicted effect of EMF from the submarine cable on compass deviation and concludes:

- For the cable route at 270° (east-west) alignment, the compass deviation for the cables in a bundled configuration and 11.5m vertical separation between the vessel and buried cable (10m water depth + 1.5m cable burial) is very small (no measurable change).
- For the cable route at 180° (north-south) alignment, the compass deviation for the cables in bundled configuration and 11.5m vertical separation between the vessel and buried cable (10m water depth + 1.5m cable burial) is greater than for 270° (east-west) alignment, but remains very small (<1%).
- At the Kingsnorth shore crossing, assuming that the cable ducts at the horizontal directional drilling will be spaced 5m apart and buried to a maximum depth of 15m below the seabed, in this localised area of the intertidal mudflats the compass deviation will exceed 3% and could be as high as 15-20° for approximately 10m from the cables.

3.10.3 Heat

During the operation of an HVDC cable heat losses occur because of the resistance in the cable/conductor. The cable design uses mass impregnated cables, which reduces the possible temperature effects compared to the use of cross-linked polyethylene (XLPE) cables. For mass impregnated cables the conductor operating temperature is 55-60°C, which is lower than XLPE cables (70-80°C) thereby reducing thermal losses to the environment.

When the interconnector is in operation there will be localised heating of the environment surrounding the cables (i.e. sediment for buried cable or water in the interstitial spaces of rock protection). There are no specific regulatory limits applied to temperature changes in the seabed, however 2°C change between seabed surface and 0.2 m depth has been used as a guideline in Germany.

WSP (2020) calculates that the maximum calculated temperature at the seabed for bundled cables buried to 1.5m is 15°C, with almost zero increase compared to the ambient seabed temperature.

As the cable bundle transitions from a buried state to surface laid at third party asset crossings, or where burial in sediment cannot be achieved due to ground conditions, the temperature at the seabed will increase, but assuming a burial depth of 0.2m will still be less than 1°C over a very limited corridor of approximately 5m.

At the third party asset crossings, the cables will be laid on the seabed with a minimum separation of 1.5m from the existing IS cable. WSP (2020) calculates any temperature change at the crossing location will be less than 2.5-3.5°C over a crossing section of less than 5-10 m. The heating effect on the existing cable will be less than 1.0 W/m at the crossing points, which will have no effect on power ratings or telecommunications signals.

At the HDD shore crossing, the cables will be laid in separate ducts at a depth of 15m below the seabed. The maximum calculated temperature at the seabed is less than 16°C, representing less than a 1°C change.

3.10.4 Sound

The predominant sound generating activities during the different phases of the Proposed Development are:

- Geophysical survey equipment (e.g. side scan sonar, multi-beam echosounder, sub-bottom profiler and magnetometer);
- UXO detonation (if required);
- Cable trenching (vessel and equipment noise);
- Placement of external cable protection (vessel, equipment and rock placement noise); and
- Movement of vessels.

These activities are required during installation, cable repair and decommissioning. No sound will be produced during operation of the Proposed Development.

Based on frequency and intensity characteristics, anthropogenic sound is categorised into two groups:

1. High-intensity impulsive sound characterised by large fluctuations of pressure in time, and typically exhibit rapid rise times. Examples of impulsive sound include pulses generated during geophysical survey and explosives detonation from UXO clearance.
2. Continuous sound characterised by low levels of sound spread over a longer period of time, typically many seconds, minutes or even hours. The amplitude of the sound may vary throughout the duration of the activity, but the amplitude does not fall to zero for any significant time. Examples of continuous sound includes vessel noise.

Each group is associated with particular effects on marine fauna. The significance of the effect depends on:

- The predicted source level – the apparent strength of a sound source at a reference distance, typically 1m; and
- How the sound propagates (spreads) through the water – as sound spreads through water the acoustic power decreases with distance travelled. The rate of decrease is influenced by factors such as the frequency of the sound, temperature, salinity, water depth, and seabed conditions. High frequency sounds attenuate rapidly with distance, whilst low frequency sounds can travel great distances.

The sound pressure levels (SPLs) assumed for different aspects of the Proposed Development are as follows:

- Geophysical survey SBP (Chirper) – 211 dB re 1µPa (peak)
- Geophysical survey MBES – 235 dB re 1µPa (peak)
- UXO detonation (1.54kg) – 275.8 dB re 1µPa (peak)
- UXO detonation (50kg) – 287.2 dB re 1µPa (peak)
- DP vessel movement – 184 dB re 1 µPa @ 1m (RMS)
- Trenching operation – 178 dB re 1 µPa @ 1m (RMS)
- Rock placement operation – 188 dB re 1 µPa @ 1m (RMS)

Further information is provided in Technical Appendix I – Underwater Noise Assessment.

3.11 Zone of Influence

The spatial extent over which the Proposed Development activity and subsequent pressures is predicted to have an effect on the receiving environment are based on the assumptions presented in Table 3-12.

Table 3-12 Assumptions used to establish zone of influence

Project Activity	Description / Assumptions	Footprint used to establish Zone of Influence
Vessel positioning	Anchors will be used to maintain the position of the CLB. Up to 4 anchors may be used secured between 500m and 1200m from vessel	Within Application Corridor
	Vessel will be requested to remain 500m from Project Vessels	1km wide x 12 km along centreline (in any 24-hour period)
Cable Installation	Cable trench will be up to 1m wide	1m
	A typical excavation tool has a seabed footprint of 15m	15m
	Trailing suction hopper dredger or MFE will excavate a 15m wide at the base of the sandwave for the installation tool. Slope angles will be 1:3. Due to differing sandwave heights the widest corridor will be 63m at KP105 .	63m
	Sand and gravel deposition	Within 35m of cable route. Maximum deposition thickness varies depending on particle size distribution and trench depth but will be <5cm.
	Silt suspension – concentrations above 300mg/l (conservative threshold for significant effects on sensitive shellfish e.g. cockles)	Within 250m of the cable route perpendicular to tidal flow and about 1.4km in the direction of tidal flow. Maximum deposition thickness 2mm
	Continuous sound – threshold for onset of disturbance for marine mammals	1.2km
	Impulsive sound (geophysical survey) – threshold for onset of disturbance for marine mammals.	924m
	Impulsive sound (UXO detonation) – threshold for onset of disturbance for marine mammals	6.7km
External cable protection	Third party asset crossings – individual design parameters are defined for each crossing location with maximum width used to establish zone of influence	12.5m
	Ground conditions – individual design parameters are defined for each location with maximum width used to establish zone of influence	9.1m
Buried cables	EMF – B & iE fields elevated above background levels	10m
	Heat	<5m at locations where cable is surface-laid only and external cable protection is used.
Repair	Vessels will be requested to remain a safe distance from Project Vessels	1km x 1km
	Removal and re-trenching of buried cable	15m wide x 500m
	External cable protection (if re-burial is not feasible)	7m wide x 500m

3.13 Approach to Design

The design has been developed through an iterative process to avoid or reduce potential environmental effects, including:

- Review of good industry practices and guidance, including consideration of lessons learned from recent cable installation projects in the region e.g. BritNed, NEMO and installation of windfarm export cables.
- Pre-application consultation with fishing industry and nature conservation stakeholders to identify appropriate installation techniques for specific locations.
- Identification of sensitive environmental features through a desk-based assessment that used publicly available datasets and bathymetric, geophysical, geotechnical and environmental surveys of the seabed, and bird surveys of the intertidal mudflats.
- During cable route survey, acquisition of additional environmental data to investigate the extent and condition of potential reef habitats.

In order to minimise the potential environmental effects at source, the design has incorporated an extensive set of Embedded Mitigation measures, as listed in Table 3-13. These mitigation measures will then be supplemented by additional Project Specific Mitigation determined as a result of the assessment of each environmental topic.

Table 3-13 Embedded mitigation

ID	Embedded mitigation measure	Project Phase		
		I	O	D
EM1	Intertidal zone of the Medway Estuary at the Kingsnorth shore crossing shall be crossed by horizontal directional drilling (HDD) to avoid disturbance to the surface sediments and habitats. HDD must exit beyond the mean low water springs mark to avoid the Medway Estuary and Marshes SPA and Medway Estuary and Marshes SSSI.	■		
EM2	HDD drilling activities shall be conducted in a manner to minimise risk of bentonite breakout from the HDD entry or exit pits	■		
EM3	Submarine cables will be bundled together.	■		
EM4	Deployment of anchors/anchor chains on the seabed will be kept to a minimum in order to reduce disturbance to seabed and will be within the Proposed Development.	■	■	■
EM5	Cable burial and protection design as detailed in the Burial Assessment Study, final crossing designs and planned and remedial final external protection designs shall be within the maximum design parameters detailed in the GridLink Marine Licence Application or robust justification for the deviations provided.	■		
EM6	Cables shall be installed in sand wave troughs wherever practicable, or after pre-sweeping if required, to minimise the risk or exposure by seabed mobility	■		
EM7	External cable protection (rock and/or mattresses) shall only be deployed where it is demonstrated that adequate burial depth cannot be achieved; the footprint of any external protection shall be the minimum required to ensure adequate cable protection and stability	■		
EM8	External cable protection (excluding crossing locations) shall not reduce chart datum by more than 5%, unless agreed with the MCA and appropriate navigation authorities. If external cable protection at any location including crossings does impact on navigable depth, such locations shall be marked in accordance with Trinity House requirements and suitably marked on navigation charts	■	■	
EM9	Cable protection heights and widths shall be minimised, taking into account the requirements to maintain the structural integrity of the berms.	■		
EM10	Cable protection shall be designed to minimise snagging hazards, for example by minimising height above seabed, smooth and shallower profiles, grade used for rock placement, type of rock (e.g. smoother edges).	■		
EM11	In-service third party asset crossings shall not be carried out in buoyed navigable areas with water depths <10m	■		
EM12	London Array crossing design shall not exceed 1.76m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).	■		
EM13	London Array crossing design shall comprise one continuous cable protection across all four cables (rather than four individual cable crossings) to minimise eddy currents causing scour at end of berms	■		
EM14	London Array crossing design shall ensure vertical separation between the cables is preserved against long term settlement whilst minimising total berm height.	■		
EM15	Thanet Windfarm North crossing design shall not exceed 2.11m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).	■		

ID	Embedded mitigation measure	Project Phase		
		I	O	D
EM16	Thanet Windfarm South crossing design shall not exceed 2.11m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).			
EM17	NEMO Interconnector crossing design shall not exceed 1.96m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).			
EM18	Cable protection used in NEMO Link crossing design shall minimise footprint on seabed due to presence of Goodwin Sand MCZ Sabellaria reef in area			
EM19	PEC crossing design shall not exceed 2.11m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).			
EM20	Atlantic Crossing - Seg B1 crossing design shall not exceed 2.01m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).			
EM21	Tangerine crossing design shall not exceed 2.11m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).			
EM22	BT North Sea JOSS crossing design shall not exceed 2.21m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).			
EM23	Cutting of out-of-service cables shall be carried out in accordance with ICPC recommendation 1			
EM24	Out-of-service cables shall be cut in a manner to avoid spragging/fraying of cable ends or other snagging hazards to fishing nets			
EM25	Cut cable end locations and clump weights shall be accurately recorded and charted and positions passed to the FLO at the earliest opportunity.			
EM26	Cable installation works shall not encroach on any recognised anchorage that is charted or noted in nautical publications unless agreed with the appropriate Port Authority.			
EM27	All material disturbed by the Pre-Lay Grapnel Run (PLGR) shall be recovered (unless there is a valid reason why an item cannot be safely recovered)			
EM28	The size of the Pre-Lay Grapnel shall be optimised for the expected duty and seabed obstacles to be cleared; over-sized PLG shall not be used			
EM29	Effective channels of communication shall be established and maintained between GridLink and commercial fishing interests. This will include the continued appointment of an onshore Fisheries Liaison Officer (FLO) and if necessary, offshore FLOs. Offshore FLOs should have experience of the Thames Estuary, east Dover Straits and Falls Bank area.			
EM30	Notices shall be given to other sea users in the area of operations via Notice to Mariners, Kingfisher Bulletins, NAVTEX, and NAVAREA warnings; particular attention shall be paid to ensuring the following organisations receive the notifications: Peel Ports, Port of London Authority (PLA), Thamesport, MCA, Royal Yachting Association (RYA), Vattenfall, London Array, Estuary Services Ltd (Pilots), Trinity House, ROFF, Thanet Fishermen's Association, Whitstable Fishermen's Association, Swale Fishermen Ltd, Harwich Harbour Fishermen's Association, Thames Estuary Fishermen's Association and Leigh Trawlermen Cooperative and individual local fishermen as identified by the FLO.			

ID	Embedded mitigation measure	Project Phase		
		I	O	D
EM31	FLO shall be included on distribution list for all daily reports from Project vessels.			
EM32	Vessels shall take all reasonable efforts to ensure they do not anchor where there is significant navigational traffic or in shipping lanes when waiting on weather. If it is required, the vessels will notify and coordinate with relevant authority.			
EM33	All vessels shall have passage planning procedures, holding positions (e.g. if waiting on weather), traffic monitoring (e.g. radar, AIS and visual), means of communication with third party vessels and emergency response plans in the event a third party vessel approaches on a collision course			
EM34	All vessels (exceeding 20m) shall not exceed 14 knots during operations within the Proposed Development to protect marine mammals from ship strikes.			
EM35	Project vessels will comply with the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs) (as amended) Marking and UK Standard Marking Schedule for Offshore Installations Marking, particularly with respect to the display of lights, shapes and signals.			
EM36	Project vessels will be equipped with waste disposal facilities (sewage treatment or waste storage) to IMO MARPOL Annex IV Prevention of Pollution from Ships standards.			
EM37	Ship Oil Pollution Emergency Plans (SOPEPs) shall be provided by Contractor and implemented covering all vessels in accordance with MARPOL Annex I requirements			
EM38	Ballast water discharges from all vessels shall be managed under the International Convention for the Control and Management of Ships' Ballast Water and Sediments standard			
EM39	Hazardous chemicals and materials shall be managed in accordance with applicable standards and guidelines, including maintenance of an inventory of such substances that are used and/or stored, provision of Material Safety Data Sheets (MSDSs), preparation of Chemical Risk Assessments and storage in designated, secure facilities with suitable spill protection and control			
EM40	Biosecurity Plan (BSP) shall be prepared and implemented covering all marine operations, taking into account applicable guidance from the GB non-native species secretariat (2015)			
EM41	Environmental Management Plan (EMP) shall be prepared and implemented covering all marine operations			
EM42	Emergency Spill Response Plan (ESRP) shall be prepared and implemented covering all marine operations			
EM43	Sub-bottom profiling and multi-beam and echo-sounder surveys shall comply with the JNCC guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys (JNCC 2017) (or subsequent amendments)			
EM44	A UXO survey will be undertaken within the UXO Survey Corridor to identify anomalies. If any significant UXO is identified, the decision-making hierarchy taking into account environmental sensitivities, safety and technical considerations shall be: 1. Avoid by micro-routeing 2. If the UXO cannot be avoided, undertake clearance to surface or move UXO outside the cable installation corridor 3. If the UXO cannot be safely moved, clearance by on-site deflagration.			

ID	Embedded mitigation measure	Project Phase		
		I	O	D
EM45	UXO clearance by deflagration shall comply with the JNCC guidelines for minimising the risk of injury to marine mammals from using explosives (JNCC 2010, or as updated), including: a) Establishment of a default 1km mitigation zone for marine mammal observation, measured from the explosive source and with a circular coverage of 360 degrees b) Provision of two trained marine mammal observers (MMO) to implement the JNCC guidelines c) Provision of a Passive Acoustic Monitoring (PAM) to be operated by a suitably trained and experienced MMO to support visual observations. d) Commencement of explosive detonations only during daylight hours and good visibility e) Accurate determination of the amount of explosive required for the operation, so that the amount is proportionate to the activity and not excessive. f) If necessary, planning of a sequence of multiple explosive discharges so that, wherever possible, the smaller charges are detonated first to maximise the 'soft-start' effect. g) if the UXO identified is greater than 10kg then a soft-start procedure shall be used whereby charges of 50g, 100g, 150g, and 200g will be deployed at 5 minute intervals with a further 5 minute interval before the detonation of the UXO.	■	■	
EM46	The GridLink Marine Mammal Mitigation Plan will be implemented for all marine operations and UXO deflagrations.	■	■	■
EM47	GridLink Written Scheme of Investigation (WSI) and a Protocol for Archaeological Discoveries (PAD) shall be implemented during all marine operations.	■	■	■
EM48	Information related to the as built cable will be provided to navigation and fishing stakeholders as required.		■	
EM49	As-built co-ordinates of the cable route shall be recorded and submitted to the UK Hydrographic Office (UKHO) via a H102 hydrographic note and KIS-ORCA Service; 'as-built' cables shall be marked on Admiralty Charts and fisherman's awareness charts (paper and electronic format)		■	
EM50	Electro-magnetic fields generated by the cable system shall not cause greater than a three degrees deviation on ships' compasses for 95% of the cable route; for the remaining 5% of the cable route, a maximum of five degrees deviation must be attained unless approved by the MCA		■	
EM51	Post-installation compass deviation surveys shall be carried out where the cables are not bundled together due to the shore crossing (KP0.0 and KP1.0) or other reason and water depths are <10m; the results of any compass deviation shall be provided to UKHO and MCA		■	
EM52	Post-installation inspection surveys shall be carried out every two years (the survey frequency may be reduced only when the depth of burial and seabed restoration has been sufficiently validated).		■	
EM53	Any post-lay cable exposure for whatsoever reason shall be published in the Kingfisher Information System, Notified to Fishermen and guarded until remedial works are completed		■	
EM54	Vessels are advised in the Mariners Handbook not to anchor within 0.25nm (500m) of cables		■	
EM55	Coordination of timings will be sought from the ports during marine operations to reduce disruption on existing shipping		■	

I = Installation; O = Operation (including repair and maintenance); D = Decommissioning

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4. ASSESSMENT SCOPE AND METHODOLOGY

4.1 Introduction

There are three stages to the environmental assessment process: a) screening; b) scoping; and c) assessment.

This chapter outlines the key stages of the environmental assessment process, summarises the conclusions of the screening and scoping stages, and outlines the approach taken to identify and evaluate potential effects associated with the Proposed Development.

It considers the guidance provided in the following documents:

- IEMA Environmental Impact Assessment Guide to: Delivering Quality Development, 2016;
- The Institute of Environmental Management and Assessment (IEMA) Guidelines for Environmental Impact Assessment, 2004;
- The Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment in Britain and Ireland: Marine and Coastal, 2010;
- Scottish Natural Heritage (SNH) A handbook on environmental impact assessment: Guidance for Competent Authorities, Consultees and others involved in the Environmental Impact Assessment (EIA) Process in Scotland, 2013;

There are several different environmental assessment guidance documents available for terrestrial and marine applications which set out what an assessment should include and suggested ways it can be undertaken. However, there are few prescriptive examples on how to measure the significance of an effect. The SNH Handbook provides an example of a matrix showing significance related to sensitivity and magnitude of change. This method can be applied to any marine project irrespective of its location in the UK and has been used as a guide for the matrix in the GridLink assessment method, as agreed with the Marine Management Organisation (MMO) (through the Scoping process).

4.2 Screening

The laying of power cables within the UK territorial waters (between the mean high-water springs mark and 12 nautical miles offshore) requires a Marine Licence under the Marine and Coastal Access Act 2009. The laying of any cable beyond the UK territorial waters does not require a Marine Licence, however, associated works such as pre-lay dredge and disposal and external cable protection measures may require a Marine Licence.

The Marine Management Organisation (MMO) is obliged to grant a Marine Licence (within UK territorial waters) for power cable applications, however, environmental information can be requested by them to support the application and conditions can be included in any Marine Licence issued.

Activities listed in Schedule A1 of The Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended) (MWR) require an Environmental Impact Assessment (EIA) to be carried out before a marine licence can be granted. Activities listed in Schedule A2 of the MWR require an EIA if they are likely to have a significant effect on the environment.

A request for a Screening Opinion was submitted to the MMO in June 2018. The MMOs EIA Screening Opinion (reference EIA/2018/00042, dated 27 July 2018), confirmed that the Proposed Development

is not considered a Project under Schedule A1 or Schedule A2 of the MWR and as such a statutory EIA is not required.

However, the Applicant recognises that it is required to provide environmental supporting information in support of its Marine Licence application. In addition, as an interconnector licence holder, the Applicant has a duty to preserve amenity. The Applicant is committed to completing appropriate marine surveys, assessments of potential environmental effects and stakeholder consultations to fulfil this duty.

The Applicant considers it best practice to meet its obligations by undertaking a non-statutory Environmental Assessment. Whilst not a statutory EIA, the assessment has been undertaken in accordance with relevant best practice. This Environmental Report documents the assessment process, its findings and conclusions.

4.3 Scoping and Consultation

The Applicant has taken a pro-active approach to consultation recognising that it is a critical activity in the development of a comprehensive and balanced assessment. This section provides a summary of the consultation undertaken during the design phase of the project and consultation relevant to the environmental scoping and assessment.

4.3.1 Approach to scoping and consultation

Consultation has been undertaken with statutory consultees, stakeholders and the public during key stages of the project.

The consultation, including scoping, has the following objectives:

- To provide statutory and non-statutory consultees as well as local communities and other stakeholders with the opportunity to inform the development of the project and the final offshore route design and planning.
- To provide statutory consultees with the opportunity to comment on the proposed specialist studies commissioned to inform the assessment, and the approach to, and scope of the assessment.

4.3.2 Scoping

The aim of the scoping process is to assist in identifying the key environmental pressures associated with the Proposed Development. It also provides statutory and non-statutory consultees with an opportunity to comment on the Proposed Development, the scope of the assessment and raise any issues which they consider may be important to the assessment process. Their responses have helped to provide direction on the topics that the assessment should focus on.

Initially, a request for a Scoping Opinion (Intertek 2018) was submitted to the MMO in August 2018 in support of a non-statutory Environmental Report. This was followed by a request in November 2018 to consider an Addendum to the Scoping Report proposing (as a contingency) an alternative shore crossing method. The MMO provided a Scoping Opinion (ENQ/2018/00159) on 05 February 2019 to both the requests.

An updated request for a Scoping Opinion (Intertek 2019) was submitted to the MMO in December 2019, following the decision to change the landfall site from Damhead Creek to the Medway Estuary at the former E.On coal-fired power station (now demolished) in the Kingsnorth industrial area. The MMO provided an updated Scoping Opinion (ENQ/2019/00164) on 08 April 2020.

Both Scoping Opinions have been used to inform the assessment.

At the start of each topic chapter, a table is provided listing the scoping responses received relevant to that topic and how they have been addressed in the assessment.

Responses were also received that have informed the general content, structure and approach of the Environmental Report.

4.3.3 Stakeholder engagement

The Applicant has held meetings with a range of stakeholders since 2017; as listed in Technical Appendix B. The meetings have helped to inform route development, collect data, discuss potential areas of conflict and inform the environmental assessment. Additional stakeholders have been contacted via email and telephone.

The key stakeholders who have been contacted for the onshore and offshore assessments are listed in Table 4-1.

Table 4-1 Stakeholders contacted during assessment process

Ref	Stakeholder	Type
1	Medway Council - Planning	Local authority
2	Medway Council - Economic Development	Local authority
3	Medway Council - Highways	Local authority
4	Medway Council - Ecology	Local authority
5	Medway Council - Landscape	Local authority
6	Hoo St Werburgh Parish Council	Parish Council
7	Hoo and Chattenden Neighbourhood Plan Steering Group	Parish Council
8	Kent County Council - Cultural heritage	Cultural heritage
9	Marine Management Organisation (MMO)	Competent authority
10	Crown Estate	Competent authority
11	Peel Ports (Port of Sheerness)	Navigation authority
12	Port of London Authority (PLA)	Navigation authority
13	Uniper UK Ltd	Landowner
14	Historic England	Cultural heritage
15	Natural England	Nature conservation
16	Joint Nature Conservation Committee (JNCC)	Nature conservation
17	Centre for Environment, Fisheries and Aquaculture Science (CEFAS)	Nature conservation
18	Royal Society for the Protection of Birds (RSPB)	Nature conservation
19	Kent Wildlife Trust	Nature conservation
20	Whale and Dolphin Conservation Society	Nature conservation
21	Environment Agency	Flood risk
22	Medway Internal Drainage Board	Land drainage
23	Maritime and Coastguard Agency (MCA)	Coastguard
24	Trinity House	Cultural heritage
25	Ministry of Defence (MoD)	Military
26	Oil & Gas Authority (OGA)	Oil & gas

Ref	Stakeholder	Type
27	Offshore Petroleum Regulator for Environment and Decommissioning (OPRED)	Oil & gas
28	Chamber of Shipping	Shipping
29	British Marine Aggregate Producers Association (BMAPA)	Dredging
30	National Federation of Fishermen's Organisations (NFFO)	Fishing
31	Kent and Essex Inshore Fisheries & Conservation Authority (KEIFCA)	Fishing
32	Rochester Oyster and Floating Fishery (ROFF)	Fishing
33	Thanet Fishermen’s Association	Fishing
34	Whitstable Fishermen’s Association	Fishing
35	Swale Fishermen Ltd	Fishing
36	Harwich Harbour Fishermen’s Association	Fishing
37	Thames Estuary Fishermen’s Association	Fishing
38	Leigh Trawlermen Cooperative	Fishing
39	BritNed Development Ltd (BritNed interconnector)	Third party asset owner
40	NEMO Ltd (NEMO interconnector)	Third party asset owner
41	Blue Transmission London Array Ltd (London Array windfarm)	Third party asset owner
42	Balfour Beatty plc (Thanet windfarm)	Third party asset owner
43	Vattenfall Wind Power Ltd (Kentish Flats windfarm)	Third party asset owner
44	Vattenfall Wind Power Ltd (Thanet windfarm extension)	Third party asset owner
45	BT (various telecommunications cables)	Third party asset owner
46	CenturyLink (various telecommunications cables)	Third party asset owner
47	Royal Yachting Association	Sailing
48	Cruising Association	Sailing
49	Medway Cruising School	Sailing
50	Medway Bridge Marina	Sailing
51	Strood Yacht Club	Sailing
52	Rochester Cruising Club	Sailing
53	Skilltrack	Sailing
54	Kentish Sail Association	Sailing
55	Morning Star Trust	Sailing
56	Sail and Power Services	Sailing
57	Royal Engineers Boat Operations (Asa 133)	Sailing
58	Chatham Maritime Marina	Sailing
59	Elite Sailing	Sailing
60	Guardian Marine Training Services Ltd	Sailing
61	Upnor Sailing Club	Sailing
62	Medway Yacht Club	Sailing
63	Arethusa Venture Centre	Sailing
64	Wilsonian Sailing Club	Sailing

Ref	Stakeholder	Type
65	Hoo Ness Yacht Club	Sailing
66	Port Werburgh	Sailing
67	Hundered of Hoo Sailing Club	Sailing
68	Gillingham Marina	Sailing
69	Segas Sailing Club	Sailing
70	Medway WaterSports Centre	Sailing
71	Medway Cruising Club	Sailing
72	Lower Halstow Yacht Club	Sailing
73	Kingsferry Boat Club	Sailing
74	Queenborough Harbour	Sailing
75	Queenborough Yacht Club	Sailing
76	Solo Offshore Racing Club	Sailing
77	UK Catamaran Racing Association	Sailing
78	Whitstable Yacht Club	Sailing
79	Whitstable Watersports Centre	Sailing
80	Whitstable Cruising Club	Sailing
81	Oystercoast Watersports	Sailing
82	Tankerton Bay Sailing Club	Sailing
83	Hamperton Pier Yacht Club	Sailing
84	Herne Bay Sailing Club	Sailing
85	Minnis Bay Windsurfing Club	Sailing
86	Minnis Bay Sailing Club	Sailing
87	Margate Yacht Club	Sailing
88	British Sub-Aqua Club	Diving
89	British Divers Marine Life Rescue	Diving

4.3.4 Public consultation

Wider public consultation related to the Proposed Development has been achieved through:

- Project website (www.gridlinkinterconnector.com), including regular updates on progress and provision of project documents to view and/or download;
- Virtual public exhibition on the website, including live chat session on 4 September 2020, and Feedback Forms to receive comments on the Proposed Development;
- Online public consultation meeting held on 11 September 2020;
- Newspaper notices published in both local and national newspapers, and announcements on local radio and social media platforms;
- Information points (2) for the distribution of hard copies of project literature; and
- Telephone hotline to enable questions from persons without internet access or computer literacy.

During the restrictions imposed by COVID-19, physical public exhibitions and meetings have not been possible, so a virtual/online platform has been used. The full project (onshore and offshore elements)

has been presented and the public given the opportunity to ask questions in person, online or by Feedback Forms and Contact Us forms. Issues raised during the consultation process have been considered within the Environmental Report.

Following submission and acceptance of the Marine Licence application by MMO, a 28-day public consultation period will commence. This period provides consultees and the public further opportunity to comment on the Marine Licence application and supporting documents. At the start of this period, copies of the Environmental Report will be made available to the public as directed by the MMO and on the project website (www.gridlinkinterconnector.com).

4.3.5 Scoping conclusions

The Scoping Report included an assessment of significance of each potential pressure resulting from the Proposed Development to decide which of the pressures could have a significant effect and therefore should be taken forward for further assessment.

Those which were deemed to be non-significant were scoped out and no further assessment has been undertaken. This scoping process was refined through the consultations with some pressures being scoped back-in at the request of stakeholders, or agreement reached that an additional effect could be scoped out.

Table 4-2 identifies the effects that have been scoped out of the assessment and the reason for the exclusion. These effects will not be discussed or assessed further in the Environmental Report.

Table 4-2 Effects scoped out from the Assessment and the rationale of their exclusion

Pressure & effect scoped out of Assessment	Receptor	Reason for scoping pressure out of the Assessment
Hydrocarbon and PAH contamination	All receptors	Unplanned events (accidental oil or chemical spills) and fluid breakouts from HDD have been scoped out of the scoping assessment for the following reasons: ▪ The horizontal directional drilling (HDD) for the landfall shore crossing will use industry standard barite based drilling fluids. As drilling reaches the predicted breakout point onto the seabed, the drilling fluids will be replaced with fresh water in order to minimise the release of any drill chemicals into the seabed or water column. As a result, the release of drill fluids into the seabed or water column is not expected to be significant. ▪ The likelihood of a large oil spill occurring from a Project vessel is extremely low and the risk is no greater than that for any other vessel in the Project area. ▪ All Project vessels will have control measures and shipboard oil pollution emergency plans (SOPEP) in place and will adhere to MARPOL Annex I requirements. ▪ A Construction Environmental Management Plan (CEMP) and an Emergency Spill Response Plan will be developed and implemented for the installation phase. Execution of these plans will ensure that the risks associated with an unplanned event will be effectively managed in line with relevant international and national statute.
Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion (change to seabed features)	Physical processes and seabed sediments	Ploughing: The ploughing of the seabed associated with cable installation will result in the disturbance of seabed sediments from the trench to an area of seabed either side. The material displaced will then be back filled into the trench following installation of the cable. Any changes to the seabed, sediment transport or hydrodynamics will be temporary in nature during the construction phase and natural processes will return the seabed to pre-construction conditions in a short period of time. Anchoring: Vessels operating within shallow water, e.g. the Medway Estuary, are likely to be anchored during cable installation. However, the footprint of the seabed affected by the anchoring is small and temporary in nature. Further offshore, vessels will utilise dynamic positioning ensuring that there is no interaction with the seabed and therefore no effects are expected. Note: Effects on benthic ecology are considered separately in this report.
Siltation rate changes, including smothering (depth of vertical sediment overburden):	Intertidal and benthic ecology	All species (excluding *Sabellaria spinulosa* and *Mytilus* reefs): Species can be smothered through two pathways: by displaced sediments during trenching and by the re-deposition of suspended sediment. The effect from displaced sediment will be very localised, only effecting species in the immediate vicinity of the cable trench. The generation of suspended sediments followed by re-deposition during trenching will be minimal with any material deposited likely to be quickly re-suspended and distributed by natural hydrodynamic processes.
Changes in suspended solids (water clarity)	Intertidal and benthic ecology	Construction works will displace sediment which will temporarily increase turbidity before being rapidly dispersed through natural hydrodynamic processes. Any increase in turbidity is likely to be within natural variability and benthic species will be accustomed to such variations
Temperature changes – local	Intertidal and benthic ecology	The cable will either be buried or protected by external cable protection e.g. rock or concrete mattresses. Any temperature changes will be localised to the immediate soil surrounding the cable and undetectable against natural temperature fluctuations in the surrounding sediments and water column.

Pressure & effect scoped out of Assessment	Receptor	Reason for scoping pressure out of the Assessment
Introduction or spread of non-indigenous species	Intertidal and benthic ecology Fish and shellfish	The introduction of invasive non-native species (e.g. through discharge of ballast water from project vessels) will be managed under the International Convention for the Control and Management of Ship's Ballast Water and Sediments. The project will complete a biosecurity risk assessment which will include factors such as origins of the vessels and ensuring that relevant equipment is cleaned before use.
Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion (change to seabed features)	Birds	Changes in prey availability is a potential indirect pressure on marine and coastal birds which could arise from effects on fish and shellfish and benthic species through the disturbance of sediments during cable installation and maintenance activities. The preferred method of cable installation within the intertidal area is horizontal directional drilling (HDD) at 10-15 m below ground level, and therefore there will be no effects to species using the intertidal area for feeding. Disturbance to the seabed at the breakout point of the HDD and along the cable installation trench will be localised and short term. Given the wider availability of habitat any temporary effects on changes to prey availability will not be significant.
Temperature changes (local)	Marine mammals	The cable will either by buried or protected by external cable protection e.g. rock or concrete mattresses. Any temperature changes will be localised to the immediate soil surrounding the cable and undetectable against natural temperature fluctuations in the surrounding sediments and water column. There will be no effect on marine mammals.
Visual disturbance	Marine mammals	The physical presence of project vessels during construction and maintenance (repair) has the potential to disturb marine mammals. Harbour porpoise are the designating feature of the Southern North Sea Special Area of Conservation and may be present along the Proposed Development; and grey seal are known to haul out on Goodwin sands. The region is already used by large ships and ferries, particularly in the area surrounding the Proposed Development. The addition of installation / maintenance vessels is unlikely to be noticeable against the background of normal shipping activity fluctuations. In addition, the activities will be temporary and transient, with the vessel moving slowly through the region. Therefore, no likely significant effects of visual disturbance to harbour porpoise or pinniped are expected from the presence of project vessels.
Death or injury by collision	Marine mammals	Although shipping collision is a recognised cause of marine mammal mortality worldwide, the key factor influencing the injury or mortality caused by collisions is ship size and speed. Ships travelling at 14 knots or faster are most likely to cause lethal or serious injuries. Although the presence of the cable lay vessels and support vessels will marginally increase the level of vessel activity within the area for the duration of the marine works, none of the project vessels will be travelling at speeds exceeding 14 knots. Cable lay vessels move along the cable route at the rate of cable installation, approximately 200-400 m per hour depending on sediment conditions, resulting in a low likelihood of collision. Given that vessels will be operating at less than 14 knots, the risk of a collision is significantly reduced, and this pressure is not assessed further.
Electromagnetic changes	Commercial fisheries	Electromagnetic fields have the potential to interfere with navigational compasses of fishing vessels. Due to the bundled, design of the cable with the current in each cable flowing in opposite directions, the magnetic fields in each cable will cancel each other out. The electric field generated by the cables will be mitigated through metallic screening of the cables and burial below the seabed. Near the landfall location, where the cables separate to enter the HDD ducts in shallow water there is the greatest risk of compass deviation being experienced; however, this area is very localised and unlikely to cause significant effects.

Pressure & effect scoped out of Assessment	Receptor	Reason for scoping pressure out of the Assessment
Nutrient enrichment Deoxygenation	Bathing waters Shellfish waters	The Proposed Development will not affect bacterial concentrations in seawater. The designated bathing waters and shellfish waters near the Proposed Development are not considered to be a receptor of relevance.
ALL	Third-party asset owners	Crossing and/or Proximity Agreements will be made with the operators of the infrastructure that are intersected by the Proposed Development in accordance with the requirements of The Crown Estate licence granted to GridLink Interconnector Ltd. On this basis, no significant effects on the operation of existing infrastructure is anticipated.
ALL	Other marine users	The cable route has been designed to avoid crossings areas of known aggregate extraction and offshore wind farms. No significant environmental effects, although effects on shipping and navigation and commercial fisheries will be assessed.
ALL	Air quality	Since 1 January 2015, IMO MARPOL Annex VI requires that all vessels located inside of the ECA to use fuel with a sulphur content not exceeding 0.1% sulphur, or to employ an abatement technology that can be used to reduce SOx limits to a level that would be produced by the sulphur-in-fuels limit. Vessels operating during the construction or maintenance phases of the Proposed Development will adhere to this standard. On this basis, no significant environmental effects are anticipated on air quality

4.4 Method of Environmental Assessment

The IEMA (2004) guidelines state that the assessment stage should follow a clear progression; from the characterisation of impact to the assessment of the significance of the effects taking into account the evaluation of the sensitivity and value of the receptors. In this method the term impact has been replaced with pressure(s).

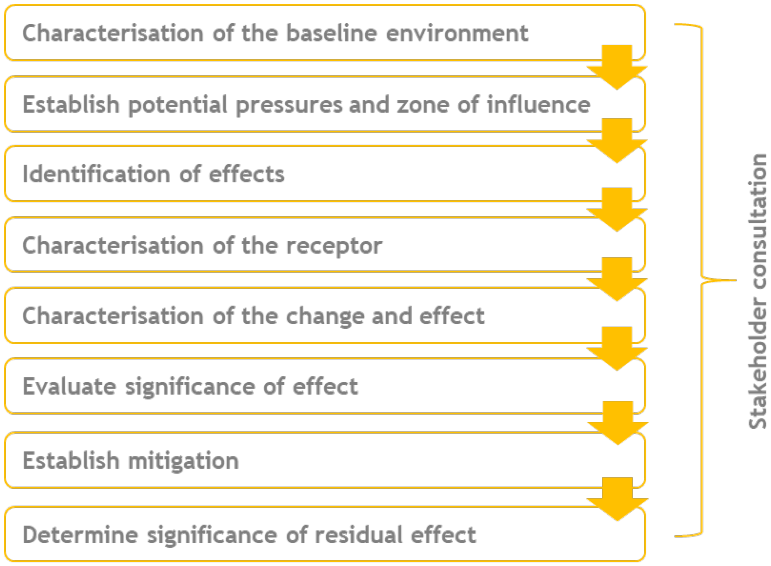
The definitions provided in Table 4-3 have been used throughout the Environmental Report.

Table 4-3 Definitions

Term	Definition
Pressure	A pressure can be defined as "the mechanism through which an activity has an effect on any part of the ecosystem". The nature of the pressure is determined by activity type, intensity and distribution. A list of marine pressures and their definitions has been formally agreed by the OSPAR Intercessional Correspondence Group on Cumulative Effects (ICG-C).
Interaction	The link between a pressure and the receptor. There must be an interaction for an effect to occur.
Effect	The consequence of the pressure; a predicted change in the baseline environment, usually measurable. Effects only occur when an activity or pressure is present within an environment that is sensitive to it.

The assessment process involves the following main steps as presented in Figure 4-1.

Figure 4-1 Steps in the Assessment



The steps are described in more detail below and are followed within each topic chapter of the Environmental Report.

4.5 Characterisation of the Baseline Environment

To assess the potential effects resulting from the Proposed Development it is necessary to establish the current physical, biological, and human conditions that exist along and near the Proposed Development and outline the likely natural evolution of the baseline (as far as natural changes can be determined) without implementation of the Proposed Development. This description is based on currently available environmental information and scientific knowledge.

A full understanding of the baseline for each environmental receptor has been achieved through some or all of the following:

- Review of primary baseline studies (field);
- Review of additional specialist baseline studies (desk-based);
- Detailed review of all secondary sources (i.e. existing publicly available documentation and literature);
- Stakeholder consultation.

The key data sources used to establish the baseline are described in each topic chapter with any limitations in the data identified.

For each topic the baseline has been described from the landfall site at Kingsnorth to the UK/France EEZ boundary.

4.6 Establish Potential Pressures and Zone of Influence

The list of marine pressures formally agreed by the OSPAR Intercessional Correspondence Group on Cumulative Effects (ICG-C), have been used in the assessment. The ICG pressure list does not include human pressures and, therefore, categories have been developed based on industry experience.

For each pressure, the zone of influence – the spatial extent over which the Proposed Development and subsequent pressures is predicted to have an effect on the receiving environment – is established. This will vary for different activities / pressures and for the different stages of the Proposed Development (installation, operation and decommissioning).

Establishing the zone of influence for different pressures and receptors will be undertaken quantitatively where possible but, if not, it will be undertaken qualitatively based on similar project experience and literature reviews.

Receptors which occur outside the zone of influence and which cannot or are unlikely to travel into the zone (e.g. benthic communities) have been scoped out. Conversely, mobile species and other mobile receptors such as other sea users can travel into the zone of influence and may therefore be affected by the Proposed Development have been scoped in.

The zone of influence used in the assessment are given in the topic chapters. The zone of influence will in many cases relate to the seabed and or sea surface footprint of the Proposed Development. However, in some cases the zone of influence may extend much further e.g. disturbance from noise may affect birds or cetaceans >1km away.

The zone of influence has been considered for each potential pressure. Where several project activities result in the same pressure (e.g. pre-sweeping, pre-lay grapnel run, trenching, resulting in seabed disturbance) or the installation technique has not been determined, the worst-case spatial extent has been applied.

4.7 Identification of Effects

The prediction of potential effects has been undertaken to determine what could happen to each environmental receptor as a consequence of the Proposed Development. The diverse range of potential effects considered in the assessment process results in a range of prediction methods being used including quantitative, semi-qualitative and qualitative. The definitions used to describe effects are presented in Table 4-4 below.

Table 4-4 Definitions of effects

Term	Definition
Direct effect	Effects that result from a direct interaction between the Proposed Development/Proposed Development's activities and the receiving environment.
Indirect effect	Effects on the environment, which are not a direct result of the Proposed Development/Proposed Development's activities, often produced away from the activity or as a result of a complex pathway (European Commission 1999). For example, loss of habitat from trenching, leading to reduction in prey species availability, having an indirect impact on predators.
Cumulative effect	Effects that result from incremental changes caused by other present or reasonably foreseeable actions together with the Proposed Development (European Commission 1999). Generally considered to be the same effect but from different projects e.g. underwater noise from two separate projects combining to affect marine mammals.
Positive / Beneficial effect	An effect that is considered to represent an improvement on the baseline condition or introduces a new desirable factor (IEEM 2010).
Negative / Adverse effect	An effect that is considered to represent an adverse change from the baseline condition or introduces a new undesirable factor (IEEM 2010).

4.8 Characterisation of the Receptor

The significance of an effect on a receptor or feature is characterised by the sensitivity, recoverability and importance of the receptor or feature as defined below. Characterisation of the receptor is achieved by balancing out these three considerations to determine the Receptor Value. The criteria used to determine the Receptor Value are presented in Table 4-5.

Sensitivity

- The sensitivity of the receptor relates to its sensitivity/vulnerability to change (including its capacity to accommodate change i.e the tolerance/intolerance of the receptor to change).

Recoverability

- The ability of the receptor to return to the baseline state before the Proposed Development caused the change.

Importance

- The importance of the receptor or feature is a measure of the value assigned to that receptor based on biodiversity and ecosystem services, social value and economic value. Importance of the receptor is also defined within a geographical context, whether it is important internationally, nationally or locally important.

Table 4-5 Criteria for characterising the sensitivity or value or the receptor (Receptor Value)

Receptor Value	Definition		
High	**Receptor has little or no ability to absorb change without fundamentally altering its character. For example:**		
	Physical	**Biological**	**Human**
	One or more combinations of: ▪ Receptor has low/no capacity to return to baseline condition within Project life, e.g. low tolerance to change and low recoverability such as a physical feature formed over a geological time scale. ▪ The receptor is a designated feature of a protected site, or is rare or unique.	One or more combinations of: ▪ Receptor has low tolerance to change, e.g. the species population is likely to be killed or destroyed by the Proposed Development activity (MarLin 2016). ▪ Recovery to baseline conditions over a very long period, i.e. > 10 years or not at all (MarLin 2010). ▪ The receptor is a designating feature of an International protected site, e.g. European site. ▪ Receptor is very rare/unique/or ecologically important.	One or more combinations of: ▪ Receptor has low/no capacity to return to baseline, e.g. low tolerance to change and low recoverability such as loss of access with no alternatives. ▪ Damage to asset(s), e.g. at cable crossing, resulting in major financial consequences for the company. ▪ Receptor is economically valuable.
Medium	**Receptor has moderate capacity to absorb change without significantly altering its character; however some damage to the receptor will occur. For example:**		
	Physical	**Biological**	**Human**
	One or more combinations of: ▪ Receptor has intermediate tolerance to change. ▪ Medium capacity to return to baseline condition, e.g. >5 of up to 10 years. ▪ The receptor is valued but not protected.	One or more combinations of: ▪ Receptor has intermediate tolerance to change, e.g. some individuals of the species may be killed/destroyed by the Proposed Development activity and the viability of a species population may be reduced (MarLIN 2016). ▪ Recovery to baseline conditions over a long period, i.e. > 5 or up to 10 years (MarLIN 2010). ▪ The receptor is designated as a national site, e.g. Site of Special Scientific Interest, Nature Reserve, Marine Conservation Zone. ▪ Uncommon or moderately valuable economically or ecologically but not rare or unique.	One or more combinations of: ▪ Receptor has intermediate tolerance to change, e.g. loss of access but acceptable alternatives, alteration to route but with no significant economic consequences. ▪ Damage to asset(s), e.g. at cable crossings, resulting in financial consequences for the company.

Receptor Value	Definition		
Low	**The receptor is tolerant to change without significant detriment to its character. Some minor damage to the receptor may occur. For example**:		
	Physical	**Biological**	**Human**
	One or more combinations of: ▪ Receptor has high tolerance to change, e.g. disturbance to unconsolidated seabed sediments or sandwaves. ▪ High capacity to return to baseline condition, e.g. within 1 year or up to 5 years. ▪ The receptor is common and/or widespread.	One or more combinations of: ▪ Receptor has high tolerance to change, e.g. the species population will not be killed/destroyed by the Proposed Development activity. However, the viability of a species population will be reduced. ▪ Recovery to baseline conditions is expected in a short period of time, i.e. within 1 year or up to 5 years (MarLIN 2010). ▪ The receptor is neither rare, unique or of significance in terms of economic or ecological value.	One or more combinations of: ▪ May affect behaviour but is not a nuisance to users. ▪ Minor/no financial consequence to the company.
Negligible	**The receptor is tolerant to change with no effect on its character.** The Proposed Development activity does not have a detectable effect on survival or viability of a species (MarLIN 2016). The habitat or species is expected to recover rapidly, i.e. within a week (MarLIN 2010).		

4.9 Characterisation of the Change and Effect

To fully characterise an effect or level of change from baseline conditions the following parameters are considered. These parameters are used to define the magnitude of effect (Magnitude Value) based on the definitions provided in Table 4-6.

Scale of Change	• The scale of change refers to the degree of change to or from the baseline environment caused by the pressure being described.
Spatial extent	• The extent of an impact is the full area over which the impact occurs.
Duration & Frequency	• The duration is the period within which the impact is expected to last prior to recovery or replacement of the feature. Frequency refers to how often the impact will occur.

Table 4-6 Factors which determine the Magnitude Value of an effect

Magnitude Value	Definition
High	Effects are of medium (7 -15 years) through to permeant duration and/or on a regional level or major alteration to key elements / features of the baseline condition such that post development character / composition of baseline will be fundamentally changed.
Medium	Effects are of short-term (1-7 years) duration and/or local level change (greater than the project footprint) or alteration to one or more key elements/features of the baseline conditions such that post development character/composition of the baseline condition will be materially changed.
Low	Effects are temporary (<1 year) or Short-term (1-7 years) in duration, site specific and/or minor shift away from baseline conditions. Changes arising from the alteration will be detectable but not material; the underlying character /composition of the baseline condition will be similar to the pre-development situation.
Negligible	Very little change from baseline conditions. Effect is momentary or brief (<less than a day) and/or barely distinguishable, approximating to a “no change” situation.

4.10 Evaluation of Significance of Effect

Having established the magnitude of change (Magnitude Value) and the sensitivity of the receptor (Receptor Value), the significance of the effect is assessed using the significance matrix adapted from the SNH (2013) Handbook on EIA, as presented in Table 4-7.

Table 4-7 Significance matrix

		Magnitude Value			
		Negligible	**Low**	**Medium**	**High**
Sensitivity of receptor (Receptor Value)	**High**	Negligible	Moderate	Major	Major
	Medium	Negligible	Minor	Moderate	Major
	Low	Negligible	Negligible	Minor	Moderate
	Negligible	Negligible	Negligible	Negligible	Minor

The result of using this matrix approach is the assignment of the level of significance of the effect for all potential pressures of the Proposed Development. This is undertaken prior to any mitigation. Project Specific Mitigation will generally only be proposed if effects are considered significant.

Definitions of the significance levels are provided in Table 4-8 below.

Table 4-8 Definitions of significance levels

Significance	Definition
Negligible	An effect capable of measurement which causes noticeable changes in the character of the environment but without effecting its sensitivities. Generally considered as insignificant.
Minor	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends. Effects are generally considered as Not Significant and adequately controlled by best practice and legal controls. Opportunities to reduce effects further through mitigation may be limited and are unlikely to be cost effective.
Moderate	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment. Generally considered as Significant but effects are those, considered to be tolerable. However, it is expected that the residual effect has been subject to feasible and cost-effective mitigation and has been reduced to as low as reasonably practicable (ALARP) and that no further measures are feasible.
Major	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment or obliterates the sensitive characteristics. Generally regarded as unacceptable prior to any mitigation measures being considered.

4.11 Identification of Mitigation Measures

Mitigation measures are the actions or systems proposed to manage or reduce the potential negative effects that are identified. Mitigation measures are sometimes confused with measures taken to ensure legal compliance, which can be similar. Legislation is often designed to ensure effects to the environment are minimised.

A standard hierarchical approach to identifying mitigation requirements has been used to inform the assessment:

- Avoid or Prevent: In the first instance, mitigation should seek to avoid or prevent the adverse effect at source for example, by routeing the marine cables away from a sensitive receptor.

- Reduce: If the effect is unavoidable, mitigation measures should be implemented which seek to reduce the significance of the effect.
- Offset: If the effect can neither be avoided nor reduced, mitigation should seek to offset the effect through the implementation of compensatory mitigation.

Mitigation measures fall into two categories: mitigation which forms part of the design of the Proposed Development, which is referred to as "Embedded Mitigation"; and mitigation which is part of the construction and operation of the Proposed Development, which is referred to as Project Specific Mitigation.

4.11.1 Embedded Mitigation

The Proposed Development has been developed through an iterative process which involved seeking to avoid or reduce potential environmental effects through routeing of the marine cables. This is the first project-specific step in mitigating potential effects by seeking to avoid or reduce environmental sensitivities.

In addition, embedded mitigation measures form part of the design of the Proposed Development. The project description also includes the measures taken to ensure compliance with international and national law and regulations, which also seek to avoid or abate negative effects.

4.11.2 Project Specific Mitigation

Mitigation measures which are to be adopted and implemented during the construction and operation of the Proposed Development to mitigate adverse effects, over and above the Embedded Mitigation, are called Project Specific Mitigation.

Appropriate, feasible and cost-effective mitigation measures have been proposed as necessary in each topic Chapter. All Project Specific Mitigation commitments are additionally listed in the Schedule of Mitigation provided as Chapter 15.

4.11.3 Mitigation Schedule

The package of Embedded Mitigation and Project Specific Mitigation measures to be incorporated into the design, installation, operation and decommissioning of the submarine cables are set out in Chapter 15. The mitigation schedule will form the basis of an Environmental Management Plan (EMP) to be implemented in the installation and operation of the marine cables.

4.12 Determination of the Significance of Residual Effects

The significance assessment is repeated taking into consideration the application of Project Specific Mitigation. This determines whether there is likely to be a residual effect. When applied after mitigation, the resulting significance level is referred to as the residual effect. Tables within the topic chapters present the results of the assessments before and after the application of Project Specific Mitigation.

Residual effects assessed as Significant after consideration of Project Specific Mitigation will normally require additional analysis in order to determine how to further mitigate effects where possible. Where further mitigation is not possible a residual effect may remain.

4.13 Cumulative Effects Assessment (CEA)

The term "cumulative effects" refers to the effects upon receptors arising from the Proposed Development when considered alongside other present or reasonably foreseeable projects, plans or licensed activities that may have an additive effect with any element of the Proposed Development. Cumulative effects can be described as the net effect of cumulative pressures, which includes both

direct and indirect effects resulting from cumulative pressures caused by different activities. An individual effect alone may be considered insignificant, but the additive effects of more than one effect, from any number of sources, could result in a significant effect, either positive or negative.

CEA is not required for pressures where it is concluded that the Proposed Development will have a significant effect (as Project Specific Mitigation will already have been proposed); instead it focuses on pressures for which the assessment has concluded that there is a minor residual effect and assesses whether other plans or projects in the region would increase the likelihood of a significant effect occurring. If a cumulative effect is identified, Project Specific Mitigation is proposed. The CEA method has been informed by guidance provided in the "MMO Strategic Framework for Scoping Effects" (MMO 2014) but has been adapted to account for the volume of proposed projects in the Thames Estuary region.

The CEA is presented in Chapter 14.

Intra-project effects (effects between different components of GridLink) are discussed in the relevant topic chapters and are summarised in Chapter 14.

4.14 Transboundary Effects

The Convention on Environmental Impact Assessment in a Transboundary Context 1991 sets out the obligations of parties to assess the transboundary environmental effect of certain activities. It also lays down the general obligations of States to notify and consult each other on all major projects under consideration that are likely to have a significant adverse environmental effect across national boundaries.

GridLink crosses two maritime jurisdictions (UK and France) and an environmental assessment has been conducted for each jurisdiction. This enables the transboundary effects and cumulative impacts of the activities in both jurisdictions to be assessed.

The assessment of transboundary effects is presented as part of the CEA in Chapter 14.

REFERENCES

1 The Chartered Institute of Ecology and Environmental Management (CIEEM) (2010). Guidelines for Ecological Impact Assessment in Britain and Ireland: Marine and Coastal.

2 The Institute of Environmental Management and Assessment (IEMA) (2004). Guidelines for Environmental Impact Assessment. Lincoln, p154.

3 IEMA (2016). Environmental Impact Assessment Guide to: Delivering Quality Development

4 Intertek (2018) GridLink Interconnector: Scoping Report for a Marine Environmental Appraisal. P2114_R4993_Rev2. 16 August 2018

5 Intertek (2019) GridLink Interconnector: Scoping Report for a Marine Environmental Appraisal – September 2019 Update. P2172_R4493_Rev3. 13 September 2019.

6 Marine Management Organisation (MMO) (2014). A Strategic Framework for Scoping Cumulative Effects. A report produced for the Marine Management Organisation, pp 224. MMO Project No: 1055. ISBN: 978-1-909452-34-3

7 MarLin (1999-2010). Sensitivity assessment methodology. [Online] Available at: http://www.marlin.ac.uk/species/MarLIN-sensitivity-methods (Accessed April 2016).

8 MarLin (2016). Species intolerance. [Online] Available at: http://www.marlin.ac.uk/glossary/intoleranceranking (Accessed April 2016).

9 Scottish Natural Heritage (SNH) (2013). A handbook on environmental impact assessment: Guidance for Competent Authorities, Consultees and others involved in the Environmental Impact Assessment (EIA) Process in Scotland. [Online] Available at: https://www.nature.scot/handbook-environmental-impact-assessment-guidance-competent-authorities-consultees-and-others (Accessed December 2019)

5. PHYSICAL ENVIRONMENT

This Chapter describes the existing baseline environment in terms of the physical conditions and marine processes, identifies the pressures associated with the Proposed Development on the receptors, presents the findings of the environmental assessment, and describes how significant effects (if any) will be mitigated.

5.1 Data Sources

The Applicant commissioned geophysical and geotechnical surveys to inform the baseline description and assessment. These have been supplemented where necessary by a review of published information, consultation with relevant bodies and modelling. The data sources used to inform the baseline description and assessment include, but are not limited to the following:

- Technical Appendix C - Sediment Suspension Calculations Technical Note (Intertek 2020);
- Technical Appendix O - GridLink Cable Route Survey – Integrated Geophysical and Geotechnical Report (MMT 2020a);
- Technical Appendix P - GridLink Cable Route Survey – Nearshore Environmental Report (MMT 2019);
- Technical Appendix Q - GridLink Cable Route Survey – Offshore Environmental Report (MMT 2020b);
- Gridlink Nearshore Geophysical Survey Report (MMT 2020c);
- Gridlink Offshore Geophysical Survey Report (MMT 2020d); and
- Medway Estuary and Swale Shoreline Management Plan 2010.

Other data sources are listed at the end of the Chapter.

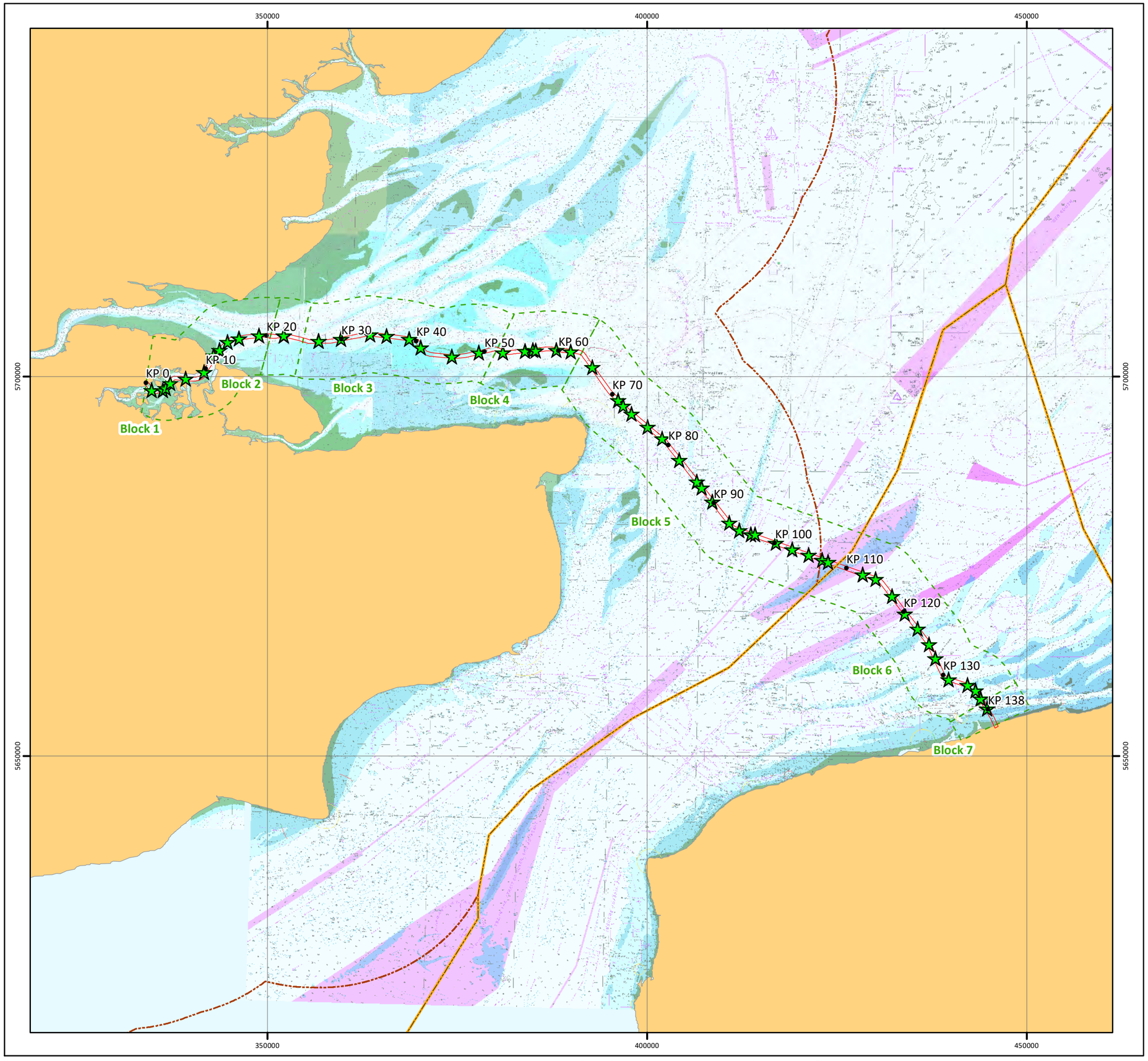
5.1.1 GridLink cable route survey

Surveys of the Asset Placement Corridor were carried out between June and October 2019 by MMT to inform cable route design and the environmental assessment.

Geophysical, geotechnical and benthic survey techniques were used to:

- Characterise the seabed and sub-seabed up to a depth of approximately 15-20m with respect to bathymetry, shallow geological and seabed features, and sediment characteristics (e.g. sediment type, sediment particle size and sediment chemistry);
- Identify obstructions and debris on the seabed e.g. magnetic targets, potential infrastructure crossings;
- Understand burial conditions e.g. types, depths and strength of seabed sediments; trenching resistance;
- Characterise the benthic community; and
- Determine the presence of any features that may have conservation significance.

The Asset Placement Corridor was divided into seven blocks with Block 01 being the closest inshore at Kingsnorth and Blocks 6 and 7 in French waters. The end of Block 5 / start of Block 6 boundary corresponds with the UK/France EEZ boundary. Blocks and sampling stations are shown in Figure 5-1 (Drawing P2172-SURV-001-A).



GRIDLINK INTERCONECTOR

SURVEY INFORMATION

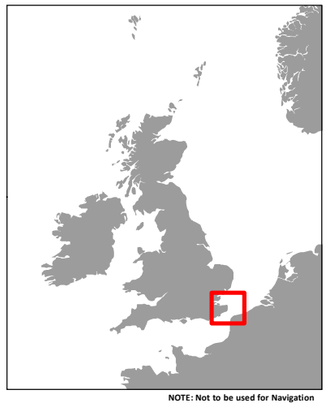
Environmental Survey Locations

Drawing No: P2172-SURV-001	A

Legend

- KP
- Asset Placement Corridor
- Grab Sample Location
- 12nm Territorial Sea Limit
- EEZ Boundary
- Survey Blocks

N W E S



NOTE: Not to be used for Navigation

Date	16 June 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	MarineRegions; UKHO; EuropaTech; GEBCO; ESRI; MMT;
File Reference	J:\Gridlink\P2172_Mxd\11_SURV\ P2172-SURV-001.mxd
Created By	Chris Dawe
Reviewed By	Emma Langley
Approved By	Nick Archibald

GRIDLINK INTERCONNECTOR

intertek

0 10 20 30 km

The scope of surveys comprised:

- Onshore/intertidal topographic survey; using an unmanned autonomous vehicle (UAV);
- Geophysical/hydrographic nearshore and offshore data acquisition;
- Geotechnical investigations;
- Environmental sampling and imagery;
- Infrastructure crossing survey with remotely operated vehicle (ROV);
- Geotechnical boreholes to inform the feasibility of horizontal directional drilling (HDD); and
- Onshore reflection and refraction survey.

These operations in the nearshore and offshore provide high-resolution and accurate measurements of the bathymetry, seabed features and shallow geological conditions within the Asset Placement Corridor.

The nearshore geophysical and geotechnical survey equipment comprised of a rigid pole mounted multi-beam echosounder (MBES) and sub-bottom profiler (SBP) system; towed side-scan sonar (SSS); a remotely operated towed vehicle (ROTV) with six magnetometers; drop down high definition (HD) camera; cone penetrometer (CPT); and a vibrocorer.

The offshore geophysical and geotechnical survey equipment comprised of a hull mounted MBES; SSS, SBP and magnetometer mounted on a ROTV; drop down HD camera; cone penetrometer; and a vibrocorer.

The TSS pipe tracker system mounted on an ROV was used for the third-party asset crossing surveys.

Data was acquired along survey lines to create a 500m wide corridor generally centred on an earlier version of the Preferred Cable Route. The survey corridor was narrower or wider in places to accommodate known constraints. Data quality is described in Table 5-1.

Table 5-1 Survey data quality

Block	Technique	Quality	Comment
Onshore survey	UAV	Good	Met project requirements
UK Nearshore (Block 1, 2 & 3)	MBES	Good	Full coverage of the required survey corridor throughout.
	SSS	Good	Considered fit for purpose.
	SBP	Good	Showed good performance, however some areas of acoustic blanking caused by diffuse or shallow gas limited penetration.
	Magnetometer	Good	Local areas of heightened magnetic background were observed in Block 01 due to outcropping gravelly sand in combination with ripples or megaripples.
UK Offshore (Blocks 4 & 5)	MBES	Good	Full coverage of the required survey corridor was achieved.
	SSS	Good	Strong currents on occasion led to some crabbing motion in the ROTV and occasional heave in the data, however full survey coverage was achieved with no compromise on the ability to interpret the data.
	SBP	Fit for purpose	Multiples of seabed and surface reflection sometimes limited the visibility of sub-bottom horizons especially in sandbank areas.
	Magnetometer	Good	No significant variation in magnetic background was observed, considered fit for purpose.

Source: MMT (2020c, d)

To acquire data on sediment properties 107 vibrocores (plus 33 reattempts); 110 nearshore CPTs (with 21 reattempts); and grab samples at 52 stations were undertaken within the Asset Placement Corridor.

Grab samples were taken with either a Hamon grab (HG) or a Dual Van Veen grab (DVV) with selection dependent on sediment type. A minimum of three replicate grab samples were retrieved for infaunal analysis and a fourth at sites where chemical data was required.

5.1.2 Topographic survey

The onshore survey consisted of topographic, seismic refraction and magnetic survey in addition to trial pits and boreholes. The topographical surveys were conducted by 4D-Ocean with UAV. In addition, Terradat performed seismic refraction and multichannel analysis of surface waves (MASW) techniques to provide detailed information to assist with the characterisation of the superficial sediments at the Converter Station site. MMT also performed a magnetic survey, primarily to ensure safe siting of the borehole and trial pit locations.

5.2 Consultation

Table 5-2 summarises the relevant consultation responses on physical conditions and marine processes.

Table 5-2 Consultation responses - physical conditions and marine processes

Stakeholder	Summary of Consultation Response	How Response has been Addressed
Marine Management Organisation (MMO)	The MMO supported the statements in the Scoping Report (SR) that pre-sweeping requirements will be minimised by avoiding sand waves where possible, and if material is removed by dredging it should be deposited in close vicinity to the location to ensure that there is no net change to the volume of sediment within the system.	The cable route has avoided sandwaves wherever possible. If the use of a trail-suction hopper dredger is required, spoil will be deposited within the Application Area.
MMO	The MMO agree that information on scour around third party infrastructure (to be attained as part of the baseline study) should be used for the assessment.	The effects of seabed scour have been assessed in Section 5.6.4.
MMO	The MMO request that the Environmental Report must consider the worst-case scenario for pre-sweeping i.e. that there could be significant effects on hydrodynamics and sediment transport processes resulting from this activity.	Detailed cable surveys and routing studies have now been undertaken. In relation to pre-sweeping, a worst case width of 63m has been assumed alongside a worst case pre-sweeping method of dredging and is assessed in Section 5.6.2.
MMO	The Environmental Report must determine the wave climate along the length of the cable route, as this is likely to vary considerably.	The wave climate along the route has been discussed in Section 5.3.2.
MMO	The Environmental Report must detail how the dimensions and lengths of cable protection measures (rock armouring and mattresses) will be minimised to reduce effects on hydrodynamic and sedimentary regimes. The Environmental Report must detail the post-installation surveys proposed that will provide assurances that the cables have reached target burial depths and that backfilling of the trenches has been adequate.	Details on the dimensions and lengths of cable protection measures have been provided in Chapter 3 and have formed the basis of the assessment in Section 5.6.4. The potential for scour at crossing locations has been a serious consideration during design and embedded mitigation (Section 5.5) lists measures taken during design to reduce the effects of scour. In addition, Project Specific Mitigation (Section 5.7) has been proposed to

Stakeholder	Summary of Consultation Response	How Response has been Addressed
		further reduce the significance of effects.
MMO	In the Medway Estuary, sediments are likely to be less mobile than in the Outer Thames and Southern North Sea. It is therefore less likely that natural hydrodynamic processes would bury the cable if backfilling was not undertaken. The Environmental Report must clarify how long-term changes in seabed levels due to trenching will be minimised.	This comment is addressed in Section 5.6.2.
MMO	The Environmental Report must specify the locations, volumes and dimensions of cable protection measures likely to be required, presenting a worst-case scenario if specific design details are yet to be determined. It must also estimate whether any remedial works are likely to be undertaken where the required burial depths are not achieved and assess potential impacts accordingly.	Details on the dimensions and lengths of cable protection measures have been provided in Chapter 3: Project Description. The Cable Risk Burial Assessment has estimated the requirement for remedial works and burial depths.
MMO	The possible mobilisation of sediments in the intertidal and subtidal areas must also be considered, and the risk of contaminants being released into the marine environment.	The risk of contaminants being released into the marine environment has been assessed in Technical Appendix G – WFD Assessment.
MMO	The potential for suspended sediment plumes and subsequent sediment deposition as a result of trenching operations must be assessed.	Technical Appendix C provides calculations showing the maximum extent of sediment deposition from cable burial. This has been used to inform the assessment presented in Section 5.6.3.
MMO	The MMO advise the assessment of an alternative methodology e.g. trenching in the event that HDD is not possible.	Trenching is not being considered as a viable alternative and has not been assessed. Section 3.7.6.3 provides justification for this decision.
MMO	The MMO would expect that water quality be considered as part of the WFD Assessment, including consideration of sediment quality in the areas to be disturbed, which can affect water quality via the mobilisation of contaminated sediment.	This comment has been addressed in Technical Appendix G – WFD Assessment

5.3 Existing Baseline

This section has been divided into the following topics:

- Wind;
- Waves;
- Tides and currents;
- Temperature and salinity;
- Bathymetry, underlying geology and superficial sediments;
- Coastal and marine processes
- Water quality; and
- Sediment quality.

The baseline description is provided to characterise the environment of the Proposed Development and to enable the identification of areas that may be geologically and/or bathymetrically sensitive to pressures from cable installation, operation and decommissioning. Where relevant and available, information has been presented corresponding to survey blocks outlined within the UK Nearshore and UK Offshore Geophysical Survey Reports (MMT 2020c, d). To provide spatial context, the description

refers to Kilometre Points (KPs) along the Preferred Cable Route; KP0 relates to the start of the cable route at the converter station site at Kingsnorth; and KP108.8 relates to the UK/France EEZ boundary.

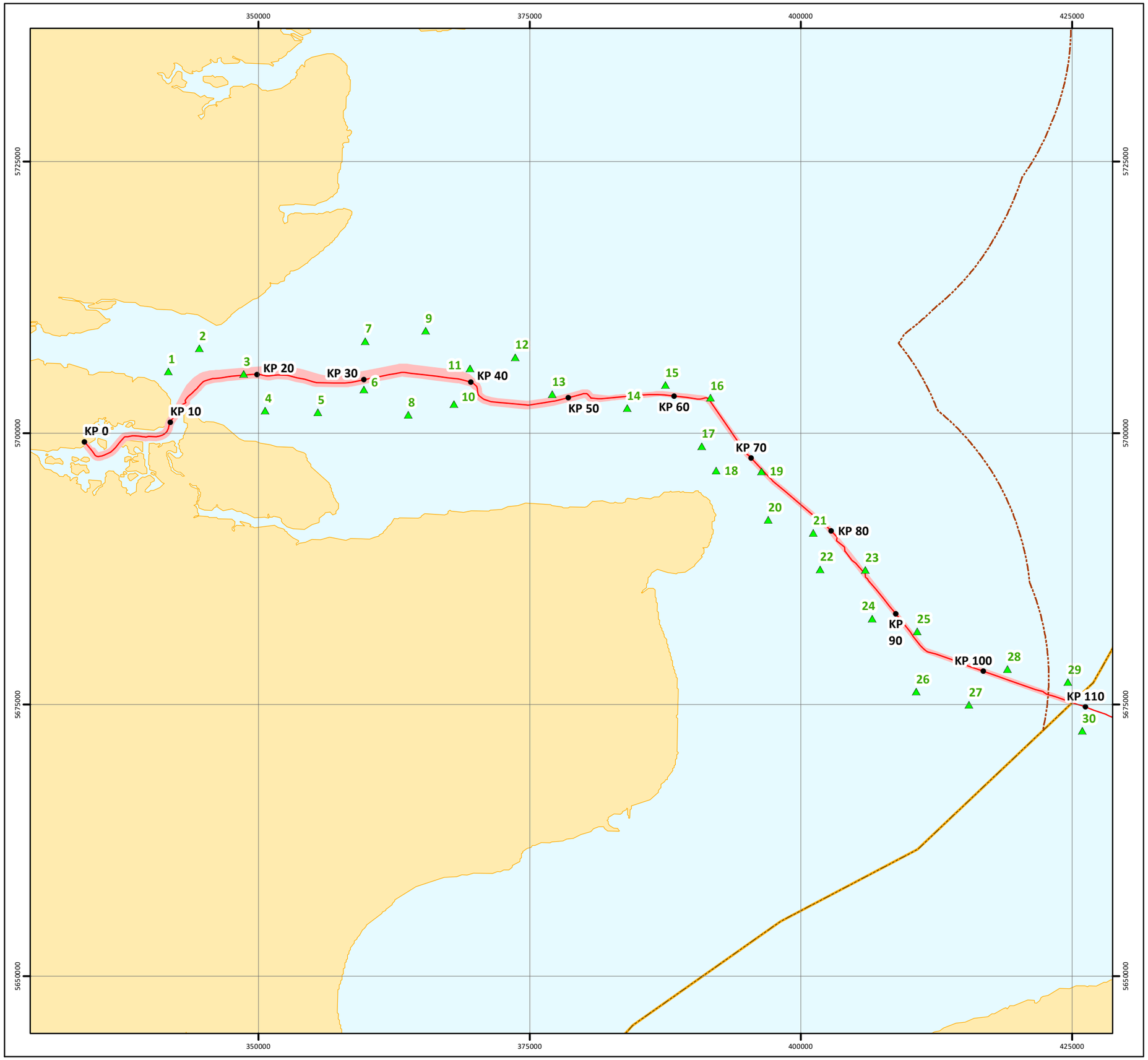
5.3.1 Wind

Winds in the Southern North Sea are generally from a south and north westerly direction, however in spring, the frequency of winds from the north and east increases (DECC[1] 2016a). Wind strengths are on average 1-11m/s in the summer with a larger proportion of strong to gale force winds reaching 7-12m/s in winter (UKHO 2013 cited within DECC 2016a). During January, 20% of winds are likely to exceed 14m/s, which reduces to 2-4% in July with easterly winds being uncommon but can bring extremely cold weather in winter (DECC 2016a). Table 5-3 shows the mean wind speed and prevailing wind direction collected along the entire Proposed Development from the Seastates Metocean Information Service (ABP Mer 2020); data points are illustrated in Figure 5-2 (Drawing P2172-PHY-004). As mentioned above, Table 5-3 confirms that the prevailing wind direction is from the south west across the entire Proposed Development with mean wind speeds ranging from 0 – 7.1m/s but generally increasing in an upwards trend from the Thames Estuary to KP108.

Table 5-3 Wind environment along the Proposed Development

ID	Lat	Long	Mean Wind Speed (m/s)	Prevailing Wind Direction	ID	Lat	Long	Mean Wind Speed (m/s)	Prevailing Wind Direction
2	51.50	0.76	5.2	SW	17	51.43	1.43	7	SW
3	51.48	0.82	5.2	SW	18	51.41	1.45	7	SW
4	51.45	0.85	5.2	SW	19	51.41	1.51	7	SW
5	51.45	0.92	5.5	SW	20	51.37	1.52	7	SW
6	51.47	0.98	5.5	SW	21	51.36	1.58	7.1	SW
7	51.51	0.98	5.4	SW	22	51.33	1.59	7.1	SW
8	51.45	1.04	5.8	SW	23	51.33	1.65	7.1	SW
9	51.52	1.06	5.8	SW	24	51.29	1.66	6.9	SW
10	51.46	1.10	5.8	SW	25	51.28	1.72	7	SW
11	51.49	1.12	5.8	SW	26	51.23	1.72	6.8	SW
12	51.50	1.18	6.2	SW	27	51.22	1.79	6.8	SW
13	51.47	1.23	6.2	SW	28	51.25	1.84	7	SW
14	51.46	1.33	6.7	SW	29	51.24	1.92	7	SW
15	51.48	1.38	6.7	SW	30	51.20	1.94	6.8	SW
16	51.47	1.44	7.1	SW					

[1] Department of Energy & Climate Change



GRIDLINK INTERCONNECTOR

PHYSICAL PROCESSES

SeaStates Data Locations

Drawing No: P2172-PHY-004	A

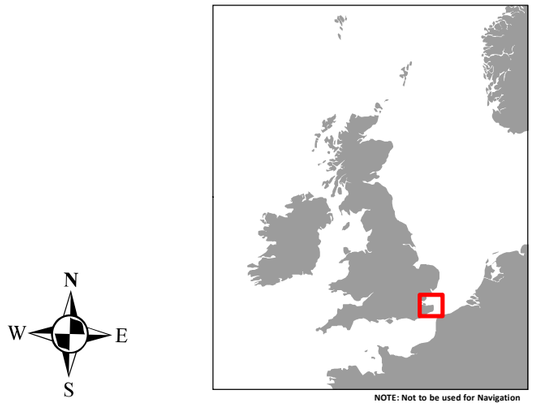
Legend

- KP
- GridLink Preferred Cable Route
- Application Corridor
- SeaStates Data Location
- 12nm Territorial Sea Limit
- EEZ Boundary

NOTE:

Locations for SeaStates Data are provided as the centre Latitude and Longitude of the model mesh elements

For more information plese visit https://www.seastates.net/explore-data/



NOTE: Not to be used for Navigation

Date	12 June 2020
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Projection	Transverse Mercator
Datum	WGS 1984
Data Source	UKHO; MarineRegions; UKRA; GEBCO; Esri; GridLink
File Reference	J:\Gridlink\P2172_Mxd\14_PHY\ P2172-PHY-004.mxd
Created By	Chris Dawe
Reviewed By	Emma Storey
Approved By	Nick Archibald

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5.3.2 Waves

Water motion within a wave follows a roughly circular trajectory, forward on a wave crest and backward on the following trough. These motions can extend to the seabed in relatively shallow water (up to several tens of metres) and can mobilise seabed sediment.

The Medway Estuary is relatively protected from North Sea waves due to the configuration of sandbanks and the narrow mouth of the estuary. The wave climate within the Medway Estuary is therefore dominated by internally generated wind waves and due to fetch limitations, local wind generated waves inside the Medway Estuary are small and will only develop during high-water conditions (Mott MacDonald 2018). It is reported that wave heights in the Medway Estuary are usually less than 1m in height and extreme waves do not exceed 2m.

Outside of the Medway Estuary, information relating to the wave environment has been collected on the Seastates Metocean Information Service (ABP Mer 2020) and is presented in Table 5-4 below; data points are illustrated in Figure 5-2 (Drawing P2172-PHY-004). Table 5-4 shows that the dominant wave direction varies along the Proposed Development, primarily propagating from the north east between KP20 and KP80 and shifting to propagating from the south west between KP85 and KP108. The north easterly dominant wave direction is attributed to large fetch lengths in the same direction within the North Sea and the south-westerly winds and wave propagation from the English Channel through the Strait of Dover (Vattenfall 2018). The mean wave height along the Proposed Development varies from 0.3m to 1.1m but has a generally increasing trend from the Thames Estuary towards KP 108.

Table 5-4 Wave environment along the Proposed Development

ID	Lat	Long	Mean Wave Height (m)	Prevailing Wave Direction	ID	Lat	Long	Mean Wave Height (m)	Prevailing Wave Direction
1	51.48	0.72	0.3	SW	16	51.47	1.44	0.7	NE, W
2	51.5	0.76	0.3	E	17	51.43	1.43	0.6	NE
3	51.48	0.82	0.4	SW	18	51.41	1.45	0.6	NE
4	51.45	0.85	0.3	NE	19	51.41	1.51	0.8	S, NE
5	51.45	0.92	0.4	NE	20	51.37	1.52	0.7	S, NE
6	51.47	0.98	0.4	NE	21	51.36	1.58	0.9	S
7	51.45	1.04	0.4	W	22	51.33	1.59	0.9	S, NE
8	51.51	0.98	0.5	NE, SW	23	51.33	1.65	0.9	SW, NE
9	51.46	1.1	0.5	NE, SW, W	24	51.29	1.66	0.9	SW
10	51.46	1.33	0.6	NE, W	25	51.28	1.72	1.0	SW
11	51.52	1.06	0.6	SW, NE	26	51.23	1.72	1.0	SW
12	51.49	1.12	0.5	W, NE, SW	27	51.22	1.79	1.0	SW
13	51.5	1.18	0.5	W, NE, SW	28	51.25	1.84	1.1	SW
14	51.47	1.23	0.5	W	29	51.24	1.92	1.1	SW
15	51.48	1.38	0.7	NE, W	30	51.2	1.94	1.1	SW

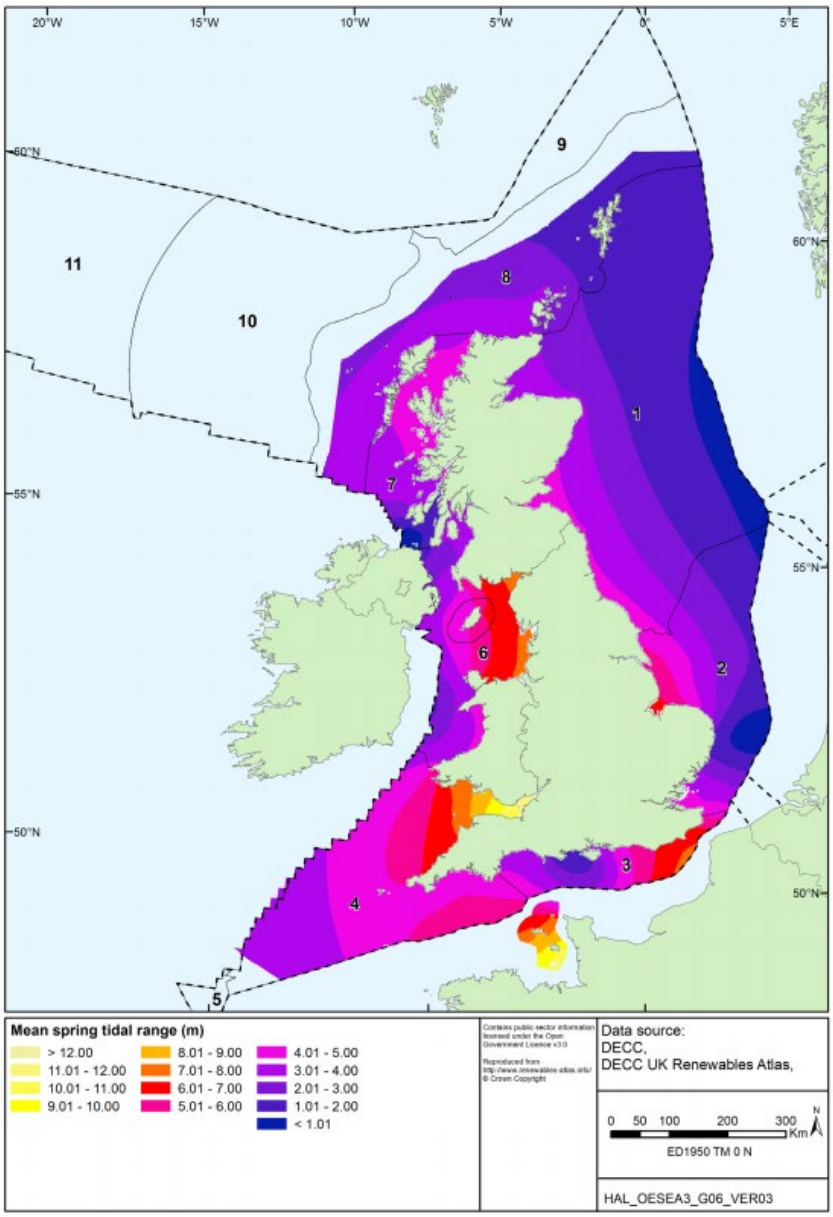
Mean significant wave heights for the sheltered central and southern North Sea, English Channel and inshore waters are low, generally <1.5m. The maximum significant wave height recorded at the Goodwin Sands between 2008-2014 was 2.37 – 3.69m, with the monthly average for 2014 ranging from 0.46m in June and September to 1.17m in February (DECC 2016a).

5.3.3 Tides and currents

All points along the Proposed Development are subject to changes in water depth and currents in response to the tidal cycle. Changes in response to meteorological forcing (e.g. surges in response to pressure variations over the North Sea) are superimposed on tidal variations. In addition to these short-term changes, which do not influence long term mean sea level relative to the coast, there are long term variations in sea level as a result of climate change and geological influences. According to the TE2100 5-year review sea levels in the Thames Estuary rose at a rate of 4.5mm per year between 1999 and 2014 and is predicted to rise between 20 – 90cm by 2100 (Environment Agency 2016).

In the Southern North Sea, the tidal wave propagates in an anti- clockwise direction around an amphidromic point off the Netherlands coast. Tidal range increases with distance away from this point, reaching a maximum in the English Channel and in the Thames Estuary. As Figure 5-3 shows, mean spring tidal range along the offshore sections of the Proposed Development, range from 4.01 – 5.00m between KP20 to KP90 and from 5.01 – 6.00m from KP90 onwards (DECC 2016b).

Figure 5-3 Mean spring tidal range around the UK (DECC 2016)



The Medway Estuary is a macro tidal estuary with a complex arrangement of tidal channels which drain around large islands and peninsulas with large areas of mudflat. Hydrodynamic conditions in the Medway Estuary are heavily influenced by tidal conditions with a spring tidal range of 5.2m at Sheerness decreasing to 5.1m at Rochester. There are differences in the dimensions of the sub-tidal and intertidal areas in the Medway Estuary due to variations in the propagation of the tidal wave through the Medway Estuary. In the outer and inner areas of the Medway Estuary, the ebb tide is dominant with a shorter duration and higher velocity, whereas in the middle the flood tide is more dominant. The tidal asymmetry affects the tidal flows recorded in the Medway Estuary. In the outer channel, peak ebb velocities reach 0.9 m/s, while flood velocities reach 0.4 m/s. In the middle section, maximum flood tidal velocities of 0.95 m/s and ebb velocities of 0.55 m/s are recorded, whereas within the inner channel velocities of 0.6 m/s and 0.4 m/s were recorded for ebb and flood tidal flows respectively. The mouth of the River Medway joins the open coast between high land on the Isle of Grain on the mainland and Sheerness, located at the north-western extent of the Isle of Sheppey. Due to its location, there are interactions between open sea and estuarine processes. The constrained ebb dominant channel is bordered by narrow and steep mudflats (Halcrow Group 2010). Further in the Medway Estuary near Kingsnorth Power Station, the flood tide is more dominant and as a result large areas of saltmarsh have prospered between Colemouth Creek and Kingsnorth Power Station.

Table 5-5 presents current velocities for seven points along the Proposed Development. The average ebb and flood tidal current has been derived separately, from the model extraction of a mean spring tide over two full semi-diurnal tidal cycles. Data has been extracted from Intertek's North Sea and Channel Modelling System (NSCMS). The NSCMS is a hydrodynamic and water quality model which has been validated against the Foundation for Water Research guidelines and accepted as fit-for-purpose for its original intended use (Bathing Water impact assessments) by the Environment Agency.

Table 5-5 Current velocities along the Proposed Development

Point	KP	Reason for selection	Average / Peak speeds (m/s)
1	11	▪ Representative location at mouth of Medway Estuary. ▪ Environmental concerns regarding presence of shellfish beds.	0.92 / 1.33
2	15	▪ Representative location within Thames Estuary. ▪ Environmental concerns regarding presence of shellfish beds.	0.62 / 0.85
3	30	▪ Representative location within Thames Estuary. ▪ Environmental concerns regarding presence of shellfish beds.	0.69 / 1.02
4	52	▪ Crossing location with London Array export cables.	0.82 / 1.11
5	63	▪ Approximate position of amphidromic point (tidal node). ▪ Tidal strength in all directions of compass point anticipated to be similar.	0.67 / 0.84
6	77	▪ Crossing location with Thanet export cables.	0.91 / 1.27
7	90	▪ Representative location within Goodwin Sands Marine Conservation Zone (MCZ). ▪ Environmental concerns regarding presence of sensitive habitats.	0.98 / 1.54

5.3.3.2 Flooding

The low-lying coastal areas of the SNS, including the Thames and Medway Estuaries, are a high risk of flooding, with extensive coastal defences to prevent this occurring (Port of London Authority 2020). The primary event leading to potential flooding is if a positive storm surge coincides with a high tide. The incidence and magnitude of storm surges depends on weather patterns over the North Sea. Positive storm surges in the North Sea are created by low air pressure over the SNS combined with

strong northerly winds. The landfall at Kingsnorth is protected by an Environment Agency maintained flood defence.

5.3.4 Temperature and salinity

Data collected by Powergen UK between 1970 and 2014 shows the average sea temperature at Kingsnorth Power Station (landfall) varies between 6°C at its coldest in February and 20.5°C at its warmest in August (Centre for Environment, Fisheries and Aquaculture Science (Cefas) 2020a). Data collected further out in the Medway Estuary at Grain Power Station shows the average temperature ranging between a minimum of 5°C in February and maximum of 19.1 in August (Cefas 2020b). Average seawater temperatures for the southern North Sea have been shown to vary from roughly 7.5°C to 16.0°C (Morris *et al.* 2018).

Salinity in the Medway Estuary fluctuates due to the mixing of freshwater from the River Medway and tidal movement from the North Sea resulting in salinities ranging from 5 – 30. Data collected by Cefas on a linear ferry route between Harwich and Rotterdam in the North Sea from 1970 to 2014 shows the average salinity is relatively constant. Ferry route data was grouped and showed range of salinities from 34 in June at its lowest point and 34.70 in November at its highest point. This trend remains largely the same the further into the North Sea with the middle of the route being 34.75 in June and 35.01 in December and the end of the route being 37.70 in June and 34.40 in December (Cefas 2020c).

5.3.5 Bathymetry, underlying geology and superficial sediments

5.3.5.1 Introduction

The following description provides a breakdown of bathymetry, seabed features, underlying geology and superficial sediments for specific sections of the Proposed Development, as presented in the survey reports. All depths are described relative to lowest astronomical tide (LAT).

The superficial seabed sediments along the Proposed Development generally comprise of clayey silt/silty sand, interrupted by areas of outcropping sub cropping of chalk bedrock, mainly in the offshore section of the cable route. The results of particle size analysis show that the sediment at the grab sample stations principally consists of fines (e.g. silt and clays) (2% to 76%) and sand (between 23% and 93%) with a generally low gravel content (0% to 50%). Further information, including Particle Size Analysis can be found within Technical Appendices O, P and Q.

5.3.5.2 KP0 to KP20.550

From the cable landfall onwards, the seabed undulates/ is generally rugged with a maximum slope of 28.4 degrees at KP0.079 and a maximum depth of 21.3m at KP12.369.

As shown in Figure 5-4 (Drawing P2172-BATH-002-A_Block_1), between KP0 and KP11, the Proposed Development follows the main channel of the River Medway where inflows from several side channels result in scour holes. The maximum depth in this section is 20.3m. Between KP9.5 and KP12.400 the Proposed Development extends parallel to the bottom edge of the slope of the deep-water basin of the Port of Sheerness, with a maximum depth of 21.3m. Steep slopes are present to the north of the Proposed Development in this area. At KP12.400 the Proposed Development crosses a shallow sandbank with a minimum depth of 1.5m. The sand bank extends until KP18 where the depth begins to increase to a depth of 15.6m due to a deep channel.

The underlying geology has a high variability due to the proximity of the Proposed Development to the banks of the Medway Estuary. Firm to stiff clay units are present within the upper 5m at the landfall and where the Proposed Development crosses the shoals associated with the Isle of Grain spit. On areas associated with the banks of the channel, sediment is typically >5m thick and consists of fines or fine to medium sand. As the Proposed Development crosses channels, coarse sand and gravel occurs within the upper 5m.

The superficial sediment predominantly comprises of silty and sand clays with a few areas of silty and gravelly sand (Figures 5-9 to 5-11, Drawing P2172-SURV-002_1, Drawing P2172-SURV-002_2 and Drawing P2172-SURV-002_3). Sandy areas are also located on and close to the sand banks. Clayey silt has been sampled in the very nearshore area close to the landfall.

5.3.5.3 KP20.550 to KP24.938

The seabed in this area is characterised by a deep channel crossing the Proposed Development, with a seabed morphology of ripples and hummocky seabed. The depth gradually increases from 15.7m at KP20.550 to the deepest point of 25.2m at KP22.684 (Figure 5-6, Drawing P2172-BATH-002-A_Block_2). Beyond this point, the depth steadily decreases to 17.9m at KP24.938. The maximum slope within this area is 8.3 degrees down.

The underlying geology in this section is relatively consistent where the Medway channel is crossed at a shallow angle. The geology primarily consists of silty fine sand/soft fines of 0.5 – 4m thickness overlying a coarse substrate of gravelly fine to coarse sand or sandy gravel. The superficial sediment comprises of silty sand through the entirety of this section (Figure 5-11, Drawing P2172-SURV-002_3).

5.3.5.4 KP24.938 to KP51.655

From KP24.938 the depth continues to shallow until KP25.700 where the Proposed Development begins to cross two shallow sand banks. The shallowest depth over the first sand bank is 6.3m at KP28.454. The sandbank does deepen between KP30.100 and KP30.918 to a maximum depth of 9.29m before shallowing until KP34.600. The sandbank ends at this point and the Proposed Development enters a shallow channel crossing the end of a sandbank at KP35.200 before returning to the shallow channel which continues until KP49.200. The shallowest depth over this sandbank is 1.9m at KP42.199. The depth begins to increase until KP51.655. Figure 5-6 (P2172-BATH-002-A_Block_3) provides an overview of the bathymetry along this section.

Between KP24.938 and KP37.4, along the shallow bank, there are thick successions of soft fines (clay and silt) and fine sand. On the approach to the shallow ridge from KP37.400 to KP40.600 is stiff clay, 2 – 4m thick, overlain by sift fines/sand. Between KP40.600 to KP50.738, stiff clay was intermittently detected. Where detected, it is generally >5m but proximal to KP47.274 it is 2m and at three other 1-2km sections it is 4-5m. Through this section, the upper unconsolidated sediments vary between soft/very soft fines and fine to medium sand. From KP50.738 to KP51.655 the shallow geology consists of silty fine to medium sand >5m thick.

Superficial deposits primarily comprise of silty sand or gravelly silty sand as illustrated in Figure 5-12 to Figure 5-15 (Drawings P2172-SURV-002_4, Drawing P2172-SURV-002_5, Drawing P2172-SURV-002_6 and Drawing P2172-SURV-002_7).

5.3.5.5 KP51.656 to KP62.942

The bathymetry shallows slightly at the beginning of this section reaching its shallowest point at 11m at KP51.374 and then continues in a generally deepening trend into the channel until it rises slightly over a small sandbank at it shallowest point at KP55.800 at 21.2m. From there the bathymetry increases in depth as the Proposed Development crosses the deepest section of the channel between KP56.237 and KP57.707 with the deepest point being 31.7m at KP56.731. The bathymetry then begins to decrease in depth until KP61.805. The maximum slope is this section is 9.1 degrees in an upward direction at KP61.374. Figure 5-7 (Drawing P2172-BATH-002-A_Block_4) presents the bathymetry along this section of the Proposed Development.

The beginning of this section comprises very loose silt sand or very loose gravelly silty sand as a top unit or a thin veneer overlying a stiff silty clay. Upon reaching the Queen's Channel the superficial sediments are dominated by very loose silt and silty clays moving towards very loose sand and very loose gravelly sand towards the end of the section. Superficial sediments overly units comprising firm

to stiff clay. Superficial deposits are illustrated in Figure 5-15 (Drawing P2172-SURV-002_7) and Figure 5-16 (Drawing P2172-SURV-002_8).

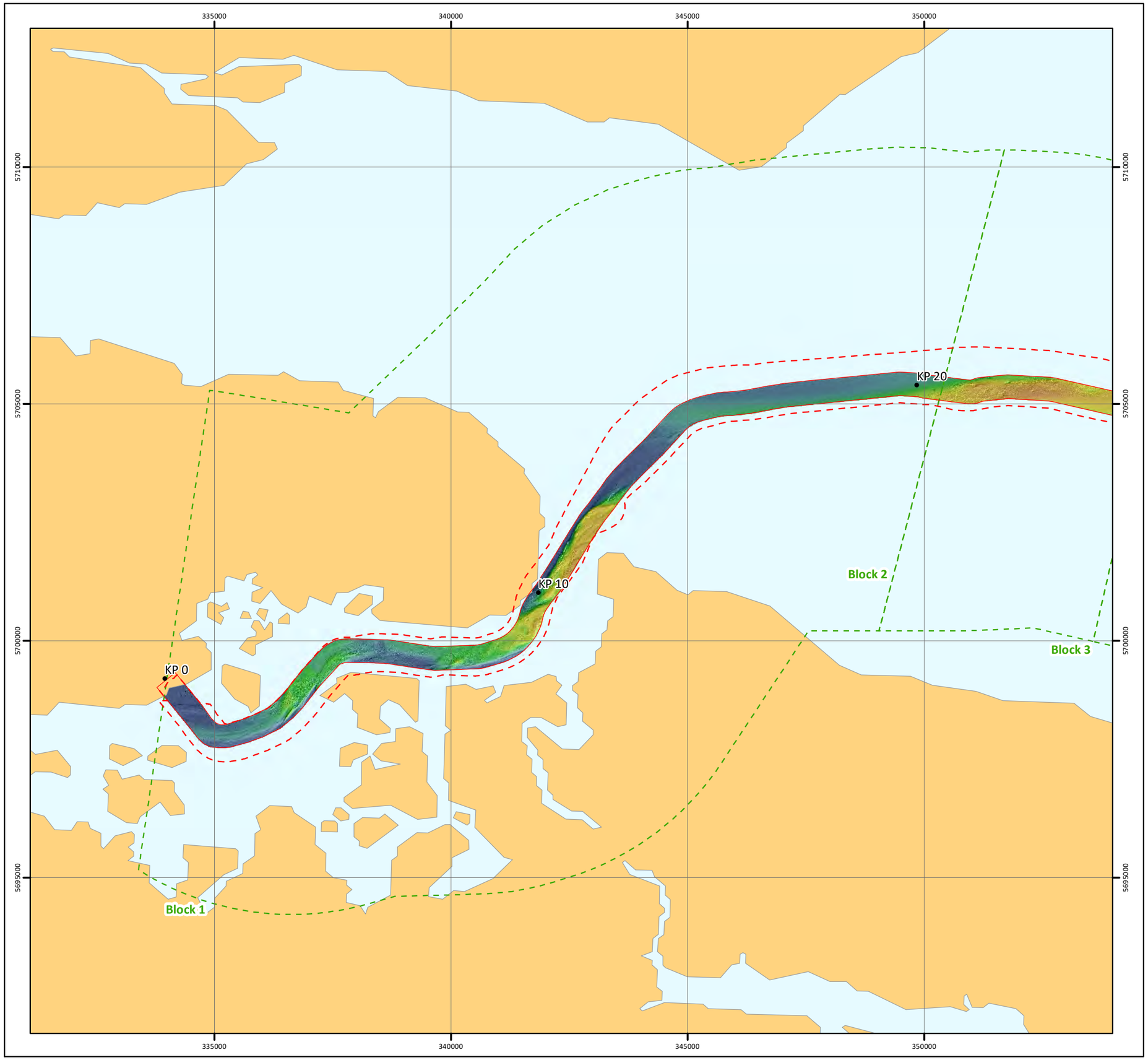
5.3.5.6 KP62.942 to KP108.8

The depth gradually increases between KP 61.805 and KP71.400 However, there is a solitary sandwave, with a crest 2.3m above the surrounding seabed and a maximum slope angle of 15.7° crossing the proposed route at KP 66.582. Between KP66.582, sandwaves cause undulations, on a generally deepening trend, which continues to KP86.058. The depth increases rapidly from 22.5m at KP86.056 to 52.2m at KP85.908 with a maximum slope of 7.2 degrees. Depths are constant until KP93.821 where the Proposed Development rises over a sandbank at KP93.821 with a shallowest point of 10.5m at KP94.540 and a maximum slope of 9.5 degrees at KP94.207. The Proposed Development crosses a small channel between KP98.850 and KP98.935 which has a maximum depth of 40.9m at KP98.896. An area of sandwaves are present between KP101.000 and KP103.270 and from KP105.164 to KP108.8. Bathymetry for this section is shown in Figure 5-8 (Drawing P2172-BATH-002-A_Block_5).

This section of the cable route is dominated by chalk close to the seabed surface. Chalk is present from KP66.800 to KP114.400 and between KP70 and KP112 the chalk subcrops and between KP88.100 and KP89.900 the chalk outcrops. There are limited Holocene sediments throughout this section apart from where the South Fall and Sandettie Sandbank intersect the Proposed Development. Superficial Holocene sediments here comprise of very loose to loose gravelly silty sand, sand gravel with sandbanks consisting of very loose to loose sand (Figure 5-17 to Figure 5-22; Drawings P2172-SURV-002_9, Drawing P2172-SURV-002_10, Drawing P2172-SURV-002_11, Drawing P2172-SURV-002_12, Drawing P2172-SURV-002_13, Drawing P2172-SURV-002_14). The sandbanks directly overlay chalk, with the chalk remaining relatively planar beneath the sandbanks.

5.3.5.7 Anthropogenic features

Various anthropogenic features on the seabed were identified within the Proposed Development. These included anchors, anchor chains, or buoyed anchors; infrastructure e.g. in-service and out-of-service cables; structures associated with Grain battery and Red Sand Sea Fort; debris; and 12 wrecks. Wrecks are discussed in more detail in Chapter 13.



GRIDLINK INTERCONECTOR

BATHYMETRY

Surveyed Bathymetry - Block 1

Drawing No: P2172-BATH-002	A

Legend

- KP
- Asset Placement Corridor
- Application Corridor
- Survey Blocks

Surveyed Bathymetry

Depth Below LAT (m)

High : -0.78

Low : -31.77

N W E S

NOTE: Not to be used for Navigation

Date	22 June 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	MarineRegions; GEBCO; ESRI; MMT;
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Created By	Chris Dawe
Reviewed By	Emma Langley
Approved By	Nick Archibald

GRIDLINK INTERCONNECTOR

intertek

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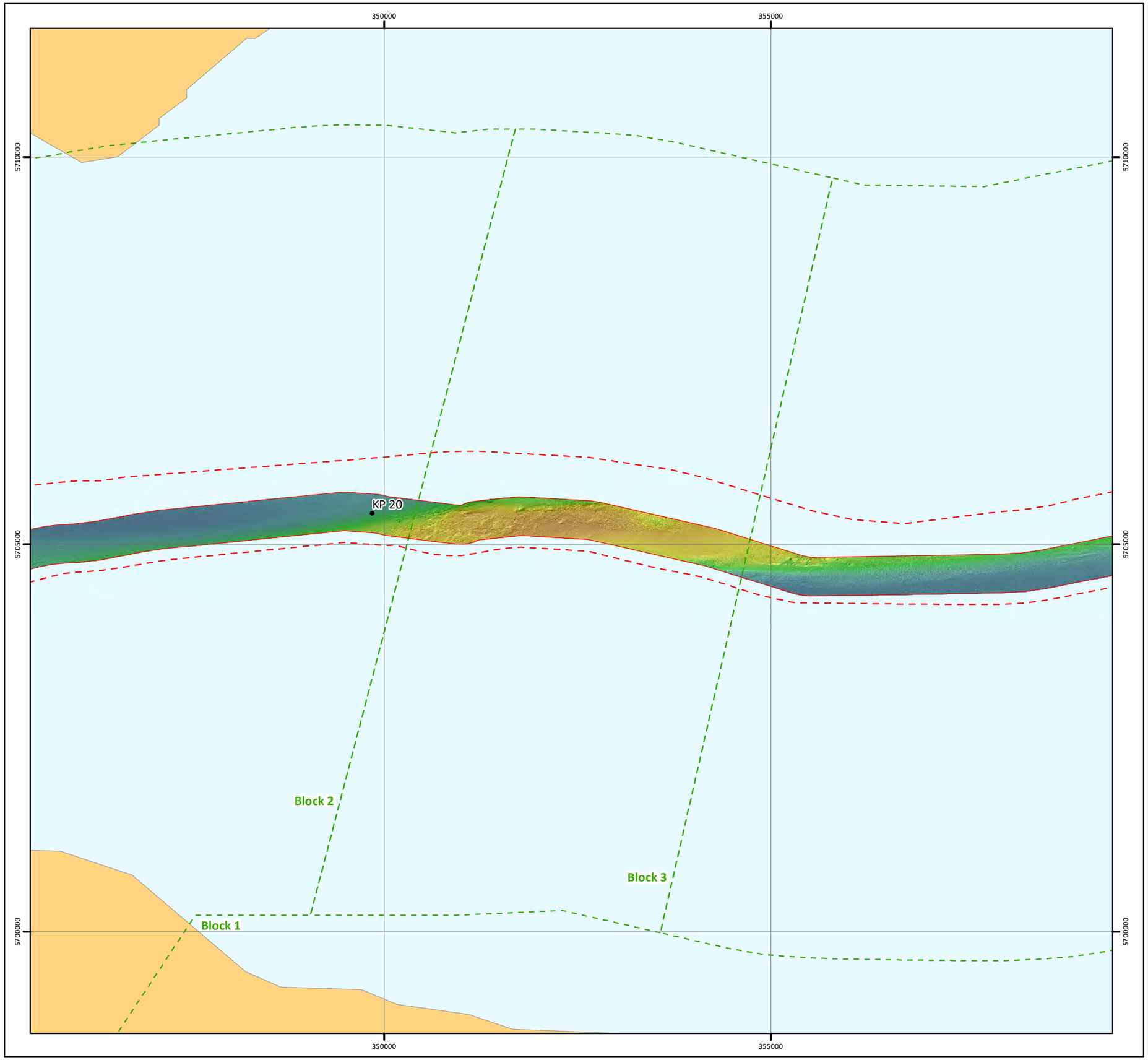

GRIDLINK INTERCONECTOR

BATHYMETRY

Surveyed Bathymetry - Block 2

Drawing No: P2172-BATH-002 | **A**

Legend

- KP
- Asset Placement Corridor
- Application Corridor
- Survey Blocks

Surveyed Bathymetry

Depth Below LAT (m)

High : -0.78

Low : -31.77

N W E S

NOTE: Not to be used for Navigation

Date	22 June 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
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Created By	Chris Dawe
Reviewed By	Emma Langley
Approved By	Nick Archibald

GRIDLINK INTERCONNECTOR

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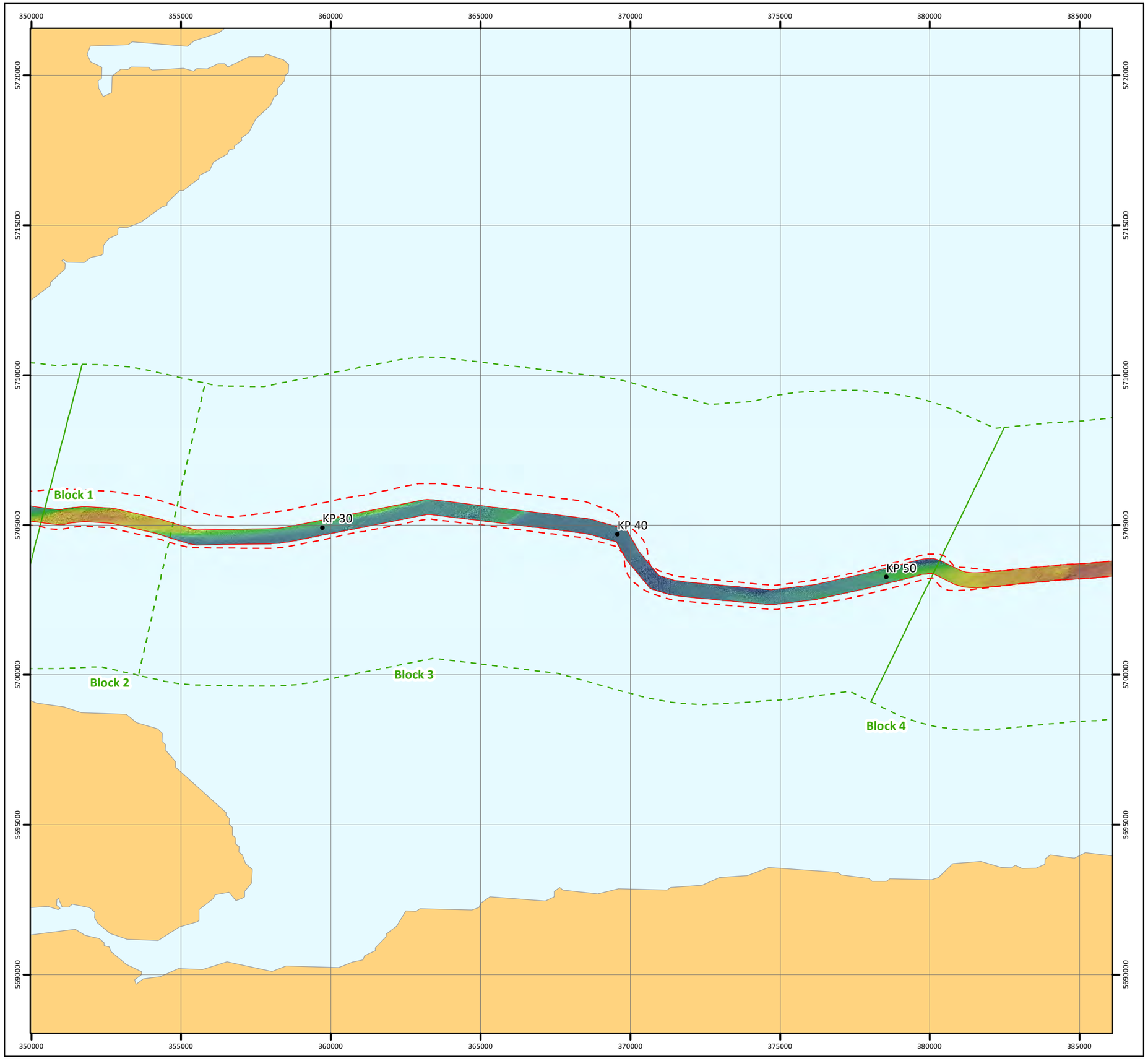

GRIDLINK INTERCONECTOR

BATHYMETRY

Surveyed Bathymetry - Block 3

Drawing No: P2172-BATH-002 | **A**

Legend

- KP
- Asset Placement Corridor
- Application Corridor
- Survey Blocks

Surveyed Bathymetry

Depth Below LAT (m)

High : -0.78

Low : -31.77

N
W E
S

NOTE: Not to be used for Navigation

Date	22 June 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	MarineRegions; GEBCO; ESRI; MMT;
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Created By	Chris Dawe
Reviewed By	Emma Langley
Approved By	Nick Archibald

GRIDLINK INTERCONNECTOR

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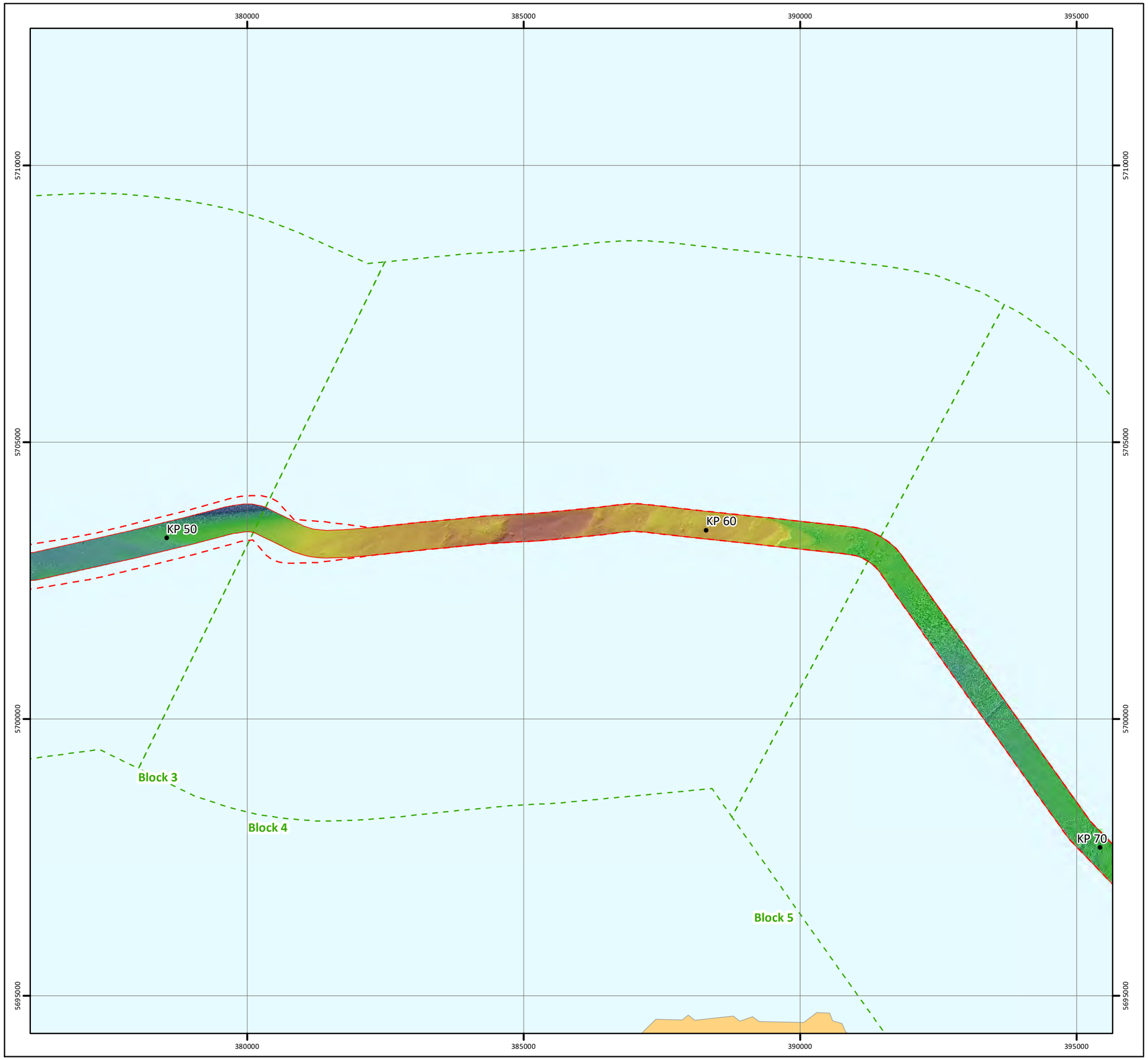

GRIDLINK INTERCONECTOR

BATHYMETRY

Surveyed Bathymetry - Block 4

Drawing No: P2172-BATH-002 | **A**

Legend

- KP
- Asset Placement Corridor
- Application Corridor
- Survey Blocks

Surveyed Bathymetry

Depth Below LAT (m)

High : -0.78

Low : -31.77

N W E S

NOTE: Not to be used for Navigation

Date	22 June 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
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Created By	Chris Dawe
Reviewed By	Emma Langley
Approved By	Nick Archibald

GRIDLINK INTERCONNECTOR

intertek

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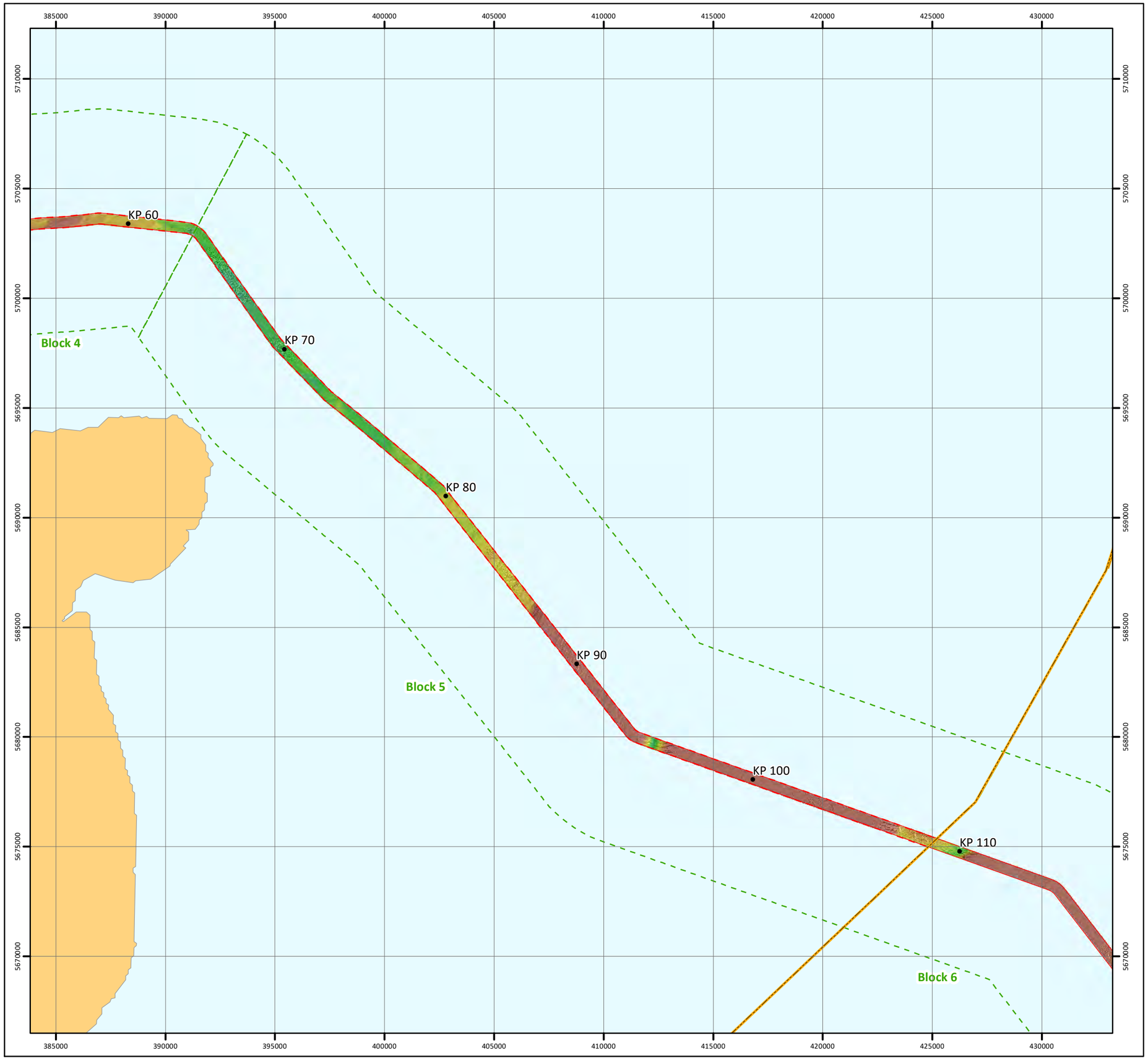

GRIDLINK INTERCONECTOR

BATHYMETRY

Surveyed Bathymetry - Block 5

Drawing No: P2172-BATH-002	A

Legend

- KP
- EEZ Boundary
- Asset Placement Corridor
- Application Corridor
- Survey Blocks

Surveyed Bathymetry

Depth Below LAT (m)

High : -0.78

Low : -31.77

N W E S

NOTE: Not to be used for Navigation

Date	22 June 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
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GRIDLINK INTERCONNECTOR

intertek

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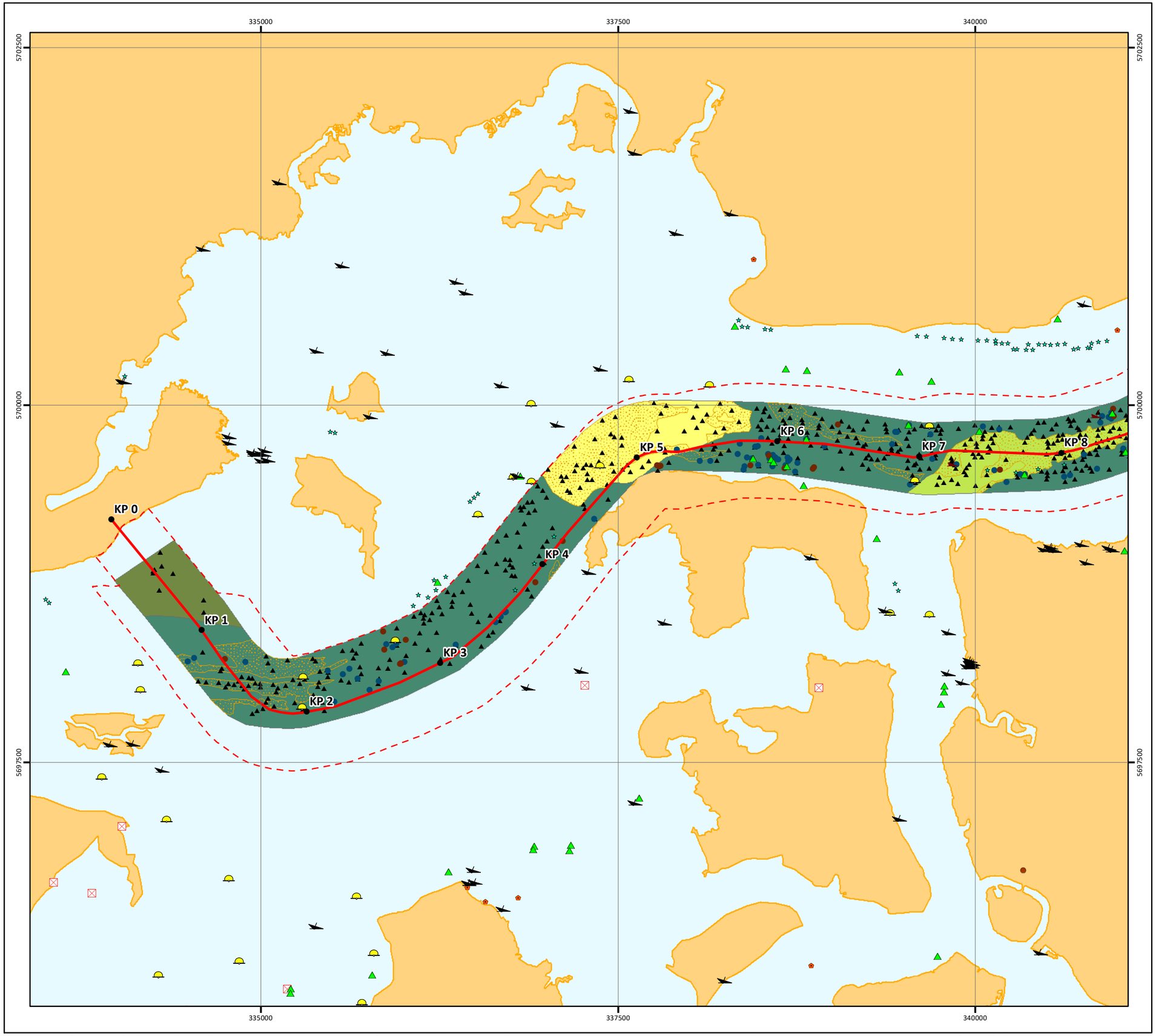

GRIDLINK INTERCONNECTOR

SURVEY INFORMATION

Geophysical Data: Cable Route & Seabed Features

Sheet 1 of 14

Drawing No: P2172-SURV-002_1	A

Legend

- KP
- GridLink Preferred Cable Route
- Application Corridor
- Obstruction
- Wreck
- Harbour Facility
- Pile/Post/Stake
- Turbine, Wind
- Beacon
- Buoy

Seabed Features

- Ripples

Seabed Sediments

- Clayey SILT
- CLAY
- Gravelly SAND
- SAND

Seafloor Contacts

- Anchor/Anchor Chain
- Boulder
- Debris
- Wreck
- Magnetic Anomaly

N W E S

NOTE: Not to be used for Navigation

Date	24 June 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
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Created By	Chris Dawe
Reviewed By	Emma Storey
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

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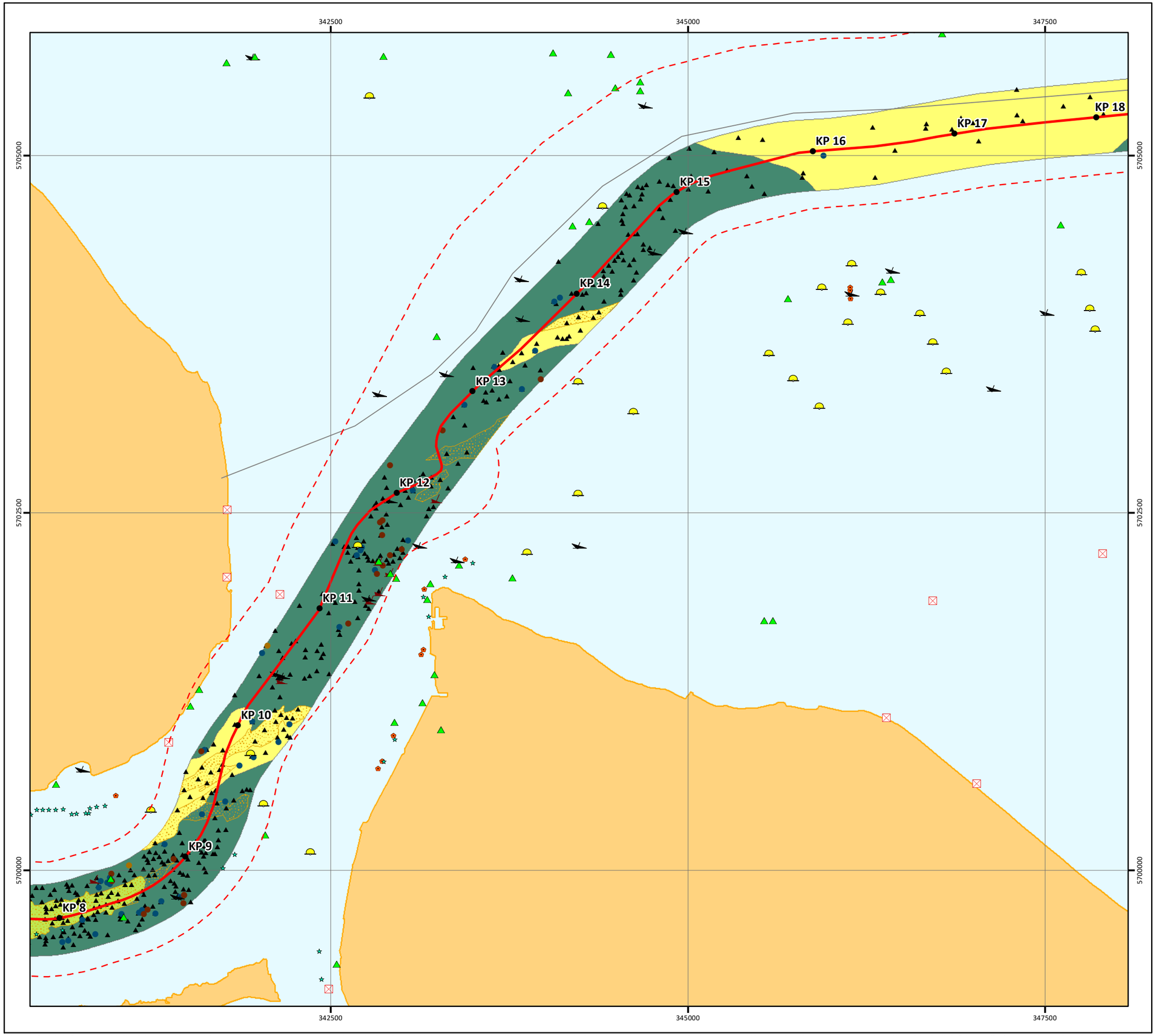


GRIDLINK INTERCONNECTOR

SURVEY INFORMATION

Geophysical Data: Cable Route & Seabed Features

Sheet 2 of 14

Drawing No: P2172-SURV-002_2	A

Legend

- KP
- GridLink Preferred Cable Route
- Application Corridor
- Power
- Obstruction
- Wreck
- Harbour Facility
- Pile/Post/Stake
- Beacon
- Buoy

Seabed Features

- Ripples

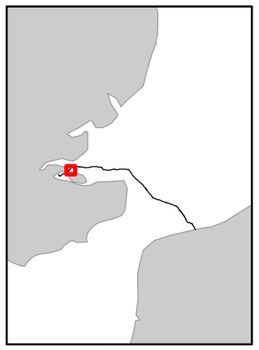
Seabed Sediments

- CLAY
- Gravelly SAND
- SAND

Seafloor Contacts

- Anchor/Anchor Chain
- Boulder
- Debris
- Wreck
- Magnetic Anomaly

N W E S



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Created By	Chris Dawe
Reviewed By	Emma Storey
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

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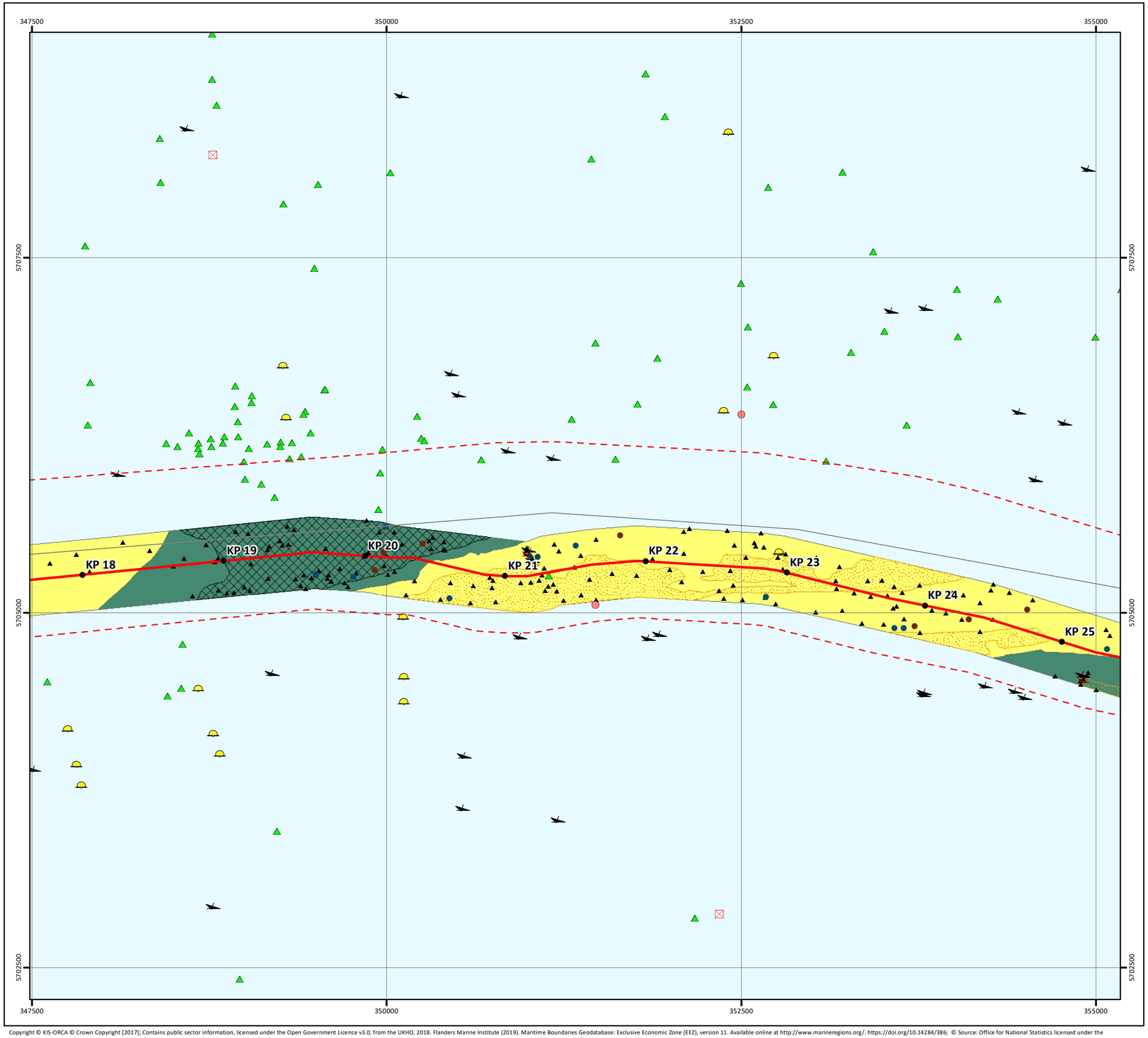


GRIDLINK INTERCONNECTOR

SURVEY INFORMATION

Geophysical Data: Cable Route & Seabed Features

Sheet 3 of 14

Drawing No: P2172-SURV-002_3	A

Legend

- KP
- GridLink Preferred Cable Route
- Application Corridor
- Power
- Obstruction
- Wreck
- Beacon
- Buoy
- Pilot Boarding Place

Seabed Features

- Ripples
- Trawl Mark Area

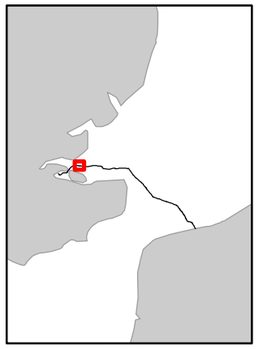
Seabed Sediments

- CLAY
- SAND

Seafloor Contacts

- Boulder
- Debris
- Wreck
- Magnetic Anomaly

N
W E
S



NOTE: Not to be used for Navigation

Date	24 June 2020
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Reviewed By	Emma Storey
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GRIDLINK INTERCONNECTOR

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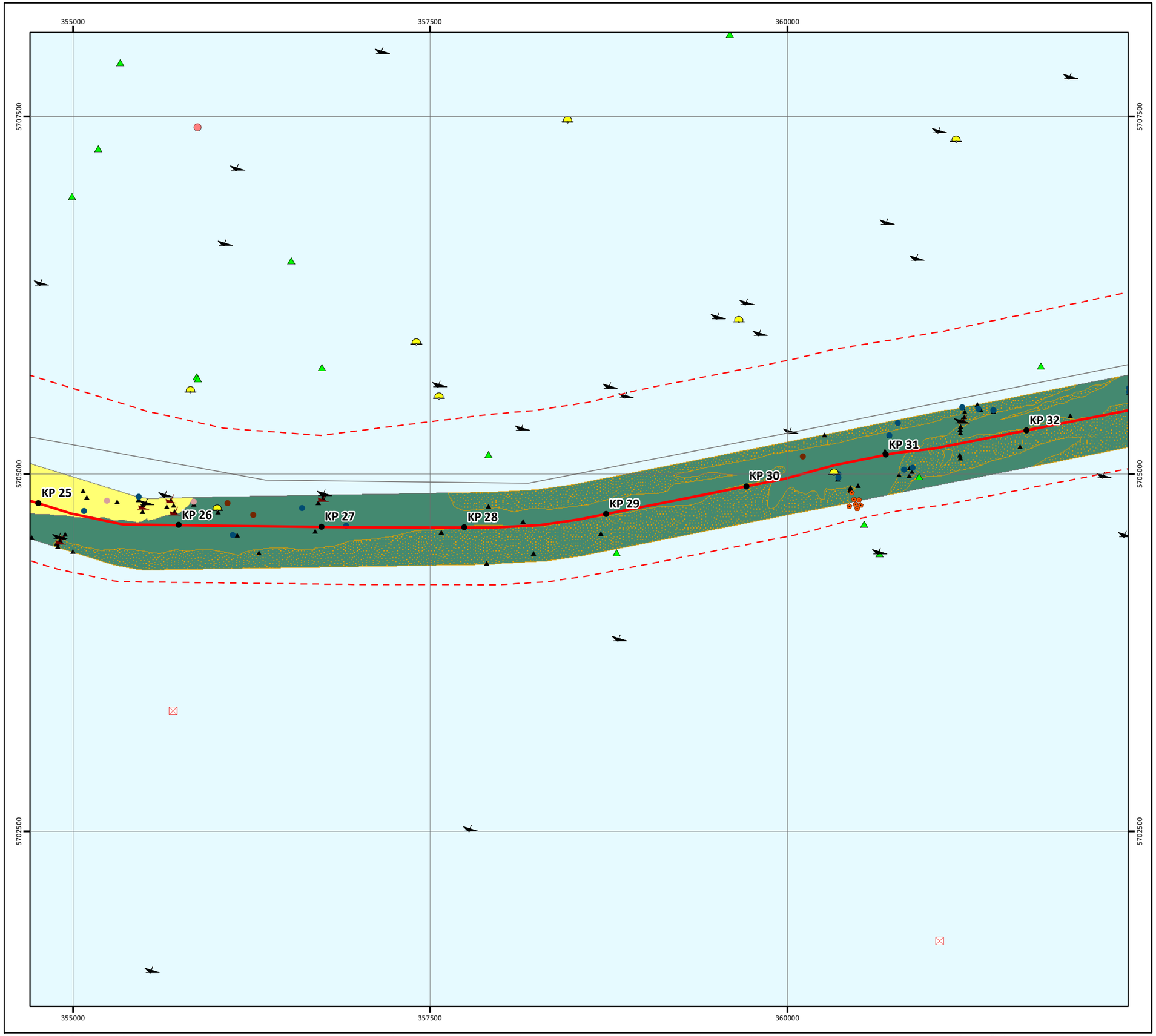


GRIDLINK INTERCONNECTOR

SURVEY INFORMATION

Geophysical Data: Cable Route & Seabed Features

Sheet 4 of 14

Drawing No: P2172-SURV-002_4 | **A**

Legend

- KP
- GridLink Preferred Cable Route
- Application Corridor
- Power
- Obstruction
- Wreck
- Pile/Post/Stake
- Beacon
- Buoy
- Pilot Boarding Place

Seabed Features

- Ripples

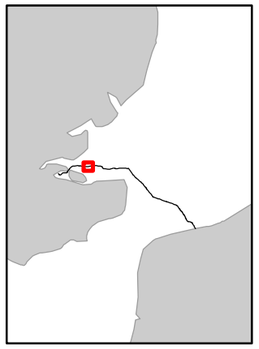
Seabed Sediments

- CLAY
- SAND

Seafloor Contacts

- Boulder
- Debris
- Mound
- Wreck
- Magnetic Anomaly

N W E S



NOTE: Not to be used for Navigation

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Created By	Chris Dawe
Reviewed By	Emma Storey
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

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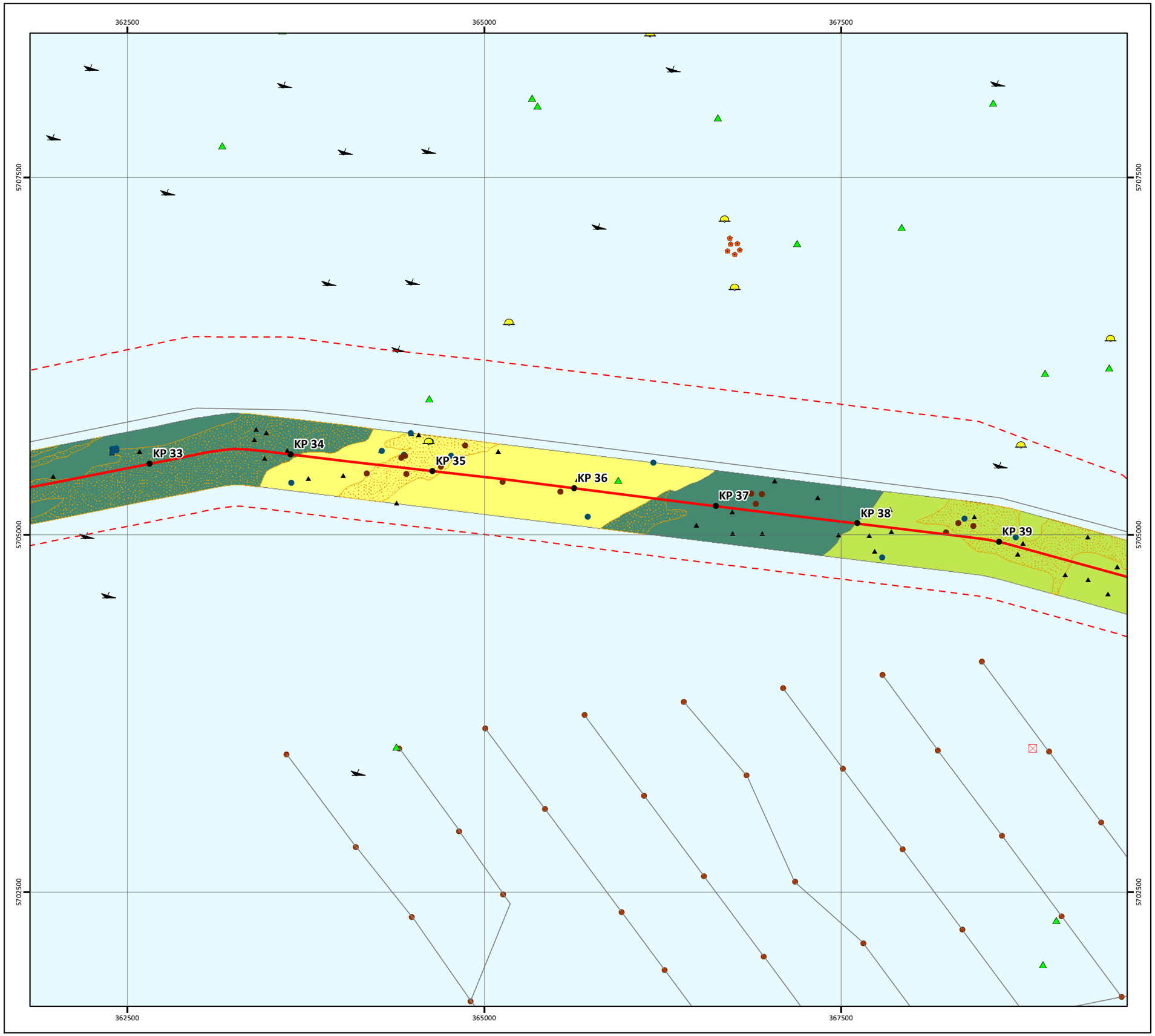


GRIDLINK INTERCONNECTOR

SURVEY INFORMATION

Geophysical Data: Cable Route & Seabed Features

Sheet 5 of 14

Drawing No: P2172-SURV-002_5	A

Legend

- KP
- GridLink Preferred Cable Route
- Application Corridor
- Power
- Obstruction
- Wreck
- Pile/Post/Stake
- Turbine, Wind
- Beacon
- Buoy

Seabed Features

- Ripples

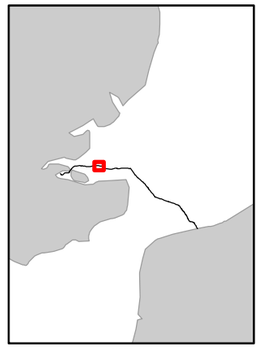
Seabed Sediments

- CLAY
- Gravelly SAND
- SAND

Seafloor Contacts

- Boulder
- Debris
- Magnetic Anomaly

N
W E
S



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Created By	Chris Dawe
Reviewed By	Emma Storey
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

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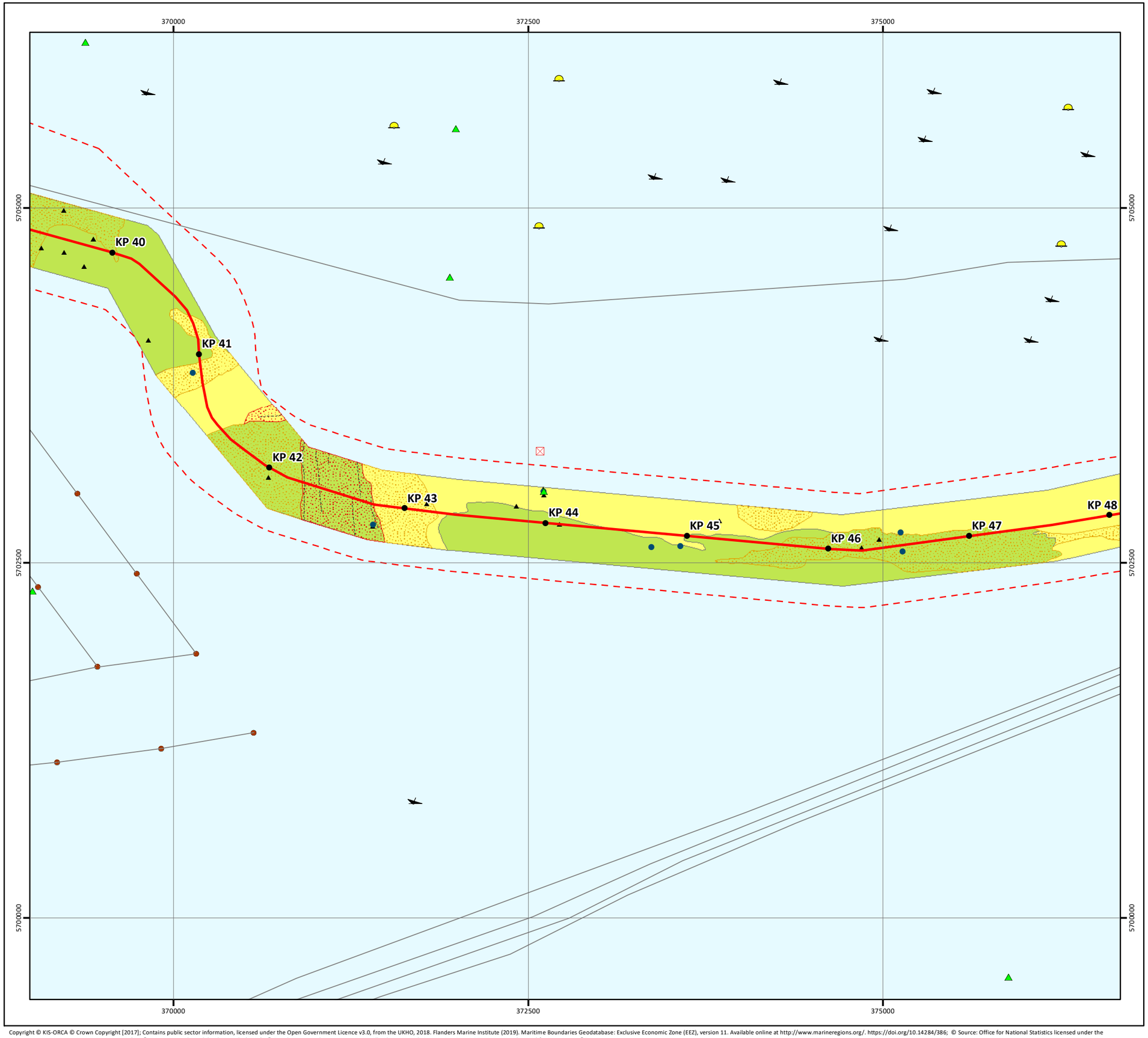


GRIDLINK INTERCONNECTOR

SURVEY INFORMATION

Geophysical Data: Cable Route & Seabed Features

Sheet 6 of 14

Drawing No: P2172-SURV-002_6	A

Legend

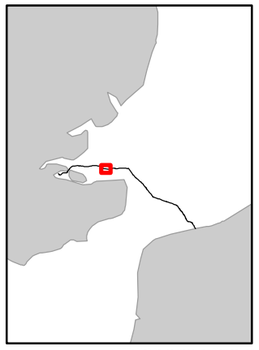
- KP
- GridLink Preferred Cable Route
- Application Corridor
- Power
- Obstruction
- Wreck
- Turbine, Wind
- Beacon
- Buoy

Seabed Features
- Ripples
- Sand Waves

Seabed Features
- Sandwave crest

Seabed Sediments
- Gravelly SAND
- SAND

Seafloor Contacts
- Debris
- Magnetic Anomaly



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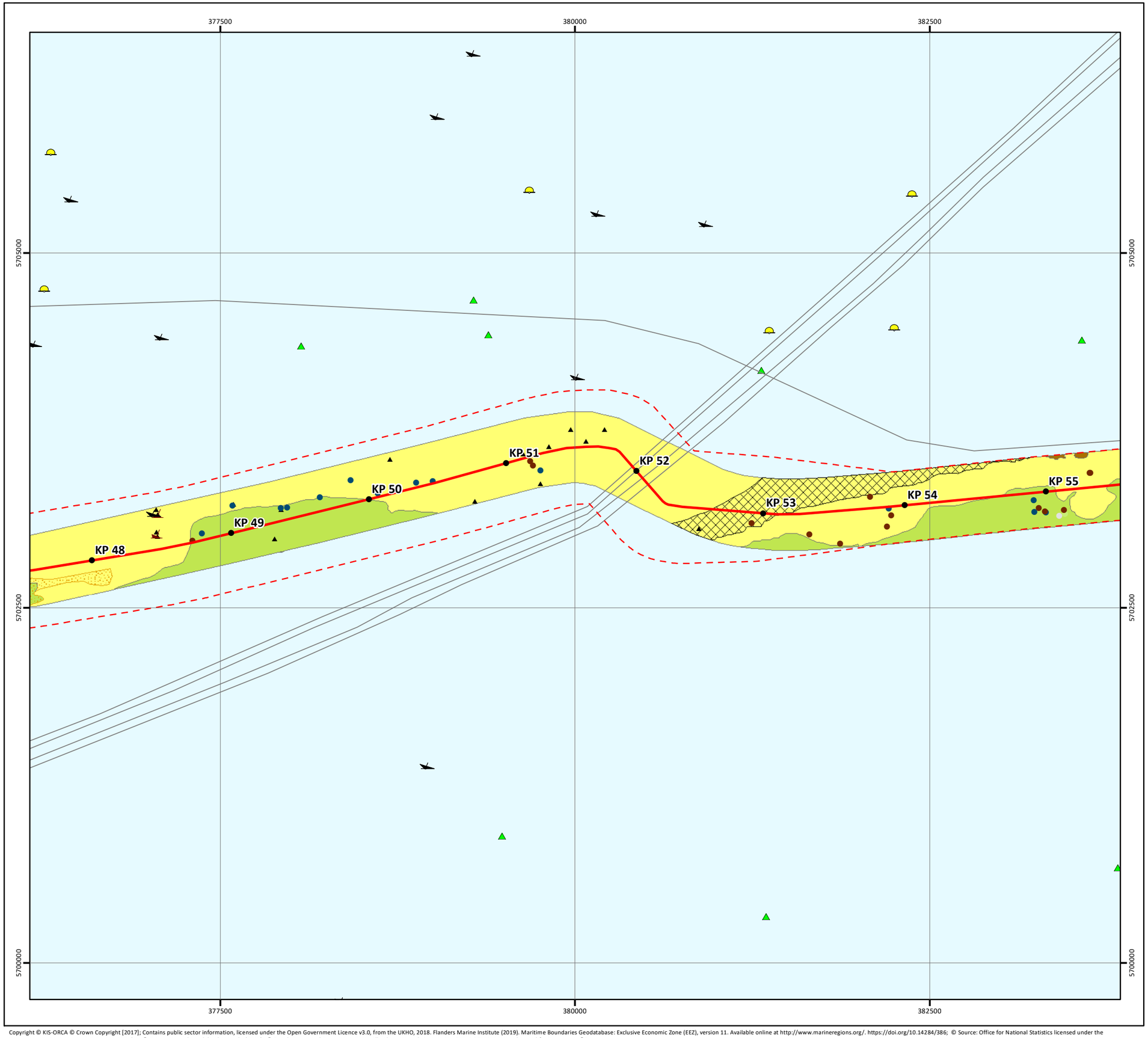
Created By	Chris Dawe
Reviewed By	Emma Storey
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

0 0.25 0.5 0.75 1 km



GRIDLINK INTERCONNECTOR

SURVEY INFORMATION

Geophysical Data: Cable Route & Seabed Features

Sheet 7 of 14

Drawing No: P2172-SURV-002_7 | **A**

Legend

- KP
- GridLink Preferred Cable Route
- Application Corridor
- Power
- Obstruction
- Wreck
- Buoy

Seabed Features

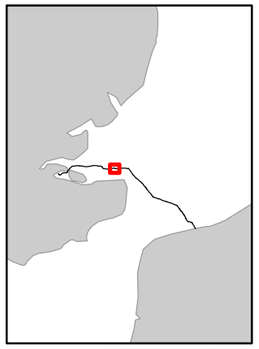
- Ripples
- Trawl Mark Area

Seabed Sediments

- SILT
- Gravelly SAND
- SAND

Seafloor Contacts

- Boulder
- Debris
- Other
- Wire
- Wreck
- Magnetic Anomaly



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Created By	Chris Dawe
Reviewed By	Emma Storey
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

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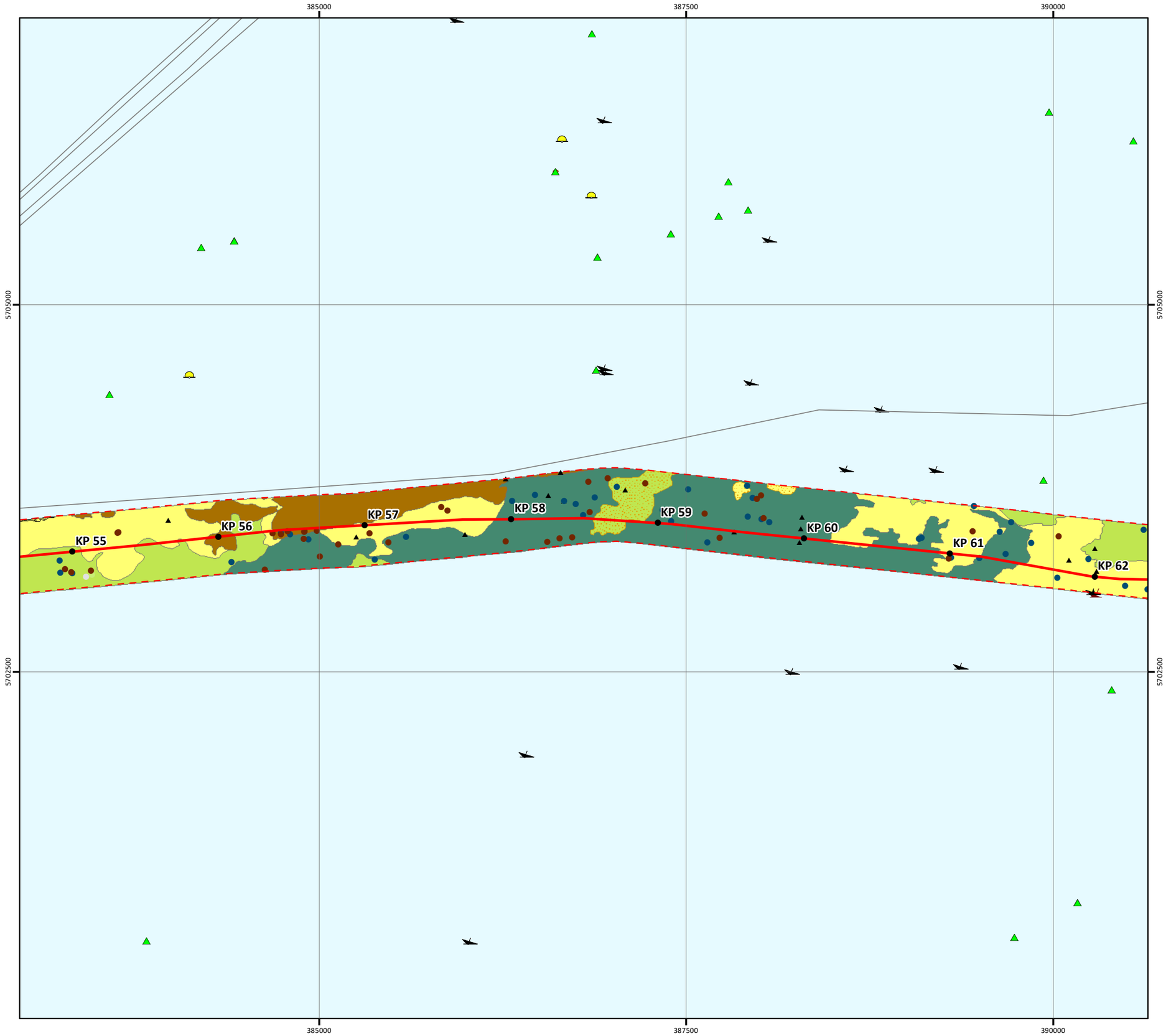


GRIDLINK INTERCONNECTOR

SURVEY INFORMATION

Geophysical Data: Cable Route & Seabed Features

Sheet 8 of 14

Drawing No: P2172-SURV-002_8	A

Legend

- KP
- GridLink Preferred Cable Route
- Application Corridor
- Power
- Obstruction
- Wreck
- Pile/Post/Stake
- Buoy

Seabed Features

- Ripples
- Trawl Mark Area

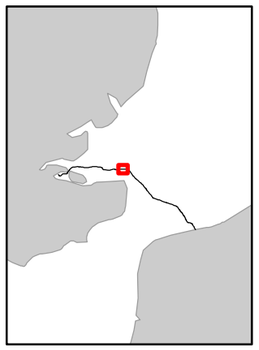
Seabed Sediments

- SILT
- CLAY
- Gravelly SAND
- SAND

Seafloor Contacts

- Boulder
- Debris
- Other
- Wire
- Wreck
- Magnetic Anomaly

N W E S



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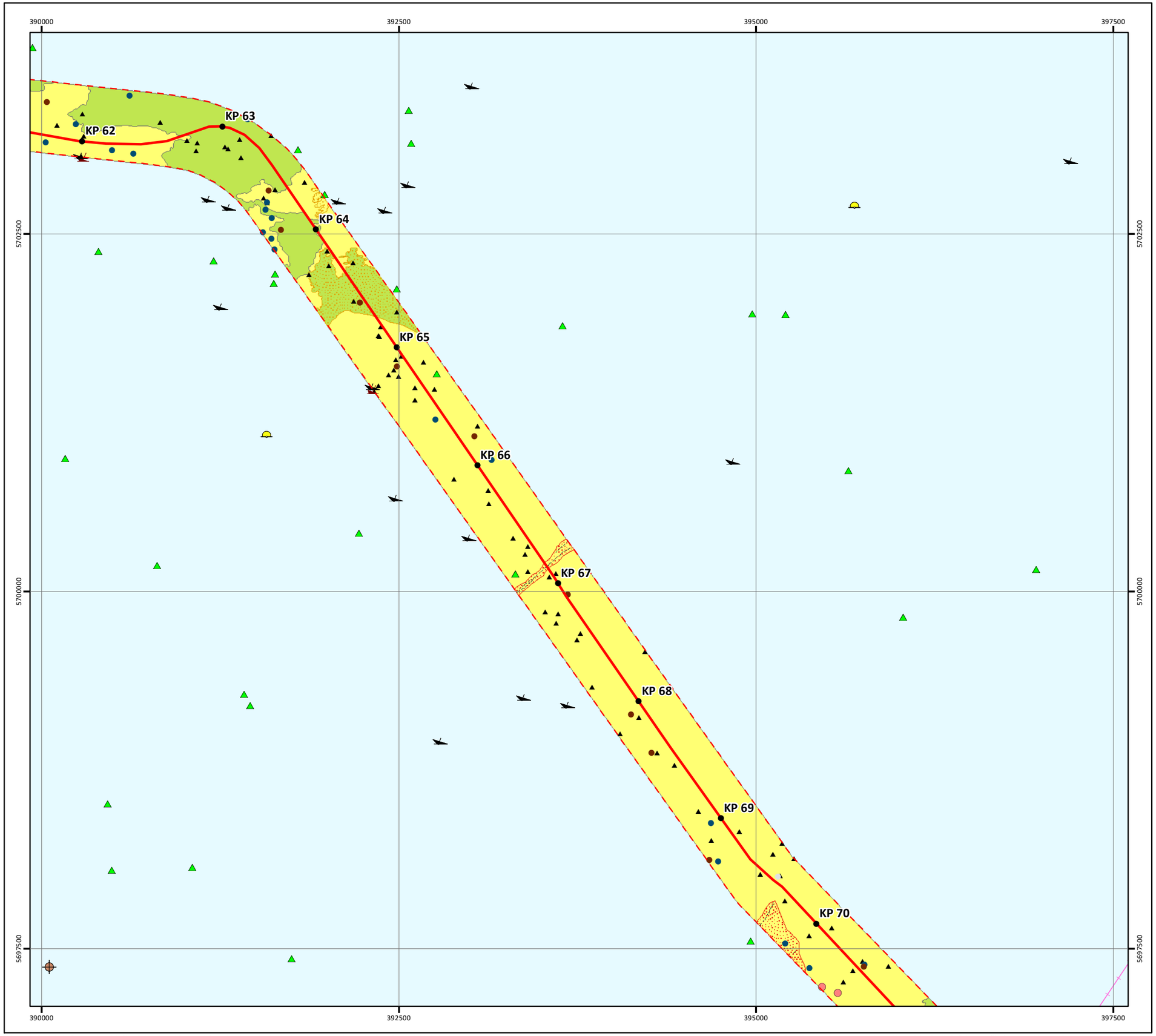
Created By	Chris Dawe
Reviewed By	Emma Storey
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

0 0.25 0.5 0.75 1 km



GRIDLINK INTERCONNECTOR

SURVEY INFORMATION

Geophysical Data: Cable Route & Seabed Features

Sheet 9 of 14

Drawing No: P2172-SURV-002_9	A

Legend

- KP
- GridLink Preferred Cable Route
- Application Corridor
- Telecom (Disused)
- Obstruction
- Wreck
- Buoy
- Anchorage area
- Pilot Boarding Place

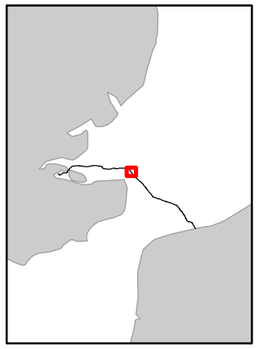
Seabed Features
- Ripples
- Sand Waves

Seabed Features
- Sandwave crest

Seabed Sediments
- Gravelly SAND
- SAND

Seafloor Contacts
- Boulder
- Debris
- Other
- Wreck
- Magnetic Anomaly

N W E S



NOTE: Not to be used for Navigation

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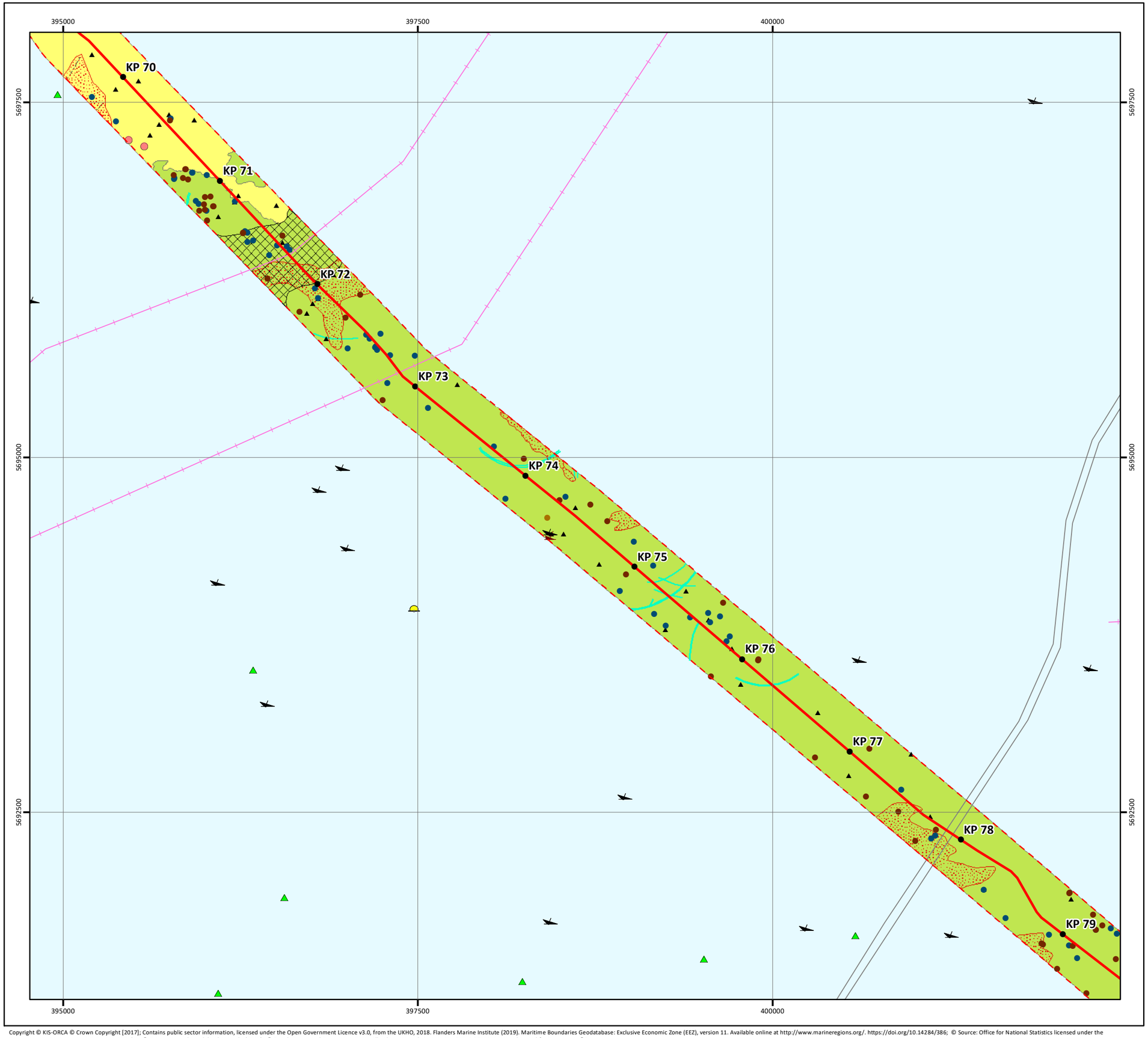
Created By	Chris Dawe
Reviewed By	Emma Storey
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

0 0.25 0.5 0.75 1 km



GRIDLINK INTERCONNECTOR

SURVEY INFORMATION

Geophysical Data: Cable Route & Seabed Features

Sheet 10 of 14

Drawing No: P2172-SURV-002_10	A

Legend

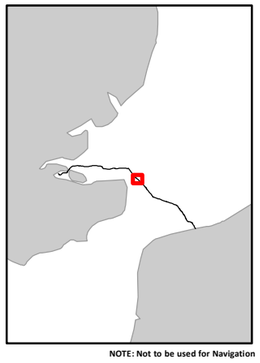
- KP
- GridLink Preferred Cable Route
- Application Corridor
- Power
- Telecom (Disused)
- Obstruction
- Wreck
- Buoy
- Pilot Boarding Place

Seabed Features
- Sand Waves
- Trawl Mark Area

Seabed Features
- Linear Trawl Mark
- Sandwave crest

Seabed Sediments
- Gravelly SAND
- SAND

Seafloor Contacts
- Anchor/Anchor Chain
- Boulder
- Debris
- Other
- Wreck
- Magnetic Anomaly



NOTE: Not to be used for Navigation

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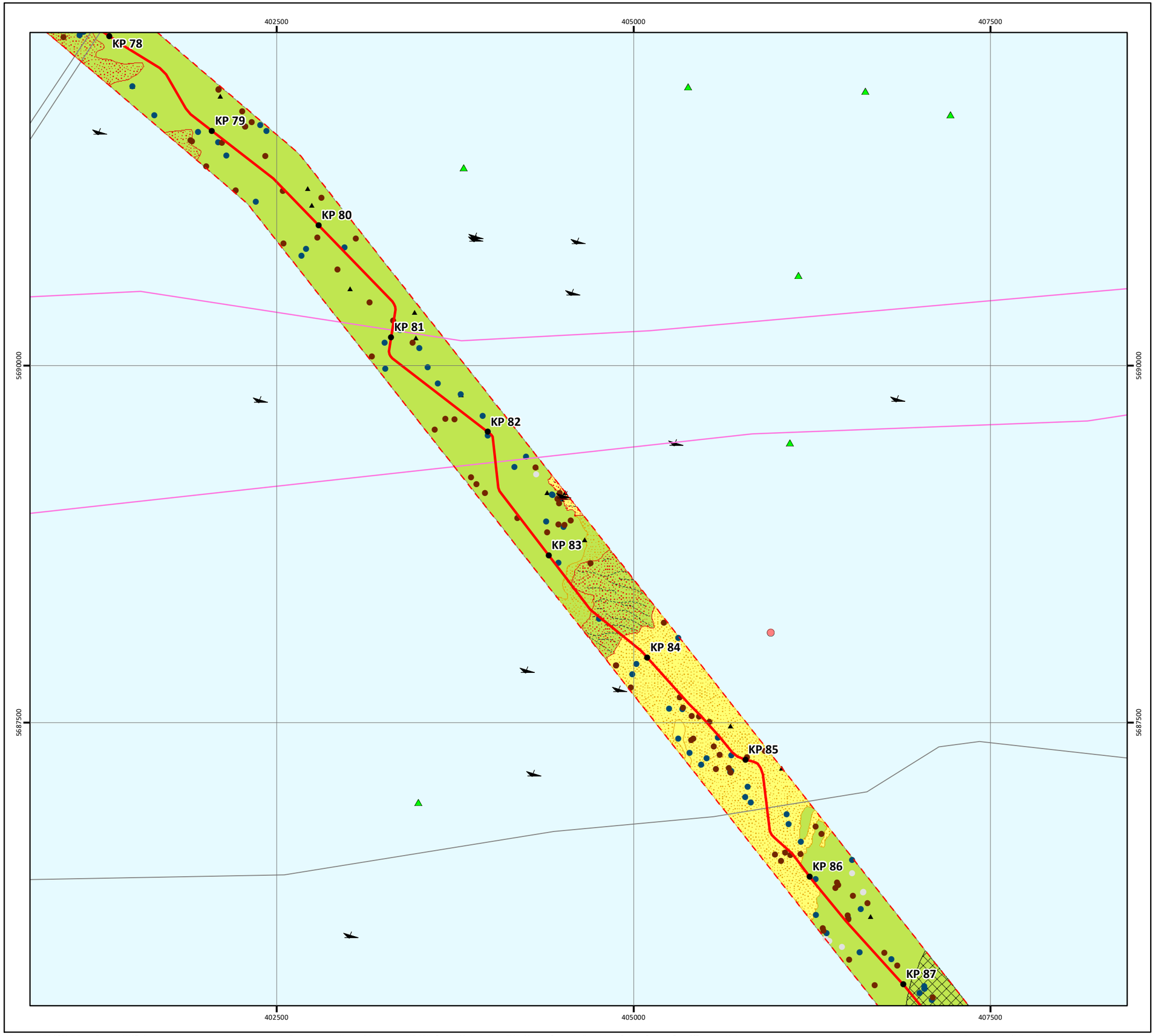
Created By	Chris Dawe
Reviewed By	Emma Storey
Approved By	Anna Farley

0 0.25 0.5 0.75 1 km



GRIDLINK INTERCONNECTOR

SURVEY INFORMATION

Geophysical Data: Cable Route & Seabed Features

Sheet 11 of 14

Drawing No: P2172-SURV-002_11	A

Legend

- KP
- GridLink Preferred Cable Route
- Application Corridor
- Power
- Telecom
- Obstruction
- Wreck
- Pilot Boarding Place

Seabed Features

- Ripples
- Sand Waves
- Trawl Mark Area

Seabed Features

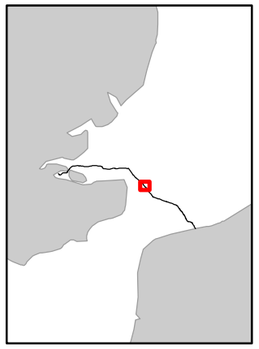
- Sandwave crest

Seabed Sediments

- Gravelly SAND
- SAND

Seafloor Contacts

- Boulder
- Debris
- Other
- Wreck
- Magnetic Anomaly



NOTE: Not to be used for Navigation

N W E S

Date	24 June 2020
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Datum	WGS 1984
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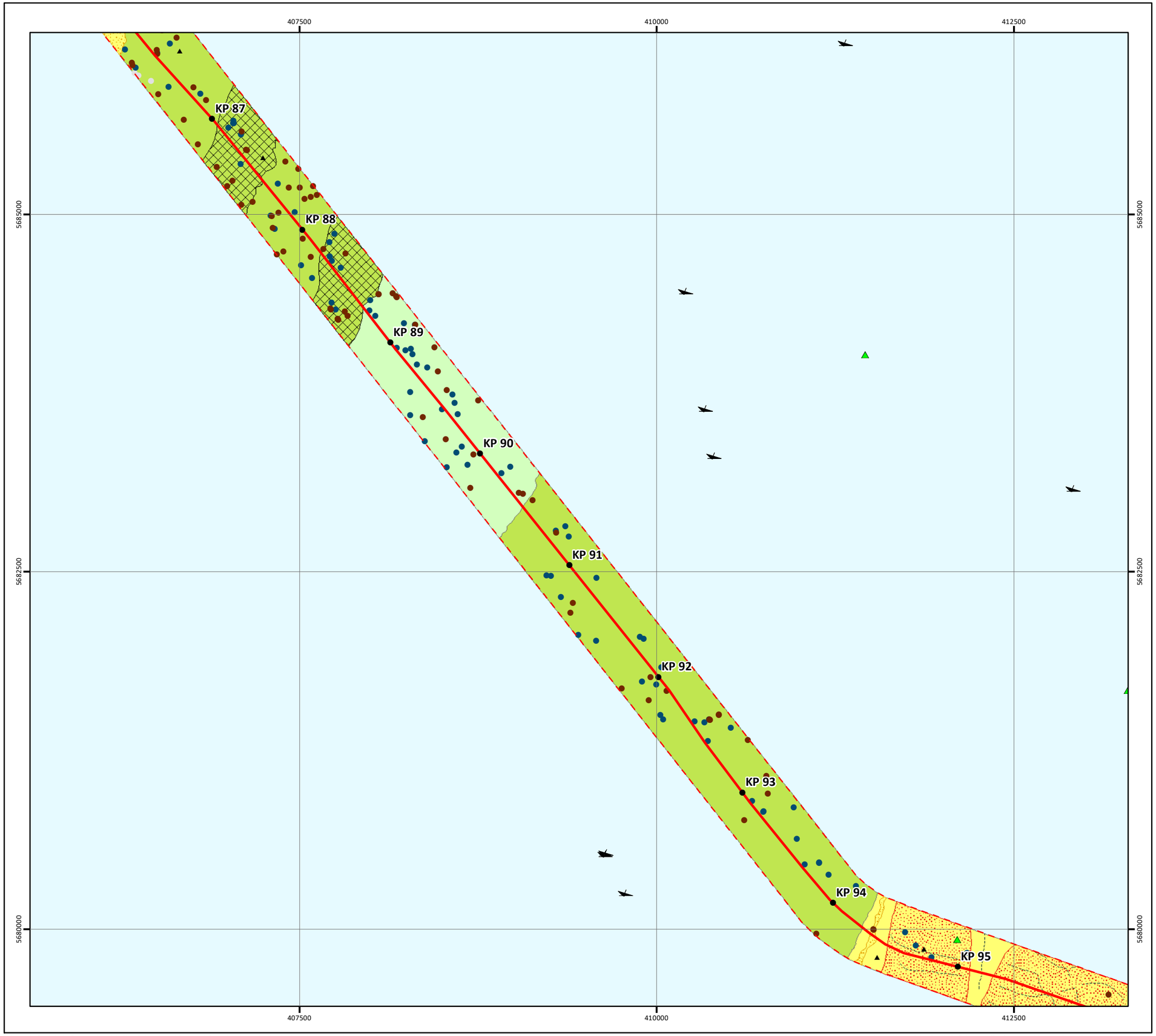
Created By	Chris Dawe
Reviewed By	Emma Storey
Approved By	Anna Farley

0 0.25 0.5 0.75 1 km



GRIDLINK INTERCONNECTOR

SURVEY INFORMATION

Geophysical Data: Cable Route & Seabed Features

Sheet 12 of 14

Drawing No: P2172-SURV-002_12	A

Legend

- KP
- GridLink Preferred Cable Route
- Application Corridor
- Obstruction
- Wreck

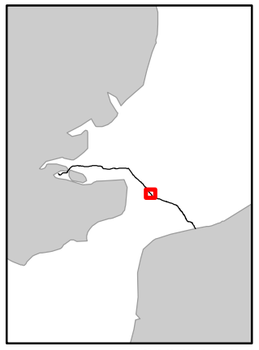
Seafloor Contacts
- Boulder
- Debris
- Other
- Magnetic Anomaly

Seabed Features
- Ripples
- Sand Waves
- Trawl Mark Area

Seabed Features
- Sandwave crest

Seabed Sediments
- CHALK
- Gravelly SAND
- SAND

N W E S



NOTE: Not to be used for Navigation

Date	24 June 2020
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Projection	Transverse Mercator
Datum	WGS 1984
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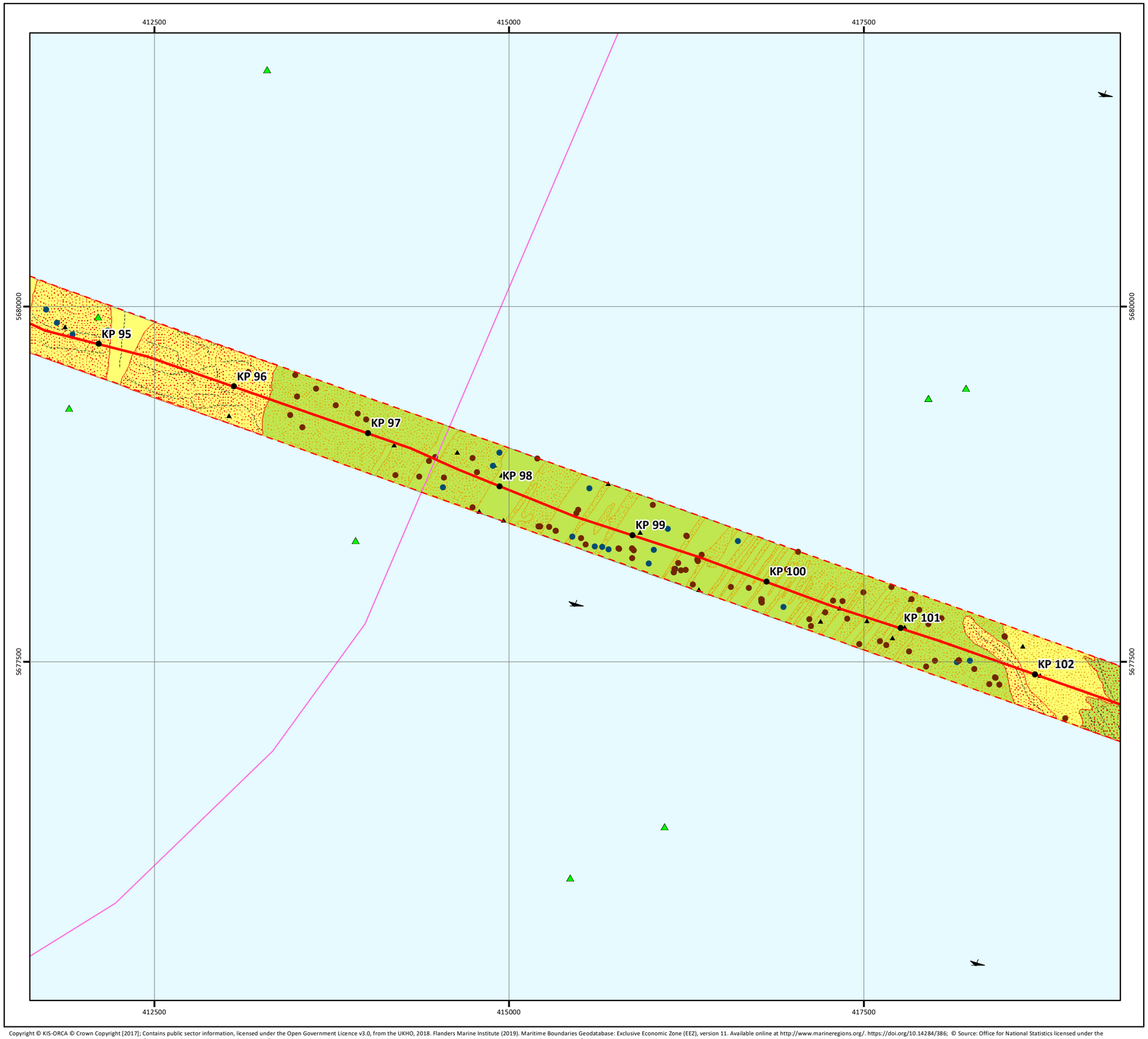
File Reference	J:\Gridlink\P2172_Mxd\11_SURV\ P2172-SURV-002.mxd
Created By	Chris Dawe
Reviewed By	Emma Storey
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

0 0.25 0.5 0.75 1 km



GRIDLINK INTERCONNECTOR

SURVEY INFORMATION

Geophysical Data: Cable Route & Seabed Features

Sheet 13 of 14

Drawing No: P2172-SURV-002_13	A

Legend

- KP
- GridLink Preferred Cable Route
- Application Corridor
- Telecom
- Obstruction
- Wreck

Seafloor Contacts
- Boulder
- Debris
- Magnetic Anomaly

Seabed Features
- Ripples
- Sand Waves

Seabed Features
- Sandwave crest

Seabed Sediments
- Gravelly SAND
- SAND

N
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NOTE: Not to be used for Navigation

Date	24 June 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	KISCA; UKHO; MarineRegions; MMT; GridLink; ONS; ESRI
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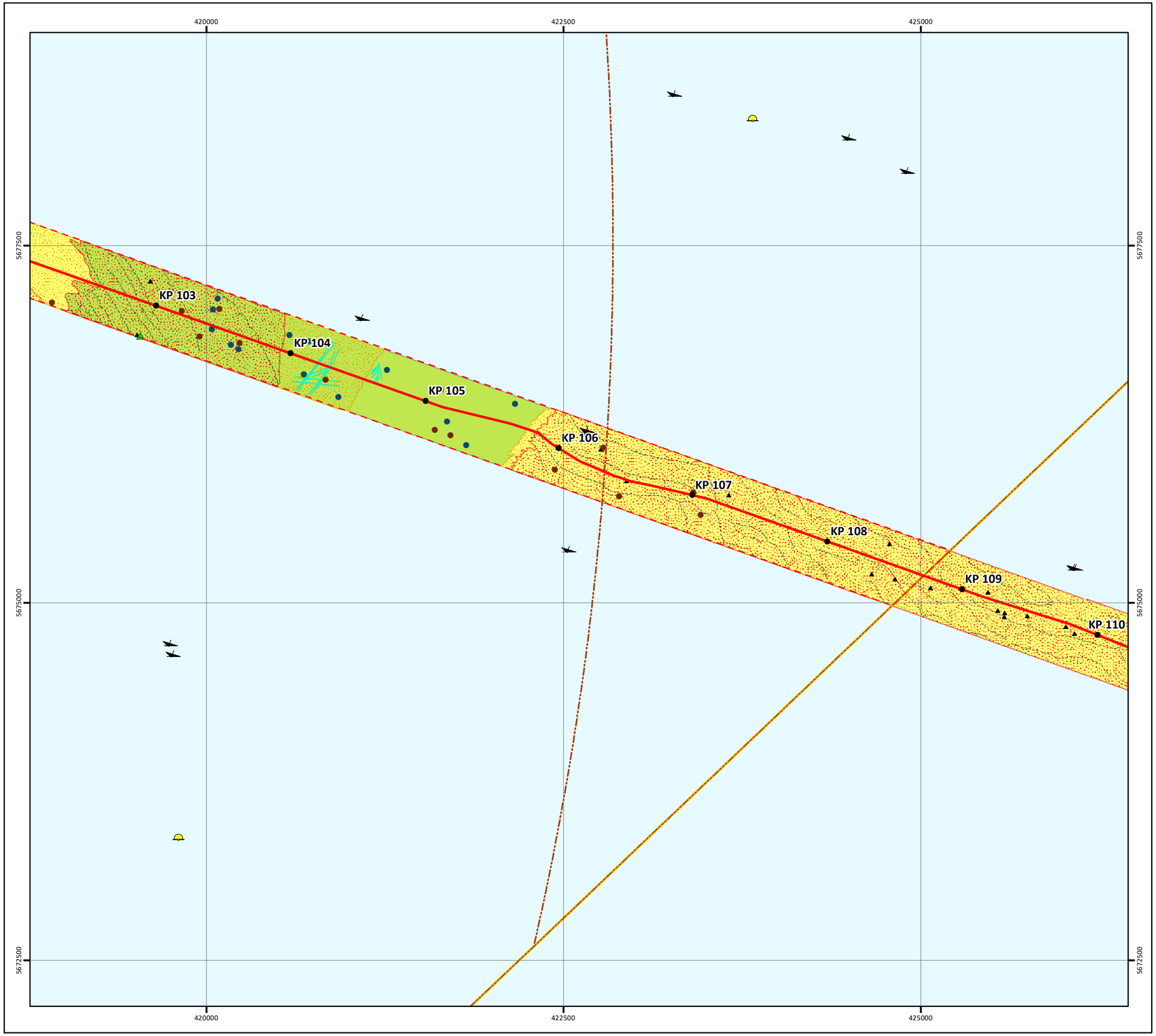
Created By	Chris Dawe
Reviewed By	Emma Storey
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

0 0.25 0.5 0.75 1 km



GRIDLINK INTERCONNECTOR

SURVEY INFORMATION

Geophysical Data: Cable Route & Seabed Features

Sheet 14 of 14

Drawing No: P2172-SURV-002_14	A

Legend

- KP
- GridLink Preferred Cable Route
- Application Corridor
- EEZ Boundary
- 12nm Territorial Sea Limit
- Obstruction
- Wreck
- Buoy

Seabed Features

- Ripples
- Sand Waves

Seabed Features

- Linear Trawl Mark
- Sandwave crest

Seabed Sediments

- Gravelly SAND
- SAND

Seafloor Contacts

- Boulder
- Debris
- Magnetic Anomaly

N
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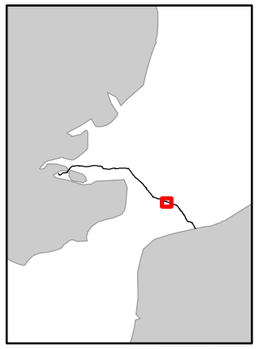

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Created By	Chris Dawe
Reviewed By	Emma Storey
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

0 0.25 0.5 0.75 1 km

5.3.6 Coastal and marine processes

5.3.6.1 Medway Estuary

Coastal and flooding defences constructed to protect developments and agricultural land along the shoreline of the Medway and Thames Estuary have modified natural sediment movement from eroded London Clay cliffs within the estuary and on the northern coastline of Sheppey or sediment transported onshore from offshore. As a result, only limited areas of the shoreline are free to erode, providing limited quantities of sediment to the Medway Estuary. The most important source of sediment to the Medway Estuary is the offshore supply of fine suspended sediments from the Greater Thames Estuary (Halcrow Group 2010). Further supplies may also include relict sediments within saltmarshes, alluvium and sediment from London Clay cliffs within the Medway Estuary and along the northern coastline of the Isle of Sheppey (Halcrow Group 2010).

A lot of the original saltmarsh of the estuary has been lost due to historical industry or as a result of land reclamation and coastal defences. Furthermore, fragmentation and erosion of surviving salt marsh areas is common with erosion of the seaward edge of saltmarsh occurring widely in high energy locations within the estuary (MEASS[2] 2019). Erosion in the estuary is exacerbated by climate change leading to increase in sea level and resultant higher wave energies where it is currently estimated that over the next 100 years there will be a total loss of saltmarsh equivalent to 113ha (0-20 years), 140ha (21-50 years) and 308ha (51-100years) (MEASS 2019). The area of Ham Green (located within the Medway Estuary, roughly 4.4km south east of landfall) which shares a similar clay geology has shown to have an erosion rate of approximately 0.07m/year, however it should be noted this area is protected by an embankment with rock revetments (Environment Agency 2018).

Areas in the Medway Estuary are more protected from wave action, however as the land is more sheltered, historically there has been more land reclamation (Halcrow Group 2010). Current velocity data shows that there are much higher velocities present on the ebb tide than on the flood tide which are likely strong enough to remobilise material deposited on the previous tide and therefore result in the net removal of material from the estuary. This is supported by the fact that the Medway Estuary has low levels of vertical accretion (sediment accumulation rate of 4-5mm per year (Cundy *et al*. 2007)) and further supported by grab samples taken within the Proposed Development which show that particle size varies greatly throughout the Medway Estuary, with most samples consisting primarily of sands and muds.

As the landfall is the site of the former Kingsnorth Power Station there are significant erosion and flooding defence structures. The preferred policy for this area has previously been to 'hold the line' to protect the nationally important Power Station. Although the Power Station no longer exists the policy in the region is still to 'hold the line'. This is achieved by maintaining the defences. The Medway Estuary and Swale Shoreline Management Plan states that *"As sediment supply within the estuary is expected to meet demand through this epoch, intertidal mudflat and saltmarsh evolution is predicted to continue with erosion in some areas (e.g. Oakham Marsh Island), increasing pressure on defences, and accretion in others*' (Halcrow Group 2010).

5.3.6.2 Thames Estuary and English Channel

The currents and movement of sediments in the outer Thames Estuary are dominated by tidal flow. The sediment mobility indicators include sand streaks and ribbons, mega ripples and sand waves.

The presence of sandbanks in the Southern North Sea generates complex sediment transport pathways in certain areas. Sandbanks located off the north Kent coast are believed to influence sediment transport patterns, and sand from these banks feed onshore, replenishing the sand beaches

[2] Medway Estuary and Swale Strategy

along the Thanet coast. Sediment transport along the eastern UK coast is generally northwards but is directed southwards through the deeper water of the Straits of Dover.

The southern North Sea is a shallow shelf that is dominated by a deep channel to the west, connected to the Straits of Dover, flowing into the English Channel. Mobile sediments are common within the Proposed Development with extensive areas of ripples and mega ripples in shallower areas, primarily in the channel of the Medway River and crossing the Sheerness Middle Sand (KP0-KP20.550) as shown in Figures 5-9 and 5-10 (Drawing P2172-SURV-002_1 and Drawing P2172-SURV-002_2). Between KP20.550 and KP24.938, ripples and mega ripples are common as shown in Figure 5-11 (Drawing P2172-SURV-002_3). Beyond KP24.938, the seabed morphology consists of extensive mobile sediment bedforms including ripples, mega ripples and sand waves shown in Figures 5-11 to 5-15 (Drawings P2172-SURV-002_2, Drawing P2172-SURV-002_3 Drawing P2172-SURV-002_4, Drawing P2172-SURV-002_5, Drawing P2172-SURV-002_6 and Drawing P2172-SURV-002_7). Rippled seabed features are common and sand waves are limited to one section between KP24.938 and KP51.656. These sand waves are low (<3m in height) and extend in perpendicular fashion along the Proposed Development. Sand ribbons, sandbanks and sand waves are a common feature of the southern North Sea, although the water is shallow enough for wave induced currents with sufficient strength to move bottom sediments these are considered to be of minor importance compared to the stronger influence of the tidal currents.

KP51.656 to KP62.942 contains occasional areas of ripples and mega ripples shown in Figures 5-15 and 5-16 (Drawing P2172-SURV-002_7 and Drawing P2172-SURV-002_8). Between KP62.942 to KP108.066 there are extensive areas of mobile sediment bedforms including ripples, megaripples and sandwaves shown in Figures 5-17 to 5-22 (Drawing P2172-SURV-002_9, Drawing P2172-SURV-002_10, Drawing P2172-SURV-002_11, Drawing P2172-SURV-002_12, Drawing P2172-SURV-002_13 and Drawing P2172-SURV-002_14). Sandwaves are primarily located on and around the South Fall and Sandettie Bank sandbanks.

A total of eight areas crossing the Proposed Development have been classified as sandbanks which are slightly covered by seawater all the time. These areas extend from KP13.053 to KP14.870, KP16.939 to KP18.622, KP41.418 to KP43.152, KP44.418 to KP45.976, KP49.180 to KP51.656, KP66.471 to KP66.643, KP93.661 to KP95.719 and KP105.138 to KP108.066.

5.3.7 Water quality

Water quality at any location on the UK continental shelf is the result of a combination of source, transport and removal mechanisms for the individual chemical species under consideration.

The EU Marine Strategy Framework Directive adopted in 2008 requires that the UK takes “the necessary measures to achieve or maintain Good Environmental Status in the marine environment by the year 2020 at the latest” (UKMMAS[3] 2010). The report on the current state of the UK seas (UKMMAS 2010) concludes that good progress has been made towards this with significant contamination restricted to industrial estuaries and coastal areas.

The requirement for monitoring UK rivers and near-shore waters has increased as a result of the implementation of the EU Water Framework Directive (WFD), with more stringent criteria for water quality in rivers applied. River Basin Management Plans (RBMP) have been developed as a requirement of the WFD and report on the ‘ecological status’ of surface and ground water in coastal waters (out to 1nm from the baseline) and ‘chemical status’ of surface and ground waters in territorial waters (out to 12nm from the baseline). The Proposed Development is located within or in proximity to seven coastal and estuarine waterbodies including:

- Medway (GB530604002300)

[3] UK Marine Monitoring and Assessment Strategy

- Swale (GB530604011500)
- Thames Lower (GB530603911401)
- Thames Coastal North (GB640603690000)
- Essex (GB650503520001)
- Thames Coastal South (GB640604640000)
- Kent North (GB650704510000)

All waterbodies have a current ecological status of 'Moderate' and all but one waterbody have a chemical status of 'Good'. The Medway waterbody has a current chemical status of 'Fail'.

Water quality, defined in terms of bacterial concentration, is monitored within Bathing Waters designated under the revised Bathing Water Directive (2007/7/EC). These are classified as Excellent, Good, Sufficient and Poor. Bathing waters at the nearest point (Sheerness) have been classified as Excellent for the last four years (2016 – 2019) (Environment Agency 2020). The bathing water sample point lies at the centre of the beach; approximately 1.8km southeast of the Proposed Development.

Water quality is also monitored for shellfish waters designated under The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. The Outer Thames Estuary contains six shellfish water protected areas namely; Southend, Foulness, Sheppey, Swalecliff, Margate and Outer Thames. A figure showing the designated areas is provided in Chapter 12 (Drawing P2172-FISH-011). The Proposed Development crosses the Southend, Sheppey and Outer Thames areas, and is in proximity (south) of the Foulness waters.

Shellfish waters are monitored for various parameters based on water quality standards established by the Shellfish Waters Directive. These parameters include suspended solids and metals amongst others. The standard for suspended solids is that a discharge affecting shellfish waters must not cause the suspended solid content of the waters to exceed by more than 30% the content of waters not affected. 75% of the samples analysed must meet the standard. For metals the standard is that the concentration of each substance in the shellfish waters or in the shellfish flesh must not reach or exceed a level, which has harmful effects on the shellfish and their larvae.

Further information on water quality including an assessment can be found in Technical Appendix G - GridLink WFD Assessment.

5.3.8 Suspended sediments

Suspended sediment in the water column arises as a result of biological activity, inputs from land and re-suspension of sediments. The suspended particulate matter (SPM) is made up of organic and inorganic fractions.

The organic fraction is predominantly the result of biological activity in the water column, and is primarily composed of planktonic material, including bacteria. This will not be influenced by any activities associated with the Proposed Development and will not be discussed further in this Chapter.

Inorganic SPM results from inputs from rivers (derived from erosion in the river catchments and from chemical reactions in the estuarine zone), fallout from the atmosphere and coastal erosion combined with resuspension of existing sediments and chemical reactions in the water column. As a result, inorganic SPM loads vary widely, generally increasing with proximity to the coastline and are highly dependent on energy inputs (e.g. storms).

<u>Medway Estuary</u>

A modelling study conducted by Mott MacDonald (2018) found that SSC in Medway Estuary typically ranged from 0.1mg/l – 30 mg/l with the highest sediment concentrations occurring during high water on spring tides and during winter months, where SSC can reach 100mg/l especially in the outer estuary

and offshore area. Mott MacDonald (2018) indicates that SSC concentrations in both the Thames Estuary, adjacent to the Medway Estuary, and in the River Medway are in excess of 60mg/l.

Thames Estuary

Average surface layer suspended particulate matter concentrations within the outer Thames Estuary, extending to approximately 1.5°E, were >30mg/l decreasing to 5-10mg/l outside the Thames 'plume' (with the note that sampling data is generally biased to lower concentrations due to the constraints on observations as these were generally restricted to fine weather conditions), over the period 1998 to 2015 (Silva et al 2016). The same report also indicates that data is highly variable (order of magnitude or greater) both spatially and temporally over the southern North Sea.

Water sampling at discrete points in the Thames Estuary downstream of Gravesend by HR Wallingford (2002) identified near seabed concentrations during a spring tide of up to 2000mg/l in Lower Hope Reach. SSCs decreased to 1000mg/l at Coryton and to 100 mg/l at Southend on Sea, with a similar pattern occurring during a neap tide, with measurements of 500mg/l at Lower Hope Reach and less than 100mg/l at Southend on Sea (Port of London Authority 2014).

In addition, SSCs were monitored within the Thames Estuary between January and December 2009 as part of the London Gateway baseline surveys and were also measured at a variety of locations between 2009 and 2014 during the capital dredging required for London Gateway (Mott Macdonald 2018). The 2009 and 2014 monitoring showed concentrations within the inner estuary ranging between 10mg/l to 3000mg/l and between 10mg/l and 1000mg/l towards the outer extent of the Thames Estuary (Mott MacDonald 2018). These monitoring locations are slightly north of the Proposed Development, but are considered representative of SSC within the general area of the inner and outer Thames estuary.

5.3.9 Sediment quality

Sediment samples taken during the cable route survey were tested for metal, organics and polycyclic aromatic hydrocarbons (PAH) concentrations.

5.3.9.1 Metal Concentrations

Metal concentrations were low across all UK Nearshore grab sample sites and rarely exceeded any threshold values except for Arsenic, Chromium, Nickel and Mercury (Table 5-6). The concentrations were compared to various thresholds that relate to guideline action levels for the disposal of dredged material. CEFAS Action Level (AL 1) is not a pass or fail criteria, however in general, contaminant levels in dredged materials below AL1 are of no concern and are unlikely to influence a licensing decision regarding the disposal of dredged material. The CEFAS AL1 threshold value is exceeded for Arsenic in four out of seventeen samples tested. Arsenic is a natural component of seawater and rocks and given the lack of variability between samples, it is expected that the values are of natural origin rather than anthropogenic. The CEFAS AL1 threshold value is exceeded for Chromium in four of seventeen samples and is breached for Nickel in one of seventeen samples. Although the Cefas AL1 threshold values for mercury were not exceeded in any of the nearshore samples, the lower OSPAR Effects Range Low (ERL) threshold value for mercury was exceeded in one of seventeen samples and the CCME ISQC threshold value exceeded in two of the seventeen samples[4]. These exceedances of threshold values for Mercury were within samples taken closest to the landfall and within the Medway Estuary. The Medway Estuary has a history of mercury pollution from historic dockyards and industrial facilities such as Kingsnorth Power Station (Ouddane 2008), therefore it is unsurprising that exceedances are found here and are likely to be of historic anthropogenic origin.

The full test results are provided in Technical Appendix P.

[4] These two values relate to concentrations at which biological effects on organisms may be experienced. Concentrations below the ERL level rarely cause adverse effects in marine organisms.

Table 5-6 Summary of metal concentrations (µg/g dry weight) in sediment across UK Nearshore grab sample sites together with threshold values

ANALYTE	ARSENIC	CADMIUM	CHROMIUM	COBALT	COPPER	LEAD	NICKEL	TIN	VANADIUM	ZINC	ALUMINIUM	BARIUM	IRON	MERCURY	MAGNESIUM
Limit of Detection	1	0.1	0.5	0.1	2	2	0.5	0.5	2	3	10	1	10	0.01	4
OSPAR ERL	-	1.2	81	-	34	47	-	-	-	150	-	-	-	0.15	-
CEFAS AL2	100	5	400	-	400	500	200	-	-	800	-	-	-	3	-
CEFAS AL1	20	0.4	40	-	40	50	20	-	-	130	-	-	-	0.3	-
CCME PEL	41.6	4.2	160	-	108	112	-	-	-	271	-	-	-	0.7	-
CCME ISQG	7.24	0.7	52.3	-	18.7	30.2	-	-	-	124	-	-	-	0.13	-
Dutch RIVM	85	14	380	240	190	580	210	-	-	2000	-	-	-	10	-
Units	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g
UK001	6.0	0.1	30.9	4.7	9.3	23.5	12.4	2.5	45.2	46.6	25200	247	14000	0.16	5000
UK002	5.8	0.2	35.5	5.5	12.9	21.0	16.6	2.9	51.4	80.2	21700	177	13700	0.10	5500
UK003	7.2	0.2	45.6	6.8	16.2	26.9	20.0	3.8	69.5	79.2	34300	216	19600	0.15	6800
UK004	6.8	0.2	42.5	6.5	14.7	25.5	19.8	2.8	64.7	73.7	32100	210	19300	0.13	6600
UK005	8.0	0.1	37.8	5.9	10.3	13.7	15.6	1.8	59.3	50.2	26400	201	15900	0.04	5900
UK006	27.3	<0.1	13.3	6.7	7.6	29.0	12.8	3.5	44.6	70.8	7920	78.5	16200	0.04	2200
UK007	12.7	0.1	43.4	7.4	10.0	13.4	22.0	1.7	77.7	58.7	33300	229	19000	<0.01	6700
UK008	7.3	<0.1	21.1	4.1	5.4	9.5	10.2	1.0	37.8	34.0	15900	159	10300	0.02	3300
UK009	10.9	<0.1	22.4	5.6	8.8	15.0	12.7	3.4	41.6	46.6	18500	196	13400	0.06	3200
UK010	8.7	<0.1	21.1	4.2	6.9	15.1	11.1	1.5	36.3	37.0	17300	185	11400	0.05	3100
UK011	11.8	0.1	40.7	6.6	13.0	26.1	19.4	2.7	66.2	70.2	28900	217	16700	0.09	5500
UK012	13.8	0.1	34.5	5.6	13.7	20.2	17.1	2.0	59.0	52.9	26300	210	15300	0.08	5000
UK013	12.6	0.1	28.5	5.0	7.1	11.6	14.8	1.5	51.4	37.9	25300	227	14000	0.02	4900
UK015	24.1	<0.1	17.6	4.8	5.3	12.8	8.6	0.9	46.1	38.4	11400	132	13600	0.04	2500
UK016	20.2	<0.1	15.6	4.0	5.6	12.0	10.6	1.0	37.2	34.0	13600	176	10500	<0.01	2300
UK017	25.3	<0.1	13.6	4.3	6.6	11.1	10.1	0.8	39.7	41.3	9060	127	10400	<0.01	2800
Mean	13.0	0.1	29.0	5.5	9.6	17.9	14.6	2.1	51.7	53.2	21699	187	14581	0.1	4456
SD	7.2	0.0	11.3	1.1	3.5	6.6	4.2	1.0	12.9	16.6	8588	44	3085	0.0	1658
Min	5.8	0.0	13.3	4.0	5.3	9.5	8.6	0.8	36.3	34.0	7920	79	10300	0.0	2200
Max	27.3	0.2	45.6	7.4	16.2	29.0	22.0	3.8	77.7	80.2	34300	247	19600	0.2	6800
Median	11.4	0.1	29.7	5.6	9.1	15.1	13.8	1.9	48.8	48.4	23450	199	14000	0.1	4950

Source: MMT (2019); Note: highlighted cells indicate where threshold values have been exceeded

Metal concentrations were also predominantly low across all UK Offshore grab sample sites (Table 5-7). The CCME ISQG threshold value for Arsenic was exceeded for all sampled sites and the CEFAS AL1 threshold value was exceeded for three of the five sites. The full test results are provided in Technical Appendix Q.

Table 5-7 Summary of Metal Concentrations (µg/g dry weight) in sediment across UK Offshore grab sample sites together with threshold values

ANALYTE	ARSENIC	CADMIUM	CHROMIUM	COBALT	COPPER	LEAD	NICKEL	TIN	VANADIUM	ZINC	ALUMINIUM	BARIUM	IRON	MERCURY	MAGNESIUM
Limit of Detection	1	0.1	0.5	0.1	2	2	0.5	0.5	2	3	10	1	10	0.01	4
OSPAR ERL	-	1.2	81	-	34	47	-	-	-	150	-	-	-	0.15	-
CEFAS AL2	100	5	400	-	400	500	200	-	-	800	-	-	-	3	-
CEFAS AL1	20	0.4	40	-	40	50	20	-	-	130	-	-	-	0.3	-
CCME PEL	41.6	4.2	160	-	108	112	-	-	-	271	-	-	-	0.7	-
CCME ISQG	7.24	0.7	52.3	-	18.7	30.2	-	-	-	124	-	-	-	0.13	-
Dutch RIVM	85	14	380	240	190	580	210	-	-	2000	-	-	-	10	-
Units	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g
UK043	20.9	0.1	7.9	2.0	9.8	7.4	5.3	1.3	39.0	28.6	10500	153	5850	<0.01	250
UK044	22.9	<0.1	8.4	1.9	5.2	6.3	4.9	1.0	41.0	16.8	10100	140	5410	<0.01	600
UK047	24.6	<0.1	3.6	2.2	3.8	5.1	3.2	0.6	40.4	14.7	4950	441	3820	<0.01	350
UK049	15.6	<0.1	6.2	1.4	4.4	5.8	3.7	0.8	34.0	13.6	9550	458	4220	<0.01	230
UK050	15.3	<0.1	8.8	1.4	4.9	5.0	3.9	0.7	32.9	13.8	9440	269	4420	<0.01	270
Mean	19.9	0.1	7.0	1.8	5.6	5.9	4.2	0.9	37.5	17.5	8908	292	4744	-	340
SD	4.2	-	2.1	0.4	2.4	1.0	0.9	0.3	3.8	6.3	2254	152	851	-	152
Min	15.3	0.0	3.6	1.4	3.8	5.0	3.2	0.6	32.9	13.6	4950	140	3820	-	230
Max	24.6	0.1	8.8	2.2	9.8	7.4	5.3	1.3	41.0	28.6	10500	458	5850	-	600
Median	20.9	0.1	7.9	1.9	4.9	5.8	3.9	0.8	39.0	14.7	9550	269	4420	-	270

Source: MMT (2019); Note: highlighted cells indicate where threshold values have been exceeded

5.3.9.2 Organics

Concentrations of organics was consistent across all UK Nearshore Survey samples with all PAH's being found in concentrations of <1µg/Kg. Concentrations of PAH in UK Offshore Survey samples were all below the limits of detection. The UK Nearshore Environmental Survey Report documented the bottom layers of grab sample sites UK-001, UK-002, UK-003, UK-004, UK-005, UK-007 within the Medway Estuary and UK-008, UK-009, UK-010, UK-011, UK-012, UK-013 within the Thames Estuary were black indicating hypoxic conditions. It is only at UK-015 where a decrease in levels of hypoxic sediment is observed with the report stating that the bottom layer of UK 015 indicated slightly hypoxic conditions.

5.3.9.3 Polycyclic Aromatic Hydrocarbons (PAH)

Table 5-8 presents a summary of the PAH's concentrations at each grab sample site in the UK Nearshore Environmental Survey. Concentrations of PAH varied greatly and concentrations of one or several PAH's exceeded the Cefas AL1 threshold at sites UK001 to UK004, UK007 and UK012. The data for sites UK001 to UK004 is consistent with the high level of industrial use for the Medway Estuary. The results for UK007 and UK012 suggests a localised source of contamination at each site, rising selected PAH concentrations above the background levels.

Concentrations of PAH were below detection limits for all grab sample sites in the UK Offshore Environmental Survey (Table 5-9).

Table 5-8 Summary of PAH (µg/kg dry weight) in sediment across UK Nearshore grab sample sites together with threshold values

ANALYTE	NAPHTHALENE	ACENAPHTHYLENE	ACENAPHTHENE	FLUORENE	PHENANTHRENE	DIBENZOTHIOPHENE	ANTHRACENE	FLUORANTHENE	PYRENE	BENZO[A]ANTHRACENE	CHRYSENE	BENZO[B]FLUORANTHENE	BENZO[K]FLUORANTHENE	BENZO[E]PYRENE	BENZO[A]PYRENE	PERLENE	INDENO[123,CD]PYRENE	DIBENZO[A,H]ANTHRACENE	BENZO[GHI]PERYLENE	SUM OF ALL
Limit of Detection	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
OSPAR ERL	160	-	-	-	240	190	85	600	665	-	384	-	-	-	430	-	240	-	85	-
CEFAS AL1	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	-
CCME PEL	391	128	88.9	144	544	-	245	1494	1398	693	846	-	-	-	763	-	-	135	-	-
CCME ISQG	34.6	5.87	6.71	21.2	86.7	-	46.9	113	153	74.8	108	-	-	-	88.8	-	-	6.22	-	-
Units	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg
UK001	26.70	13.30	6.89	12.90	85.60	8.46	29.10	160.00	167.00	103.00	113.00	140.00	63.30	116.00	145.00	71.30	127.00	27.00	115.00	1530.55
UK002	17.00	11.80	5.75	9.49	63.50	6.17	20.50	137.00	126.00	78.60	89.90	103.00	64.80	101.00	113.00	52.20	101.00	19.50	104.00	1224.21
UK003	25.00	15.60	7.86	13.60	66.80	8.24	23.70	151.00	150.00	79.00	89.50	151.00	65.50	122.00	145.00	69.20	149.00	23.50	138.00	1493.50
UK004	24.30	15.60	6.05	12.00	66.20	7.57	21.70	121.00	119.00	76.40	93.90	118.00	70.90	93.60	117.00	70.30	110.00	25.00	107.00	1275.52
UK005	7.16	3.14	1.71	3.76	23.00	2.59	5.10	33.5	33.30	17.50	21.60	33.80	12.30	28.50	29.70	85.30	32.60	6.02	31.60	412.18
UK006	6.45	2.48	<1	2.37	14.90	1.50	6.01	31.9	28.9	18.20	20.1	26.80	13.90	21.00	25.40	13.00	22.50	4.21	21.40	281.02
UK007	2.77	<1	<1	1.44	10.70	<1	<1	5.87	6.00	2.89	4.73	4.79	2.08	5.68	3.38	136.00	2.95	<1	6.00	195.28
UK008	1.67	<1	<1	<1	7.97	<1	1.92	11.40	11.20	6.15	6.99	9.37	4.36	7.83	8.68	6.27	7.67	<1	8.13	99.61
UK009	3.99	3.01	<1	2.27	13.40	1.50	4.33	27.90	25.90	14.50	16.80	25.90	13.50	19.90	24.10	11.20	23.90	4.33	21.20	257.63
UK010	12.40	8.88	5.72	8.34	46.70	4.71	14.30	91.80	89.70	49.50	53.10	77.40	39.70	62.50	80.40	34.10	72.80	11.30	64.00	827.35
UK011	11.90	7.56	3.11	5.53	30.90	3.33	9.47	58.30	58.80	32.40	36.70	60.90	28.40	48.80	59.40	24.30	60.60	10.70	53.30	604.40
UK012	18.80	10.40	11.00	15.30	118.00	10.30	30.20	195.00	171.00	95.10	107.00	134.00	48.10	104.00	140.00	52.00	124.00	20.30	106.00	1510.50
UK013	6.92	3.09	1.87	3.01	21.70	2.10	5.81	39.80	37.10	21.60	24.90	35.00	17.60	28.10	33.60	47.30	34.40	5.87	31.50	401.27
UK015	7.03	3.36	1.86	3.24	21.90	2.16	6.12	41.40	39.10	21.90	26.20	37.20	18.50	29.20	34.70	16.30	36.30	6.17	32.40	385.04
UK016	<1	<1	<1	<1	4.66	<1	<1	5.28	5.45	2.79	3.59	5.78	2.36	4.75	4.82	2.51	5.93	<1	5.77	53.69
UK017	1.28	<1	<1	<1	6.70	<1	1.53	10.50	10.40	5.50	6.57	8.10	3.99	6.73	8.33	3.24	7.92	1.32	7.06	89.17

Source: MMT (2019); Note: highlighted cells indicate where threshold values have been exceeded

Table 5-9 Summary of PAH (µg/kg dry weight) in sediment across UK Nearshore grab sample sites together with threshold values

ANALYTE	NAPHTHALENE	ACENAPHTHYLENE	ACENAPHTHENE	FLUORENE	PHENANTHRENE	DIBENZOTHIOPHENE	ANTHRACENE	FLUORANTHENE	PYRENE	BENZO[A]ANTHRACENE	CHRYSENE	BENZO[B]FLUORANTHENE	BENZO[K]FLUORANTHENE	BENZO[E]PYRENE	BENZO[A]PYRENE	PERLENE	INDENO[123,CD]PYRENE	DIBENZO[A,H]ANTHRACENE	BENZO[GHI]PERYLENE	SUM OF ALL
Limit of Detection	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
OSPAR ERL	160	-	-	-	240	190	85	600	665	-	384	-	-	-	430	-	240	-	85	-
CEFAS AL1	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	-
CCME PEL	391	128	88.9	144	544	-	245	1494	1398	693	846	-	-	-	763	-	-	135	-	-
CCME ISQG	34.6	5.87	6.71	21.2	86.7	-	46.9	113	153	74.8	108	-	-	-	88.8	-	-	6.22	-	-
Units	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg	µg/Kg
UK043	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	0.00
UK044	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	0.00
UK047	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	0.00
UK049	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	0.00
UK050	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	0.00

Source: MMT (2019)

5.4 Potential Pressure Identification and Zone of Influence

A scoping exercise undertaken to inform the content of the Environmental Appraisal has excluded the following pressures from consideration in this topic Chapter. Explanation for the exclusion is provided in Chapter 4, Table 4-1.

- Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion during construction, ploughing and anchoring.

The pressures listed in Table 5-10 will be assessed further. For each pressure the assessment considered the different aspects of the Proposed Development during installation, operation (including repair & maintenance) and decommissioning. In order to evaluate the most significant effects, the largest zone of influence from these aspects was selected. The zones of influence are presented in Table 5-10.

Table 5-10 Pressure identification and zone of influence – Physical Environment

Pressure	Aspect	Project Phase	Project Activity	Receptor	Zone of Influence
Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	Pre-sweeping	Installation	Seabed preparation	Subtidal sands	Select locations as identified in Table 3-4. Maximum of 63m wide.
	Trenching (Ploughing or jet-trenching)		Cable burial	Chalk bedrock	Select locations. 1m wide trench
	Trenching (Ploughing or jet-trenching)	Operation	Cable repair and maintenance		Up to 3 locations. 1m wide x 500m long
	De-trenching	Decommissioning	Cable removal		1m wide trench for entire Preferred Cable Route
Changes in suspended solids (water clarity)	Pre-sweeping	Installation Operation	Seabed preparation	Water quality	SSC above 300mg/l will occur within 250m of the cable route perpendicular to tidal flow and about 1.4km in the direction of tidal flow. Maximum deposition thickness 2mm. Note 2
	Trenching (Ploughing or jet-trenching)		Cable burial, Cable repair		
	Deposit of external cable protection		Cable protection		
	De-trenching	Decommissioning	Cable removal		
Local water flow (tidal current) changes	Trenching (Ploughing or jet-trenching)	Installation	Cable burial	Chalk bedrock	Proposed Development
	Deposit of external cable protection		Cable protection	Sediments	
		Operation	Cable repair		
Physical change to another seabed type	Deposit of external cable protection	Installation	Cable protection	Sediments	Select locations as identified in Tables 3-9 and 3-11. Maximum of 12.5m wide at crossings and 9.1m wide where required for ground conditions. Note 1
		Operation	Cable repair		3 locations 7m wide x 500m long

Pressure	Aspect	Project Phase	Project Activity	Receptor	Zone of Influence

1. Berm widths at crossings range from 9.8m to 12.5m. The maximum berm width associated with the planned Mercator / Joss crossing has been used for the zone of influence. It is possible that at the London Array crossing fronded mats will be placed around the perimeter of the crossing. This will increase the seabed footprint to a width of 20m.

2. Technical Appendix C concluded that the full extent of a suspended sediment plume is approximately 800 m perpendicular to the tidal flow and 14 km in each direction along the line of the tidal current, but that over most of the plume the increase in SSC are generally lower than baseline variations and therefore unlikely to have a significant effect on water quality. The footprint of the plume for maximum concentrations at 300 mg/l is approximately 250 m by 1.4 km, although as this is taken from the maximum concentration plot, this footprint is time independent and therefore will not all occur at once. The plume will rapidly disperse.

5.5 Embedded Mitigation

The embedded mitigation relevant to the physical environment are provided in Table 5-11 below. When undertaking the assessment, it is assumed that these measures will be complied with.

Table 5-11 Embedded mitigation – Physical Processes

ID	Embedded mitigation measure	Project Phase		
		I	O	D
EM1	Intertidal zone of the Medway Estuary at the Kingsnorth shore crossing shall be crossed by horizontal directional drilling (HDD) to avoid disturbance to the surface sediments and habitats. HDD must exit beyond the mean low water springs mark to avoid the Medway Estuary and Marshes SPA and Medway Estuary and Marshes SSSI.			
EM2	HDD drilling activities shall be conducted in a manner to minimise risk of bentonite breakout from the HDD entry or exit pits			
EM3	Submarine cables will be bundled together.			
EM4	Deployment of anchors/anchor chains on the seabed will be kept to a minimum in order to reduce disturbance to seabed and will be within the Proposed Development.			
EM5	Cable burial and protection design as detailed in the Burial Assessment Study, final crossing designs and planned and remedial final external protection designs shall be within the maximum design parameters detailed in the GridLink Marine Licence Application or robust justification for the deviations provided.			
EM6	Cables shall be installed in sand wave troughs wherever practicable, or after pre-sweeping if required, to minimise the risk or exposure by seabed mobility			
EM7	External cable protection (rock and/or mattresses) shall only be deployed where it is demonstrated that adequate burial depth cannot be achieved; the footprint of any external protection shall be the minimum required to ensure adequate cable protection and stability			
EM9	Cable protection heights and widths shall be minimised, taking into account the requirements to maintain the structural integrity of the berms.			
EM13	London Array crossing design shall comprise one continuous cable protection across all four cables (rather than four individual cable crossings) to minimise eddy currents causing scour at end of berms			
EM14	London Array crossing design shall ensure vertical separation between the cables is preserved against long term settlement whilst minimising total berm height.			
EM18	Cable protection used in NEMO Link crossing design shall minimise footprint on seabed due to presence of Goodwin Sand MCZ Sabellaria reef in area			
EM36	Project vessels will be equipped with waste disposal facilities (sewage treatment or waste storage) to IMO MARPOL Annex IV Prevention of Pollution from Ships standards.			

ID	Embedded mitigation measure	Project Phase		
		I	O	D
EM37	Ship Oil Pollution Emergency Plans (SOPEPs) shall be provided by Contractor and implemented covering all vessels in accordance with MARPOL Annex I requirements			
EM38	Ballast water discharges from all vessels shall be managed under the International Convention for the Control and Management of Ships' Ballast Water and Sediments standard			
EM39	Hazardous chemicals and materials shall be managed in accordance with applicable standards and guidelines, including maintenance of an inventory of such substances that are used and/or stored, provision of Material Safety Data Sheets (MSDSs), preparation of Chemical Risk Assessments and storage in designated, secure facilities with suitable spill protection and control			
EM41	Environmental Management Plan (EMP) shall be prepared and implemented covering all marine operations			
EM42	Emergency Spill Response Plan (ESRP) shall be prepared and implemented covering all marine operations			
EM51	Post-installation compass deviation surveys shall be carried out where the cables are not bundled together due to the shore crossing (KP0.0 and KP1.0) or other reason and water depths are <10m; the results of any compass deviation shall be provided to UKHO and MCA			
EM53	Any post-lay cable exposure for whatsoever reason shall be published in the Kingfisher Information System, Notified to Fishermen and guarded until remedial works are completed			

5.6 Significance Assessment

5.6.1 Summary of assessment

Table 5-12 and Sections 5.6.2 to 5.6.5 present the assessment conducted on the Proposed Development. Where the assessment concluded the effects are potentially significant, Project Specific Mitigation has been proposed and is described in Section 5.7. Where there is potential for residual effects after the Project Specific Mitigation, this is discussed further in Section 5.8.

Table 5-12 Assessment summary – physical environment

Section	Determination of Potential Effect					Significance Assessment			Consideration of Mitigation	Residual Effect Assessment		
	Project Phase	**Aspect**	**Potential pressure**	**Embedded Mitigation (Table 5-11)**	**Receptor**	**Magnitude**	**Sensitivity**	**Significance**	**Project Specific Mitigation (Table 5-16)**	**Magnitude**	**Sensitivity**	**Significance of Residual Effect**
5.6.2	Installation	Pre-sweeping	Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	EM3, EM6	Subtidal Sands	Low	Medium	Minor	-	Low	Medium	Minor
	Installation Operation	Trenching (Ploughing or jet-trenching)		EM3, EM5	Chalk Bedrock	Low	Medium	Minor	PS4	Low	Medium	Minor
	Decommissioning	Cable removal										
5.6.3	Installation	Pre-sweeping	Changes in suspended solids (water clarity)	-	Water Quality	Low	Low	Negligible	-	-	-	-
	Installation Operation	Trenching (ploughing and jet trenching)				Low	Low	Negligible	-	-	-	-
	Installation Operation	Deposit of external cable protection				Negligible	Low	Negligible	-	-	-	-
	Decommissioning	Cable removal				Low	Low	Negligible	-	-	-	-
5.6.4	Installation Operation Decommissioning	External cable protection	Water flow (tidal current changes)	EM5, EM7, EM9, EM13, EM14	Chalk Bedrock	Low	Medium	Minor	PS4	Low	Medium	Minor
					Sandy Sediments	Low	High	Moderate	PS1, PS2, PS3	Negligible	High	Minor

Section	Determination of Potential Effect					Significance Assessment			Consideration of Mitigation	Residual Effect Assessment		
	Project Phase	**Aspect**	**Potential pressure**	**Embedded Mitigation (Table 5-11)**	**Receptor**	**Magnitude**	**Sensitivity**	**Significance**	**Project Specific Mitigation (Table 5-16)**	**Magnitude**	**Sensitivity**	**Significance of Residual Effect**
5.6.5	Installation Operation	External cable protection	Physical change to another seabed type	EM5, EM7, EM9, EM13, EM14	Sandy sediments in Protected site	Low	High	Moderate	PS1, PS2, PS3	Negligible	High	Minor
					Other sediments in Protected site	Low	Medium	Minor	PS4	Low	Medium	Minor
					Other sediments	Low	Medium	Minor	-	Low	Medium	Minor

5.6.2 Penetration and / or disturbance of the substrate below the surface of the seabed, including abrasion

5.6.2.1 Installation

The scoping exercise concluded that for most receptors this pressure could be scoped out as changes to the seabed will be temporary in nature. The MMO raised a concern that within the Medway Estuary there is the potential that sediments may be less mobile and possibly natural hydrodynamic processes would not bury the cable if backfilling was not undertaken.

A detailed cable burial risk assessment has been undertaken for the Proposed Development which has identified the recommended minimum depth of lowering and target depth of lowering (TDOL) values for the cables. Due to high traffic densities and in places the presence of extremely low strength clay (within which anchors will penetrate very deeply) the TDOL is generally 1.7m but it does vary along the Preferred Cable Route, reaching up to 3.5m in the Medway Estuary. Proper burial to the TDOL is a key design constraint of the Proposed Development and it is important that the trench is filled to achieve this.

Within the Medway Estuary, between KP0.41 and KP7.1 it is likely that an advanced cable plough with vertical injectors will be required to achieve the 3.5m TDOL. Deep burial ploughs use water jets fitted within the plough share to fluidise material at the leading edge of the share. The installation technique does not leave an open trench and will leave the seabed near its original state. A shallow depression may be observed directly over the cable, as finer fractions of sediment suspended during the burial process are dispersed by currents. However, the depression will be a temporary feature with local sediment transport filling it in. The cables will be bundled together in one trench (embedded mitigation EM3), which will reduce the footprint of effects.

Two other sedimentary areas were identified as potentially being sensitive to the pressure: areas of outcropping and sub cropping chalk bedrock; and subtidal sands. These are discussed below:

Chalk Bedrock

Stiff/hard clays and chalk bedrock are prevalent within the Proposed Development between KP13-KP14, KP40 and KP47, KP70 to KP74 and at KP108.8. Stiff/hard sediment and bedrock may cause problems with reaching the required burial depth, therefore will require cutting to create a trench or the use of external cable protection to ensure the Proposed Development is buried to a sufficient depth. The spatial extent of cutting would be localised, approximately a 1m wide trench, however it is unlikely that a trench of this nature will be completely backfilled, leaving a visible depression/scar on the seabed. The stiff/hard sediments are a result of extensive years of compaction; therefore, it will take a relatively long period of time for clays and silts to deposit and compact to reach pre-installation levels. A remnant depression may remain until the sediment has sufficiently compacted.

It cannot be guaranteed that the seabed will recover to its pre-installation state where trenching is carried out in areas of chalk bedrock. The effects of penetration and disturbance of this sediment have the potential to be long-term, however they will be highly localised, restricted to the width of the trench (up to 1m). Consideration has been given as to whether mechanical backfill would be a viable solution at these locations but has been discounted as likely to cause wider disturbance than the installation. Due to the small footprint of any remnant trench it is unlikely there will be wider effects such as changes to sediment transport pathways.

The magnitude of effect has been assessed as low, based on the extremely localised disturbance in relation to the wide area covered by these sediment units. The sensitivity of the receptor has been assessed as medium as some damage will occur but the integrity of the sediment units overall will not be affected. The overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

As best practice, Project Specific Mitigation (PS4) has been proposed and is presented in Section 5.7.

Subtidal Sands

Pre-sweeping has the potential to effect subtidal sands. Review of the geophysical and geotechnical survey data has provided preliminary (indicative) locations at which pre-sweeping may be required. These ten locations are illustrated in Figure 3-11 (Drawing P2172-LOC-006) with further detail provided in Table 3-4. Notable areas include at Sheerness Middle Sand, South Fall sand bank (KP93 – KP95) and Sandettie sand bank (KP105 – KP109).

The process of clearing an installation track through the sandwaves will create a short-term change to the morphology of the sandwaves. The area to be pre-swept must be wide enough for the passage of the trenching equipment at the base of the sandwave; which is typically 10-20m wide. Depending on the height of the sandwave, the corridor at the crest may be wider to ensure the sides of the trench do not collapse onto the equipment. The maximum clearance width has been calculated at 63m (Sandettie Sandbank, KP105-KP109), with most locations requiring a width of 45m or less.

If mass flow excavation is used, the material is retained within the system, just pushed to either side; with dredging, the material is effectively moved to a different place within the Proposed Development, where it is re-deposited.

Due to the dynamic nature of sediments in the southern North Sea it is expected that the features of the system are likely to reform and recover in areas of active sandwaves. The sediment will likely be reworked by wave action and migrate across, filling the area cleared and trenched. The rate of recovery at each location varies on the rate of sediment transport, i.e. faster infill and recovery rates will be associated with higher flow speeds and frequent wave influence. Based on flow speeds, water depths and sediment availability, the Southern North Sea is an active and dynamic sediment environment that is conducive to the development and maintenance of sandwaves. The availability of sand to form sandwaves as a result of sediment transport processes and its continuation means there is a constant potential for new sandwaves to be established and the process will not be disrupted by the pre-sweeping works. The shape of sandwaves may recover to its original condition (i.e. a single crest feature), however may be displaced in the direction of normal migration resulting from sediment transport and waves. Timescales for recovery are expected to be in the order of 1 – 2 years for the trenching scar to be covered by the sand waves.

The magnitude of the effect has been assessed as low. This is the worst-case and represents the magnitude of the effect should pre-sweeping be undertaken by suction hopper dredging, over a maximum width at the crest of 63m, and with the spoil deposited within the Application Area but down-current of the sandwave system it has been removed from. It should be noted that the magnitude of effect will depend on the scale of pre-sweeping, the installation technique used and how sediment is retained within the system. The magnitude of effect would be of a lesser extent using mass flow excavation and/or if sediment is returned to the seabed up-stream of the sandwave allowing it to migrate back on to the disturbed sandwaves. Disturbance will be a one-off event causing a very localised change.

The sensitivity of the receptor has been assessed as medium, as although most locations are within protected sites the sandwaves are all considered to be part of active systems and therefore replenishment and recovery of these features to their baseline condition is possible in the short term. In addition, of the ten locations identified the physical feature of only two sandwaves are recognised as a designated feature of a protected site, as listed below:

- Two of the locations (KP42.15 – KP42.35 and KP42.527 – KP42.717) lie within the Margate and Longsands SAC and due to their water depth (<20m) would fall within the category of the Primary Feature 'Sandbanks which are slightly covered by sea water all the time'.
- A sand wave between KP66.57 - KP66.71 is also within the Margate and Longsands SAC but forms part of the habitat sub-features rather than a physical aspect of the Primary Feature.

- A sand wave at KP83 – KP83.39 lies within the Goodwin Sands Marine Conservation Zone (MCZ). Sandbanks are not a Protected Feature for this site.
- Four locations (KP101.83 – KP102.4, KP102.58 – KP102.7, KP103.08 – KP103.240 and KP105 – KP108) either are within or partly overlap with the Foreland MCZ. Sandbanks are not a Protected Feature for this site.

It should be noted that the effects on habitats associated with these physical features is discussed in Chapter 6 and Technical Appendices E and F.

The overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

5.6.2.2 Operation (including maintenance and repair)

No seabed disturbance will occur from the operating cables. Effects during any unforeseen repair and maintenance works will be of a smaller magnitude when compared to cable installation. The assessment considered three discrete cable repairs during operation of up to 500m in length and concluded the significance of the effect as **Minor** and is **Not Significant** for bedrock and stiff/hard sediments and areas of sandwaves requiring pre-sweeping.

5.6.2.3 Decommissioning

Two decommissioning options have been assessed including leaving the cables in-situ and recovery and removal of the cables. If the cables are left in-situ there will be no effect on sediments during decommissioning. However, if the option to remove the cables (and any associated production) is selected, this process would essentially be the same as installation activities but in reverse. Therefore, any effects that could arise due to the decommissioning phase of the Proposed Development will be of a comparable magnitude to those assessed above for cable installation and so the effect has been assessed as **Minor** and is **Not Significant** for chalk bedrock and stiff/hard sediments and areas of sandwaves requiring pre-sweeping.

5.6.3 Change in suspended solids (water clarity)

5.6.3.1 Installation

Seabed preparation (pre-sweeping) and cable burial (ploughing and/or jetting) will briefly change suspended sediment concentrations (SSC) (increasing turbidity). An increase in SSC has the potential to indirectly affect biological receptors by reducing light levels or as sediment is re-deposited on surrounding habitats.

Within the Medway Estuary, SSC's are generally low, ranging between 0.1mg/l to 30mg/l. However, SSC's in the Thames Estuary are typically higher, ranging from 100mg/l to 1000mg/l. SSC's in the Southern North Sea rarely exceed 20mg/l (CEFAS 2016) but vary seasonally, with concentrations increasing in autumn and winter.

The extent of suspension, dispersion and re-deposition is to a large extent a function of the sediment being disturbed as follows:

- Sand and gravel disturbed during the cable burial operations will settle back to the seabed very swiftly and the footprint is unlikely to extend any great distance from the Preferred Cable Route.
- Silts, clay and chalk particles will remain in suspension for a greater time period and will be dispersed over a much greater distance, depending upon the strength of tidal currents. However, the depth of deposition over such a large area is very small.

Intertek have utilised an existing in-house hydrodynamic model (NSCMS)[5] covering the area of interest to estimate the likely extent and duration of elevated SSC due to the cable trenching activity, and the

[5] The model used is Intertek's North Sea and Channel Modelling System (NSCMS). The NSCMS is a two-dimensional (2D) hydrodynamic and water quality model which has been calibrated and validated against a range of current velocity and

footprint and thickness of the disturbed sediment following deposition on the seabed. The NSCMS model has been used to model a moving discharge of sediment, released into the water column over a 24-hour period, to represent the disturbed sediment due to cable trenching activity along a discrete section of the Preferred Cable Route. A section between KP19 and KP21.4 was selected due to the proximity to two sensitive shellfish areas (as provided by the Kent and Essex Inshore Fisheries and Conservation Authority).

The results from this modelled section of the Preferred Cable Route can be extrapolated along the Proposed Development to provide an indication of the likely resulting SSC and sedimented material along the Preferred Cable Route. However, it should be acknowledged that the hydrodynamic conditions will vary along the route. For this reason, current velocities have been extracted from the NSCMS at seven other locations along the Preferred Cable Route in order to provide an estimate of the likely orientation and extent of SSC plumes and deposition footprints throughout the Proposed Development. These current speeds have also been used to estimate the distance sediments suspended by cable trenching are likely to travel before settling out of suspension.

Technical Appendix C presents the findings of the modelling exercise. It concludes that:

- Sands and gravels
  - Do not form part of the suspended sediment load and will settle very quickly (within about a minute for sand and seconds for gravel).
  - Deposition will occur within a short distance of the Preferred Cable Route; approximately 35m for sand and up to 4m for gravel.
  - The maximum deposition thickness along the Preferred Cable Route is calculated as 10.5mm for sand and 50.5mm for gravels.
- Fine fractions (silt and clay)
  - Disturbed silt and clay size particles are likely to remain in suspension over periods of hours to days, depending on particle size.
  - The full extent of the plume is approximately 800 m perpendicular to the tidal flow and 14 km in each direction along the line of the tidal current, but that over most of the plume the increase in SSC are generally lower than baseline variations (<30mg/l) and therefore unlikely to have a significant effect on water quality.
  - Concentrations are highest around slack water, due to the lower rates of advection and dispersion, with typical values between 150 mg/l to 250 mg/l, although peak values are up to 1000 mg/l. These peaks are very transitory and reduce quickly as tidal currents increase. Concentrations during peak flows (both ebb and flood tides) reach a maximum of about 60 mg/l.
  - The footprint of the plume for maximum concentrations at 300 mg/l is approximately 250 m by 1.4 km, although as this is taken from the maximum concentration plot, this footprint is time independent.
  - Following the end of the release of sediment, concentrations in the plume reduce to below 30 mg/l (approximate typical background level) within 40 minutes, and to below 10 mg/l within 5 hours and 40 mins.
  - The modelled deposition thicknesses are small. The footprint of 1 mm of silt deposition covers an area of approximately 500 m by 75 m, with a maximum thickness of 1.3mm.

water level data at multiple sites, using the Foundation for Water Research guidelines. The model has been accepted as fit for its original intended use (Bathing Water impact assessments) by the Environment Agency.

- Within the Medway Estuary, due to a deeper trench the maximum deposition thickness for fine sediment is likely to be in the range of 2mm.

The Proposed Development will result in temporary increase in SSC's. The magnitude of the increase will be dependent on the seabed conditions. However, calculations indicate the concentrations will be within the range of natural variability expected for the region, will be limited in extent and brief in nature. The magnitude of the effect has been assessed as low, as the level of change is reversible and there will be no effect on the baseline character. The sensitivity of the receptor has been assessed as low recognising the generally low levels of suspended sediments in the Medway Estuary but the high concentration variability within the Thames Estuary. The overall significance of effect is **Negligible** and is **Not Significant.**

5.6.3.2 Operation (including maintenance and repair)

During operation, the requirement for jetting or ploughing would be limited to discrete repair locations, for example to where the cable needs to be reburied. In this event, jetting and / or ploughing would lead to the localised release of suspended particulate matter, however similarly to installation, areas of gravel and sand would re-settle swiftly. Finer clays and silts would also be mobilised in small volumes, however these will quickly disperse in tidal currents and will re-deposit on the seabed in an immeasurable thickness. Based on the above, the magnitude of the effect has been assessed as negligible. The sensitivity of the receptor remains as low, therefore the overall significance of effect is **Negligible** and is **Not Significant**.

5.6.3.3 Decommissioning

If the cables are left in-situ there will be no effect on sediments during decommissioning. However, if the option to remove the cables (and any associated production) is selected, this process would essentially be the same as installation activities but in reverse. Therefore, any effects that could arise due to the decommissioning phase of the Proposed Development will be of a comparable magnitude to those assessed above for cable installation and so the effect has been assessed as **Negligible** and is **Not Significant.**

5.6.4 Water flow (tidal current) changes – local

5.6.4.1 Installation and Operation

Several aspects of the Proposed Development have the potential to cause localised water flow changes namely; excavation at the HDD exit point; and deposit of external cable protection. Of these the deposit of external cable protection has the most potential to cause significant localised changes, with the main direct effect of a change in water flow being scour of the seabed.

Excavation at the HDD exit point

If the HDD is driven from onshore there is the possibility that the end of the duct will need to be dug out using an excavator, just prior to cable pull-in. In this scenario, material excavated could be left adjacent to the HDD exit point and refilled after the cable pull-in. The timing between excavation, pull-in and re-burial would be brief (a couple of days) to ensure the ducts do not become filled with debris. If left on the seabed, excavated material has the potential to influence wave energy to the shore resulting in a localised morphological change in the intertidal area e.g. scour or increased sedimentation. However, it is important to note that the HDD exit pit and associated spoil mound would be temporary in nature before the excavated material is used to back fill the pit. The potential for longer term morphological change arising from alterations to the hydrodynamic and/or wave regime is therefore low.

External cable protection

The aspect of Proposed Development which has the greatest potential to cause water flow changes is the deposit of external cable protection at cable crossings or in challenging areas of seabed where

TDOL may not be reached. Typically, it is the action of waves on seabed sediments that causes the development of pits, roughs or depressions (i.e. scour) in the seabed sediment around the edges of external cable protection. Where this modifies the seabed from its natural state it can affect sensitive receptors through habitat alteration and rate of additional sediment suspension.

The depth at which waves can affect seabed sediments is a function of the wavelength. Below a depth of half the wavelength, the water column is unaffected by wave energy. Wave energy also decreases with depth. Wavelength (L) can be calculated using the calculation L = C X T where C is wave speed and T is wave period. The wave periods in the eastern English Channel are in the region of 10s (Uncles and Stephens 2007), with wave periods in the Thames Estuary shorter at between 1.5s to 6.1s (Environment Agency 2011). The speed of a wave (C) in shallow water depends on water depth (D) and is equivalent to 3.1/D. Using these equations, the wave lengths at the positions of external cable protection have been calculated and are shown in Table 5-15. Review of Table 5-15 indicates that due to the water depth at most locations the seabed is unlikely to be affected by wave energy and therefore wave induced scour is unlikely around external cable protection. This holds true even with the reduction in water depth caused by the height of the external cable protection. The exception is Zone 10 (KP13.3 to KP13.9) where wave lengths could be up to over 12m.

Table 5-13 Calculated wave lengths

Location	Water Depth (D)	Wave speed (C)	Wave Period (T)	Wave lengths (L)
	m	m/s	s	m
London Array	15.8	0.196	6.1	1.20
Joss	16.4	0.189	10	1.89
Thanet	16.9	0.183	10	1.83
NEMO	22.1	0.140	10	1.40
PEC	20	0.155	10	1.55
Tangerine	17.6	0.176	10	1.76
Atlantic Seg	36.5	0.085	10	0.85
Zone 10	1.53	2.026	6.1	12.36
Zone 42	11.59	0.267	10	2.67
Zone 43	13.07	0.237	10	2.37
Zone 44	10.8	0.287	10	2.87
Zone 46	13.3	0.233	10	2.33
Zone 50	14.27	0.217	10	2.17

The deposition of external cable protection can also result in turbulent flow from acceleration or deceleration of tidal flow over the cable protection structure. The magnitude of turbulence created by external cable protection corresponds to the shape and size of the protection. It is considered that hydrodynamic changes as a result of the low profile external cable protection will be highly localised with turbulent flow present for several metres downstream of each cable protection structure.

Scour will only occur in areas of sediment where bottom current either already exceeds the critical bedload parting velocity, or where external cable protection results in an increase in current velocity to above the critical bedload parting velocity. The type of sediment that the external cable protection lays upon can also have a large influence on the potential for scouring. Based on the locations of external cable protection, sediments have been split into two categories in recognition of their differing sensitivities: Sandy sediments and chalk bedrock. Consideration has also been given to

whether the sediment supports a protected habitat. For example Chapter 3, Table 3-9 identifies that three crossings are located within a protected site designated for a habitat feature. The London Array wind farm export cables crossing is within the Margate and Longsands SAC and is sited on sandy sediment and therefore may be prone to scouring; whilst the Tangerine telecoms and NEMO Interconnector crossings are within the Goodwin Sands MCZ but are sited on stable circalittoral sediments rather than loose sediment and therefore are less likely to be prone to scour. Chapter 3, Table 3-11 identifies areas of challenging sediments where external cable protection may be required due to ground conditions. Of these locations, one is within the Goodwin Sands MCZ.

Sandy sediments

Of the locations sited in sandy sediments, the crossing with London Array has been identified as the most sensitive in terms of potential for scour.

Roulund et al (2019a) and Roulund et al (2019b) concur that scour is prone to develop in strong current environments where the external cable protection is aligned oblique or perpendicular to the prevailing currents. However, sediment conditions are a key component and rock bed and stiff clays may prevent scour development. Rock berms aligned more parallel to the current experience no or less scour.

To reduce the likelihood of scour occurring the Applicant incorporated measures into the design of the London Array crossing. A crossing location in relatively deep waters has been identified. The crossing shall comprise one continuous cable protection across all four cables (rather than four individual cable crossings) to minimise eddy currents causing scour at the end of berms (embedded mitigation EM13). In addition, the London Array crossing design shall ensure vertical separation between the cables is preserved against long term settlement whilst minimising total berm height (embedded mitigation EM14). This will be achieved by using a cable separation system such as URADUCT.

The sensitivity of the sediments at the London Array crossing has been assessed as high, as they are a sub-feature of the Primary Feature of the Margate and Longsands SAC. The magnitude of the effect has been assessed as low because although there it is a strong possibility that scour will occur, it will be very localised, confined to the area around the external cable protection.

In conclusion, the overall significance of the effect has been assessed as **Moderate** and is **Significant**.

Project Specific Mitigation has therefore been proposed, PS1, PS2 and PS3 to reduce the significance of the residual effect. This is discussed in Sections 5.7 and 5.8.

Chalk bedrock

The soft and friable nature of chalk bedrock means that chalk is easily eroded by water energy and movement. Medium dense structureless chalk has been identified between approximately KP70 and KP108. Within this section of the Proposed Development, Table 3-11 indicates that 1.955km of external cable protection may be deposited (within Zones 43 to 50). The chalk in this area is overlain by a thin veneer (0.2m – 0.5m) of very loose sand or very loose gravel.

The sensitivity of chalk bedrock has been assessed as medium because relative to sandy sediments, chalk bedrock is not as sensitive to scour based on the compact nature of chalk bedrock deposits. Chalk is more cohesive than sand and a large change in tidal flow would be required to cause significant scour in areas of chalk bedrock. The presence of a sediment veneer over the chalk will also offer protection.

The magnitude of effect has been assessed as low. The maximum height of external cable protection in the assessed areas ranges from 0.95m – 1.15m. Considering the relatively low profile, external cable protection may lead to localised water flow turbulence but it is expected to return to baseline levels within several metres. Analysis of the geophysical survey data has not identified any areas were wave action is currently causing scour of the seabed and therefore it is not expected that the reduction in water depth as a result of the external cable protection will cause wave induced scour.

The overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

As best practice, Project Specific Mitigation (PS4) has been proposed and is presented in Section 5.7.

Sediment transport

The description of this pressure also includes sediment transport considerations, e.g. whether the installation of the external cable protection could affect sediment transport, particularly within the Medway Estuary and for intertidal habitats. As discussed in Section 5.3.3, the most important source of sediment to the Medway Estuary is the offshore supply of suspended fine sediments from the Greater Thames Estuary with further supplies from relict sediments within saltmarshes and alluvium and sediment from London Clay Cliffs. Considering the localised nature of water flow changes and with the nearest external cable protection measure being at KP13 and in general sediment transport occurring in a north-east to south west orientation (HR Wallingford 2002), sediment transport in the Medway Estuary and intertidal habitats will not be affected.

5.6.5 Physical change (to another seabed type)

5.6.5.1 Operation

Where external cable protection is required, e.g. at the crossing locations, and in areas where burial in sediment cannot be achieved, there will be a localised change in seabed sediment type. The cables will be laid bundled in one trench (embedded mitigation EM3), which will reduce the potential spatial footprint of the change. External cable protection will only be deployed where it is demonstrated that adequate burial depth cannot be achieved; the footprint of any external protection shall be the minimum required to ensure adequate cable protection and stability (embedded mitigation EM7).

Sediments where external cable protection is potentially necessary range from very loose sand to high strength clay underlying sand to medium dense structureless chalk.

External cable protection will likely consist of rock in the size range of 2-22cm. This will represent a coarsening of the sediment. Up to 28,575m^2 of seabed could be affected, if all indicative locations are required. The sediments identified cover large areas of the North Sea and the Proposed Development.

The assessment considered three categories of sediment; sand sediments in protected sites; other sediments in protected sites; and all other sediments.

Three crossing locations where external cable protection is required are located with a protected site designated for habitat features. Of the three locations, the crossing of the London Array windfarm export cables within the Margate and Long Sands SAC is considered the most sensitive. Crossings of the Tangerine telecoms cable and NEMO Interconnector will also be made with the Goodwin Sands MCZ.

Sand sediments in protected sites

The London Array crossing is in a sand environment where the deposit of external cable protection will markedly change the sediment. The sand habitat at the crossing location is a sub-feature of the Primary Sandbank Feature of the SAC and has therefore been assessed as having a high sensitivity to change. The magnitude of the change has been assessed as low given the localised nature of the deposit in relation to the wider area of sand habitat within the SAC. The overall significance of the effect has been assessed as **Moderate** and is **Significant**. The effect of external cable protection on Sandbanks within Margate and Longsands SAC has been assessed further within Technical Appendix E.

Project Specific Mitigation has therefore been proposed, PS1, PS2 and PS3 to reduce the significance of the residual effect. This is discussed in Sections 5.7 and 5.8.

Other sediments in protected sites

Protected features of the Goodwin Sands Marine Conservation Zone (MCZ) include the *Sabellaria spinulosa* reef habitat, subtidal sands and subtidal coarse sediment. The sand and gravelly sand between KP81.7 and KP91.6 support this habitat. External cable protection for the Tangerine telecommunications cable and NEMO interconnector as well as to achieve TDOL in an area of chalk bedrock are required in this area, therefore external cable protection has the potential to alter the sedimentology of the habitat, considered an important element of the structure and function of the *Sabellaria spinulosa* protected feature. The extent of *Sabellaria spinulosa* is not available for the Goodwin Sands MCZ, however the UK Offshore Environmental Survey Report identified both medium and low grade biogenic *Sabellaria spinulosa* reef. The medium grade habitat was primarily between KP81.4 and KP85.5 with the habitat decreasing in intensity towards the Proposed Development. The UK Offshore Environmental Survey Report identified that low grade *Sabellaria spinulosa* reef was distributed quite widely within the survey corridor. The footprint of the external cable protection within this habitat will cover approximately 14,105m^2 including 1093m^2 at the Tangerine crossing, 1021m^2 at the NEMO interconnector crossing and approximately 11,991m^2 within Zone 50.

Despite the overall extent of *Sabellaria spinulosa* reef within the Goodwin Sands MCZ not being known, the magnitude of the effect has been assessed as low. While the external cable protection features will be permanent *Sabellaria spinulosa* shows no preference for a particular habitat and can recover very quickly. In addition, the changes to sediment type which affects the character of the baseline will be localised. The sensitivity of the receptor has been assessed as medium, recognising that it is a protected feature within the Goodwin Sands MCZ. The overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

For further information, this potential effect has been considered within the Marine Conservation Zone Assessment (Technical Appendix F). Stage 1 Assessment concluded no likely significant effects or any hinderance to achieving conservation objectives.

As best practice, Project Specific Mitigation (PS4) has been proposed and is presented in Section 5.7.

All other sediments

Based on the extents of the other sediments within the Proposed Development and North Sea, where external cable protection will or may be required the physical change to another seabed type due to external cable protection will be highly localised. The magnitude of effect has been assessed as low and the sensitivity of the receptor is considered medium. The overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

5.7 Project Specific Mitigation

In addition to the embedded mitigation discussed in Section 5.5, Table 5-16 presents Project Specific Mitigation that will be implemented.

Table 5-14 Project Specific Mitigation Physical Environment

ID	Project Specific Mitigation
PS1	London Array crossing design shall incorporate fronded mats either as individual gravity secured mats or as attached to tapered concrete mattresses in conjunction with cable protection to facilitate sediment capture and reduce scour. The objective shall be to cover the external cable protection with sand to minimise fishing disruption to bottom drift netting and trawling and return the seabed to a sand habitat within the Margate and Longsands SAC.
PS2	Subject to agreement with asset owner and thermal calculations consideration shall be given to reducing the crossing angle (from 90 degrees) for the London Array crossing to orientate the crossing with the tidal flow and direction to minimise risk of scour.
PS3	The London Array crossing design shall encourage natural resedimentation of the crossing.

ID	Project Specific Mitigation
PS4	The cable burial and protection strategy shall adhere to the following two principles, in order of priority: 1. Achieving Target DOL along the route so External Protection is not required and in particular no use of External Protection in MCZs and SACs. 2. Minimise any displacement of seabed which may not recover naturally within 2-3 years of installation (or else include methods to restore or aid the restoration of the seabed where viable).

5.8 Residual Effects

The assessment presented in Table 5-12 indicated that two pressures could potentially have effects of Moderate significance on the physical environment. Therefore, Project Specific Mitigation has been applied to reduce the effect. As best practice, Project Specific Mitigation has also been applied to Minor effects to further reduce their significance, despite them not being significant. The significance of these pressures was re-assessed taking into consideration the Project Specific Mitigation outlined in Section 5.7 to determine if a significant residual effect remains.

5.8.1 Water flow (tidal current) changes – local

The assessment concluded that external cable protection for the London Array cable crossing has the potential to result in effects on sandy sediments (a sub-feature of the Primary Feature of the Margate and Longsands SAC) which are Moderate and Significant.

Careful consideration has been given to how the potential for scour can be reduced at the crossing. It is proposed (Project Specific Mitigation PS1) that the crossing design will incorporate fronded mats which aim to capture sediment around the external cable protection. As local currents transport sediment through the fronds, the fronds locally interrupt and reduce the velocity of the near bottom currents, preventing scour from occurring. Transported sediment drops out of suspension due to the velocity change and builds up to form an embankment on and around the mats. Both current and waves induce movement of the fronds across the vertical plane, which vibrates the sediment and leads to compaction creating a reinforced sand bank which provides additional stability and eliminates edge scour.

In addition, depending on the technical design requirements, the crossing angle may be reduced from 90 degrees to align the external cable protection to tidal flow (Project Specific Mitigation PS2). Changing the crossing angle to present less of a barrier to tidal flow will reduce turbulent flow at the crossing and subsequently reduce scour.

Project Specific Mitigation (PS4) requires the cable installation contractor to seek to achieve target depth of lowering without the need for external cable protection. Removing the requirement for external cable protection will remove the pressure-receptor pathway entirely resulting in no effect. Although this will not be feasible at crossings, it is anticipated that at least some of the areas assessed as locations for external cable protection due to ground conditions will not be required.

This Project Specific Mitigation enables the significance of the potential effects to be reduced to **Minor** and **Not Significant**.

5.8.2 Physical change (to another seabed type)

The assessment concluded that the use of external cable protection has the potential to have a Moderate and Significant effect on sandy sediments within the Margate and Long Sands SAC. As external cable protection is required on sub-features that form part of the Primary Feature, Project Specific Mitigation has been proposed to reduce the significance of the effect with the aim to capture sediment over the rock berm returning the location to a sand veneer.

PS1 aims to recapture sandy sediments over the top of the London Array crossing by using frond mats and PS3 places an obligation on the Installation Contractor to ensure re-sedimentation of the crossing is considered the design.

It is anticipated that fronded mats will be placed around the entire perimeter of the crossing and discussions with the manufacturer have also indicated that it may be feasible to place mats over the external cable protection as well. The use of fronded mats is a permanent solution. Although a storm could erode sand from the fronds, exposing the berm, the fronds will then recapture sediment to re-cover the berm. Therefore, there may be periods when the berm/fronded mats are not covered in sand but this will be only for short periods of time. Based on the above, the significance of the residual effect has been re-assessed as **Minor** and **Not Significant**.

Further assessment is provided in the Marine Habitats Regulations Assessment – Technical Appendix E to support this conclusion.

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6. PROTECTED AREAS

There are international and national protected sites of conservation value near and in the wider region of the Proposed Development. To ensure that the Proposed Development does not have a significant effect on protected sites, either alone or in combination with other plans or projects, a Habitats Regulations Assessment (HRA) and Marine Conservation Zone (MCZ) Assessment have been carried out to support the competent authority's decision-making process under the relevant legislation.

This chapter explains the HRA and MCZ assessment process and summarises the findings of both assessments; provided as Technical Appendices E and F.

Through consultation with Natural England it was agreed that breeding marsh harrier from Medway Estuary and Marshes Site of Special Scientific Interest (SSSI) should also be assessed in the HRA. The assessment for the other features of this site are captured by the assessment of the Medway Estuary and Marshes Special Protection Area (SPA) as the designations overlap.

The Proposed Developed also crosses the Pan Sand Hole Kent and Essex Inshore Fisheries and Conservation Authority (KEIFCA) byelaw area. An assessment of the potential effects on the designated features of this site are provided in Chapter 7 and are summarised in this chapter.

6.1 Relevant Protected Areas

Table 6-1 describes the site designations found near and in the wider region of the Proposed Development and briefly describes the legislative basis they are adopted under.

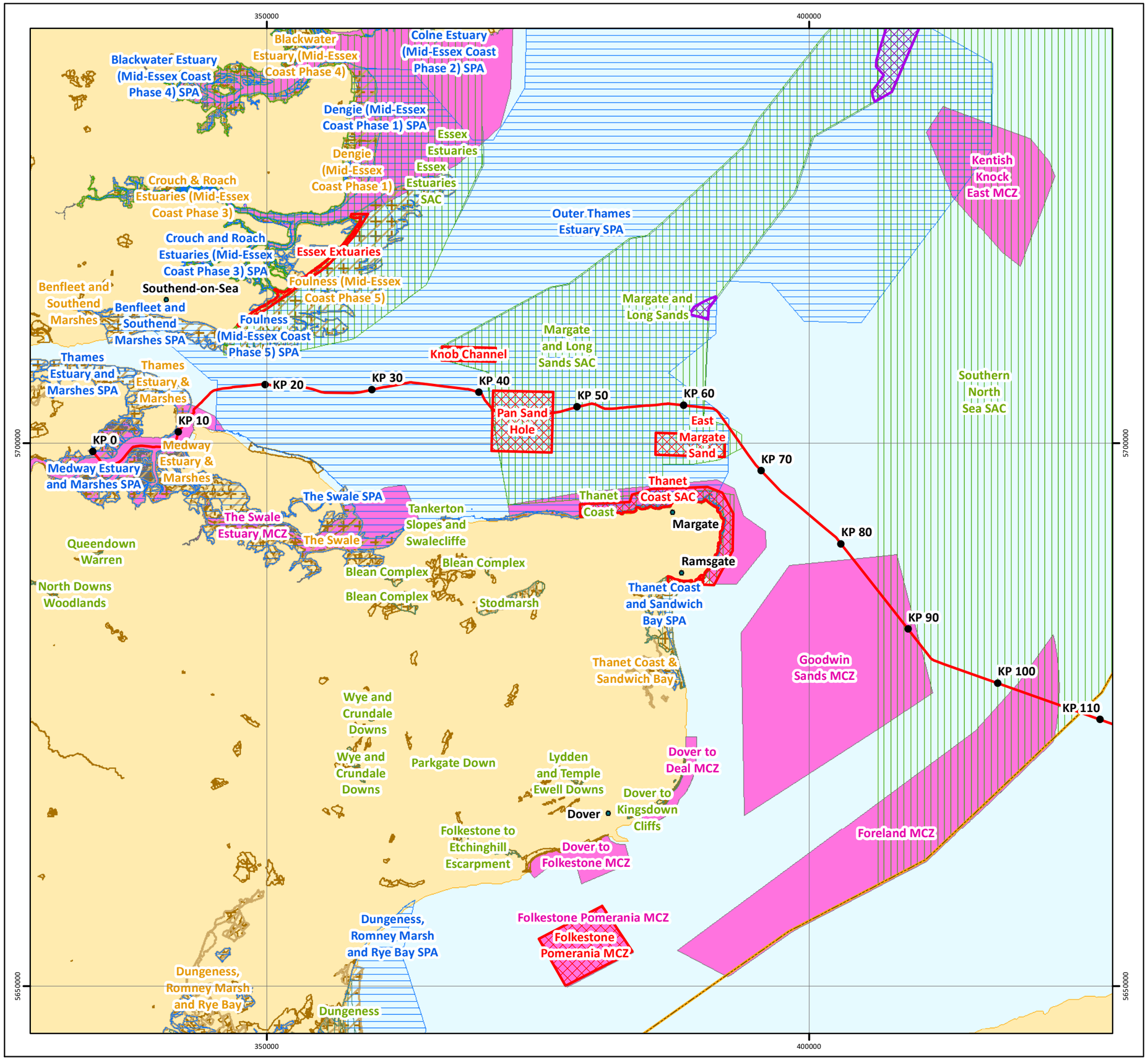
Table 6-1 Conservation designations

Designation	Description
Special Area of Conservation (SAC)	Protected sites for habitats/species listed under Annexes I and II of the Habitats Directive. In the UK SAC's are designated under the Conservation of Habitats and Species Regulations 2017 (COHSR) and the Conservation of Offshore Marine Habitats and Species Regulations 2017 (COMHSR).
Special Protection Area (SPA)	Protected sites for rare and vulnerable birds listed under Annex I of the Birds Directive. SPA's are designated in the UK under the Wildlife and Countryside Act 1981 and the Conservation (Natural Habitats, & c.) Regulations 2010 (as amended) for terrestrial sites, and under the COMHSR 2017 for offshore sites.
Ramsar Sites	Sites designated under the International Treaty for The Conservation and Sustainable Use of Wetlands. In the UK a wetland site meeting one or more of the treaties designated criteria can be designated and is commonly referred to as a Ramsar site. For the purposes of legislation and management Ramsar sites are generally designated in association with relevant European sites and conservation objectives and advice on operations are provided as part of the relevant European/European marine site.
Marine Conservation Zones (MCZ)	The Marine and Coastal Access Act 2009 (MCAA) allows for the creation of MCZs. MCZs protect a range of nationally important marine wildlife, habitats, geology and geomorphology, and can be designated anywhere in English and Welsh territorial and UK offshore waters. Additionally, the MCAA allowed for the conversion of previously designated Marine Nature Reserves to MCZ's.
Sites of Special Scientific Interest (SSSI)	Areas of land that have been identified by scientific survey as being of the highest degree of conservation value. SSSIs are protected by law to conserve their wildlife or geology. In England and Wales, SSSI's are notified under the Wildlife and Countryside Act 1981 as amended (primarily by the Countryside and Rights of Way Act 2000).
Kent and Essex Inshore Fisheries and Conservation Authority (KEIFCA) Byelaw Area	Areas identified under a KEIFCA Byelaw passed in 2017 where bottom-towed fishing gear is prohibited. The purpose of the Byelaw is to provide protection of designated features and habitats and to prevent any potential damages or deterioration of

Designation	Description
	those habitats within the Margate and Long Sands SAC. Six prohibited areas were defined in the Schedule of the Byelaw.

Using a Geographical Information System (GIS), protected areas within the wider Thames Estuary region have been identified and mapped in relation to the Proposed Development. As illustrated in Figure 6-1 (Drawing P2172-PROT-001), it has been identified that the Proposed Development crosses or lies partly within the following sites:

- Medway Estuary and Marshes SPA (site code: UK9012031);
- Medway Estuary and Marshes Ramsar site (site no. 645);
- Thames Estuary and Marshes SPA (site code: UK9012021);
- Thames Estuary and Marshes Ramsar site (site no. 1025);
- Outer Thames Estuary SPA (site code: UK9020309);
- Southern North Sea SAC (site code: UK0013104);
- Margate and Long Sands SAC (site code: UK0030371);
- Medway Estuary MCZ (site code: UKMCZ0011);
- Goodwin Sands MCZ (site code: UKMCZ0061);
- Foreland MCZ (site code: UKMCZ0060);
- Medway Estuary and Marshes SSSI; and
- KEIFCA Byelaw Prohibited Area 4 – Pan Sand Hole.



GRIDLINK INTERCONNECTOR

PROTECTED SITES

Environmental Designations - UK Waters

Drawing No: P2172-PROT-001	D

Legend

- KP
- GridLink Preferred Cable Route
- EEZ Boundary
- Margate & Long Sands Prohibited Area
- KEIFCA Prohibited Area

Environmental Designation

- SAC
- SPA
- RAMSAR
- SSSI
- MCZ

N W E S

NOTE: Not to be used for Navigation

Date	22 June 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	CDA; UKHO; JNCC; NE; GEBCO; ESRI; KEIFCA; MMO; GridLink
File Reference	J:\Gridlink\P2172_Mxd\05_PROT\P2172-PROT-001.mxd
Created By	Chris Dawe
Reviewed By	Chris Carroll
Approved By	Kerri Gardiner

GRIDLINK INTERCONNECTOR

intertek

0 5 10 15 20 km

6.2 Habitats Regulations Assessment (HRA)

6.2.1 Requirement for HRA

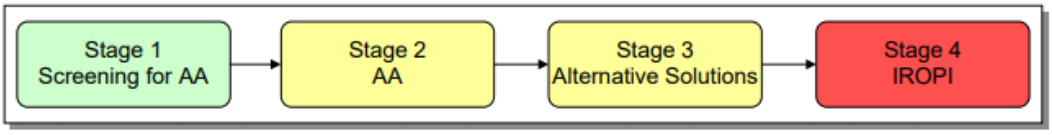
Regulation 63(1) of The Conservation of Habitats and Species Regulations 2017 (CHSR) and Regulation 28 (2) of The Conservation of Offshore Habitats and Species Regulations 2017 (COHSR) (collectively referred to as the 'Habitat Regulations') requires that any plan or project which has the potential to adversely affect a European site, no matter how far away from that site, be subject to the Habitats Regulations Assessment (HRA) process in order to determine whether an Appropriate Assessment is required.

'Collectively, Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Ramsar sites[1] are referred to as European sites under UK Regulations. Sites which are in the process of designation (e.g. Sites of Community Importance, candidate or possible SACs, proposed SPAs) are included in the definition as if fully protected.

A key protection mechanism under these directives is to consider the possible nature conservation implications of any plan or project on the European site network before any decision is made to allow that plan or project to proceed. Each plan considered for approval, must take into consideration the possible effects it may have in combination with other plans and projects on the conservation objectives of the site. If the project is likely to have a significant negative effect on a European site, either alone or in combination with other plans or projects, it must undergo an appropriate assessment (AA) by the competent authority (those with decision making powers). If an adverse negative effect is identified it may be possible to adjust the plan/project or introduce certain mitigation measures to avoid or pre-empt, remove or reduce effects to a non-significant level so that the plan/project may be approved (EC 2018).

The obligation to undertake AA derives from Articles 6(3) and 6(4) of the Habitats Directive. Both articles involve a number of steps and tests that need to be applied in sequential order. The European Commission's methodological guidance (EC 2002) outlines a four-stage approach to the process, where the outcome at each successive stage determines whether a further stage in the process is required. The four stages, shown in Figure 6-2 and summarised in Section 6.2.1.2 - 6.2.1.5, collectively make up what is referred to in the UK as the HRA process.

Figure 6-2 Stages of the HRA



Whilst the obligation to undertake the AA is derived from Articles 6(3) and 6(4) of the Habitats Directive, it is Regulation 28 of the COHSR and 63 of the CHSR that sets out procedural requirements. They require that the applicant provide such information as the component authority may reasonably require for the purposes of assessment or to enable them to determine whether an Appropriate Assessment is required.

[1] UK Government policy (ODPM Circular 06/2005) states that sites designated under the Convention on Wetlands (Ramsar, Iran 1971), known as the "Ramsar Convention", are also included under the definition Natura 2000. The vast majority of Ramsar sites are also classified as SPAs.

There is no statutory method for undertaking the HRA process, however UK Government guidance (The Planning Inspectorate 2017) outlines the steps to be taken by the applicant at each Stage. This guidance was followed when preparing the GridLink Marine HRA (Technical Appendix E).

6.2.1.2 Stage 1 - Screening for Appropriate Assessment

Screening is the process that addresses and records the reasoning and conclusions in relation to the first two tests of Regulations 28 of the COHSR and Regulation 63 of the CHSR:

- Whether a plan or project is directly connected to or necessary for the management of the site, and
- Whether a plan/project likely to have a significant effect on the interest features of the European site alone or in-combination with other plans/projects?

Where significant effects are likely, uncertain, or unknown at the screening stage, then the process must proceed to Stage 2 (AA).

6.2.1.3 Stage 2 – Appropriate Assessment

If Stage 1 concludes a likely significant effect on a European site, either from the project alone or in combination with other plans or projects, cannot be discounted, the applicant needs to consider whether those effects will adversely affect the integrity of the site in view of its conservation objectives.

If the assessment concludes that the plan or project will adversely affect the integrity of a European site, then the process must proceed to Stage 3, or the plan or project should be abandoned.

Any mitigation measures necessary to avoid, reduce or offset negative effects should be proposed at this stage.

6.2.1.4 Stage 3 – Alternative solutions

This stage examines any alternative solutions or options that enable the plan or project to proceed without adverse effects on the integrity of a European site. The process must return to Stage 2 as alternatives will require AA to proceed. Demonstrating that all reasonable alternatives have been considered and assessed, and that the least damaging option has been selected, is necessary to progress to Stage 4.

6.2.1.5 Stage 4 – Imperative Reasons of Overriding Public Interest (IROPI)/Derogation

Stage 4 is the main derogation process of Article 6(4) which examines whether there are imperative reasons of overriding public interest (IROPI) for allowing a plan or project that will have adverse effects on the integrity of a European site to proceed in cases where it has been established that no less damaging alternative solution exists.

6.2.2 HRA conclusions

6.2.2.1 Stage 1: Screening

The Proposed Development crosses the following seven European sites:

- Medway Estuary and Marshes SPA (site code: UK9012031);
- Medway Estuary and Marshes Ramsar site (site code: UK11040);
- Thames Estuary and Marshes SPA (site code: UK9012021);
- Thames Estuary and Marshes Ramsar site (site no. 1025);
- Outer Thames Estuary SPA (site code: UK9020309);
- Southern North Sea SAC (site code: UK0013104); and

- Margate and Long Sands SAC (site code: UK0030371)

Additionally, the Proposed Development also crosses the Medway Estuary and Marshes SSSI.

The Proposed Development is not directly connected with or necessary to the management of the European sites. Therefore, under the Habitats Regulations it is necessary that the Proposed Development should be subject to the HRA process.

To determine whether the Proposed Development is likely to have a significant effect on any European sites, either individually or in-combination with other plans or projects, Stage 1 AA screening was carried out (Technical Appendix E).

The screening assessed the seven European sites listed above, and an additional twelve European sites that were either within the direct zone of influence of the Proposed Development or contain mobile Annex II species which could potentially travel into the Proposed Development. In addition, the Medway Estuary and Marshes SSSI was also screened.

Technical Appendix E, Table 4-3 lists all the sites screened by the HRA.

A review of the Proposed Development identified ten pressures that could be exerted on Qualifying Features during installation, operation, and decommissioning. These include:

- Visual disturbance;
- Above water noise;
- Changes in suspended solids (water clarity);
- Siltation rate changes, including smothering (depth of vertical sediments overburden);
- Changes to supporting habitat and prey availability;
- Electromagnetic changes;
- Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion;
- Habitat structure changes - removal of substratum (extraction);
- Water flow (tidal current) changes, including sediment transport considerations;
- Physical change (to another seabed type); and
- Electromagnetic changes

Sites were assessed to determine if there was a potential pressure-receptor pathway between the Proposed Development and the Qualifying Feature(s).

The screening assessment (Technical Appendix E, Section 4.4) concluded, that there exists a pressure-receptor pathway between the Proposed Development and the Qualifying Interests of ten of the 19 European sites reviewed, and the one SSSI assessed. Initial screening took into consideration whether there was the potential for a cumulative effect between the Proposed Development and other plans and projects in the region.

To identify relevant projects to consider for potential cumulative effects, common pressure-receptor pathways were established between the Proposed Development and other projects in the region. Where there was a common pressure-receptor pathway it was determined if the effects spatially overlapped with the Proposed Development within or near a European Site. A Cumulative Effects Assessment (CEA) was undertaken to determine what projects could potentially have a cumulative effect with the Proposed Development, and these were considered in the Stage 1 screening.

For all Qualifying Features where it was determined that there was a possible interaction (i.e. a pressure-receptor pathway), the likely significance of the effect, alone and in combination with other projects in the area was assessed. This assessment is provided in Technical Appendix E, Section 4.5.

Table 6-2 summarises the conclusions of the assessment of likely significant effects (LSE) and Stage 1 Screening.

Screening concluded that Appropriate Assessment is required for:

- Margate and Long Sands SAC;
- Southern North Sea SAC; and
- Bancs des Flandres SAC.

Table 6-2 European Sites screened in – Summary of potential for likely significant effects

Site Name and Code (where applicable)	Applicable Qualifying Feature	Potential Pressure on European Site	Conclusion		
			Installation	Operation	Decommissioning
Medway Estuary and Marshes SPA (UK9012031)	**On passage:** Ringed plover **Over winter:** Avocet; Black-tailed godwit; Dark-bellied Brent goose; Dunlin; Grey plover; Northern pintail; Redshank; Ringed plover; and Shelduck. **Breeding Season:** Little tern; and Avocet.	Visual disturbance	No potential for LSE, AA is not required		
		Change in suspended solids (water clarity)	No potential for LSE, AA is not required		
		Above water noise	No potential for LSE, AA is not required		
Medway Estuary and Marshes Ramsar	Internationally important waterfowl assemblage **Overwintering** internationally important birds: Dark-bellied Brent goose; Dunlin; Grey Plover; Knot; Pintail; Redshank; Ringed plover; and Shelduck.	Visual disturbance	No potential for LSE, AA is not required		
Medway Estuary and Marshes SSSI	**Breeding** Marsh Harrier.	Visual disturbance	No potential for LSE, AA is not required		
		Above water noise	No potential for LSE, AA is not required		
Outer Thames Estuary SPA (UK9020309)	**Non-breeding:** Red-throated diver. **Breeding:** Common tern; and Little tern	Visual disturbance	No potential for LSE, AA is not required		
		Change in suspended solids (water clarity)	No potential for LSE, AA is not required		
		Above water noise	No potential for LSE, AA is not required		
Thames Estuary and Marshes SPA (UK9012021)	**Over winter:** Avocet; and Hen harrier. **On passage and over winter:** Ringed plover.	Visual disturbance	No potential for LSE, AA is not required		
		Above water noise	No potential for LSE, AA is not required		
Thames Estuary and	***Spring/Autumn:*** Ringed plover; and Black-tailed godwit.	Visual disturbance	No potential for LSE, AA is not required		
		Above water noise	No potential for LSE, AA is not required		

Site Name and Code (where applicable)	Applicable Qualifying Feature	Potential Pressure on European Site	Conclusion		
			Installation	Operation	Decommissioning
Marshes Ramsar	***Winter:*** Grey plover; Red knot; Dunlin; and Common redshank.				
Foulness (mid-Essex Coast Phase 5) SPA (UK9009246)	**Breeding:** Common tern; Little tern; and Sandwich tern.	Visual disturbance	No potential for LSE, AA is not required		
		Above water noise	No potential for LSE, AA is not required		
Southern North Sea SAC (UK0013104)	**Primary Feature: Annex II species:** Harbour porpoise	Underwater noise changes	Potential for LSE, AA is required		No potential for LSE, AA is not required
Margate and Long Sands (UK0030371)	**Primary Feature - Annex 1 Habitat:** Sandbanks which are slightly covered by sea water all the time.	Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	Potential for LSE, AA is required		
		Siltation rate changes	No potential for LSE, AA is not required		
		Habitat structure changes – removal of substratum (extraction)	Potential for LSE, AA is required	No potential for LSE, AA is not required	
		Water flow (tidal current) changes	Potential for LSE, AA is required		No potential for LSE, AA is not required
		Physical change (to another seabed type)	Potential for LSE, AA is required		
Bancs des Flandres SAC (FR3102002)	**Annex 1 Habitat:** Sandbanks which are slightly covered by sea water all the time	Siltation rate changes	No potential for LSE, AA is not required		
	Annex II Species: Harbour porpoise, Grey seal, Common seal	Underwater noise changes	Potential for LSE, AA is required		No potential for LSE, AA is not required
Blanc des Flandres SPA (FR3112006)	Razorbill, Brent Goose, Black tern, Fulmar, Black throated diver, Red throated diver, Mediterranean gull, Little gull, Velvet scoter, Common scoter, Red-breasted merganser, Gannet, Leach's storm-petrel, Great crested grebe, Red-necked grebe, Kittiwake, Eider, Arctic skua, Pomarine skua, Great skua, Little tern, Common tern, Arctic tern, Sandwich tern, Guillemot	Visual disturbance	No potential for LSE, AA is not required		
		Above water noise	No potential for LSE, AA is not required		

6.2.2.2 Stage 2: Appropriate Assessment

The Stage 1 Screening documented in Section 4 of the HRA, concluded that there is the potential for likely significant effects on the following three sites and that an AA is required:

- Margate and Long Sands SAC (site code:UK0030371);
- Southern North Sea SAC (site code: UK0030395); and
- Banc des Flandres SAC (site code: FR3102002).

The AA is a focused and detailed impact assessment of the implications of the plan or project alone and in combination with other plans and projects, on the integrity of a European site in view of its conservation objectives. It is undertaken by the competent authority, which for Marine Licence applications is the Marine Management Organisation. To inform the AA, the proponent of the plan (i.e. Gridlink Interconnector Limited) must provide 'Information to Inform AA' which provides data and information on the project and an analysis of potential effects on the European site.

Information to inform AA has been provided in the Gridlink Marine HRA (Technical Appendix E, Section 5). It concluded that:

Margate and Long Sands SAC

1. With respect to the deposit of external cable protection in the Margate and Long Sands SAC there is the potential for an adverse effect on the conservation objectives for the Primary Feature ''Sandbanks which are slightly covered by sea water all the time'.
2. Project specific mitigation has been proposed; the objective of which is to encourage sediment build up over the external cable protection returning the seabed to a sand habitat.
3. Evidence has been provided to demonstrate that the project specific mitigation proposed will be an effective long-term solution in mitigating adverse effects.
4. **With implementation of the proposed mitigation, the Proposed Development will not have an adverse effect on the integrity of the Margate and Long Sands SAC either alone or in combination with other plans or projects**.

Southern North Sea SAC

1. With respect to the high order detonation of unexploded ordnance (UXO) in the Southern North Sea SAC there is the potential for an adverse effect on the conservation objectives for the Primary Feature harbour porpoise (*Phocoena phocoena*).
2. It cannot be ruled out that the Proposed Development will not have significant in-combination effects with other projects in the Southern North Sea SAC given the potential for other noisy activities (pile driving and UXO detonation) and the uncertainty surrounding construction programmes. Mitigation has been proposed in the form of coordination with the MMO and other developers to manage this risk.
3. Project specific mitigation has been proposed including low order detonation (deflagration), a seasonal restriction, acoustic deterrence and coordination with other developers in the region. The objectives of mitigation are to reduce the significance of effects by avoiding the requirement for detonation; reducing the size of the charge used; and ensuring animals are not near to the detonation.
4. The mitigation measures proposed have proven successful for similar projects in UK waters. They are proven effective at reducing the magnitude of the effect by reducing the numbers of animal exposed to the noise levels that may cause injurious effects. The sensitivity of the receptor is also reduced as the animal is encouraged to move out of an area and therefore the pathway for the effect is reduced.

5. **With implementation of the proposed mitigation, the Proposed Development will not have an adverse effect on the integrity of the Southern North Sea SAC either alone or in combination with other plans or projects.**

Bancs des Flandres

1. With respect to the high order detonation of UXO in UK waters and transboundary effects from underwater noise changes on the Bancs des Flandres there is the potential for an adverse effect on the conservation objectives for the Primary Features harbour porpoise (*Phocoena phocoena*), grey seal (*Halichoerus grypus*) and harbour seal (*Phoca vitulina*).
2. Significant intra-project effects between the Proposed Development and the French Marine components of GridLink can be adequately managed through the Applicants commitment to not undertake UXO detonation in UK and French waters on the same day.
3. Significant in-combination effects with the Thanet Extension offshore windfarm are unlikely but cannot be categorically ruled out, however, mitigation has been proposed in the form of coordination with the MMO and other developers, which will avoid the two projects coinciding and remove the pathway for effect.
4. Project specific mitigation has been proposed including low order detonation (deflagration), a seasonal restriction and acoustic deterrence. The objectives of mitigation are to reduce the significance of effects by avoiding the requirement for detonation; reducing the size of the charge used; or ensuring animals are not near to the detonation.
5. The mitigation measures proposed have proven successful for similar projects in UK waters. They are proven effective at reducing the magnitude of the effect by reducing the numbers of animal exposed to the noise levels that may cause injurious effects. The sensitivity of the receptor is also reduced as the animal is encouraged to move out of an area and therefore the pathway for the effect is reduced.
6. **With implementation of the proposed mitigation, the Proposed Development will not have an adverse transboundary effect on the integrity of the Bancs des Flandres SAC either alone or in combination with other plans or projects.**

Project specific mitigation has been proposed and is provided in Tables 6-3 and 6-4.

Table 6-3 Project specific mitigation – Margate and Long Sands SAC

ID	Project specific mitigation
PS1	London Array crossing design shall incorporate fronded mats either as individual gravity secured mats or as attached to tapered concrete mattresses in conjunction with cable protection to facilitate sediment capture and reduce scour. The objective shall be to cover the external cable protection with sand to minimise fishing disruption to bottom drift netting and trawling and return the seabed to a sand habitat within the Margate and Longsands SAC.
PS2	Subject to agreement with asset owner and thermal calculations consideration shall be given to reducing the crossing angle (from 90 degrees) for the London Array crossing to orientate the crossing with the tidal flow and direction to minimise risk of scour.
PS3	The London Array crossing design shall encourage natural resedimentation of the crossing.
PS49	Environmental monitoring at London Array crossing - The condition surveys will establish (if possible) the depth of sediment cover over the crossing. If the depth of cover is enough to allow sampling, sediment samples will be taken and analysed for particle size. If sufficient sample sizes can be obtained to allow infauna characterisation this will also be undertaken. Data will be reviewed by a benthic specialist and a report compiled and issued to the Marine Management Organisation and Natural England. The environmental monitoring will be undertaken with the first two condition surveys; anticipated for years 2 and 4 post-commissioning.

ID	Project specific mitigation
PS50	Prior to commencement of licensable activities, the Applicant will submit a Technical Note to Marine Management Organisation confirming exact locations for pre-sweeping using a dredger and defining a spoil disposal site. The disposal site shall meet the following conditions: a. Be located within the European site b. Be located on a similar sediment composition as the excavated sediment c. Be within the Application Corridor d. Be outside of the KEIFCA Pan Sands Hole Byelaw Area If a suitable disposal site cannot be identified within the Application Corridor, an external disposal site such as North Edinburgh Channel will be secured. Preference will be given to disposal sites within the Margate and Long Sands SAC. The technical note will confirm that the proposed method and disposal will not have a significant effect on the European site.

Table 6-4 Project specific mitigation – Southern North Sea SAC and Bancs des Flandres SAC

ID	Project specific mitigation
PS10	If required, UXO deflagration will be undertaken between 01 April and 31 September (to avoid effects on harbour porpoise).
PS11	Lofitech AS seal scarer acoustic deterrent device (ADD) or similar will be used prior to UXO deflagration in accordance with the GridLink Marine Mammal Mitigation Plan for all UXO deflagrations.
PS44	Deflagration will be used on all UXO charge sizes.
PS46	With respect to UXO deflagration, GridLink will ensure that UXO deflagration for the project in UK and French sectors will not occur on the same day and will liaise with the MMO to: 1. Inform the MMO of potential UXO clearance requirements and proposed schedule. 2. Confirm with the MMO if any projects in the region will be undertaking piling or UXO detonation/deflagration that overlaps with the proposed schedule. 3. Confirm if UXO deflagration should be coordinated with other developers in the region to reduce potential cumulative effects within the SAC

6.3 MCZ Assessment

6.3.1 Requirement for MCZ Assessment

MCZs are designated under the Marine and Coastal Access Act 2009 (MCAA) to protect a range of important marine habitats, species and geological formations in English and Welsh territorial waters and UK offshore waters. In conjunction with other existing international and national designations e.g. European sites and SSSIs, these sites contribute to an ecologically coherent network of Marine Protected Areas (MPA) in UK waters.

Under Section 126 (6) of the MCAA, an applicant must satisfy the public authority with the function of determining applications (in this case the MMO) that there is no significant risk of the proposed act hindering the achievement of the conservation objectives stated for the MCZ.

The Marine Conservation Zones and Marine Licensing Guidance (MMO 2013) requires an applicant undertake a similar stepped assessment process for MCZs as undertaken for European sites (HRA process). This approach is Screening; Stage 1 assessment; and Stage 2 assessment (Section 6.3.1.1 – 6.3.1.3).

The Proposed Development crosses the Medway Estuary MCZ, Goodwin Sands MCZ, and Foreland MCZ. The project is not directly related to the management of the MCZs and therefore it is regarded as necessary that the project is subject to the MCZ Assessment process.

6.3.1.1 Screening

All marine licence applications are screened to determine whether Section 126 of the MCAA should apply. It will apply if it is determined that:

- the licensable activity is taking place within or near an area being put forward or already designated as an MCZ; and
- the activity is capable of affecting (other than insignificantly) either (i) the protected features of an MCZ; or (ii) any ecological or geomorphological process on which the conservation of any protected feature of an MCZ is (wholly or in part) dependant.

If during the screening stage it has been determined that Section 126 should apply, it is necessary for the MMO to assess, through a two-stage approach, which elements of Section 126 should apply to a marine licence application.

6.3.1.2 Stage 1 Assessment

Stage 1 is the consideration of whether the conditions of Section 126 can be met by determining whether:

- There is no significant risk of the activity hindering the achievement of the conservation objectives stated for the MCZ; and
- The MMO can exercise its functions to further the conservation objectives stated for the MCZ.

If the conditions cannot be met the MMO will consider whether there is no other means of proceeding with the act which would create a substantially lower risk of hindering the achievement of the conservation objectives stated for the MCZ. This should include proceeding with it (a) in another manner, or (b) at another location.

6.3.1.3 Stage 2 Assessment

This stage of the assessment considers and determines in sequence whether:

- The benefit to the public of proceeding with the act clearly outweigh the risk of damage to the environment that will be created by proceeding with it; and, if so, then whether
- The applicant can satisfy the MMO that they will undertake or make arrangements for the undertaking of measures of equivalent environmental benefit to the damage which the act will or is likely to have in or on the MCZ.

6.3.2 MCZ Assessment conclusions

6.3.2.1 Screening

Eleven MCZ's were initially identified as requiring consideration within the MCZ Assessment process (displayed in Figure 16-1, Drawing P2172-PROT-001-D). These sites were:

- Swanscombe MCZ (site code: UKMCZ0073);
- Medway Estuary MCZ (site code: UKMCZ0011);
- The Swale Estuary MCZ (site code: UKMCZ0041);
- Blackwater, Crouch, Roach and Colne Estuaries MCZ (site code: UKMCZ0003);
- Kentish Knock East MCZ (site code: UKMCZ0080);
- Thanet Coast MCZ (site code: UKMCZ0017);
- Goodwin Sands MCZ (site code: UKMCZ0061);
- Foreland MCZ (site code: UKMCZ0060);

- Dover to Deal MCZ (site code: UKMCZ0032);
- Dover to Folkestone MCZ (site code: UKMCZ0033); and
- Folkstone Pomerania MCZ (site code: UKMCZ0006).

Following the identification of the relevant sites, potential pressures associated with the Proposed Development were identified, and zones of influence for each pressure established. These pressures were:

- Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion;
- Siltation rate changes, including smothering (depth of vertical sediment overburden);
- Water flow (tidal current) changes, including sediment transport considerations;
- Physical change (to another seabed type);
- Underwater noise changes; and
- Electromagnetic changes.

The relevant identified MCZ's were then screened to determine whether there is the potential for an interaction between the Proposed Development and the Protected Features i.e. whether there is a pressure-receptor pathway. This is determined by comparing information such as the extent of the zone of influence with information regarding the Protected Feature e.g. spatial extent of habitats, migration pathways etc.

The screening assessment (Technical Appendix F, Section 4.4) concluded, that there exists a pressure-receptor pathway between the Proposed Development and the Protected Features of the following five MCZs and that Stage 1 Assessment is required:

- Medway Estuary MCZ (site code: UKMCZ0011);
- Swale Estuary MCZ (site code: UKMCZ0041);
- Thanet Coast MCZ (site code: UKMCZ0017);
- Goodwin Sands MCZ (site code: UKMCZ0061); and
- Foreland MCZ (site code: UKMCZ0060).

6.3.2.2 Stage 1 Assessment

The five MCZs were assessed to determine if the identified pressure-receptor pathways could result in effects on the Protected Features that would hinder the achievement of the Conservation Objectives stated for the MCZs. Table 6-5 summarises the conclusions of the assessment.

Other plans and projects the effects of which could spatially overlap with the predicted effects from the Proposed Development within a MCZ were also assessed to determine if there was a potential in-combination effect. No significant in-combination effects were identified.

The Stage 1 Assessment has concluded that for all five MCZs assessed the conditions of Section 126 of the MCAA 2009 can be met. There is no significant risk that the Proposed Development either alone or in combination with other plans or projects will hinder the achievement of the conservation objectives stated for the MCZs; and the MMO can exercise its functions to further the conservation objectives for the MCZs.

Table 6-5 MCZ Assessment conclusions

Site Name	Project Phase			Relevant Protected Feature	Potential Pressure on MCZ	MCZ Assessment Conclusion
	I	O	D			
Medway Estuary MCZ (UKMCZ0011)				Subtidal coarse sediment; Subtidal mud; Subtidal sand; Peat and clay exposures, Intertidal mixed sediments; Intertidal sand and muddy sand; Low energy intertidal rock; Estuarine rocky habitats.	Penetration and/or disturbance	Achievement of conservation objectives will not be hindered
				Subtidal coarse sediment; Subtidal mud; Subtidal sand; Peat and clay exposures; Intertidal mixed sediments; Intertidal sand and muddy sand; Low energy intertidal rock; Estuarine rocky habitats.	Siltation rate changes including smothering	Achievement of conservation objectives will not be hindered
				Smelt	Underwater noise changes	Achievement of conservation objectives will not be hindered
Swale Estuary MCZ (UKMCZ0041)				Subtidal coarse sediment; Subtidal mixed sediments; Subtidal sand; Subtidal mud; Estuarine rocky habitats; Low energy intertidal rock; Intertidal mixed sediments; Intertidal coarse sediment; Intertidal sand and muddy sand.	Siltation rate changes including smothering	Achievement of conservation objectives will not be hindered
Thanet Coast MCZ (UKMCZ0017)				Subtidal coarse sediment; Subtidal mixed sediments; Subtidal sand; Moderate energy infralittoral rock; Moderate energy circalittoral rock; Peat and clay exposures; Subtidal chalk; Blue mussel beds; Ross worm reefs; Stalked jellyfish (*Haliclystus auricula*); and Stalked jellyfish (*Lucernariopsis cruxmelitensis*).	Siltation rate changes including smothering	Achievement of conservation objectives will not be hindered
Goodwin Sands MCZ (UKMCZ0061)				Subtidal coarse sediment; Subtidal sand; Moderate energy circalittoral rock	Penetration and/or disturbance	Achievement of conservation objectives will not be hindered
					Siltation rate changes, including smothering	Achievement of conservation objectives will not be hindered
					Hydrological changes	Achievement of conservation objectives will not be hindered
					Physical change to another seabed type	Achievement of conservation objectives will not be hindered

Site Name	Project Phase			Relevant Protected Feature	Potential Pressure on MCZ	MCZ Assessment Conclusion
	I	O	D			
				Blue mussel beds	Siltation rate changes, including smothering	Achievement of conservation objectives will not be hindered
				Ross worm reefs	Penetration and/or disturbance	Achievement of conservation objectives will not be hindered
					Siltation rate changes, including smothering	Achievement of conservation objectives will not be hindered
				Eastern English Channel outburst flood features.	Penetration and/or disturbance	Achievement of conservation objectives will not be hindered
Foreland MCZ (UKMCZ0060)				High energy infralittoral rock; High energy circalittoral rock; Moderate energy circalittoral rock	Siltation rate changes, including smothering	Achievement of conservation objectives will not be hindered
				Subtidal coarse sediment; Subtidal sand	Penetration and/or disturbance	Achievement of conservation objectives will not be hindered
					Siltation rate changes, including smothering	Achievement of conservation objectives will not be hindered

Without prejudice to the conclusion that there is no significant risk of the activity hindering the achievement of the conservation objectives stated for the MCZ, the Applicant has proposed Project Specific Mitigation as best practice to reduce the magnitude of the effect on the Medway Estuary MCZ and Goodwin Sands MCZ as listed in Table 6-6.

Table 6-6 Project specific mitigation

Relevant MCZ	Protected Feature	PS ID	Project Specific Mitigation
Medway Estuary	Subtidal coarse sediment; Subtidal mud; Peat and clay exposures	PS4	The cable burial and protection strategy shall adhere to the following two principles, in order of priority: 1. Achieving Target DOL along the route so External Protection is not required and in particular no use of External Protection in MCZs and SACs 2. Minimise any displacement of seabed which may not recover naturally within 2-3 years of installation (or else include methods to restore or aid the restoration of the seabed where viable).
		PS6	All planned anchor placements must be in the Consent Corridor. Contract shall avoid planned anchor placement in 'Areas of Constraint for Anchor Placement'. If planned anchor placement is required in any one of these areas robust justification shall be provided to GridLink as to why there is no alternative.
Goodwin Sands	Ross worm (*Sabellaria spinulosa*) reef	PS7	Position of planned anchor placements shall be surveyed. Data shall by analysed by both a marine ecological specialist and a marine archaeologist for presence of sensitive habitats and archaeological features respectively. Positions of planned anchor placements shall be adjusted if Sabellaria reef or marine heritage assets are identified at the location.
		PS8	A review of the Environmental Habitat Assessment shall be undertaken by acquiring detailed seabed imagery using side scan sonar and multi-beam echo sounder back scatter analysis combined with drop down camera video acquisition along ten 250m transects located between KP82 to KP92. Along the transects photographs shall be taken every 5 to 10m and / or at areas of interest, with accompanying video recorded. The Environmental Habitat Survey shall be undertaken no greater than 2 years prior to scheduled installation date to ensure baseline data collected remains valid in any future assessment of impact of the cable installation on Annex 1 biogenic reef. The results of the survey shall be used to micro-route the cable to:

Relevant MCZ	Protected Feature	PS ID	Project Specific Mitigation
			a) Avoid Sabellaria reef structures wherever practicable b) If avoidance is not possible (e.g. due to extent of reef), minimise the crossing distance across the reef structure c) If different grades of reef are present, select a cable route through the lowest grade reef.
		PS48	Within Goodwin Sands MCZ an environmental monitoring plan will be established to monitor colonisation of the external cable protection. Video transects will be run along the external cable protection to record species present, abundance and extent. The objectives of the monitoring will be to establish an evidence base to inform future development within the Goodwin Sands MCZ. Monitoring will be aligned with the condition surveys scheduled for every two years. The monitoring will be undertaken for the first two condition surveys (to cover four-year period in total).

6.4 KEIFCA Byelaw

6.4.1 Description and sensitive habitats

A Byelaw was passed by KEIFCA in 2017 (KEIFCA 2017) which prohibits the use of bottom towed fishing gear in a total of six areas in the KEIFCA jurisdiction. Bottom gears include the use of "any beam trawl, otter trawl, multi-rig trawl, pair trawl, anchor seine, Scottish seine, dredge or other similar fishing instrument designed to take or disturb sea fisheries resources on the seabed" (KEIFCA 2017).

The purpose of the Byelaw is to provide protection of designated features and habitats and to prevent any potential damages or deterioration of those habitats.

The Proposed Development crosses the Pan Sand Hole prohibited area from KP41-KP47. Pan Sand Hole prohibited area is located within the Margate and Long Sands SAC, which is designated for the Annex I habitat 'sandbanks which are slightly covered by sea water all the time' (JNCC 2019). The Application Corridor crosses the northern central part of the Pan Sand Hole prohibited area.

Natural England (A. Atterbury 2019, personal communication, 17 January) confirmed that the presence of the biotope SS.SCS.ICS.SLan 'dense *Lanice conchilega* and other polychaetes in tide-swept infralittoral sand and mixed gravelly sand' within the Margate and Long Sands SAC was a primary reason for the designation of the KEIFCA Byelaw prohibited area Pan Sand Hole.

Numerous polychaete worms have been recorded within the Margate and Long Sands SAC. Of these, the sand mason worm (*Lanice conchilega*) has been identified in relatively high abundance. Over time, the presence of dense beds of sand mason worms stabilise the sediments within the Margate and Long Sands SAC, allowing the deposition of finer sediments and a wide range of benthic species. Benthic species likely to be found on finer sediments over stabilised sediments include reef building polychaete worms, for example *Sabellaria spinulosa* and S. bombyx (Bhatia 2015).

Areas of consolidated sediments, from action of sand mason worms, have the potential to develop into Sabellaria reef, if conditions remain constant (Bhatia 2015). The GridLink marine survey did not record any occurrences *Lanice conchilega* species within the Pan Sand Hole prohibited area.

6.4.2 Assessment conclusion

The Proposed Development, including the route through the KEIFCA Byelaw Area represents the best alternative. It has been optimised to avoid crossing Annex I habitat in the wider Margate and Longsands SAC where possible. The cables will be bundled together in the same trench to reduce the footprint of the Proposed Development (embedded mitigation EM3).

No external cable protection is required within the KEIFCA Byelaw Area. The main pressure from the Proposed Development will be 'penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion' because of cable burial (trenching) during installation, and if necessary, future repairs, and cable removal during decommissioning.

Chapter 7 (Section 7.6.4) assessed the potential effect of the installation, operation and decommissioning phases of the Proposed Development on the habitats within the KEIFCA Byelaw Area. The GridLink environmental baseline survey identified three habitats between KP41 and KP47:

- A5.13 - Infralittoral coarse sediment
- A5.24 - Infralittoral muddy sand
- A5.43 - Infralittoral mixed sediments

Chapter 7 concluded that although these habitats are located within the KEIFCA Pan Sand Hole Byelaw Area, they are not considered rare or unique and they do not constitute the biotopes that the site is designated for, therefore the sensitivity of these habitats has been assessed as medium. Disturbance to these habitats will be localised resulting in an effect of low magnitude. The overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

As best practice, Project Specific Mitigation has been proposed with the aim of reducing the magnitude of effects on habitats. Although not specifically targeted at the KEIFCA Byelaw Area PS4 (listed in Table 6-6 above, in relation to the Medway Estuary MCZ) is pertinent in the wider context of its location within the Margate and Longsands SAC.

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7. BENTHIC ECOLOGY

This Chapter describes the existing baseline environment in terms of benthic ecology, identifies the pressures associated with the Proposed Development on the receptors, presents the findings of the environmental assessment, and describes how significant effects (if any) will be mitigated.

7.1 Data Sources

The Applicant has commissioned environmental surveys to inform the baseline description and assessment. These have been supplemented where necessary by a review of published information and consultation with relevant bodies. The data sources used in this Chapter include, but are not limited to the following:

- Technical Appendix E - GridLink Marine Habitats Regulations Assessment (HRA);
- Technical Appendix F - GridLink Marine Conservation Zone Assessment (MCZ);
- Technical Appendix P - GridLink Nearshore Environmental Survey Report (MMT 2019);
- Technical Appendix Q - GridLink Offshore Environmental Survey Report (MMT 2020); and
- The Marine Life Information Network (MarLin) website.

Other data sources as listed in the References at the end of the Chapter.

7.1.1 Environmental survey

Geophysical, geotechnical and environmental surveys of the Asset Placement Corridor were carried out between June and October 2019 by MMT to inform cable route design and the environmental assessment. The scope of the geophysical and geotechnical surveys is described in Section 5.1.1 and were used to focus the environmental survey strategy and subsequent data interpretation. The scope of the environmental survey was to:

- Characterise the benthic community and benthic habitats; and
- Determine the presence of any features that may have conservation significance.

The Asset Placement Corridor was divided into seven blocks with Block 01 being the closest inshore at Kingsnorth and Blocks 6 and 7 in French waters. The end of Block 5 / start of Block 6 boundary corresponds with the UK/France EEZ boundary. Blocks and environmental sampling stations are shown in Figure 5-1 (Drawing P2258-SURV-001).

Environmental sampling stations were selected based on geophysical interpretation, depth variation, sediment size and habitat changes, with the objective of providing benthic data for all habitats identified within the Asset Placement Corridor. 50 stations were selected in UK waters (named UK-001 to UK-050) at which benthic samples were acquired using a video and still camera system and grab samplers.

Drop down video and still photography were acquired initially at each station, using a SeaSpyder drop down video system. Images were then reviewed by experienced marine biologists on board to confirm the presence/absence of any potentially sensitive habitats or features of conservation importance, prior to grab sampling. Two types of grab samplers were used; the Dual Van Veen (DVV), and the Hamon grab. The DVV was used for finer sediments, while the Hamon grab was used for coarser sediments. Where grab sampling was not possible due to hard seabed or coarse substrates, only video/still photo was used for sampling.

A total of 12 stills, with continuous video recording, were acquired at each grab sample site. Visibility varied between sample sites, in both the nearshore area (KP0.3 and KP51.7) and the offshore area (KP51.7 to KP108.1) visibility was mostly described as poor due to strong tidal currents.

Video stills were analysed to identify species and their density. The different European Union Nature Identification System (EUNIS) habitat criteria were applied to the results of the stills analysis. Particular attention was paid to habitats above the elevated seabed level, together with their spatial extent, percentage biogenic cover and patchiness, as these are key criteria for evaluating areas of conservation interest and reef structures (Irving 2009; Gubbay 2007).

Ten video transects were acquired on areas with potentially sensitive fauna and/or habitats, to aid interpretation and assessment of potentially sensitive habitats and/or species. From grab sample sites and transects, the intensity values were ground truthed and grouped to provide indicative trends with regards to *S. spinulosa* presence.

For all environmental stations in the nearshore area, four replicate grab samples were aquired. One replicate was used for particle size and chemical analyses, while the remaining three replicates were used for infaunal analyses. In the offshore area, at most stations only the three replicates for infaunal analysis were acquired. However, 13 of the stations were selected for a fourth replicate for particle size and chemical analyses due to the potential that sandwaves in the locality may require pre-sweeping.

At ten stations, namely UK-004, UK-021, UK-023, UK-032, UK-033, UK-036, UK-041, UK-045, UK-046, and UK-048, all three replicate samples contained insufficient sample volume and were subsequently excluded from faunal statistical analyses.

Faunal identification and quantification were carried out for grab samples and still photographs to obtain species density data of individuals per m^2 and percentage cover for colonial species.

The environmental survey reports are provided as Technical Appendix P and Q.

7.2 Consultation

Table 7-1 summarises the relevant consultation responses on benthic and intertidal ecology.

Table 7-1 Summary of stakeholder responses on benthic and intertidal ecology

Stakeholder	Summary of Consultation Response	How response has been addressed
Marine Management Organisation (MMO)	Whilst smothering as a potential effect might be scoped out for non-designated areas, this potential effect should not be scoped out for designated features such as *Sabellaria spinulosa* reefs or mytilus reefs, where relevant.	This pressure has been assessed for *Sabellaria spinulosa* reefs or *mytilus* reefs. Mytilus reefs were not observed along the Asset Placement Corridor and have therefore not been included within this assessment. An assessment of potential effects on Mytilus reefs within the Goodwin Sands Marine Conservation Zone (MCZ) are provided in Technical Appendix F – MCZ Assessment.
MMO	The amount of hard substrate material to be utilised must be kept to a minimum. The MMO note that the long-term effect of the introduction of substratum into a naturally sandy or muddy seabed is not fully understood at present and must be carefully considered.	The use of external cable protection will be the minimum required to ensure cable safety and cable protection stability (embedded mitigation EM7). An assessment of physical change to another seabed type is provided in Section 7.6.6.
MMO	Where stabilisation material cannot be avoided, the MMO recommend using a more targeted placement method e.g. fallpipe vessel rather than using vessel-side discharge methods.	A fall pipe method will be used in water depths of 10m lowest astronomical tide (LAT) or above, in water depths below 10m LAT this is not feasible as vessel draft is too large for the water depth. At water depths below 10m a side dump or split hopper will be used. External cable protection

Stakeholder	Summary of Consultation Response	How response has been addressed
		may only be required at one location where the water depth is below 10m (CBRA Zone 10). See Technical Appendix J-NRA.
MMO	An assessment of the effect of EMF on benthic communities must be included in the Environmental Report.	Technical Appendix D - Marine Effects of EMF Technical Note concluded that there will be no significant effects on shellfish, crustacean and mollusc from the emission of EMF of the GridLink cables. Therefore, this pressure has been scoped out of the assessment in Section 7.6.
MMO	The risk of potential contamination of habitats from the use of chemicals for lubrication of the HDD drill must be considered in the Environmental Report and HRA.	Before drilling commences a steel casing will be installed to provide a rigid and safeguarded path for the start of the drill bore; this will ensure the integrity of the bore; and will prevent the inadvertent release of drill fluid from the drill bore into the marine environment (see Chapter 3 - Section 3.7.6). In addition, HDD drilling activities shall be conducted in a manner to minimise risk of bentonite breakout from the HDD entry or exit pits (see embedded mitigation EM2).
MMO	The possible mobilisation of sediments in the intertidal and subtidal areas must also be considered, and the risk of contaminants being released into the marine environment.	The risk of contaminants being released into the marine environment has been assessed in Technical Appendix G – WFD Assessment
MMO	The MMO note that the shore crossing will be achieved by HDD. The MMO strongly support the use of HDD but advised the assessment of an alternative methodology, e.g. trenching as a highly pragmatic approach in the event that HDD is not possible.	GridLink has not included the assessment of an alternative methodology due to the following reasons: 1. GridLink is confident that HDD is feasible and that there is low risk of hydrofractures; 2. The mudflats are a protected feature and it is likely that trenching will have a significant environmental effect; and 3. Trenching would require the flood defence to be temporarily breached. Further detail on the above points can be found within Section 3.7.6.3.
MMO	The MMO would like to bring your attention to the new Advice on operations specifically tailored to the HDD cable landfall technique produced by Natural England (NE). The MMO advise that you make yourselves familiar with the advice and use it to inform the designated sites section of the Environmental Appraisal	The pressures included within the advice from NE on HDD have been taken into consideration when determining the pressure to assess on protected features and habitats of principle importance. However, it should be noted that the intertidal zone of the Medway Estuary at the Kingsnorth shore crossing will be crossed by HDD to avoid disturbance to the surface sediments and habitats. The HDD will exit beyond the mean low water springs mark to avoid the Medway Estuary and Marshes SPA and Medway Estuary and Marshes SSSI (embedded mitigation EM1). Effects from HDD on the Medway Estuary MCZ has been captured in Technical Appendix F – MCZ Assessment.
MMO	The use of external cable protection within the Margate and Long Sands SAC must be addressed in the Environmental Appraisal.	A summary of the assessment of pressures on sensitive features in the Margate and Long Sands SAC is presented in Section 7.6.1 below. A full assessment is provided in the GridLink Marine HRA (Technical Appendix E).
MMO	Consideration must be given within the EA to the designated features of Goodwin Sands MCZ, Foreland MCZ and Medway Estuary MCZ, all of which list features highly sensitive to mechanical trenching.	This assessment is provided in Section 7.6.2 and within Technical Appendix F-MCZ Assessment.

7.3 Existing Baseline

7.3.1 Overview

Benthic ecology describes the assemblages of organisms living in (infauna) or on (epifauna) the seabed, and their diversity, abundance and function. Benthic communities include those found on the sea floor from the intertidal zone to the deepest parts of the marine environment. The structure of benthic communities varies temporally and spatially depending on a wide range of physical factors of which water depth, sediment type, particle size and supply of organic matter are key variables.

The Proposed Development begins in the Medway Estuary, where the sediments are largely composed of mud and sandy mud with areas of sand and coarse sediment. The most common features in the Medway Estuary are intertidal mudflats, sandflats and saltmarshes. As the Proposed Development crosses into the Thames Estuary, the sediment dominance progressively changes from mud to sand, and sandbanks and sandwaves become dominant features. Within the Thames Estuary the Proposed Development is characterised by strong currents and shallow waters. Moving out of the Thames estuary, the Proposed Development goes through the English Channel, which is primarily characterised by mixed sediments and rock. Approximately 71.5km of the Proposed Development lies within sites designated as European (Special Areas of Conservation) or nationally protected sites (Marine Conservation Zones), designated to protect benthic habitats. Key features of the sites are described below.

The Proposed Development crosses the Medway Estuary MCZ from KP0 – KP13.1. This site contains eight different habitats and two species, the fish smelt *Osmerus eperlanus* and the tentacle lagoon-worm *Alkmaria romijni.* However, the tentacled lagoon worm is not known to occur near to the Proposed Development; it is generally found in the main river channel in the upper reaches of the river near to Rochester and Chatham (Defra 2019a). The tentacle lagoon-worm inhabits sheltered estuarine sites, with muddy sediments, where they burrow in tubes (Marlin 2020). No tentacled lagoon worm were found during marine surveys. The eight habitats that are protected within the MCZ are; estuarine rocky habitats, intertidal mixed sediments, intertidal sand and muddy sand, low energy intertidal rock, peat and clay exposures, subtidal coarse sediment and subtidal mud and subtidal sand.

The Proposed Development crosses Margate and Long Sands SAC for approximately 22km. The Proposed Development enters the site at KP42- KP62, and then leaves the site for 3km, entering again at KP65-67. This site has been solely designated for Annex I Sandbanks which are slightly covered by seawater at all times, the largest of which is the Long Sands sandbank. The fauna on the crests of the bank is dominated by polychaete worms and amphipods; as expected of a species poor, mobile sand environment. A greater diversity of polychaetes, crustacea, molluscs and echinoderms are found on the bank slopes and within the troughs. Mobile epifauna found includes brown shrimp, crabs, squid and commercially important species such as Atlantic herring and common sole. Although, this site is designed solely for Sandbank Annex I interest feature, NE also noted that there is a significant amount of the reef-forming ross worm (*Sabellaria spinulosa*) at this site (Natural England 2010).

The Proposed Development crosses the Goodwin Sands MCZ from KP81.8 – KP91.6. This site is protected for six features, these are English Channel outburst flood features; subtidal coarse sediment; subtidal sand; blue mussel beds; moderate energy circalittoral rock and ross worm (*Sabellaria spinulosa*) reefs. Goodwin Sands is a large and dynamic area of coarse sediments and sand off the coastline of Kent that is often exposed at low tide. Around the Sands themselves, the site has deeper areas of subtidal coarse sediment of high biodiversity. All areas of sand and sediment protected within this site are subtidal, rather than areas of sandbanks which are exposed intermittently during the tidal cycle (Defra 2019b).

The Proposed Development crosses the Foreland MCZ from KP101.4 – KP 105.9. The site is protected for five features; English Channel outburst flood features, subtidal sand, high energy circalittoral rock,

moderate energy circalittoral rock and subtidal coarse sediment. The Foreland MCZ is mostly comprised of subtidal sediments, providing habitats for sandeel, fish species, worms, bivalves, burrowing anemones and molluscs. There are also areas of deep-water rock habitats that are subject to moderate to high energy or tidal currents and dominated by animal communities as there is insufficient light to allow flora growth. Animals such as sponges are found on rocks while sea firs, cup corals, anemones and sea squirts create a dense coverage. Important commercial species such as crabs and lobsters are found within rocky crevices, while a variety of fish species, such as wrasse and topknots, also use the habitat. The site also contains the upper most section of the English Channel outburst flood feature, which formed during the termination of the last glaciation by the collapse of ice sheets or glaciers (Natural England 2019c).

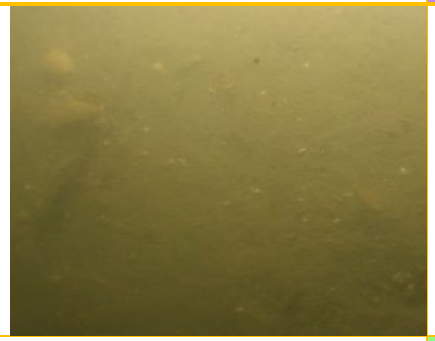
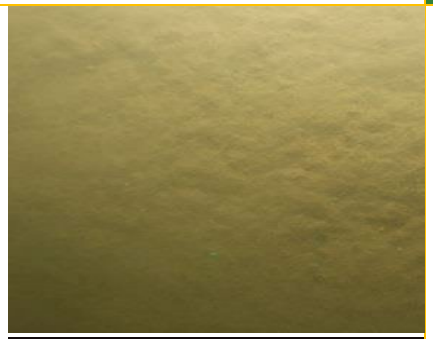
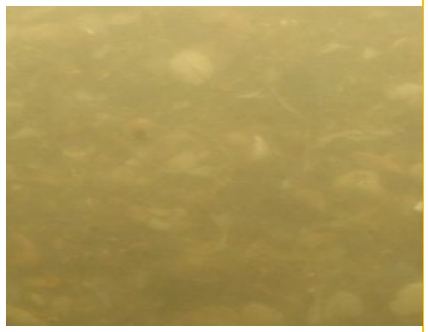
7.3.2 Subtidal habitats identified within the Asset Placement Corridor

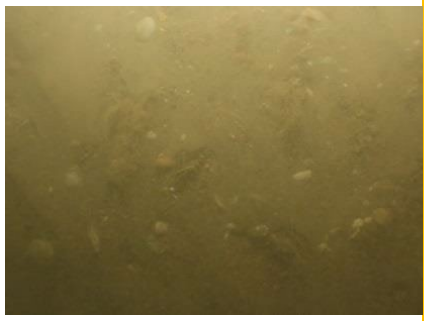
The habitat maps for the Asset Placement Corridor created from the environmental survey data are presented in Figures 7-1 to 7-8 (Drawing P2172_HAB_002, Sheets 1-8). A total of 24 habitats were identified across the Asset Placement Corridor. Table 7-2 presents a description of each habitat identified. For each habitat, the table presents the following information:

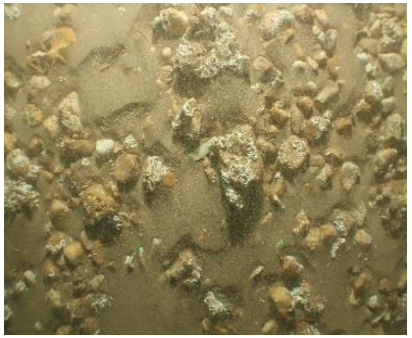
- EUNIS habitat code and description;
- Equivalent JNCC habitat code;
- Colour code for habitat in Figures 7-1 to 7-8 (Drawing P2172_HAB_002, Sheets 1-8); and
- Representative photograph from the environmental survey.

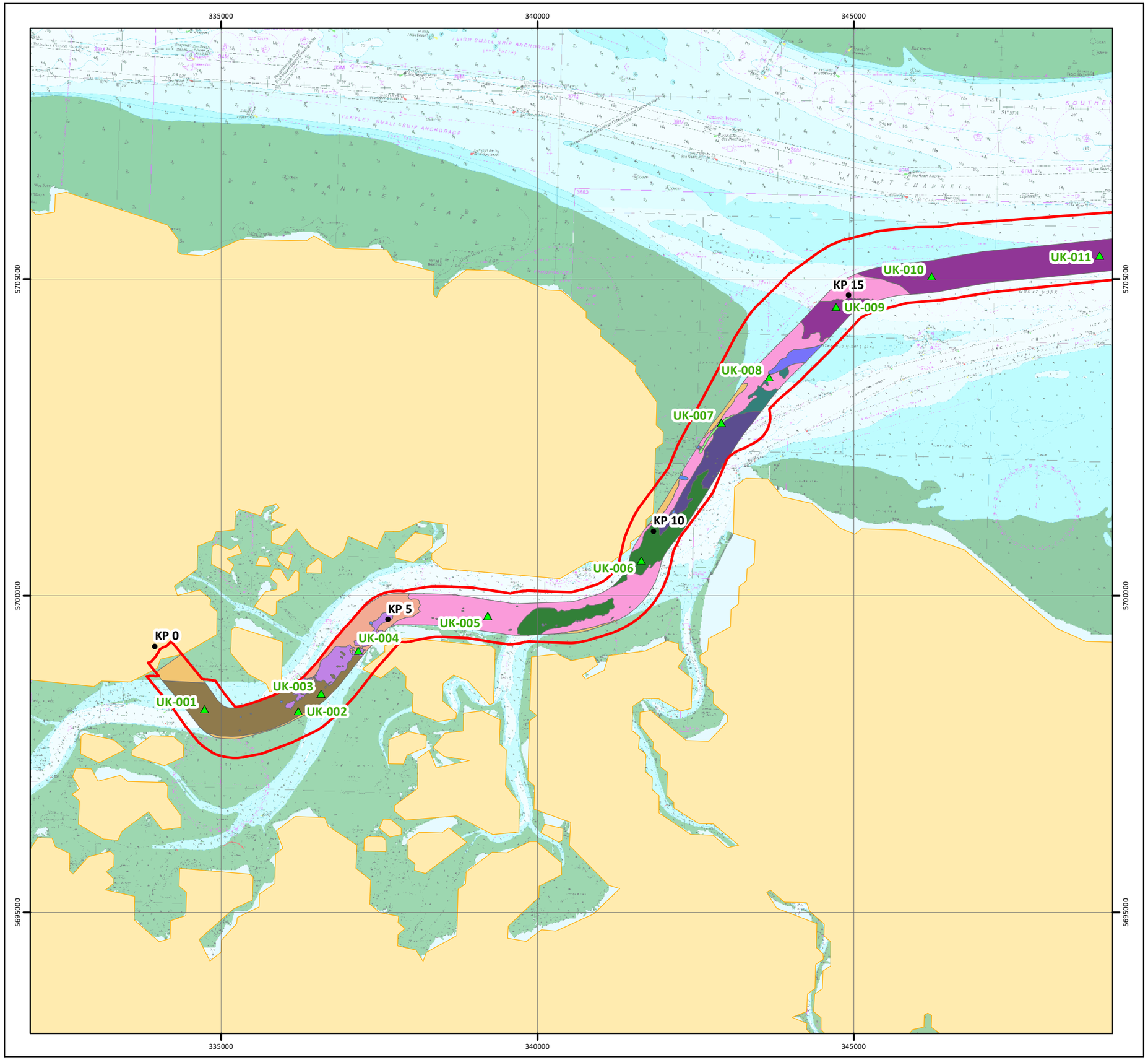
Four Annex I habitats, eight Habitats of Principle Importance and one of OSPAR's list of threatened and/or declining species were identified in the Asset Placement Corridor. These are discussed further in Section 7.3.3.

Table 7-2 Habitats found within the Asset Placement Corridor

A2.3 Littoral mud LS.LMu	A5.32 Sublittoral mud in variable salinity SS.SMu.SMuVS	A5.432 *Sabella pavonina* with sponges and anemones on infralittoral mixed sediment SS.SMx.IMx.SpavSpAn	A5.42 Sublittoral mixed sediment in variable salinity (estuaries) SS.SMx.SMxVS
photographic evidence wasn't possible due to visibility			
A5.33 Infralittoral sandy mud SS.SMu.ISaMu	A5.13 Infralittoral coarse sediment SS.SCS.ICS	A4.231 Piddocks with sparse associated fauna in sublittoral very soft chalk or clay CR.MCR.SfR.Pid	A5.43 / A5.261 Infralittoral mixed sediments / *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment SS.SMx.IMx / SS.SSa.CMuSalbNuc
			

A5.242 /A5.241 *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand / *Echinocardium cordatum* and *Ensis* spp. in lower shore and shallow sublittoral slightly muddy fine sand SS.SSa.IMuSa.FfabMag/ SS.SSa.IMuSa.EcorEns	A5.35 Circalittoral sandy mud SS.SMu.CSaMu	A5.26 Circalittoral muddy sand SS.SSa.CMuSa	A5.23 Infralittoral fine sand SS.SSa.IFiSa
			photographic evidence wasn't possible due to visibility
A5.261 *Abra alba and Nucula nitidosa in circalittoral muddy sand or slightly mixed sediment* SS.SSa.CMuSa.AalbNuc	A5.44 Circalittoral mixed sediments SS.SMx.CMx	A5.261 /A5.241 *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment / *Echinocardium cordatum* and *Ensis* spp. in lower shore and shallow sublittoral slightly muddy fine sand SS.SSa.CMuSa.AalbNuc / SS.SSa.IMuSa.EcorEns	A5.44/ A4.23 Circalittoral mixed sediments/ Communities on soft circalittoral rock SS.SMx.CMx/ CR.MCR.SfR
			

A5.25 Circalittoral fine sand SS.SSa.CFiSa	A5.611 Sabellaria spinulosa on stable circalittoral mixed sediment SS.SBR.PoR.SspiMx	A5.141 *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles SS.SCS.CCS.PomB	A5.141/ A4.23 *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles / Communities on soft circalittoral rock SS.SCS.CCS.PomB, CR.MCR.SFR
			
A5.14 Circalittoral coarse sediment SS.SCS.CCS	A5.43 Infralittoral mixed sediments SS.SSa.CMuSalbNuc	A5.3 Sublittoral mud SS.SMu	A5.24 Infralittoral muddy sand SS.SSa.IMuSa
		photographic evidence wasn't possible due to visibility	photographic evidence wasn't possible due to visibility



GRIDLINK INTERCONNECTOR

SEABED HABITAT

EUNIS Classification - Sheet 1

Drawing No: P2172-HAB-002 | **B**

Legend

- KP
- Grab Sample Position
- Application Corridor

Eunis Classification

- A2.3
- A4.231
- A5.13
- A5.23
- A5.32
- A5.33
- A5.35
- A5.42
- A5.43
- A5.43/A5.261
- A5.432
- J

N W E S

NOTE: Not to be used for Navigation

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Projection	Transverse Mercator
Datum	WGS 1984
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Created By	Chris Dawe
Reviewed By	Emma Langley
Approved By	Callum Bain

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intertek

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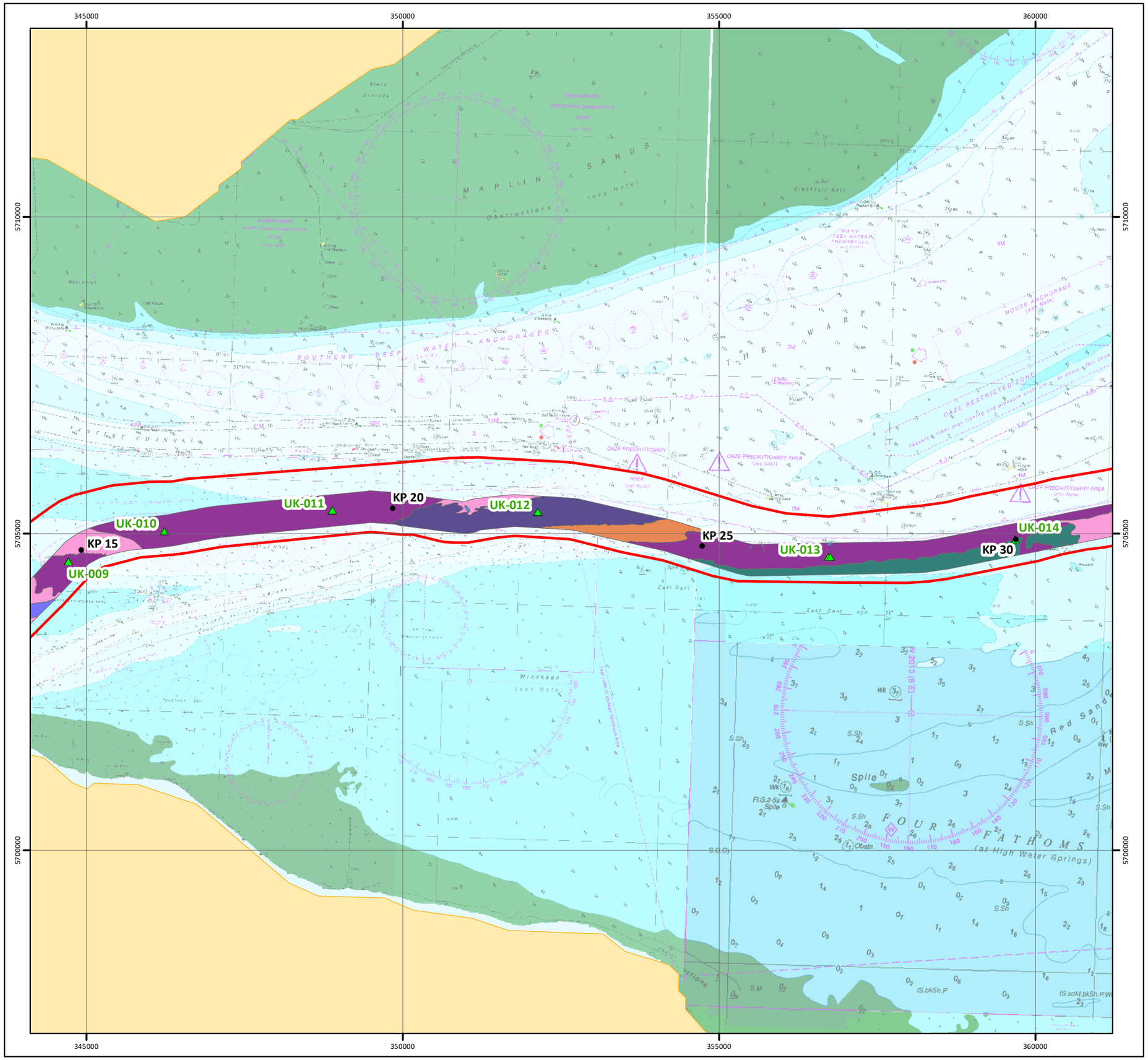

GRIDLINK INTERCONNECTOR

SEABED HABITAT

EUNIS Classification - Sheet 2

Drawing No: P2172-HAB-002 | **B**

Legend

- KP
- Grab Sample Position
- Application Corridor

Eunis Classification

- A5.23
- A5.26
- A5.33
- A5.35
- A5.43
- A5.43/A5.261
- J

N W E S

NOTE: Not to be used for Navigation

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Reviewed By	Emma Langley
Approved By	Callum Bain

GRIDLINK INTERCONNECTOR

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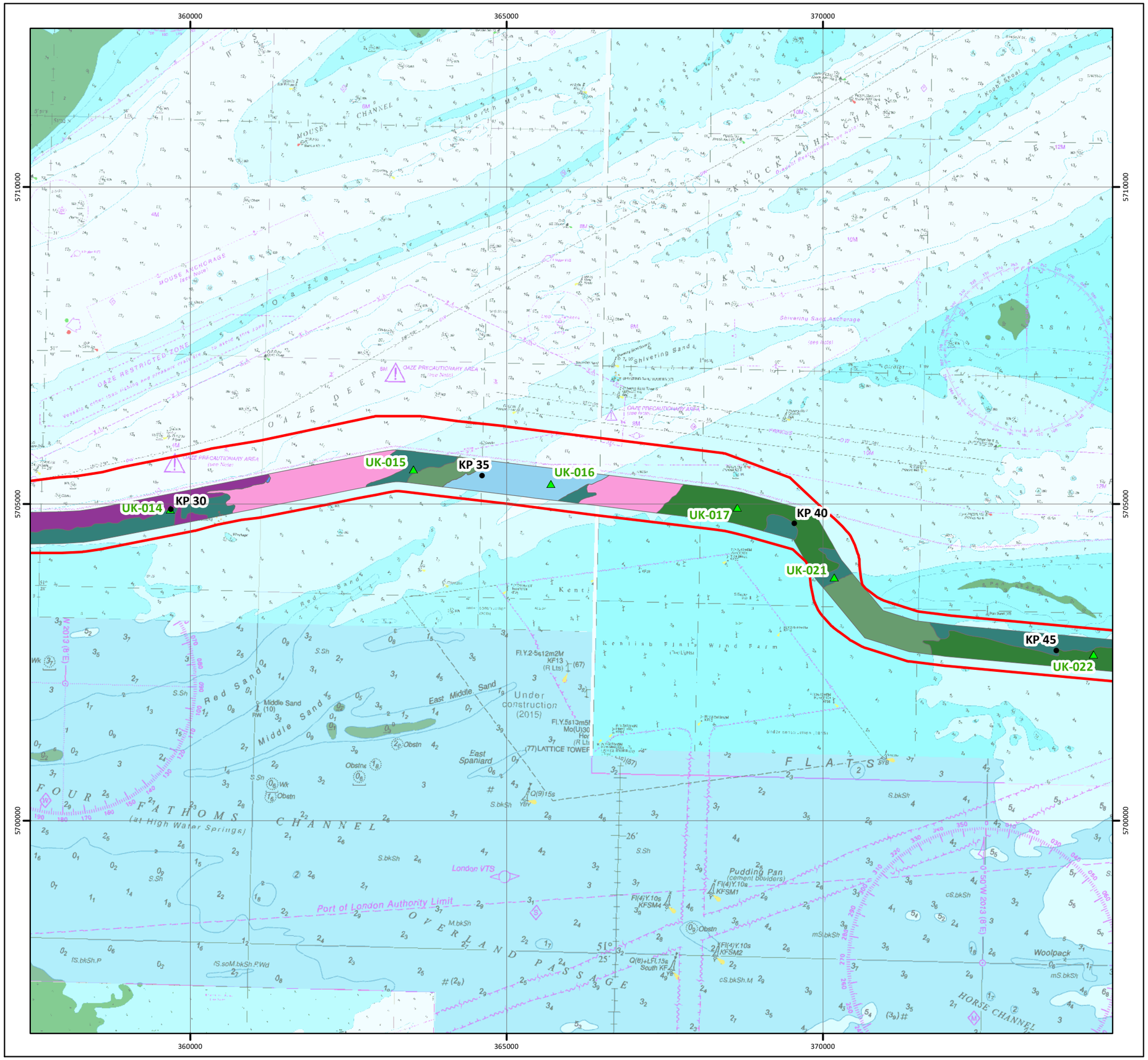

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SEABED HABITAT

EUNIS Classification - Sheet 3

Drawing No: P2172-HAB-002 | **B**

Legend

- KP
- Grab Sample Position
- Application Corridor

Eunis Classification

- A5.13
- A5.24
- A5.242/A5.241
- A5.33
- A5.43
- A5.43/A5.261
- J

N W E S

NOTE: Not to be used for Navigation

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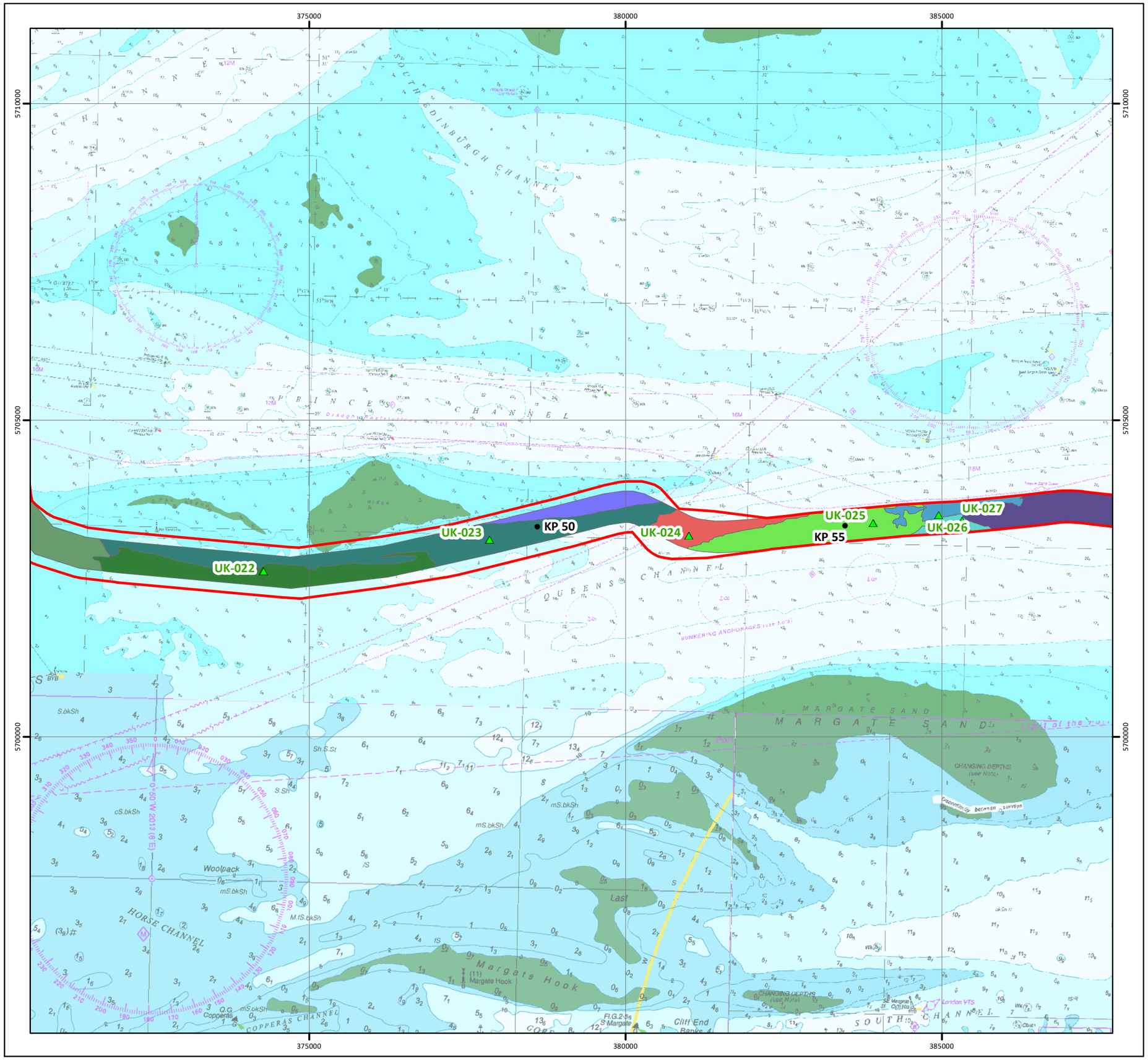

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SEABED HABITAT

EUNIS Classification - Sheet 4

Drawing No: P2172-HAB-002 | **B**

Legend

- KP
- Grab Sample Position
- Application Corridor

Eunis Classification

- A5.13
- A5.23
- A5.24
- A5.261
- A5.261/A5.241
- A5.3
- A5.35
- A5.43
- A5.44
- J

N W E S

NOTE: Not to be used for Navigation

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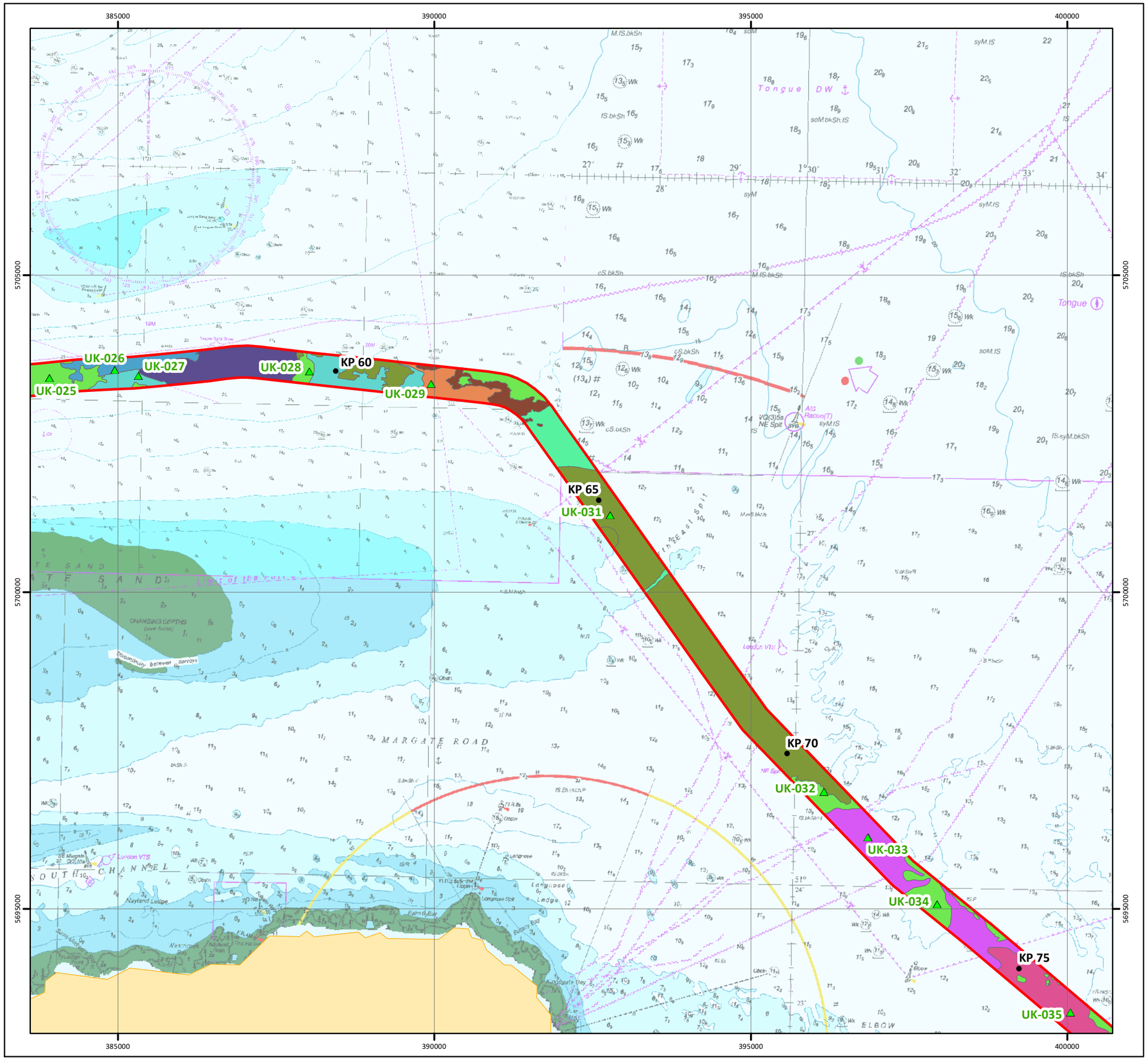

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SEABED HABITAT

EUNIS Classification - Sheet 5

Drawing No: P2172-HAB-002 | **B**

Legend

- KP
- Grab Sample Position
- Application Corridor

Eunis Classification

- A5.14
- A5.141
- A5.25
- A5.26
- A5.261
- A5.261/A5.241
- A5.3
- A5.35
- A5.44
- A5.44/A4.23
- A5.611

N W E S

NOTE: Not to be used for Navigation

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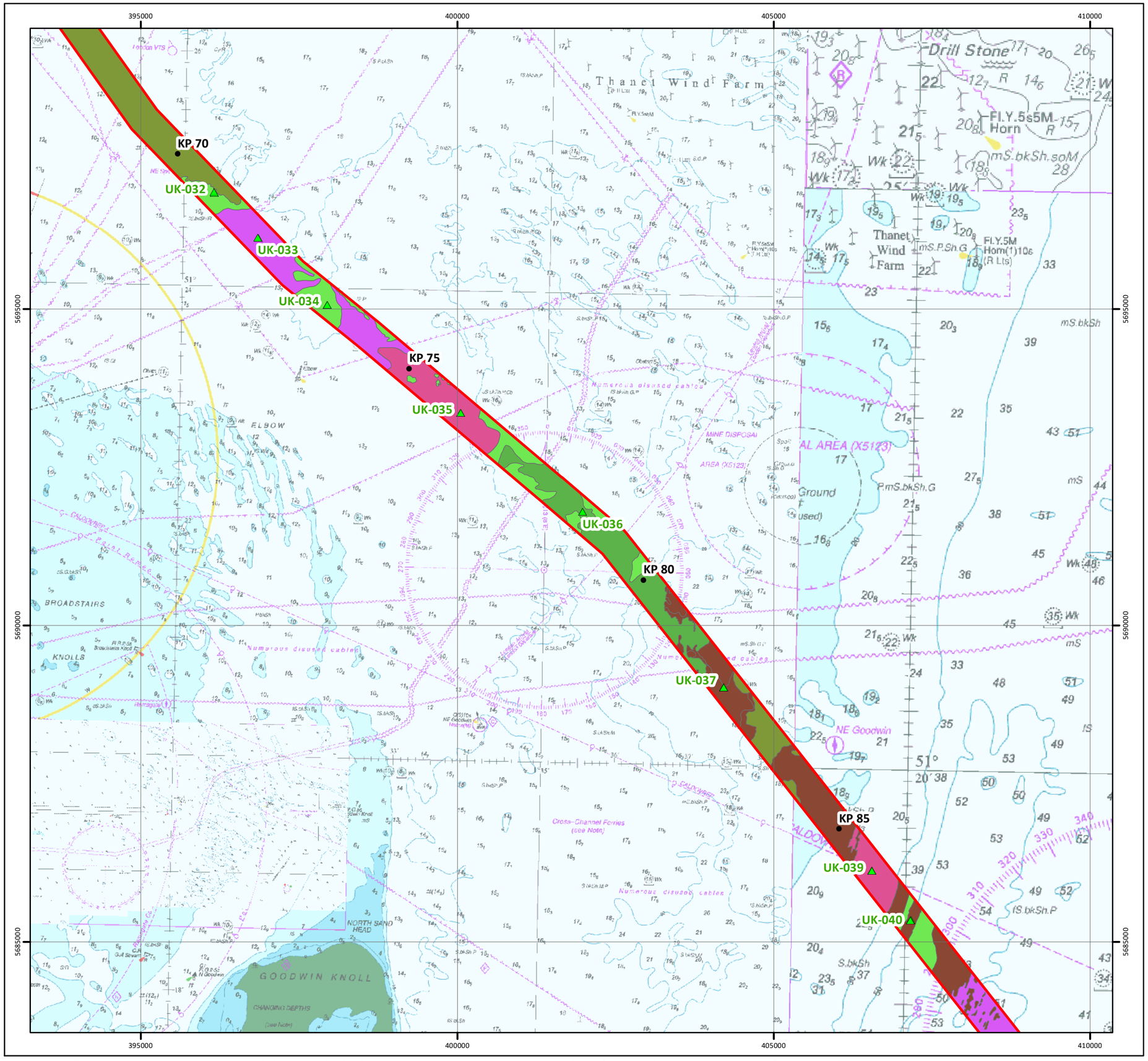

GRIDLINK INTERCONNECTOR

SEABED HABITAT

EUNIS Classification - Sheet 6

Drawing No: P2172-HAB-002 | **B**

Legend

- KP
- Grab Sample Position
- Application Corridor

Eunis Classification

- A5.141
- A5.141/A4.23
- A5.25
- A5.44
- A5.44/A4.23
- A5.611

N W E S

NOTE: Not to be used for Navigation

Date	29 May 2020
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Projection	Transverse Mercator
Datum	WGS 1984
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GRIDLINK INTERCONNECTOR

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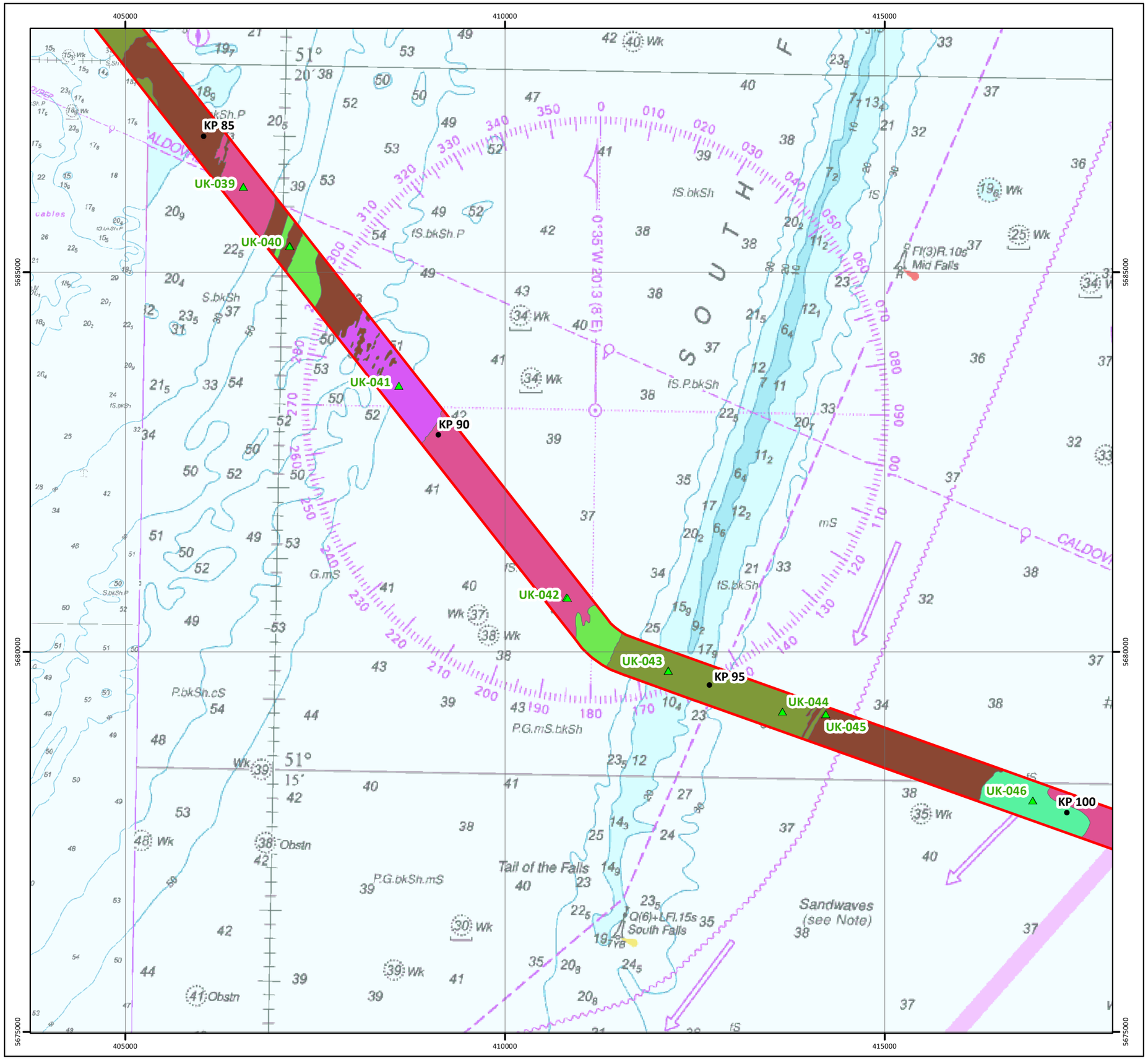

GRIDLINK INTERCONNECTOR

SEABED HABITAT

EUNIS Classification - Sheet 7

Drawing No: P2172-HAB-002 | **B**

Legend

- KP
- Grab Sample Position
- Application Corridor

Eunis Classification

- A5.14
- A5.141
- A5.25
- A5.44
- A5.44/A4.23
- A5.611

N W E S

NOTE: Not to be used for Navigation

Date	29 May 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
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Created By	Chris Dawe
Reviewed By	Emma Langley
Approved By	Callum Bain

GRIDLINK INTERCONNECTOR

intertek

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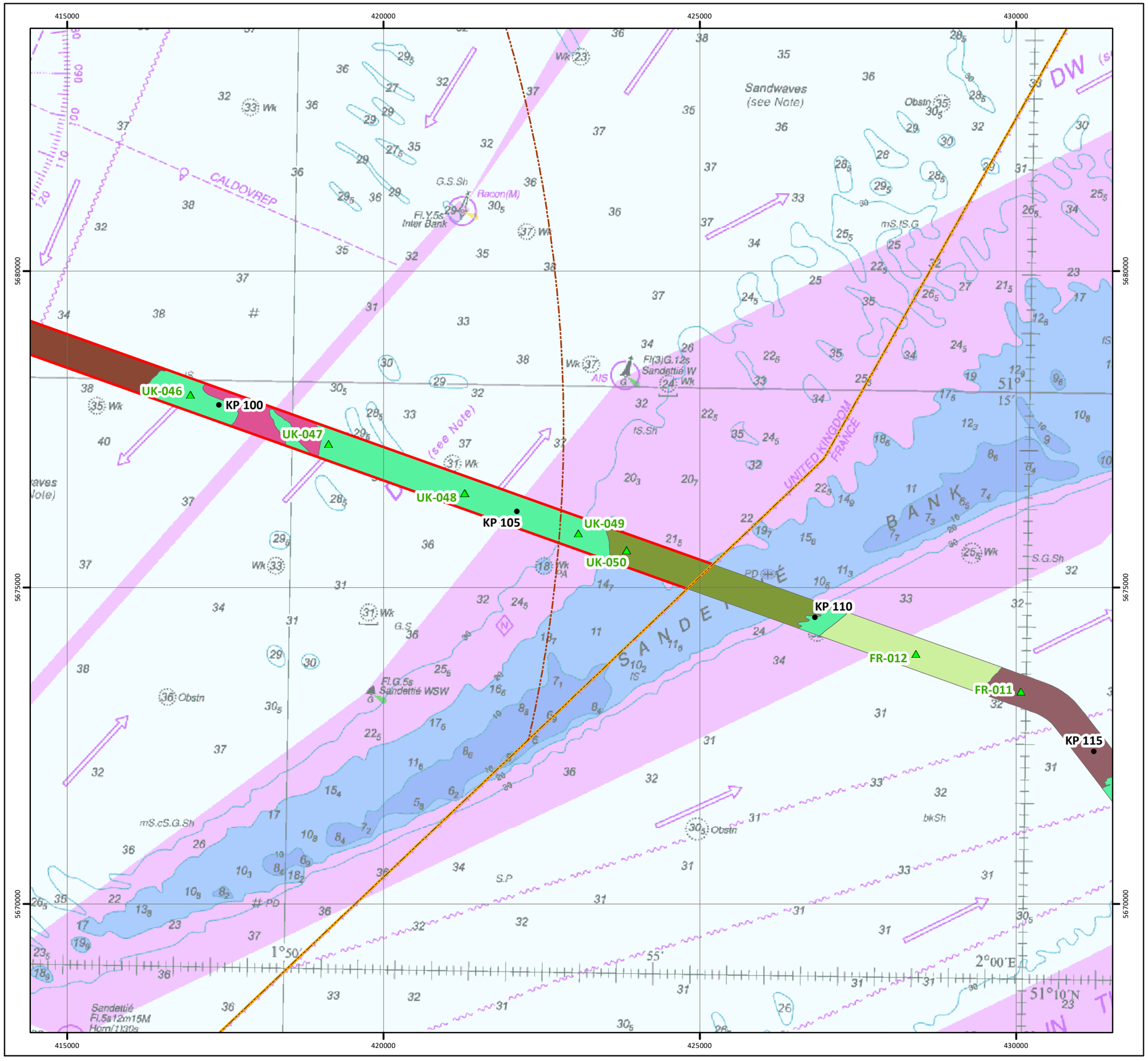

GRIDLINK INTERCONNECTOR

SEABED HABITAT

EUNIS Classification - Sheet 8

Drawing No: P2172-HAB-002 | **B**

Legend

- KP
- Grab Sample Position
- 12nm Territorial Sea Limit
- EEZ Boundary
- Application Corridor

Eunis Classification

- A5.14
- A5.141
- A5.146
- A5.25
- A5.446
- A5.611

N W E S

NOTE: Not to be used for Navigation

Date	29 May 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	MarineRegions; UKHO; EuropaTech; MMT; GEBCO; GridLink; ESRI
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Created By	Chris Dawe
Reviewed By	Emma Langley
Approved By	Callum Bain

GRIDLINK INTERCONNECTOR

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7.3.3 Protected habitats and species of conservation importance

7.3.3.1 Overview

The following four EC Habitats Directive Annex I listed habitats were identified in the Proposed Development:

- 1130 - Annex I Estuaries;
- 1110 – Annex l Sandbanks which are slightly covered by seawater all the time;
- 1140 – Annex l Mudflats and sandflats not covered by seawater at low tide; and
- 1170 – Annex I Biogenic Reef.

The location of Annex I Habitats found within the Proposed Developed is illustrated in Figures 7-14 to 7-21 (Drawings P2172-HAB-003 Sheet 1-8).

In addition, Protected Features of the Medway Estuary MCZ, Goodwin Sands MCZ and Foreland MCZ were observed within the Proposed Development. These are as follows:

- Subtidal coarse sediment – Medway Estuary MCZ, Goodwin Sands MCZ and Foreland MCZ;
- Subtidal sands - Goodwin Sands MCZ and Foreland MCZ;
- Subtidal mud - Medway Estuary MCZ;
- Peat and clay exposures - Medway Estuary MCZ; and
- *Sabelleria spinulosa* reefs – Goodwin Sands MCZ (also found in areas outside of the protected sites).

Four juvenile ocean quahog (*Arctica islandica*), a species listed on OSPARs list of threatened and/or declining species, were observed at environmental stations UK-032 (KP78).

The following four habitats of Principal Importance have also been identified within the Proposed Development:

- Subtidal sands;
- Sheltered muddy gravels;
- Mud habitats in deep waters; and
- Subtidal chalk.

Further information on protected habitats and species observed within the Proposed Development is provided in Section 7.3.3.2 – 7.3.3.14.

Where the seabed at environmental stations has been classified as a protected habitat, as a precaution and where appropriate, it has been assumed that the extent of this habitat extends with the mapped EUNIS habitat classification.

A Byelaw was passed by Kent and Essex Inshore Fisheries and Conservation Authority (KEIFCA) in 2017 (KEIFCA 2017) which prohibits the use of bottom towed fishing gear in a total of six areas in the KEIFCA jurisdiction. The Proposed Development crosses the Pan Sand Hole prohibited area from KP42.1 to KP47.7.

7.3.3.2 Annex I Estuaries

Estuaries are habitat complexes which comprise an interdependent mosaic of subtidal and intertidal habitats, which are closely associated with surrounding terrestrial habitats. Estuaries are defined as the downstream part of the river valley and are subject to the tide. There is a gradient of increasing salinity towards the open sea.

One area located within the Medway Estuary between KP 0.7 and KP 13.1 is classified by MMT (2019) as Annex I (1130) – Estuaries (Figure 7-12 Drawing P2171-HAB-004). Although this habitat is not a protected feature of Medway Estuary MCZ, it is made up of a mosaic of subtidal habitats which are protected features of this MCZ and have been observed within the Proposed Development, these include:

- Subtidal coarse sediment (Section 7.3.3.5)
- Subtidal mud (Section 7.3.3.7)
- Peat and clay exposures (Section 7.3.3.9)

Within Annex I Estuaries the sediment type changes sequentially along the Proposed Development from mud through to sandy mud which is then intervened with areas of mixed and coarse sediment. Correspondingly, the habitat type and key fauna change with the sediment type. Table 7-3 provides information on these changes.

Table 7-3 Habitats and key fauna within Annex I Estuaries

KP	Sediment type	Associated EUNIS habitats	Key fauna within grab sample
KP0.7-KP4	Mud	A2.3, A5.32 and A5.15	Stations UK001- UK003 - Polychaetes and bivalves with the most dominant species being the horseshoe worm *Phoronis* sp
KP 2.8 and KP 3.6	Mud with occasional cobbles and boulders	A5.432	Transects T1-T4 showed *S. pavonina* tangled up with green algae but also tubes protruding from the muddy seabed along with aggregations of the non-native slipper limpet *Crepidula fornicate*.
KP 4-13.1	Sandy mud habitats, intervened with areas of coarse sediment and mixed sediment	Sandy mud habitats - A5.15, A5.33, A5.43, A5.35 and A5.23 Coarse and mixed sediment habitats - A5.42, A5.432 and A5.13	Stations UK005, UK008 and UK009 Sandy mud habitats - The horseshoe worms *Phoronis* sp. and acorn barnacles, including *Balanus crenatus* dominated the samples Station UK004, Mixed sediment habitats - Anemones, Actiniaria, dominated the samples, Nemertea and *S.Spinulosa* were also observed. No *S. spinulosa* reef features were identified from the imagery collected.
KP12	Very soft chalk or clay	A4.231	Station UK007 - Bivalve *Barnea candida* and *polychaetes Glycera alba*, *S. pavonina* and *Eunereis longissimi*

7.3.3.3 Annex l sandbanks which are slightly covered by seawater all the time

The Margate and Long Sands SAC covers an area of 648km^2. Annex I sandbanks which are slightly covered by sea water all the time consist of sandy sediments that are permanently covered by shallow sea water and are typically located at depths of less than 20m. The sandbank habitat of Margate and Long Sands SAC can be divided into two sub-features:

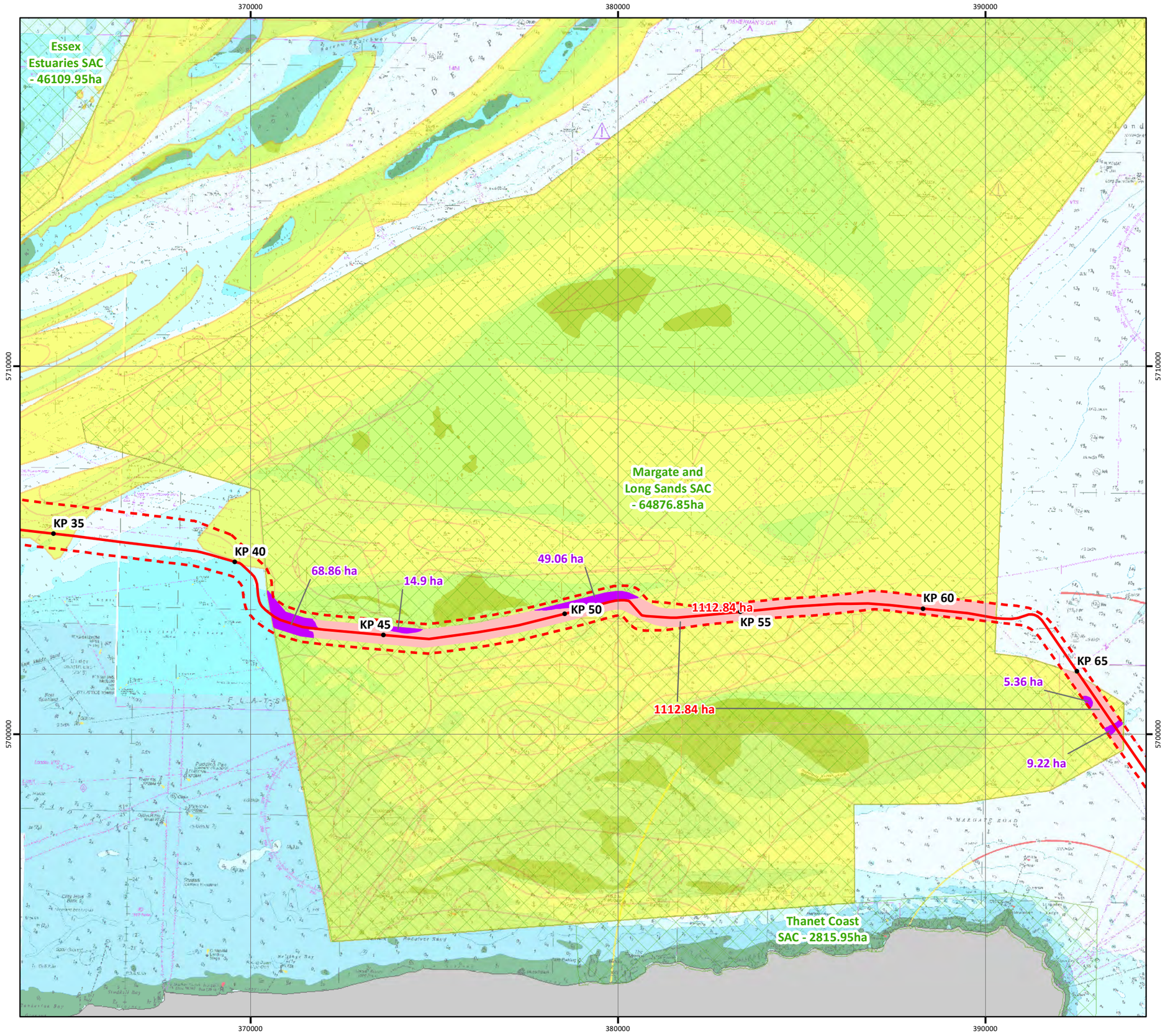
- Dynamic sand communities; and
- Gravelly muddy sand communities.

Eight areas along the Proposed Development were classified as Annex I (1110) - Sandbanks which are slightly covered by sea water all the time. Classification was based on known sandbanks in the area and water depth measurements. Table 7-4 provides an overview of the areas classified as habitat 1110 along with the sediment type, associated EUNIS habitats and fauna and whether the habitat is located within a protected site.

The Proposed Development crosses Margate and Long Sands SAC for approximately 22km. The Proposed Development enters the site at KP42 - KP62, and then leaves the site for 3km, entering again at KP65 - KP67. The Natura Standard data form details that the extent of Primary feature (PF) Sandbanks covers 410km^2 (40995.68ha). From the environmental survey, the four areas along the Asset Placement Corridor classified as Annex I Sandbank within the SAC are estimated to cover an area of 1.42km^2, Figure 7-9 (Drawing P2172-HAB-004).

Table 7-4 Habitats and key fauna within Annex I sandbanks which are slightly covered by seawater all the time

KP	Sediment type	Protected site	Associated EUNIS habitats	Key fauna within grab sample
KP13.1 to KP14.9	Sandy mud and fine sand	Medway Estuary MCZ	A5.33 A5.23	Station UK008 - Dominated by polychaete *Notomastus* sp
KP17.0 to KP18.6,	Muddy sand and mixed sediment	None	A5.43/ A5.261	Station UK010 - Dominated by bivalve *N. nitidosa.*
KP41.2 to KP43.2	Muddy sand	Margate and Long Sands SAC	A5.24	No grab samples obtained near to this location
KP44.4 to KP46.0	Mixed sediment	Margate and Long Sands SAC	A5.43	No grab samples obtained near to this location
KP49.2 to KP51.7	Fine sand	Margate and Long Sands SAC	A5.23	No grab samples obtained near to this location
KP66.5 to KP66.6	Fine Sand	Margate and Long Sands SAC	A5.25	Station UK031 - Low diversity and abundance. Polychaetes comprised the majority of the identified taxa with regards to abundance
KP93.7 to KP 95.7	Fine Sand	None	A5.25	Station UK043 - Dominated by Mysida shrimp *Gastrosaccus spinifer*
KP105.1 to KP108.1	Coarse sediment	Foreland MCZ	A5.14	Station UK049 - Dominated by polychaetes *N. cirrosa*, *G. oxycephala*, *O. borealis*, amphipod *Bathyporeia elegans*, and bivalves, including, *A. pygmaea.*
	Fine sand		A5.25	Station UK050 - One replicate did not contain any fauna and others were Nematoda, shrimp *Philocheras trispinosus*, and lesser sandeel *Ammodytes tobianus*, polychaete *G. oxycephala* and Decapoda zoea larvae.



GRIDLINK INTERCONNECTOR

ENVIRONMENTAL HABITATS
Annex I Sandbanks within Margate & Long Sands SAC

Drawing No: P2172-HAB-004 | **B**

Legend

- KP
- GridLink Preferred Cable Route
- Application Corridor
- Asset Placement Corridor Within SAC

Environmental Designations

- SAC

Annex I Habitat

- Sandbank Area (High Confidence)
- Surveyed Annex I Sandbanks within SAC

N W E S

NOTE: Not to be used for Navigation

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Projection	Transverse Mercator
Datum	WGS 1984
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Created By	Chris Dawe
Reviewed By	Chris Carroll
Approved By	Kerri Gardiner

GRIDLINK INTERCONNECTOR intertek

0 1 2 3 4 km

7.3.3.4 Annex I - Mudflats and sandflats not covered by seawater at low tide

Based on substrate type and water depth, six areas along the Asset Placement Corridor were classified as Annex I (1140) – Mudflats and sandflats not covered by seawater at low tide. These areas of 1140 habitat extended from KP0.4 to KP0.7, KP1.55 to KP3.1, KP7.70 to KP8.6, KP10 to KP11 and KP11.7 to KP13 and are all located within the Medway Estuary MCZ. The habitat at these locations was classified as A2.3 - Littoral Mud. No grab samples were retrieved from this habitat type. However, sediment of this type is usually colonised by burrowing fauna such as worms, crustaceans, bivalve molluscs and echinoderms.

Although habitat 1140 is not listed as designated feature of the Medway Estuary MCZ, it is closely associated with intertidal sand and muddy sand which is a protected feature of the MCZ.

7.3.3.5 Annex I Reef (biogenic) and *Sabellaria spinulosa* reefs

15 areas of potential Annex I Biogenic Reef (*Sabellaria spinulosa* reefs) were observed along the Asset Placement Corridor, 10 of which were classified as Annex I Biogenic Reef (and Habitat of Principle Importance) (Table 7-5).

The distinction of what is considered a reef is not precise, particularly in the case for *Sabellaria spinulosa*. The presence of *S. spinulosa* does not automatically qualify the area as an Annex I habitat. Therefore, a scoring system based on a series of physical, biological and spatial characteristic reef features is used to assess the degree of "reefiness". The reefiness is weighted according to the perceived importance of each feature. Furthermore, the reefiness is increased with a score indicating the confidence in the feature score. Gubbay (2007) proposes threshold ranges for the reef characteristics elevation; spatial extent; and patchiness of *S. spinulosa.* These were used by MMT (2019 and 2020) to categorise the areas of *S.spinulosa* identified within the Asset Placement Corridor.

The Proposed Development extends through areas of *Sabellaria spinulosa* reef of medium and low grade (Table 7-5). The Biogenic reef type found was medium grade Biogenic *S. spinulosa* reefs at KP80.5 - KP80.7, KP83.6 and KP84.3 (Table 7-5). Figures 7-12 and Figure 7-13 show a backscatter intensity map highlighting the high density of *Sabellaria* found within the Goodwin Sands MCZ, located from approximately KP81.5 to KP85.3 and covering an area of 1.18km^2. At this location *S.spinulosa* reef cover the entire width of the Asset Placement Corridor. Figures 7-18 to 7-20 (Drawing P2172-HAB-003 Sheets 6 – 8) shows areas designated as potential Annex I Biogenic reef along with the reefiness grading.

Table 7-5 Location of *Sabellaria spinulosa* and Biogenic Reef

KP	Sediment type	Protected site	Associated EUNIS habitats	Reefiness grade
KP 9.5	Silty and sand clays with areas of silty and gravelly sand	Medway Estuary MCZ	A5.13	Not a Reef
KP 14.7	Silty and sand clays with areas of silty and gravelly sand	Outer Thames Estuary SPA	A5.43/ A5.261	Not a Reef
KP 19	Silty and sand clays with areas of silty and gravelly sand	Outer Thames Estuary SPA	A5.43/ A5.261	Not a Reef
KP 22.4	Silty sand	Outer Thames Estuary SPA	A5.35	Not a Reef
KP 33.9	Silty sand or gravelly silty sand	Outer Thames Estuary SPA	A5.43	Not a Reef
KP 61.87	Very loose sand and very loose gravelly sand	Outer Thames Estuary SPA, Margate and Long Sands SAC	A5.26	Low

KP	Sediment type	Protected site	Associated EUNIS habitats	Reefiness grade
KP 63.11	Very loose to loose silty sand or very loose gravelly silty sand	Outer Thames Estuary SPA, Margate and Long Sands SAC	A5.611	Low
KP 82	Fine sand	Goodwin Sands MCZ	A5.611	Low
KP 80.539 – 80.752	Very loose to loose silty sand or very loose gravelly silty sand	-	A5.141/ A4.23	Medium
KP 83.64	Very loose to loose silty sand or very loose gravelly silty sand	Goodwin Sands MCZ	A5.611	Medium
KP 84.38	Very loose to loose silty sand or very loose gravelly silty sand	Goodwin Sands MCZ	A5.611	Medium
KP 84.75	Very loose to loose silty sand or very loose gravelly silty sand	Goodwin Sands MCZ	A5.611	Low
KP 87.5	Muddy sand with occasional cobbles and boulders	Goodwin Sands MCZ, Southern North Sea SAC	A5.611	Low
KP 87.75	Muddy sand with occasional cobbles and boulders	Goodwin Sands MCZ, Southern North Sea SAC	A5.611	Low
KP96.58	Very loose to loose silty sand or very loose gravelly silty sand	Southern North Sea SAC	A5.611	Low

Figure 7-10 Photographic evidence of Annex I (1170) Biogenic Reefs, *S. spinulosa*

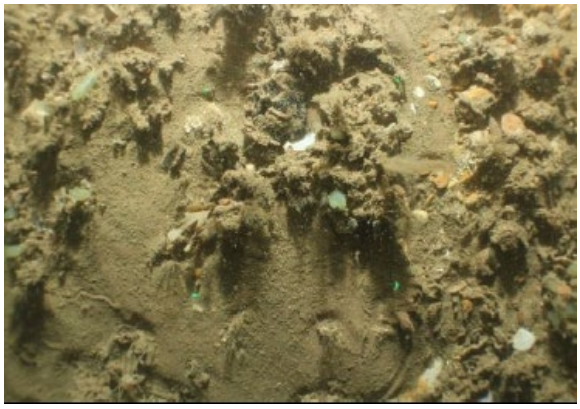


Figure 7-11 Backscatter intensity map of *Sabellaria* (KP82)

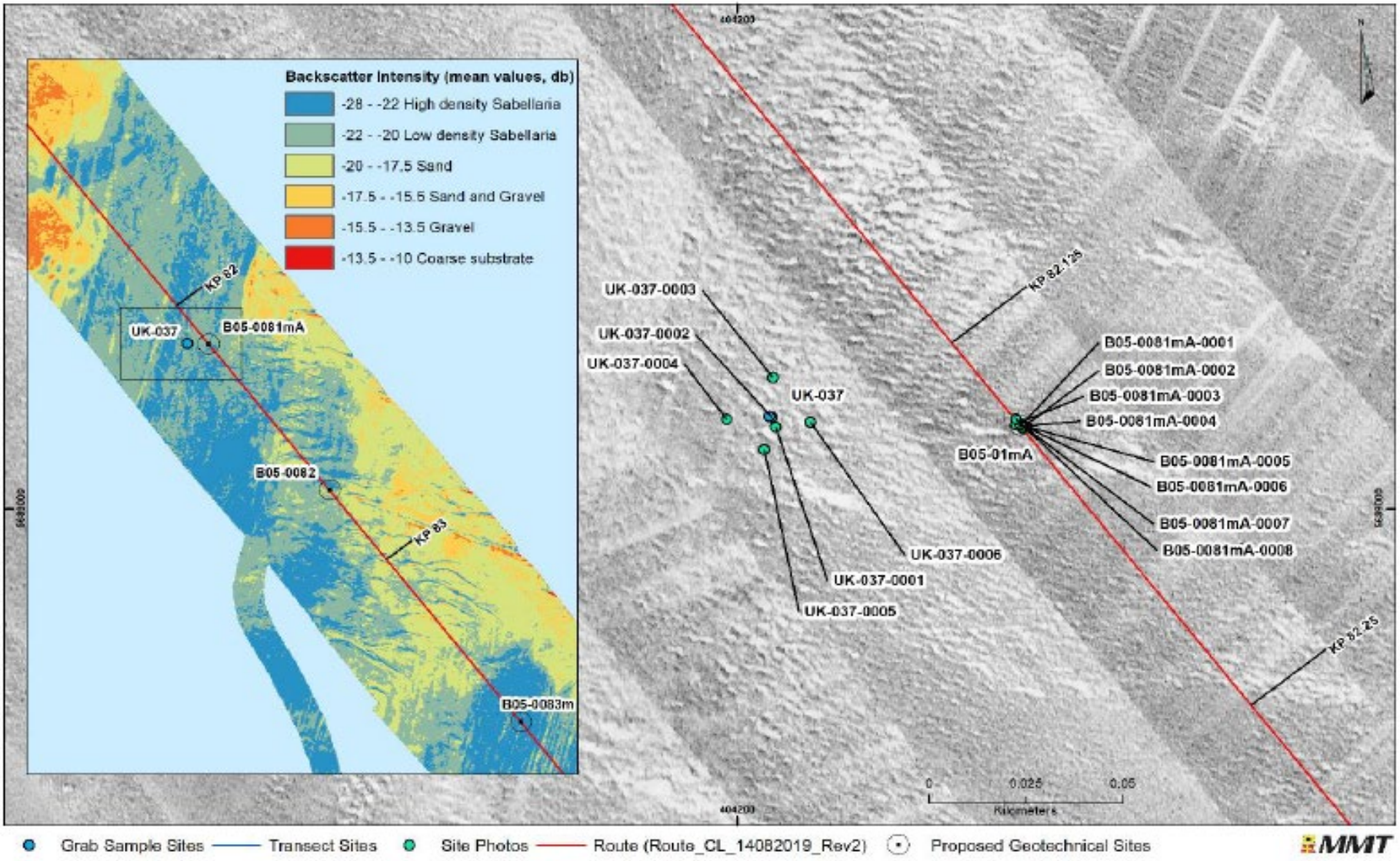
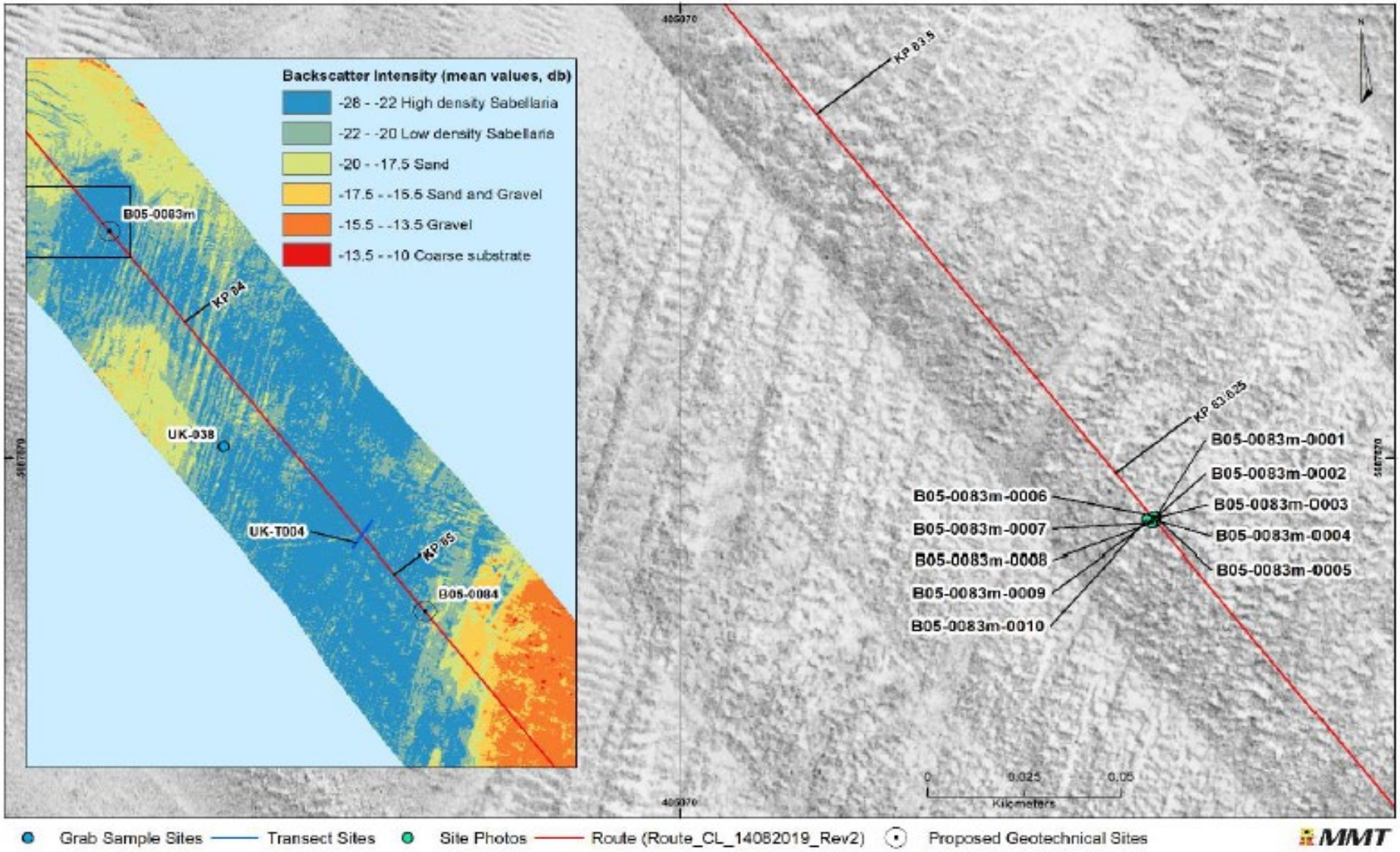
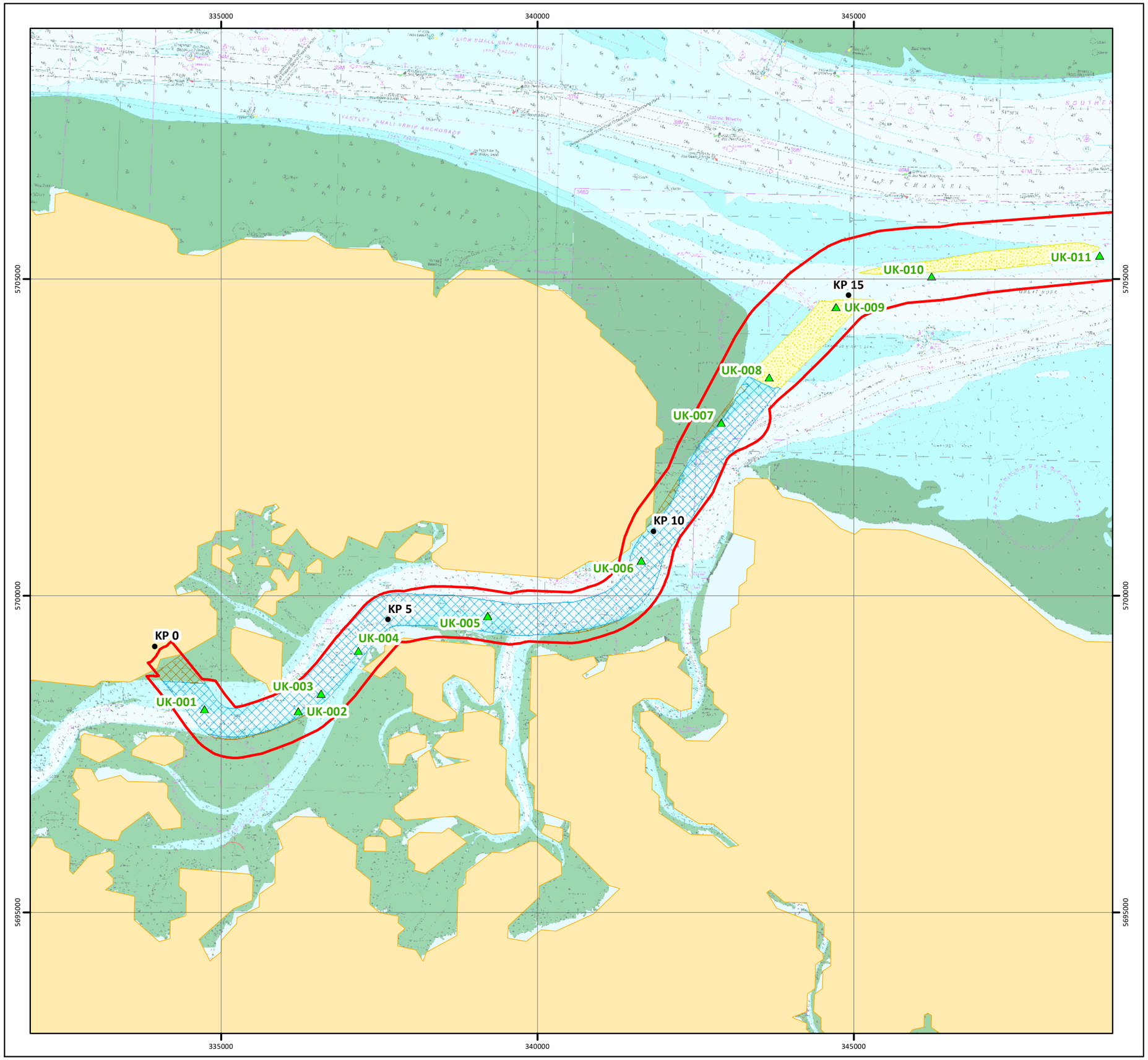


Figure 7-12 Backscatter intensity map of *Sabellaria* (KP83)





GRIDLINK INTERCONNECTOR

SEABED HABITAT

Surveyed Annex I Classification - Sheet 1

Drawing No: P2172-HAB-003 | **B**

Legend

- KP
- Grab Sample Position
- Application Corridor

Annex I Habitat Classification

- ANNEX I (1110) Sandbanks which are slightly covered by sea water all the time
- ANNEX I (1130) Estuaries
- ANNEX I (1140) Mudflats and sandflats not covered by seawater at low tide

N W E S

NOTE: Not to be used for Navigation

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Created By	Chris Dawe
Reviewed By	Emma Langley
Approved By	Callum Bain

GRIDLINK INTERCONNECTOR

intertek

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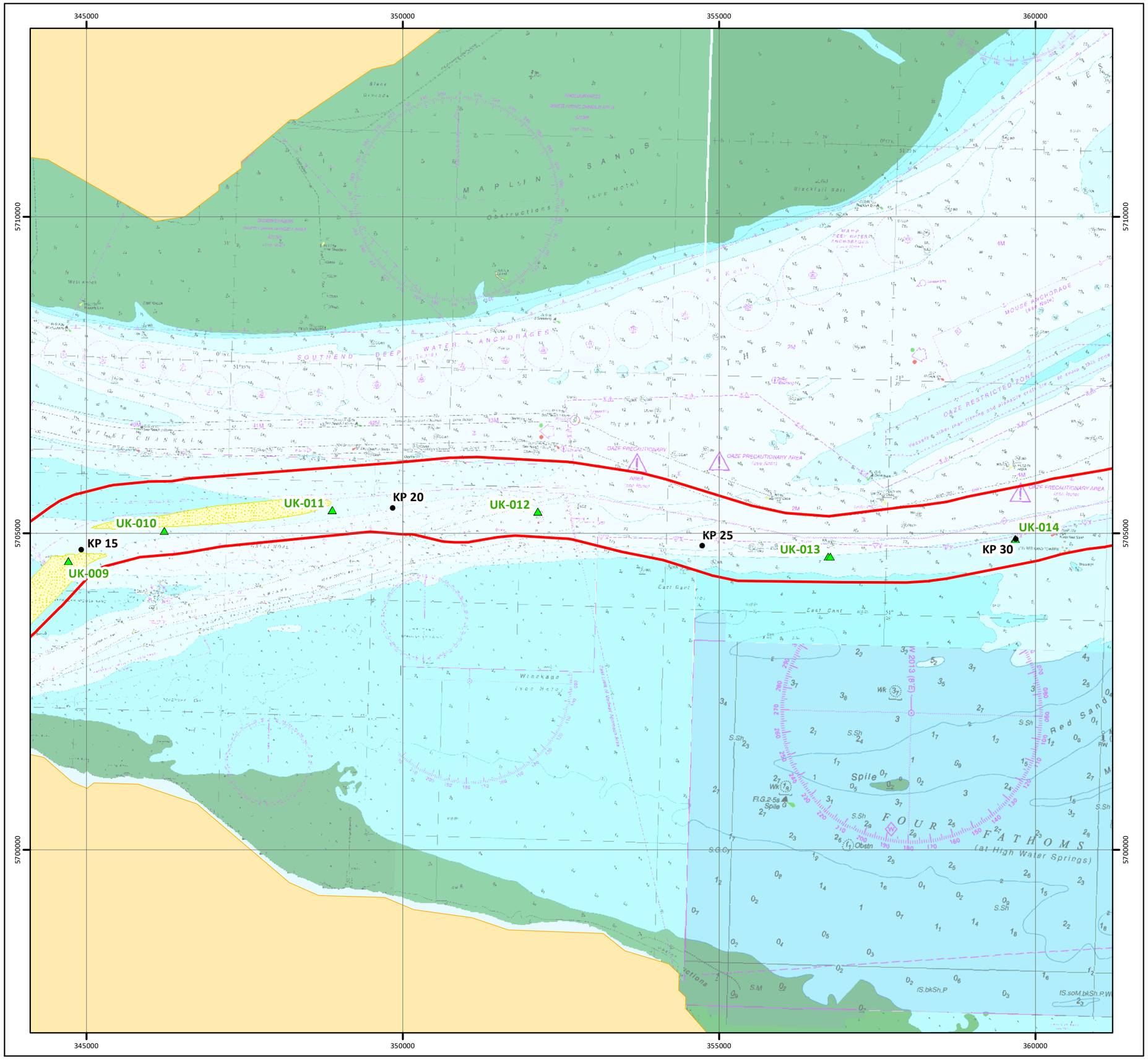

GRIDLINK INTERCONNECTOR

SEABED HABITAT

Surveyed Annex I Classification - Sheet 2

Drawing No: P2172-HAB-003 | **B**

Legend

- KP
- Grab Sample Position
- Application Corridor

Annex I Habitat Classification

- ANNEX I (1110) Sandbanks which are slightly covered by sea water all the time

N W E S

NOTE: Not to be used for Navigation

Date	29 May 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
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Created By	Chris Dawe
Reviewed By	Emma Langley
Approved By	Callum Bain

GRIDLINK INTERCONNECTOR

intertek

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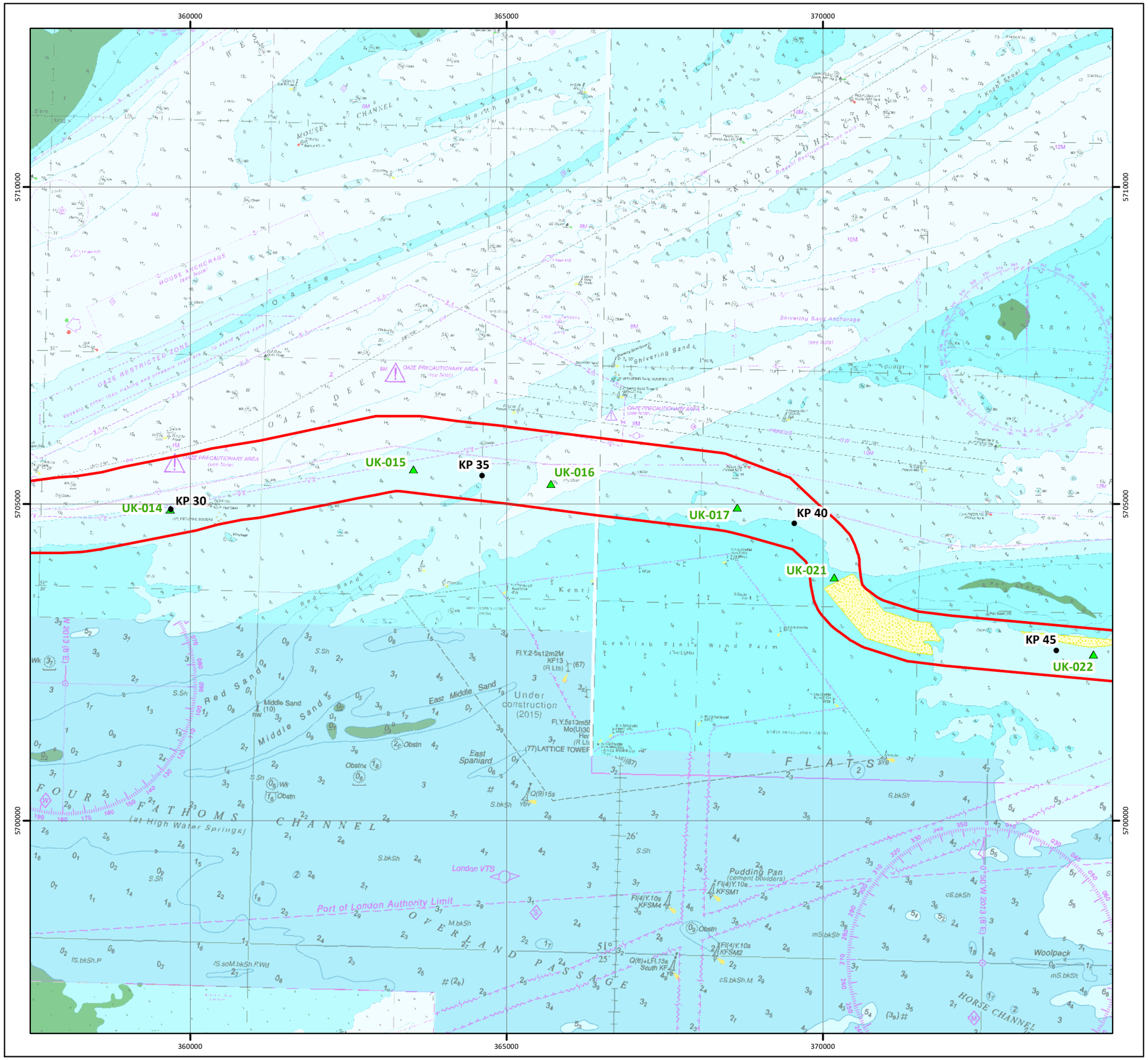

GRIDLINK INTERCONNECTOR

SEABED HABITAT

Surveyed Annex I Classification - Sheet 3

Drawing No: P2172-HAB-003 | **B**

Legend

- KP
- Grab Sample Position
- Application Corridor

Annex I Habitat Classification

- ANNEX I (1110) Sandbanks which are slightly covered by sea water all the time

N W E S

NOTE: Not to be used for Navigation

Date	29 May 2020
Coordinate System	WGS 1984 UTM Zone 31N
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Created By	Chris Dawe
Reviewed By	Emma Langley
Approved By	Callum Bain

GRIDLINK INTERCONNECTOR

intertek

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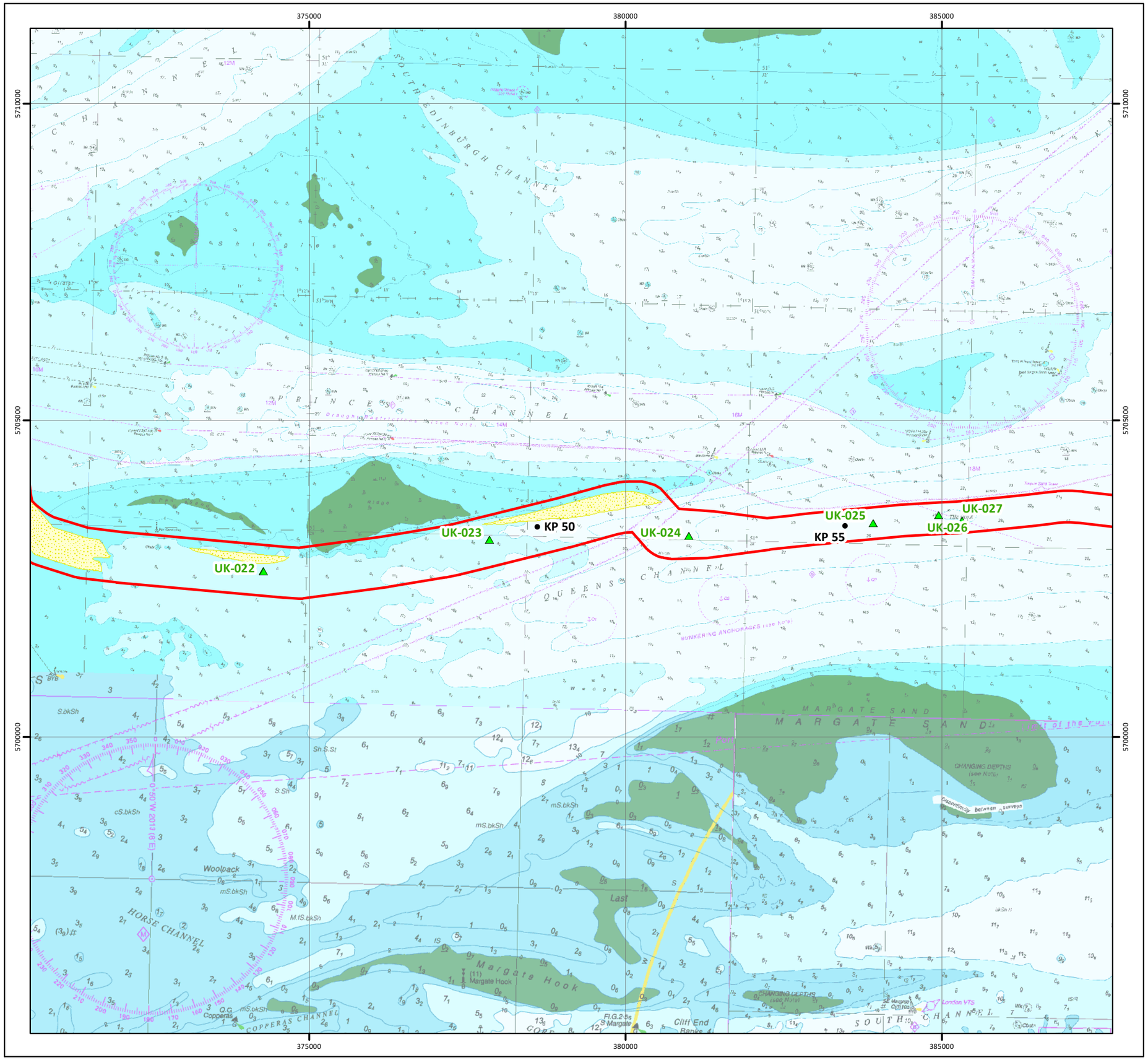

GRIDLINK INTERCONNECTOR

SEABED HABITAT

Surveyed Annex I Classification - Sheet 4

Drawing No: P2172-HAB-003	B

Legend

- KP
- Grab Sample Position
- Application Corridor

Annex I Habitat Classification

- ANNEX I (1110) Sandbanks which are slightly covered by sea water all the time

N W E S

NOTE: Not to be used for Navigation

Date	29 May 2020
Coordinate System	WGS 1984 UTM Zone 31N
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Reviewed By	Emma Langley
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GRIDLINK INTERCONNECTOR

intertek

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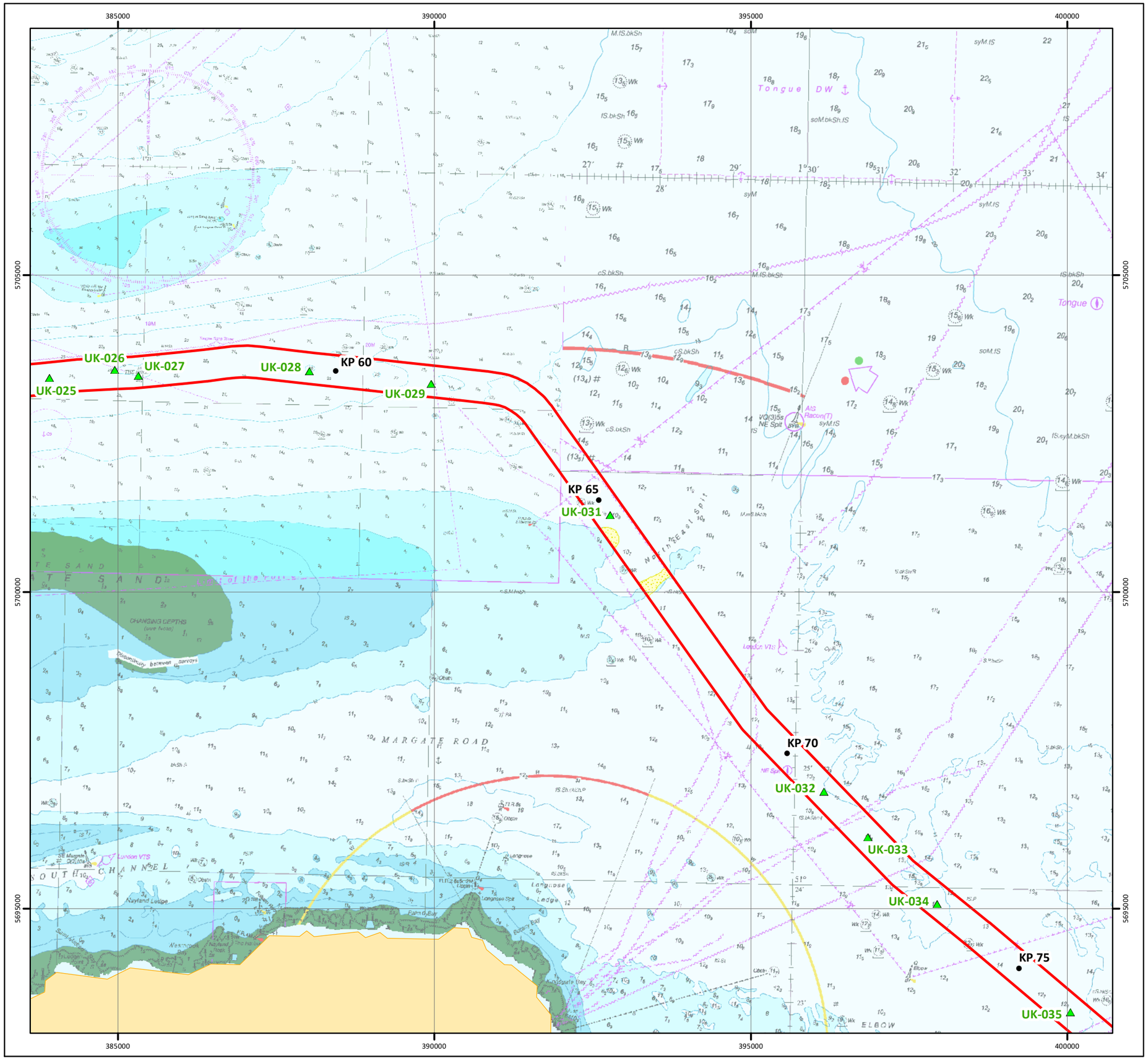

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SEABED HABITAT

Surveyed Annex I Classification - Sheet 5

Drawing No: P2172-HAB-003	B

Legend

- KP
- Grab Sample Position
- Application Corridor

Annex I Habitat Classification

- ANNEX I (1110) Sandbanks which are slightly covered by sea water all the time

N W E S

NOTE: Not to be used for Navigation

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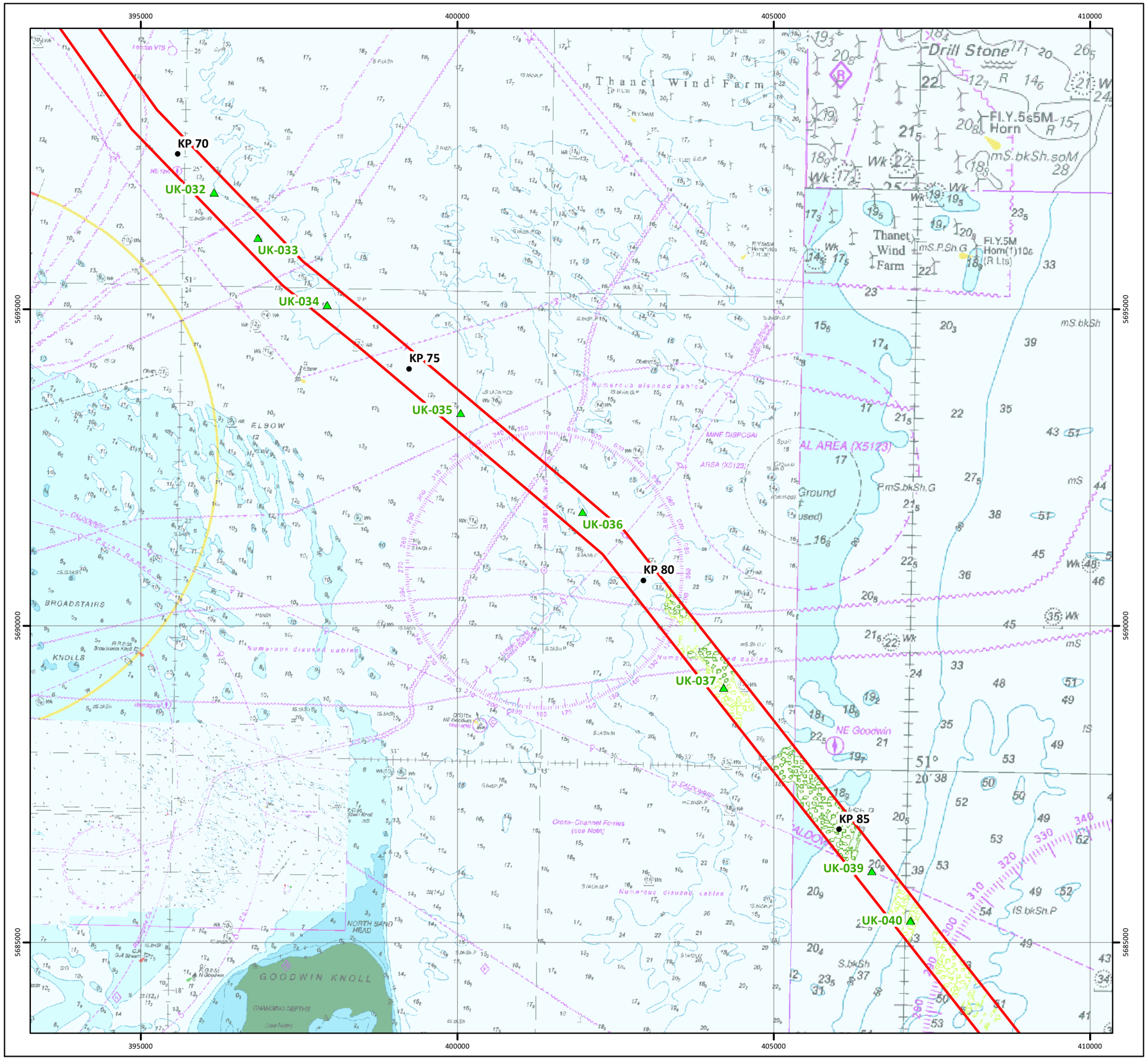

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SEABED HABITAT

Surveyed Annex I Classification - Sheet 6

Drawing No: P2172-HAB-003 | **B**

Legend

- KP
- Grab Sample Position
- Application Corridor

Annex I Habitat Classification

- ANNEX I (1170) Biogenic S. spinulosa Reefs, Low Grade
- ANNEX I (1170) Biogenic S. spinulosa Reefs, Medium Grade

N W E S

NOTE: Not to be used for Navigation

Date	29 May 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
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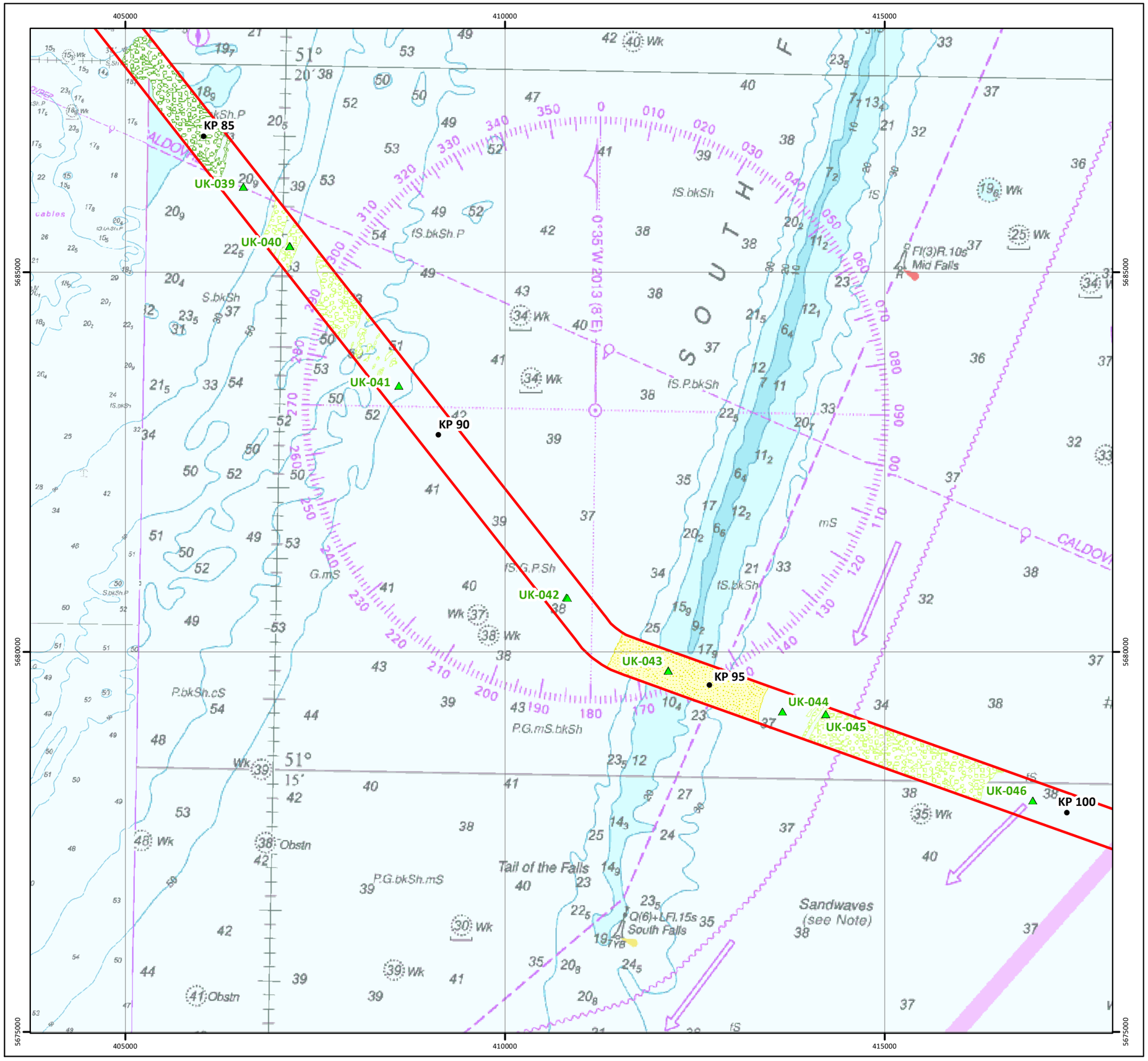

GRIDLINK INTERCONNECTOR

SEABED HABITAT

Surveyed Annex I Classification - Sheet 7

Drawing No: P2172-HAB-003 | **B**

Legend

- KP
- Grab Sample Position
- Application Corridor

Annex I Habitat Classification

- ANNEX I (1110) Sandbanks which are slightly covered by sea water all the time
- ANNEX I (1170) Biogenic S. spinulosa Reefs, Low Grade
- ANNEX I (1170) Biogenic S. spinulosa Reefs, Medium Grade

NOTE: Not to be used for Navigation

Date	29 May 2020
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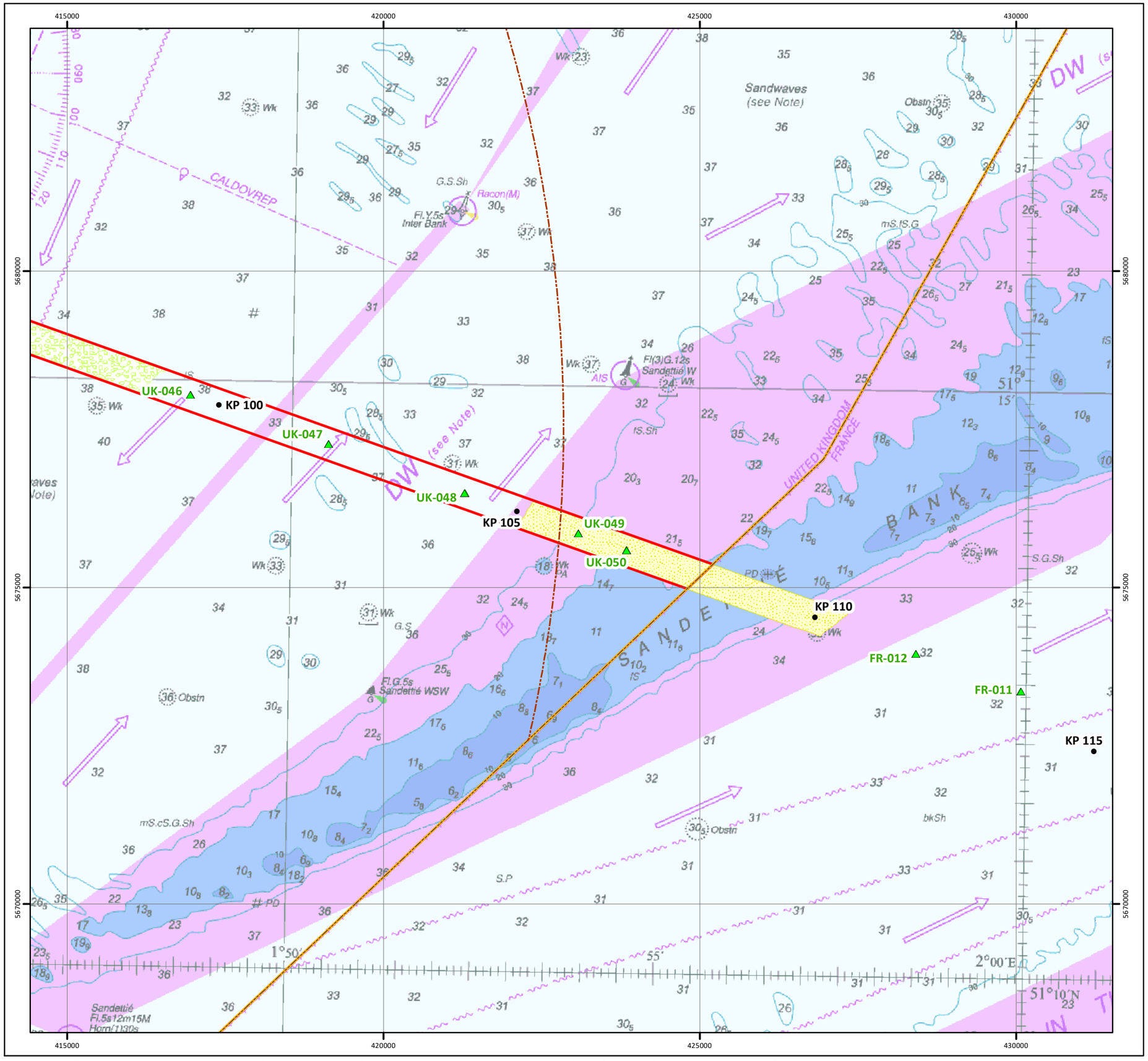

GRIDLINK INTERCONNECTOR

SEABED HABITAT

Surveyed Annex I Classification - Sheet 8

Drawing No: P2172-HAB-003 | **B**

Legend

- KP
- Grab Sample Position
- 12nm Territorial Sea Limit
- EEZ Boundary
- Application Corridor

Annex I Habitat Classification

- ANNEX I (1110) Sandbanks which are slightly covered by sea water all the time
- ANNEX I (1170) Biogenic S. spinulosa Reefs, Low Grade

N W E S

NOTE: Not to be used for Navigation

Date	29 May 2020
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Created By	Chris Dawe
Reviewed By	Emma Langley
Approved By	Callum Bain

GRIDLINK INTERCONNECTOR

intertek

0 1 2 3 km

7.3.3.6 Habitat of Principal Importance - Subtidal coarse sediment

Subtidal coarse sediment is a designated feature of the Medway Estuary MCZ. The environmental survey identified habitats corresponding to subtidal coarse sediment at station UK-006 (KP 9.5). The EUNIS habitat at this location is classified as A5.13 - Infralittoral coarse sediment. This habitat is also located from KP7.2 to KP8.632 and appears again at KP9.39 and KP10.2. Analysis of the grab samples showed the seabed comprised a high abundance of large whole shells of Ostrea (oysters) as well as sands and gravel. The survey identified a large area of subtidal coarse sediment extending south west to north east across the Asset Placement Corridor.

Subtidal coarse sediment is also a designated feature of the Goodwin Sands MCZ. The environmental survey identified habitats corresponding to subtidal coarse sediment at station UK-039 (KP85.5). This aligns with the findings of the Goodwin Sands MCZ Feature Map (Defra 2019b), which shows large areas of subtidal coarse sediment within the MCZ designation. The EUNIS habitat at this location is classified as A5.141 *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles. The epifauna identified in the imagery at this station was dominated by *Serpulidae* polychaetes and infaunal analyses also found that samples were dominated by *Serpulidae* polychaetes, including *S. lamarcki*. Within the Goodwin Sands MCZ, EMODnet data (EMODNet 2020) has been used to calculate the area of habitat defined as coarse sediment. This data estimates that coarse sediment covers an area of 119.2km^2 of the MCZ; of which 3.4km^2 is found within the footprint of the Asset Placement Corridor; equivalent to 3.25% of the habitat within the MCZ.

The presence of subtidal coarse sediment was confirmed at station UK-047 (KP 101.8) which is located within the Foreland MCZ. The EUNIS habitat at this station is classified as A5.14 - circalittoral coarse sediment. Infaunal analyses at this site found that the fauna was dominated by bivalves *Asbjornsenia pygmaea* and *G. triangularis.* The Foreland MCZ Feature Map (Defra 2019c) shows extensive areas of subtidal coarse sediment throughout the MCZ designation, estimated to cover 165.81km^2. A total of 1.96km^2 of subtidal coarse sediment was found within the footprint of the Asset Placement Corridor; equivalent to 1.18% of the habitat within the MCZ.

7.3.3.7 Habitat of Principal Importance - Subtidal sands

Subtidal sand was identified at station UK-039 (KP86) (along with coarse sediment - see Section 7.3.3.4). This aligns with the findings of the Goodwin Sands MCZ Feature Map (Defra 2019b) which shows large areas of subtidal sand within the MCZ designation. EMODnet data (EMODnet 2020) shows that subtidal sand within the MCZ is estimated to cover 42.5km^2. A total of 0.67km^2 of subtidal coarse sediment was found within the Asset Placement Corridor, representing 1.6% of the habitat within the MCZ. Habitat at UK-039 was classified as A5.141 and grab samples were dominated by *Serpulidae* polychaetes, including *S. lamarcki*.

The MCZ Feature Map for the Foreland MCZ (Defra 2019c) shows three distinct pockets of subtidal sand, two being located in the north east and one in the centre of the designation. The presence of both subtidal sand (along with coarse sediment - see Section 7.3.3.4) was confirmed by the environmental survey with station UK047 (KP101.9) identifying subtidal coarse sediment and UK-048 (KP104.1) identifying subtidal sand. EMODnet data (EMODnet 2020) shows that subtidal sand within the MCZ is estimated to cover 92km^2. A total of 1.74km^2 of subtidal coarse sediment was found within the Asset Placement Corridor, representing 0.8% of the habitat within the MCZ. Habitat at UK-047 was classified as A5.14 and grab samples were characterised by bivalves and polychaetes.

7.3.3.8 Habitat of Principal Importance - Sheltered muddy gravels/subtidal mud

Sheltered muddy gravels were found within the Medway Estuary MCZ (corresponding to habitat subtidal mud a designated feature of the Medway Estuary MCZ). Sheltered muddy gravels were identified at stations UK-003, and UK-004 (KP2.8-5.1). Stations UK-003 and UK-004 comprised dense beds of Sabella pavonina and were therefore classified as A5.432 - Sabella pavonina with sponges and anemones on infralittoral mixed sediment.

The environmental survey identified areas classified as sheltered muddy gravels in areas between UK-008 to UK-011 (KP12 - KP20.8) UK-013 to UK-015 (KP24 – KP34.5) and UK-021 (KP40.6 - KP41.2), classified as habitats A5.33, A4.43/A5.261, A5.432. Fauna in these areas were dominated by anemones, polychaetes and bivalves.

7.3.3.9 Habitat of Principal Importance - Subtidal sands and gravels

The environmental survey classified 12 areas along the Asset Placement Corridor as subtidal sands and gravels. Table 7-6 provides an overview of the areas classified as subtidal sand and gravels along with the sediment type, associated EUNIS habitats and fauna.

Table 7-6 Habitats and key fauna within Annex I sandbanks which are slightly covered by seawater all the time

KP	Sediment type	Associated EUNIS habitats	Key fauna within grab sample
KP38 - KP41	Coarse sand with shell gravel.	A5.13	Station UK-0017 dominated by polychaetes, including *Spirobranchus lamarcki*, Serpulidae and *S. bombyx*
KP52 - KP55	Muddy sand.	A5.261	Station UK-024 dominated, with regards to abundance, by bivalves *Abra alba*, *Tellimya ferruginosa* and *Kurtiella bidentata* as well as polychaete *Owenia sp*. and sea potato *Echinocardium cordatu*
KP56.3 - KP58	Muddy sand	A5.261/ A5.241	Station UK-026 dominated, with regards to abundance, by bivalves *N. nitidosa*, *T. ferruginosa, K. bidentata* and *A. alba* a well as polychaete *Owenia* sp
KP61.4 - KP62.6	Muddy sand and gravel	A5.26	Station UK-029 characterised by polychaete *S. bombyx.*
KP 63.2 - KP64.5	Coarse sediment.	A5.14	No grab samples obtained within this habitat
KP64.5 - KP71.2	Fine sand	A5.25	Station UK-031 dominated by polychaetes.
KP74.2 - KP76.8	Cobbles and sands	A5.141	Station UK-035 dominated by sepulidae polychaetes, including *Spirobranchus lamarcki*
KP85.1 - KP85.7	Coarse substrate with minor intermediate sand.	A5.141	Station UK-039 dominated by Serpulidae polychaetes, including *S. lamarcki*
KP89.8 - KP93.1	Fine sand and gravel	A5.141	Station UK-042 dominated by serpulidae polychaetes, including *S. lamarcki* and *S. triqueter*, and colonial sea anemone *E. couchii*
KP93.6 - KP96.5	Cobbles and fine sand	A5.25	Station UK-043 dominated by Mysida shrimp *Gastrosaccus spinifer* Station UK-044 dominated by bivalves *Goodallia triangularis* and juvenile *Spisula* sp
KP98 - KP106.5	Gravel and coarse sand	A5.14	Station UK046 – UK049 were dominated by polychaetes and bivalves,
KP106.5 - KP108	Fine sand	A5.25	Station UK050 was dominated by roundworms Nematoda, shrimp *Philocheras trispinosus*,

7.3.3.10 Habitat of Principal Importance - Peat and clay exposures

Peat and clay exposures, a designated feature of the Medway Estuary MCZ, were potentially identified around UK-007 (KP12), within the Medway Estuary MCZ. Samples indicated a presence of firm clay buried below the sand, but also exposed on the seabed surface which could be due to dredging in the area. The grab sample was dominated by juvenile piddock *Barnea candida*, therefore the site was classified as piddocks with a sparse associated fauna in sublittoral very soft chalk or clay. This clay or peat exposure often have a sparse fauna associated as the substratum is too hard for sedimentary species and too soft for epifauna and flora to attach to.

7.3.3.11 Habitat of Principal Importance - Mud habitats in deep waters

Habitats corresponding to Subtidal sands and gravels were identified between KP56.865 and KP59.366. The habitat at the site was classified as A5.261/ A5.241, while grab samples taken in the area were dominated, by bivalves *N. nitidosa*, *T. ferruginosa*, *K. bidentata* and *A. alba* as well as polychaete *Owenia* sp.

7.3.3.12 Habitat of Principal Importance - Subtidal chalk

Habitats corresponding to subtidal chalk was identified at stations UK-033 (KP71.8), UK-036 (KP78.4) and UK-041 (KP89.1). It is worth noting that there is some uncertainty regarding the extent of the habitat as visibility at these sites was poor. Vibrocores collected during the geotechnical survey found that chalk occurred some centimetres below the sediment surface and there is no evidence from the environmental survey of any outcrops of chalk along the Asset Placement Corridor. Therefore, this habitat has been scoped out of the assessment in Section 7.6.

7.3.3.13 OSPAR listed Threatened and/or Declining Species - Ocean quahog (*Arctica islandica*)

Four juvenile individuals of Ocean quahog were identified in a grab sample replicate from station UK—032 (KP71).

7.3.3.14 Pan Sand Hole KEIFCA Byelaw Area

A Byelaw was passed by KEIFCA in 2017 (KEIFCA 2017) which prohibits the use of bottom towed fishing gear in a total of six areas in the KEIFCA jurisdiction. Bottom gears include the use of “any beam trawl, otter trawl, multi-rig trawl, pair trawl, anchor seine, Scottish seine, dredge or other similar fishing instrument designed to take or disturb sea fisheries resources on the seabed” (KEIFCA 2017).

The Proposed Development crosses the Pan Sand Hole prohibited area from KP42.1 to KP47.7. Pan Sand Hole prohibited area is located within the Margate and Long Sands SAC, which is designated for the Annex I habitat ‘sandbanks which are slightly covered by sea water all the time’ (JNCC 2019). The Proposed Development crosses the northern central part of the Pan Sand Hole prohibited area. Within this area the Proposed Development could potentially cross the following three biotopes classified within the SAC Fisheries Assessment (Defra 2017):

- SS.SCS.ICS.SLan: Dense *Lanice conchilega* and other polychaetes in tide-swept infralittoral sand and mixed gravelly sand;
- SS.SSa.IMuSa.FfabMag: *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand; and
- SS.SSa.IFiSa.NcirBat: *Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand.

Natural England (A. Atterbury 2019, personal communication, 17 January) confirmed that the presence of the biotope SS.SCS.ICS.SLan ‘dense *Lanice conchilega* and other polychaetes in tide-swept infralittoral sand and mixed gravelly sand’ within the Margate and Long Sands SAC was a primary reason for the designation of the KEIFCA Byelaw prohibited area Pan Sand Hole.

Numerous polychaete worms have been recorded within the Margate and Long Sands SAC. Of these, the sand mason worm (*Lanice conchilega*) has been identified in relatively high abundance during a

2014 survey of the SAC (Bhatia 2015). No seabed photograph is available within Bhatia (2015). Dense beds of sand mason worms are generally found in areas of coarse to medium fine gravelly sand (Natural England 2012; JNCC 2015). Sand mason worms are an indication of sediment and formation stability. Over time, the presence of dense beds of sand mason worms stabilise the sediments within the Margate and Long Sands SAC, allowing the deposition of finder sediments and a wide range of benthic species. Areas of finer sediments, consolidated through the action of sand mason worms, have the potential to develop into *Sabellaria* reef, if conditions remain constant (Bhatia 2015).

Table 7-7 lists the habitats within the Asset Placement Corridor identified by the environmental survey. The environmental survey did not record any occurrences of *Lanice conchilega*, *Sabellaria* reef or individual *Sabellaria spinulosa* within the Pan Sand Hole prohibited area.

Table 7-7 Habitats and key fauna within Pan Sand Hole KEIFCA Byelaw Area

KP	Sediment type	Associated EUNIS habitats	Key fauna within grab sample
KP40 - KP41 KP43 - KP48	Coarse sand and gravel	A5.13	Station UK-022 dominated by polychaetes *Ophelia borealis* and *Nephtys cirrosa*, and amphipods, including *Bathyporeia elegans* and *Urothoe brevicornis*.
KP43 - KP47 KP41	Muddy coarse sand and gravel.	A5.24	Station UK-021 dominated by anemones Actiniaria and polychaete *Notomastus* sp. Classified as Annex I (1110) - Sandbanks which are slightly covered by sea water all the time
KP43 - KP47	Sands and gravel	A5.43	Station UK-023 dominated by polychaetes *S. bombyx* and *L. koreni*, anemones Actiniaria, amphipod *A. obtusata* and ribbon worms Nemertea

7.4 Potential Pressure Identification and Zone of Influence

A scoping exercise undertaken to inform the content of the Environmental Appraisal has excluded the following pressures from consideration in this topic Chapter. Explanation for the exclusion is provided in Chapter 4, Table 4-1.

- Hydrocarbon and PAH contamination;
- Siltation rate changes, including smothering (depth of vertical sediment overburden) with the exception of *Sabellaria spinulosa*
- Changes in suspended solids (water clarity) - with the exception of *Sabellaria spinulosa*;
- Temperature changes – local;
- Introduction or spread of non-indigenous species
- Electromagnetic changes - Technical Appendix D - Marine Effects of EMF Technical Note concluded that there will be no significant effects on shellfish, crustacean and mollusc from the emission of EMF of the GridLink cables. Therefore, effects from Electromagnetic changes has been scoped out of this assessment; and
- Transition elements and organo-metal contamination - Contamination along the Proposed Development by transition elements and organo-metals has been detailed in Chapter 5 and assessed in Chapter 12 and Technical Appendix G. It is unlikely that the small volumes of suspended sediment that will be disturbed by the cable installation activities will lead to significant changes in contamination levels. Additionally, any locations where elevated contaminant levels were detected were typical of either natural origin e.g. arsenic, or of historical anthropogenic origin

from the Medway Estuary. As such, the significance of the pressure was assessed as negligible and not significant and will not be assessed further in this chapter.

The pressures listed in Table 7-8 will be assessed further. For each pressure the assessment considered the different aspects of the Proposed Development during installation, operation (including repair & maintenance) and decommissioning. In order to evaluate the most significant effects, the largest zone of influence from these aspects was selected. The zones of influence are presented in Table 7-8.

Table 7-8 Pressure identification and zone of influence – benthic ecology

Potential Pressure	Aspect	Project Phase	Project Activity	Receptor	Zone of Influence
Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	Pre-sweeping	Installation	Seabed preparation	Subtidal habitats	Select locations as identified in Table 3-4. Maximum of 63m wide
	PLGR, Cable trenching (ploughing and jet trenching)		Cable burial		15m wide along entire Preferred Cable Route
		Operation	Cable repair		Up to 3 locations. 1m wide x 500m long
	De-trenching	Decommissioning	Cable removal		15m wide along entire Preferred Cable Route
Siltation rate changes, including smothering	Pre-sweeping	Installation	Seabed preparation	Annex I Reef (biogenic) and *Sabellaria spinulosa* reefs	Within 75m of the cable route perpendicular to tidal flow and about 500m in the direction of tidal flow (extent of 1mm deposition contour)*
	Cable trenching (ploughing and jet trenching)		Cable burial		
		Operation	Cable repair		
	De-trenching	Decommissioning	Cable removal		
Physical change (to another seabed type)	Deposit of external cable protection	Installation	Cable burial	Subtidal habitats	Specific locations as identified in Tables 3.9 and 3.11. Maximum 12.5m wide at crossings and 9.1m wide where required for ground conditions.
		Operation	Cable repair		3 locations. 7m wide x 500m long**

*Technical Appendix C

** Assumes that external cable protection will only be used for repair works within areas where review of geophysical and geotechnical data has identified that full burial in sediment may not be achievable.

7.5 Embedded Mitigation

The embedded mitigation relevant to benthic ecology is provided in Table 7-9 below. When undertaking the assessment, it is assumed that these measures will be complied with.

Table 7-9 Embedded mitigation – benthic ecology

ID	Embedded mitigation measure	Project Phase		
		I	O	D
EM1	Intertidal zone of the Medway Estuary at the Kingsnorth shore crossing shall be crossed by horizontal directional drilling (HDD) to avoid disturbance to the surface sediments and habitats. HDD must exit beyond the mean low water springs mark to avoid the Medway Estuary and Marshes SPA and Medway Estuary and Marshes SSSI.	■		
EM2	HDD drilling activities shall be conducted in a manner to minimise risk of bentonite breakout from the HDD entry or exit pits	■		
EM3	Submarine cables will be bundled together.	■		
EM4	Deployment of anchors/anchor chains on the seabed will be kept to a minimum in order to reduce disturbance to seabed and will be within the Proposed Development.	■	■	■
EM5	Cable burial and protection design as detailed in the Burial Assessment Study, final crossing designs and planned and remedial final external protection designs shall be within the maximum design parameters detailed in the GridLink Marine Licence Application or robust justification for the deviations provided.	■		
EM6	Cables shall be installed in sand wave troughs wherever practicable, or after pre-sweeping if required, to minimise the risk or exposure by seabed mobility	■		
EM7	External cable protection (rock and/or mattresses) shall only be deployed where it is demonstrated that adequate burial depth cannot be achieved; the footprint of any external protection shall be the minimum required to ensure adequate cable protection and stability.	■		
EM9	Cable protection heights and widths shall be minimised, taking into account the requirements to maintain the structural integrity of the berms.	■		
EM13	London Array crossing design shall comprise one continuous cable protection across all four cables (rather than four individual cable crossings) to minimise eddy currents causing scour at end of berms	■		
EM18	Cable protection used in NEMO Link crossing design shall minimise footprint on seabed due to presence of Goodwin Sand MCZ Sabellaria reef in area	■		
EM36	Project vessels will be equipped with waste disposal facilities (sewage treatment or waste storage) to IMO MARPOL Annex IV Prevention of Pollution from Ships standards.	■	■	■
EM37	Ship Oil Pollution Emergency Plans (SOPEPs) shall be provided by Contractor and implemented covering all vessels in accordance with MARPOL Annex I requirements	■	■	■
EM38	Ballast water discharges from all vessels shall be managed under the International Convention for the Control and Management of Ships' Ballast Water and Sediments standard	■	■	■
EM39	Hazardous chemicals and materials shall be managed in accordance with applicable standards and guidelines, including maintenance of an inventory of such substances that are used and/or stored, provision of Material Safety Data Sheets (MSDSs), preparation of Chemical Risk Assessments and storage in designated, secure facilities with suitable spill protection and control	■	■	■
EM40	Biosecurity Plan (BSP) shall be prepared and implemented covering all marine operations, taking into account applicable guidance from the GB non-native species secretariat (2015)	■	■	■
EM41	Environmental Management Plan (EMP) shall be prepared and implemented covering all marine operations	■	■	■
EM42	Emergency Spill Response Plan (ESRP) shall be prepared and implemented covering all marine operations	■	■	■

7.6 Significance Assessment

The GridLink Marine HRA (Technical Appendix E) and the GridLink MCZ Assessment (Technical Appendix F) provide comprehensive assessments of the potential effects on habitats of conservation importance within protected sites. The assessment conclusions are presented in Chapter 6 and are only summarised in Sections 7.6.1 and 7.6.2.

For those habitats of conservation importance found outside protected sites or within a protected site not specifically designated for that feature, a significance assessment has been provided in Section 7.6.3. Where the assessment concluded the effects are potentially significant, Project Specific Mitigation has been proposed and is described in Section 7.7. Where there is potential for residual effects after the Project Specific Mitigation, this is discussed further in Section 7.8.

7.6.1 Habitats of conservation importance within Protected Sites

7.6.1.1 HRA conclusions

HRA Stage 1 Screening concluded that there will be no likely significant effects (LSE) on the Qualifying Interests of the Thanet Coast and Essex Estuaries SACs.

For Margate and Long Sands SAC there is the potential for LSE on the Primary Feature 'Sandbanks which are slightly covered by sea water all the time', and Appropriate Assessment (AA) is required. This specifically relates to the deposit of external cable protection at the crossing with the London Array wind farm export cables and for pre-sweeping at three locations within the SAC. The Stage 2 Information to Inform AA provides more detailed ecological assessment of the proposed activities, taking into consideration the conservation objectives of the Margate and Long Sands SAC and its overall integrity.

Guidance in the formal advise document (Natural England, 2012) states that, to ensure a favourable condition of the Sandbanks, it should be determined through assessment that the following are maintained in the long term:

1. Extent of the habitat
2. Diversity of the habitat and its component species
3. Community structure of the habitat (e.g. population structure of individual notable species and their contribution to the functioning of the ecosystem)
4. Natural environmental quality (e.g. water quality, suspended sediment levels, etc.)
5. Natural environmental processes (e.g. biological and physical processes that occur naturally in the environment, such as water circulation and sediment deposition should not deviate from baseline at designation).

Attributes which are ecological characteristics or requirements for the designated species and habitats within the site have been defined by Natural England. The attributes applicable to this assessment are presented in HRA Stage 2 Information to Inform AA.

The HRA Stage 2 Information to Inform AA presents an assessment of the effects against each of the conservation objectives listed above and associated attributes. For pre-sweeping it was concluded that there would be no adverse effects on the conservation objectives of the SAC. It concludes that without mitigation, external cable protection deposited on sub feature of PF Sandbanks – gravelly muddy sand communities, could have an adverse effect on the following conservation objectives and associated attributes.

- Extent and distribution of Habitat
- The structure: topography

- Natural environmental processes (e.g. biological and physical processes that occur naturally in the environment, such as water circulation and sediment deposition should not deviate from baseline at designation).

It is not feasible to avoid the European site. Instead PF sandbank features were avoided during route development with the decision taken to route through the PF sub-features. In order to reduce and offset potential adverse effects on the conservation objectives of the site Project Specific Mitigation has been proposed; specifically, id codes PS1, PS2 and PS3 in Table 7-18, Section 7.7. The objectives of these measures are to prevent scour and encourage sedimentation of the crossing such that the external cable protection is covered by sand, returning the seabed to a sand habitat.

The HRA provides evidence that the use of fronded mats (as proposed by PS1) will provide a permanent solution in returning the crossing to a sand habitat. Based on evidence from the Bacton Pipeline in the SNS, it is expected that the mats will become covered in sand within 37 days and will have fully developed into a compacted sediment bank within a year. In addition, given that fauna identified at the crossing are widespread and have short life cycles, it is expected that the fronded mats will also become colonised within a year, as was seen at fronds used on the Bacton Pipeline.

Considering this, it is concluded that with implementation of the Proposed Mitigation, the Proposed Development will not have an adverse effect on the integrity of the Margate and Long Sands SAC either alone or in combination with other plans or projects.

7.6.1.2 MCZ Assessment conclusions

MCZ Assessment Screening concluded that there exists a pressure-receptor pathway between the Proposed Development and the Protected Features of the following five MCZs and that Stage 1 Assessment is required:

- Medway Estuary MCZ (site code: UKMCZ0011);
- The Swale Estuary MCZ (site code: UKMCZ0041);
- Thanet Coast MCZ (site code: UKMCZ0017);
- Goodwin Sands MCZ (site code: UKMCZ0061); and
- Foreland MCZ (site code: UKMCZ0060).

The five MCZs were assessed to determine if the identified pressure-receptor pathways could result in effects on the Protected Features that would hinder the achievement of the Conservation Objectives stated for the MCZs. Table 6-5 (Chapter 6) summarises the conclusions of the assessment.

Other plans and projects the effects of which could spatially overlap with the predicted effects from the Proposed Development within a MCZ were also assessed to determine if there was a potential in-combination effect. No significant in-combination effects were identified.

The Stage 1 Assessment concluded that for all five MCZs assessed the conditions of Section 126 of the MCAA 2009 can be met. There is no significant risk that the Proposed Development either alone or in combination with other plans or projects will hinder the achievement of the conservation objectives stated for the MCZs; and the MMO can exercise its functions to further the conservation objectives for the MCZs.

Without prejudice to the conclusion that there is no significant risk of the activity hindering the achievement of the conservation objectives stated for the MCZ, GridLink has proposed Project Specific Mitigation as best practice to reduce the magnitude of the effect on the Medway Estuary MCZ and Goodwin Sands MCZ; specifically id codes PS4, PS5, PS6, PS7, PS8 and PS48 in Table 7-18, Section 7.7.

7.6.2 Habitats of conservation importance found outside European Sites and MCZs

Table 7-10 presents the assessment carried out on habitats of conservation importance identified outside protected sites or within a protected site but are not a Qualifying Interest/Protected Feature. These habitats are as follows:

- Annex I Estuaries – KP0.7 - KP13.1
- Annex I – Mudflats and sandflats not covered by sea water at low tide; KP0.5 - KP2 and KP0 - KP13
- Annex I – Sandbanks which are slightly covered by seawater at all time; KP13 - KP15 and KP15.3 - KP19
- Annex I Reef (biogenic) and *Sabellaria spinulosa* reefs (low – medium grade); KP61.9, KP63.11, KP80.54 – KP 80.75 and KP96.6
- Habitat of Principle Importance - Sheltered muddy gravels; KP13 -KP20.7, KP24 – KP34.5 and KP40.6 - KP41.2
- Habitat of Principle Importance - Subtidal sands and gravels; KP38 - KP41, KP52 - KP55, KP56.3 - KP58, KP61.4 - KP62.6, KP 63.2 - KP64.5, KP64.5 - KP71.2, KP74.2 - KP76.8, KP77 - KP81.3, KP93.6 - KP96.5 and KP99 - KP101.
- Habitat of Principle Importance - Mud habitats in deep waters - KP56.87 and KP59.4
- Pan Sand Hole KEIFCA Byelaw Area - KP41 - KP47

Table 7-10 Assessment summary – benthic ecology

Section	Determination of Potential Effect					Significance Assessment			Consideration of Mitigation	Residual Effect Assessment		
	Project Phase	**Aspect**	**Potential pressure**	**Embedded Mitigation (Table 7-9)**	**Receptor**	**Magnitude**	**Sensitivity**	**Significance**	**Project Specific Mitigation (Table 7-17)**	**Magnitude**	**Sensitivity**	**Significance of Residual Effect**
7.6.4	Installation Installation Operation Decommissioning	Pre-sweeping	Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	EM3, EM6	Habitat of Principle Importance: Subtidal sands and gravel	Low	Low	Negligible	-	-	-	Negligible
		PLGR, cable burial, cable repair, cable removal. Anchor placement		EM1, EM3, EM4	Annex I – Estuaries Annex I – Mudflats and sandflats not covered by sea water at low tide waters Annex I Sandbanks which are slightly covered by seawater all the time	Low	Medium	Minor	PS4, PS5	Low	Medium	Minor
					Annex I Reef (biogenic) and *Sabellaria spinulosa* reefs	Low	Medium	Minor	PS6, PS7	Low	Medium	Minor
					Habitats of Principle Importance: Sheltered muddy gravels; Subtidal sands and gravels; Mud habitats in deep waters	Low	Medium	Minor	PS4, PS5	Low	Medium	Minor
					Pan Sand Hole KEIFCA Byelaw Area	Low	Medium	Minor	PS4, PS5	Low	Medium	Minor
7.6.5	Installation Operation Decommissioning	Pre-sweeping, cable burial, cable removal	Siltation rate changes, including smothering (depth of		Annex I Reef (biogenic) and Sabellaria spinulosa reefs	Low	Medium	Minor	-	Low	Medium	Minor

Section	Determination of Potential Effect					Significance Assessment			Consideration of Mitigation	Residual Effect Assessment		
	Project Phase	**Aspect**	**Potential pressure**	**Embedded Mitigation (Table 7-9)**	**Receptor**	**Magnitude**	**Sensitivity**	**Significance**	**Project Specific Mitigation (Table 7-17)**	**Magnitude**	**Sensitivity**	**Significance of Residual Effect**
			vertical sediments overburden)									
7.6.6	Installation Operation	External cable protection	Physical change to another seabed type	EM5, EM7, EM9, EM18	Annex I Reef (biogenic) and Sabellaria spinulosa reefs	Low	Medium	Minor	PS4	Low	Medium	Minor
					Sandbanks which are slightly covered by seawater at all time Habitat of Principle Importance: Sheltered sands and muddy gravels; Subtidal sands and gravel.	Low	Medium	Minor	PS4	Low	Medium	Minor

7.6.3 Penetration and / or disturbance of the substrate below the surface of the seabed, including abrasion

7.6.3.1 Installation

This pressure is associated with activities that disturb the seabed but where there is limited or no loss of substrate from the system. Activities considered by the assessment that cause this pressure include cable route preparation (e.g. pre-sweeping, pre-lay grapnel run), cable burial, cable repair, cable removal and anchor placement.

The seabed within the direct zone of influence of the installation will be temporarily disturbed. The actual cable installation is a one-off event, but the seabed along the cable centreline could be disturbed on two to three discrete occasions within approximately a three-month period. The first occasion will be for any seabed preparation works e.g. pre-sweeping; the second occasion will be the pre-lay grapnel run; and the third occasion will be the cable lay and burial. These activities will be within the same zone of influence. When assessing the significance of the effect the assessment has considered the culmination of these activities.

It is likely that a high proportion of the benthic invertebrates within the width of the installation equipment footprint, will be susceptible to mortality, injury or displacement as a result of coming into contact with the route clearance grapnel, dredging and/or cable installation machinery. This is more likely to affect sessile species such as *Sabellaria spinulosa*, bryozoans and hydroids and less mobile species such as echinoderms and polychaetes. Activities causing displacement and injury to infaunal species could also result in increased predation resulting from exposure of individuals.

The magnitude of the effect has been assessed as low for the following reasons:

- The effect will be equivalent to a single event which will not lead to continuous or repetitive disturbance of the seabed.
- The zone of influence is narrow (for the most part up to 15m wide) in comparison to the wider extent of habitats in the Proposed Development and surrounds.
- Sediment will not be removed or altered leaving the underlying character of the habitat similar to that pre-development.

To determine the sensitivity of the habitats to the pressure, the assessment has used the Marine Evidence based Sensitivity Assessment (MarESA) from the Marine Life Information Network (MarLin); adapted as necessary based on expert judgement to take into consideration the specific pressure. The discussion below has been split into four categories as follows:

- Pre-sweeping on subtidal sand and gravel
- Annex I - Estuaries, Mudflats and sandflats not covered by sea water at low tide waters and Sandbanks which are slightly covered by seawater all the time Annex I Stony Reef habitat
- Annex I Biogenic Reef habitat
- Broadscale Habitats of Principle Importance - Sheltered muddy gravels, subtidal sands and gravels, mud habitats in deep waters

Pre-sweeping on subtidal sand and gravel

Out of the habitats listed in Section 7.6.3, pre-sweeping will only take place on areas classified as subtidal sand and gravel. This will be a localised activity that will potentially be required at three locations on this habitat; as outlined in Table 7-11[1]. The combined length of the Preferred Cable Route

[1] Pre-sweeping will be required in other areas along the Proposed Development (Table 3-4). However these areas are not on habitats classified as Annex I Habitat or a Habitat of Principle Importance.

that may require pre-sweeping on subtidal sand and gravel is 2.4km. The width of seabed disturbed is estimated to be up to 45m. The total seabed footprint of the pre-swept area on subtidal sand and gravel is 0.1km^2.

Table 7-11 Areas of pre-sweeping on subtidal sand and gravel

KP start	KP end	Maximum height of sandwave (m)	Distance to be cleared (m)	Maximum clearance width (m)*	Maximum seabed footprint (m^2)	Maximum volume of sediment removed and re-deposited (m^3)**
66.57	66.71	2.3	140	28.8	4032	7051.8
93.77	95.67	5.0	1900	45	85500	285000
101	101.356	5.0	356	45	16020	53400
Total			**2396**	**118.8**	**105552**	**345451.8**

*Assumes base trench width of 15m and 1:3 side slope.

**Maximum volumes based on maximum height of sand wave, noting that this will typically be a one-off spot height with the remainder of the sandwave lower. These values are therefore worst-case.

The habitats at the three locations are A5.25 – circalittoral fine sand and A5.14 – circalittoral coarse sediment. There is no sensitivity for these habitats on MarLIN therefore the following subcategories have been used to determine the sensitivity to the pressure.

- A5.251 *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand; and
- A5.143 -*Protodorvillea kefersteini* and other polychaetes in impoverished circalittoral mixed

The sensitivity has been assessed as low. Although this habitat is a Habitat of Principle Importance, it is not considered rare or unique and the pre-sweeping locations are not within a Protected site. MarLIN reports that A5.251 and A5.143 both have a low sensitivity to disturbance and abrasion; resilience and recovery are both recorded as high as recovery will occur through migration of adults from the surrounding unaffected area and through recruitment of juveniles from planktonic larvae. Recruitment rates will depend on favourable hydrodynamic conditions but as the habitat has been widely identified within the Proposed Development and EMODNet (2020) shows the broadscale habitat A5.25 covers extensive areas of the southern North Sea recovery is expected to occur within 2 years.

The overall significance of the effect has been assessed as **Negligible** and is **Not Significant**.

Annex I Estuaries, Annex I Mudflats and sandflats not covered by sea water at low tide waters and Annex I Sandbanks which are slightly covered by seawater all the time, and Pan Sands KEIFCA Byelaw Area

An assessment of the Pan Sands KEIFCA Byelaw Area has been grouped with these Annex I Habitats as the habitats identified in this section are sub-features of the Annex I Sandbanks Habitat, a designated feature of the Margate and Long Sands SAC.

The sensitivity of these Annex I habitats has been assessed as medium. This is because the MarLIN assessment for the component EUNIS habitats, presented in Table 7-12, concludes that the habitats have a low to medium sensitivity to the pressures penetration and/or disturbance of the substratum below the surface and abrasion/disturbance of the substratum on the surface of the seabed. This is further supported by evidence looking at the recovery of benthic communities after aggregate extraction activities (Newell *et al*. 1998), where following dredging activities, the characteristic recovery time for subtidal sand communities may be two to three years.

The outer Thames Estuary is dominated by strong tidal currents which suspend high levels of sediment in the water column. The dynamic nature of this environment means that sediment deposition takes place constantly and therefore any localised depressions created through the installation activities will be quickly infilled and it is unlikely to cause any significant effects to the habitat or species inhabiting the area. In addition, these Annex I habitats given the dominance of sand and mud, can be viewed as adaptable to physical disturbance. Many infaunal species may live at depths where they will be protected from surface disturbance and in the narrow area (up to 1m wide trench) where direct loss occurs, it is likely that adjacent areas will act to replenish communities rapidly as most infaunal species are mobile and the zone of influence is narrow.

Although these habitats are Annex I Habitats, they are not considered rare or unique and are not Qualifying Interests of a European site. As discussed in Section 7.3.3.14, the environmental survey did not record any occurrences of *Lanice conchilega* species within the KEIFCA Byelaw Area.

The overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

Table 7-12 Sensitivity of component habitats

EUNIS habitat code	Penetration and/or disturbance of the substratum below the surface				Abrasion/disturbance of the substratum on the surface of the seabed			
	Resistance	Resilience	Sensitivity	Confidence	Resistance	Resilience	Sensitivity	Confidence
Annex I Estuaries								
A2.3 - Littoral mud	*Low*	*High*	*Low*	*Low/ Medium*	*Low*	*High*	*Low*	*Medium*
A5.32 - Sublittoral mud in variable salinity (estuaries)	*None*	*Medium*	*Medium*	*High*	*Low*	*High*	*Low*	*High*
A5.15 - Deep circalittoral coarse sediment	*Medium*	*High*	*Low*	*High-Medium*	*Medium*	*High*	*Low*	*Medium*
A5.432 - *Sabella pavonina* with sponges and anemones on infralittoral mixed sediment	Low	Medium	Medium	Medium	Low	Medium	Medium	Medium
A5.33 - Infralittoral sandy mud	*Low*	*Low*	*Medium*	*Low/ Medium*	*Low*	*Medium*	*Medium*	*Low/ Medium*
A5.43 - Infralittoral mixed sediments	*Low*	*Medium*	*Medium*	*Medium*	*Low*	*Medium*	*Medium*	*Medium*
A5.35 - Circalittoral, cohesive sandy mud	-	-	-	-	-	-	-	-
A5.23 - Infralittoral fine sand	*Medium*	*High*	*Low*	*High*	*Low*	*Medium*	*Low*	*High*
A5.42 - Sublittoral mixed sediment in variable salinity (estuaries)	*Low*	*High*	*Low*	*Medium*	*Low*	*High*	*Low*	*Medium*
A5.13 - Infralittoral coarse sediment	*High*	*High*	*Not sensitive*	*High*	*High*	*High*	*Not sensitive*	*High*
A5.231 - Infralittoral mobile clean sand with sparse fauna	Medium	High	Low	High	Low	High	Low	High
Annex I Mudflats and sandflats not covered by seawater at low tide								
A2.3 - Littoral mud	*Low*	*High*	*Low*	*Low/ Medium*	*Low*	*High*	*Low*	*Medium*

EUNIS habitat code	Penetration and/or disturbance of the substratum below the surface				Abrasion/disturbance of the substratum on the surface of the seabed			
	Resistance	Resilience	Sensitivity	Confidence	Resistance	Resilience	Sensitivity	Confidence
Annex I Sandbanks which are slightly covered by seawater all the time								
A5.33 - Infralittoral sandy mud	*Low*	*Low*	*High*	*Low/ Medium*	*Low*	*Medium*	*Medium*	*Medium/ Low*
A5.23 - Infralittoral fine sand	*Medium*	*High*	*Low*	*Medium/ High*	*Low*	*High*	*Low*	*Low*
A5.43 - Infralittoral mixed sediments	*Low*	*High*	*Low*	*Low/ Medium*	*Low*	*High*	*Low*	*Low/ Medium*
A5.261 - *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment	Medium	High	Low	Medium/ High	Medium	High	Low	Medium/ High
A5.25 - Circalittoral fine sand	*Medium*	*High*	*Low*	*Medium/ High*	*Medium*	*High*	*Low*	*Medium/ High*
A5.14 - Circalittoral coarse sediment	*Low*	*High*	*Low*	*Low/ Medium*	*Low*	*High*	*Low*	*Low/ Medium*
Pan Sands KEIFCA Byelaw Area								
A5.13 - Infralittoral coarse sediment	*High*	*High*	*Not sensitive*	*High*	*High*	*High*	*Not sensitive*	*High*
A5.24 - Infralittoral muddy sand	*None*	*Medium*	*Medium*	*High/medium*	*Low*	*Medium*	*Medium*	*High*
A5.43 - Infralittoral mixed sediments	*Low*	*High*	*Low*	*Low/Medium*	*Low*	*High*	*Low*	*Low/Medium*

Notes

Source – MarLIN (2020)

* specific to sensitivity

- no sensitivity assessment available for this habitat or a sub habitat

Italics & grey = Assessment based on sublevel habitat assessments

Annex I Biogenic Reef habitat and *Sabellaria spinulosa* reefs

The sensitivity of this Annex I habitat and Habitat of Principle Importance has been assessed as medium because as indicated in Table 7-13 the associated EUNIS habitats have a low to medium sensitivity to the pressure and the associated fauna are typically fast-growing epifauna and widespread.

S.spinulosa reefs classified as low through to medium grade were observed at four locations within the Asset Placement Corridor outside of the Goodwin Sands MCZ (where they are listed as a Protected Feature). As listed in Table 7-5 (Section 7.3.3.5), three of these locations (KP 61.87, KP63.11 and KP96.58) are within SACs but are not listed as a Qualifying Interest of the European Site. The remaining location (KP80.539 – KP80.752) is outside of any protected site designation. Additional observations of *S.spinulosa* were made within the Asset Placement Corridor but these were not classified as reef. Although this habitat is an Annex I Habitat, it is not considered rare or unique; MarLIN has identified that *S.spinulosa* is found in areas all around the British Isles.

S.spinulosa are directly exposed to physical damage that impacts surface layers and penetrates deeper beneath the surface of the reef. Structural damage to the seabed and sub-surface is likely to damage tube aggregations leading to the loss of reef habitat within the footprint of the installation activities

(Tillin et al. 2020). The characterising species, *S.spinulosa* can form dense aggregations with recruitment generally from existing individuals. The reproductive phase for this species appears to be relatively long, spending 6-8 weeks as planktonic larvae which result in a good larval supply and high dispersal potential (Tillin et al. 2020). Research has suggested that *Sabellariid* polychaetes may spawn in response to disturbance as a means of securing the future population (Pearce *et al*. 2011).

Areas of habitat directly along the Preferred Cable Route will by temporarily disturbed. Evidence of *S.spinulosa* reef recovery rates is limited which makes predicting how the reef will respond to disturbance difficult. Some evidence has shown some *S. spinulosa* reefs are relatively ephemeral and disappear following natural disturbance but recovering the next year, suggesting recovery is high (within 2 years). However, other evidence has shown recolonisation within 16-18 months, but full recovery to pre-impact condition with high adult density and biomass is considered to take three to five years (Tillin et al. 2020).

The Proposed Development will have a short-term effect on the extent of this habitat but will not affect its structure and function based on the surrounding extents of *Sabellaria spinulosa* reef. In addition, recovery via recruitment from the surrounding area is likely to occur in the short-term (within two years).

The overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

Table 7-13 Annex I Biogenic Reef – sensitivity assessment

EUNIS habitat code	Penetration and/or disturbance of the substratum below the surface				Abrasion/disturbance of the substratum on the surface of the seabed			
	Resistance	Resilience	Sensitivity	Confidence	Resistance	Resilience	Sensitivity	Confidence
A5.26 - Circalittoral muddy sand	*Medium*	*High*	*Low*	*Medium/ High*	*Medium*	*High*	*Low*	*Medium/High*
A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	None	Medium	Medium	Medium	Low	Medium	Medium	Medium/Low
A5.141/ A4.23 - Pomatoceros triqueter with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles / Communities on soft circalittoral rock	*Low / Low*	*High / Very Low*	*Low / High*	*Low/ Medium*	*Low / Medium*	*High / Very Low*	*Low / Medium*	*Low/Medium*

Notes

Source – MarLIN (2020)

* specific to sensitivity

- no sensitivity assessment available for this habitat or a sub habitat

Italics & grey = Assessment based on sublevel habitat assessments

Habitats of Principle Importance - sheltered muddy gravels, subtidal sands and gravels and mud habitats in deep waters

The habitats were found at various location along the Proposed Development; as described in Sections 7.3.3.6 to 7.3.3.11.

The sensitivity of these Habitats of Principle Importance has been assessed as medium because as indicated in Table 7-14 the associated EUNIS habitats have a low to medium sensitivity to the pressure. The fauna associated with these habitats are typically fast-growing epifauna and widespread. The

resilience of such subtidal sediments is generally considered high, with previous research showing that biological assemblages present in these type of habitats are characterised by species that are relatively tolerant of penetration and disturbance, either because they are buried in sediment or are adapted to habitats with frequent disturbance and recover quickly (Tillin 2016). The recoverability of communities is likely to occur through a combination of recruitment from surrounding unaffected areas and larval dispersal with recovery likely to occur within two years (Tillin 2016). This is also reported in evidence looking at the recovery of benthic communities after aggregate extraction activities (Nedwell et al. 1998), where following dredging activities, the characteristic recovery time for subtidal sand communities may be two to three years.

Cable installation activities are considered far less invasive than aggregate extraction and dredging activities and disturbance caused by cable installation activities will be short-term and not repetitive. While the subtidal coarse sediment and any fauna present within the Proposed Development footprint would be disturbed; the seabed will quickly return to pre-installation conditions following installation as adult individuals in the surrounding area will remain unaffected and will be able to recolonise the seabed which is likely to speed up the rate of recovery.

Although these habitats are Habitats of Principle Importance, they are not considered rare or unique. EMODnet data (EMODnet 2020) shows that these habitats cover large areas of the SNS.

The overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

Table 7-14 Habitats of Principle Importance – sensitivity assessment

EUNIS habitat code	Penetration and/or disturbance of the substratum below the surface				Abrasion/disturbance of the substratum on the surface of the seabed			
	Resistance	Resilience	Sensitivity	Confidence	Resistance	Resilience	Sensitivity	Confidence
A5.261 - *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment	Medium	High	Low	Medium/ High	Medium	High	Low	Medium/ High
A5.261/A5.241 - *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment / *Echinocardium cordatum and Ensis spp.* in lower shore and shallow sublittoral slightly muddy fine sand	Medium / None	High / Medium	Low / Medium	Medium/ High	Medium / Low	High / Medium	Low / Medium	Medium / High
A5.26 - Circalittoral muddy sand	*Medium*	*High*	*Low*	*Medium/ High*	*Medium*	*High*	*Low*	*Medium / High*
A5.141 - *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	Low	High	Low	Low / Medium	Low	High	Low	Low/ Medium
A5.25 - Circalittoral fine sand	*Medium*	*High*	*Low*	*Medium / High*	*Medium*	*High*	*Low*	*Medium/ High*
A5.14 - Circalittoral coarse sediment	*Low*	*High*	*Low*	*Low / Medium*	*Low*	*High*	*Low*	*Low/ Medium*
A5.33 - Infralittoral sandy mud	*Low*	*Low*	*High*	*Low/ Medium*	*Low*	*Medium*	*Medium*	*Medium/ Low*

EUNIS habitat code	Penetration and/or disturbance of the substratum below the surface				Abrasion/disturbance of the substratum on the surface of the seabed			
	Resistance	Resilience	Sensitivity	Confidence	Resistance	Resilience	Sensitivity	Confidence
A4.43/A5.261 - Communities on soft circalittoral rock /	*Not relevant /Medium*	*Not relevant / High*	*Not relevant / Low*	*Medium/ High*	*Low / Medium*	*Medium / High*	*Medium / Low*	*Low / Medium*
A5.432 - *Sabella pavonina* with sponges and anemones on infralittoral mixed sediment	Low	Medium	Medium	Medium/ Low	Low	Medium	Medium	Medium/ Low
A5.261 - *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment	Medium	High	Low	Medium/ Low	Medium	High	Low	Medium / High

Notes

Source – MarLIN (2020)

* specific to sensitivity

- no sensitivity assessment available for this habitat or a sub habitat

Italics & grey = Assessment based on sublevel habitat assessments

7.6.3.2 Operation

No habitat disturbance will occur from the operating cables.

The assessment considers three repair events occurring over the lifetime of GridLink. It assumes that for each repair event a 500m section of cable will need to be removed and re-buried. The maximum total seabed footprint is 22,500m^2 (0.023km^2). Although the magnitude of the effect will be even smaller than for installation, should any one of the repair events occur within areas of the Proposed Development identified as an Annex I habitat or a Habitat of Principal Importance then the conclusions for installation remain pertinent. The overall significance of the effect has therefore been assessed as **Minor** and **Not Significant**.

7.6.3.3 Decommissioning

It is assumed that the cable will be removed at decommissioning. This process would essentially be the same as installation activities but in reverse. It is likely that the seabed footprint of the cable removal will be like that for installation. Any effects that could arise during the decommissioning phase will be of a comparable magnitude to those assessed for cable installation and so the overall significance of the effect has been assessed as **Minor** and **Not Significant**.

7.6.4 Siltation rate changes, including smothering (depth of vertical sediment overburden) - *Saballeria Spinulosa* reef

7.6.4.1 Installation

This assessment only includes the effects from Siltation rate changes, including smothering (depth of vertical sediment overburden) on *S.spinulosa* reef. No *Mytilus* reefs were observed along the Asset Placement Corridor. See Table 4-1 for a full justification for the exclusion of other habitats.

This section focuses on smothering from sediment either displaced or settling out of suspension following installation activities e.g. pre-sweeping, cable trenching. Chapter 5 concluded that sand and gravel will be suspended briefly (about 1 minute for sand and less than 10 seconds for gravel) and will settle within 35m of the trench. Maximum settling depths depend on the proportion of sand and gravel in the sediments and the depth of the trench but will be less than 5cm. The maximum

deposition thickness of silt will be <1cm, and is likely to be in the range of 1-2mm maximum thickness (based on the modelling results presented in Technical Appendix C).

Although modern equipment and installation techniques have reduced the re-suspension of sediment during cable trenching activities, remaining suspended sediment dispersed into the water column has the potential to affect *S. spinulosa,* a sessile filter feeder and once settled out, could potentially smother *S.spinulosa* reefs within the deposition area.

The sensitivity of the receptor has been assessed as medium. Although the EUNIS habitats identified as present at the locations where *S.spinulosa* reef was identified are not sensitive to smothering (as outlined in Table 7-15), according to Tillin et al. (2015) *Sabellaria spinulosa* reefs have a resistance of none, a resilience of medium and a sensitivity of medium to siltation rate changes including smothering. Therefore, as a precaution, the higher sensitivity value has been used in the assessment.

While evidence suggests that siltation can block feeding apparatus which may impact worm development (Last et al. 2011). Research has also suggested that *Sabellaria spinulosa* can survive intermittent sand burial of up to 7cm across 32 days (Last et al. 2011) through the creation of emergence tubes, therefore the depth of the deposited layers of sand are well within the tolerable range for this species and are likely to be similar or less than that experience during natural storm events (Tillin et al. 2015). Furthermore, recovery of *Sabellaria spinulosa* reefs is considered swift based on the fact that larval dispersal would not be interrupted and therefore new reefs are likely to be established by individuals over buried ones following sedimentation (Fariñas-Franco et al. 2014).

The magnitude of the effect has been assessed as low for the following reasons:

- The four areas where *S.spinulosa* were observed at a low to medium reefiness were in areas of sand and mixed sediments. Sand and gravel deposits will fall back into the trench or directly to either side so the spatial extent for effect is very narrow.
- While there will be high concentrations of suspended sediments, particularly sand and gravel, SSC will return to normal levels within a tidal cycle; and
- Deposited thicknesses for sand, gravel and silt is well within the tolerable range for *Sabellaria spinulosa* and therefore will not adversely affect the extent of this habitat or its structure and function.

The overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

Table 7-15 *S. spinulosa* reef sensitivity to pressure 'Siltation rate changes, including smothering (depth of vertical sediment overburden)'

EUNIS habitat code	Resistance	Resilience	Sensitivity	Confidence
A5.26 - Circalittoral muddy sand	*Medium*	*High*	*Low*	*Medium*
A5.611 - *Sabellaria spinulosa* on stable circalittoral mixed sediment	High	High	Not sensitive	High
A5.141/ A4.23 - *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	High	High	Not sensitive	Medium

Notes

Source – MarLIN (2020)

* specific to sensitivity

- no sensitivity assessment available for this habitat or a sub habitat

Italics & grey = Assessment based on sublevel habitat assessments

7.6.4.2 Operation (including maintenance and repair)

No siltation rate changes will occur from the operating cables.

The assessment considers three repair events occurring over the lifetime of GridLink. It assumes that for each repair event a 500m section of cable will need to be removed and re-buried. The maximum total seabed footprint is 22,500m^2 (0.023km^2). Although the magnitude of the effect will be even smaller than for installation, should any one of the repair events occur within an area of *S. spinulosa* reef then the conclusions for installation remain pertinent. The overall significance of the effect has therefore been assessed as **Minor** and **Not Significant**.

7.6.4.3 Decommissioning

It is assumed that the cable will be removed at decommissioning. This process would essentially be the same as installation activities but in reverse. Any effects that could arise during the decommissioning phase will be of a comparable magnitude to those assessed for cable installation and so the overall significance of the effect has been assessed as **Minor** and **Not Significant.**

7.6.5 Physical change (to another seabed type)

7.6.5.1 Installation

External cable protection will be installed where the Proposed Development crosses a third-party telecommunications cable, and where ground conditions are unsuitable for cable burial. Of the habitats listed in Section 7.6.2, external cable protection will be deposited on:

- Annex I Reef (biogenic) and *Sabellaria spinulosa* reefs;
- Habitats of Principle Importance – Sheltered muddy gravels and Subtidal sands and gravel; and
- Annex I – Sandbanks which are slightly covered by seawater at all times.

Table 7-16 presents information on the location and extent of cable protection on these habitats. It should be noted it excludes the areas of external cable protection which will or may be required in European Sites and MCZs. The extent of the cable protection presented in this table is a worst case.

Table 7-16 Indicative external cable protection requirements in habitats of conservation importance

Habitat	KP Start	KP End	Crossing Description/ CBRA* Zone	Rock berm design envelope		
				Estimated length of berm (km)	Maximum berm width (m)	Estimated seabed footprint (m^2)
Annex I Biogenic reef - Low Grade	80.5	80.63	PEC telecom cable	0.080	11.86	1093
Annex I – Sandbanks which are slightly covered by seawater at all time Sheltered muddy gravels	13.3	13.9	10	0.446	8.2	3659
Subtidal sands and gravels	68.9	70.0	42	0.825	7.3	6023
Subtidal sands and gravels	70.0	70.8	43	0.200	7.0	1400
Subtidal sands and gravels	70.8	72.87	44	0.518	7.9	4088
Subtidal sands and gravels	73.84	74.5	46	0.165	6.7	1102
Subtidal sands and gravels	76.84	84.0	50	1.790	6.7	11991

* Cable Burial Risk Assessment

Annex I Biogenic Reef habitat and *Sabellaria spinulosa* reefs

The UK Offshore Environmental Survey Report (Technical Appendix P and Q) shows the seabed type at the PEC crossing to be low grade *S. spinulosa* reefs on stable circalittoral mixed sediment. Approximately 1,093m^2 of the habitat will be lost under the cable protection deposit and replaced by a novel hard substrate. This habitat has no resistance, very low resilience and high sensitivity to this pressure however, it should be noted that the species that creates it (*S.spinulosa*) is considered not sensitive based on studies of habitat preferences.

The sensitivity of the receptor has been assessed as medium as although the habitat within the direct footprint of the deposit will be lost, it is noted that *S.spinulosa* can colonise bedrock and artificial structures (Tillin et al. 2020). Wider evidence suggests that *S.spinulosa* has been recorded on a variety of substrates including artificial surfaces such as pipelines, wave-breakers, seawalls and artificial reefs (Pohler 2004; Braithwaite *et al*. 2006; Chen and Dai 2009; Ponti *et al*. 2010). Braithwaite *et al*. (2006) found sabellarid aggregations encrusting several kilometres of exposed pipeline, although it was noted four or five years after the extent of aggregations had reduced which aligns with the ephemeral characteristic of this species. Therefore, the presence of the artificial habitat will not preclude biogenic reef adapting and reforming in the area. IN addition, although the habitat is classed as Annex I Biogenic Reef, it is not a Qualifying Interest of a European site and the Biogenic reefs are not considered rare or unique. MarLIN has identified that *S.spinulosa* is found in areas all around the British Isles.

The magnitude of the effect has been assessed as low due to the extremely localised footprint of the deposit. Although the introduction of external cable protection will lead to a permanent change to the reef habitat, it is expected that that the external cable protection will become colonised by *S.spinulosa* and it will not affect the wider area of reef habitat. The environmental survey identified wider areas of *S. spinulosa* reef within the Asset Placement Corridor and there is evidence (Tillin et al. 2020) suggesting that *S. spinulosa* reefs can recover quickly from short-term or intermediate levels of disturbance, with recovery accelerating if some of the reef is left intact following disturbance which will promote larval settlement of the species.

The overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

Annex I – Sandbanks which are slightly covered by seawater at all times, Habitats of Principle Importance – Sheltered muddy gravels and Subtidal sands and gravel

If cable protection is required between KP13.3 and KP13.9 it will reduce the extent of the sand habitat identified along the Preferred Cable Route by 0.004km^2. Habitats at this location are classified as Sandy mud and fine sand, A5.33 – Infralittoral muddy sand and A5.23 – infralittoral fine sand.

The introduction of external cable protection into habitat defined as Habitat of Principal Importance - subtidal sands and gravels has the potential to reduce the extent of this habitat by 0.024m^2. Habitats were classified by the environmental survey as A5.25 – Circalittoral fine sand and A5.141 - *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles.

The sensitivity of these habitats has been assessed as medium. The MarLIN sensitivity assessment concludes that the sensitivity for the subcategories of these habitats to the pressure physical change (to another seabed type) is high, based on the fact a change to an artificial or rock substratum would alter the character of the biotope leading to reclassification. However, the habitats identified are not Qualifying Interests of a European site, and the species identified in benthic grab samples obtained at habitats A5.33, A5.23, A5.25 and A5.141 are widespread species which are typical of these types of sediment. No species obtained from the samples were rare or of conservation importance.

The magnitude of the effect has been assessed as low. With respect to Annex I Sandbanks, this habitat covers very large areas of the southern North Sea and Thames Estuary area. A small loss of these habitats (0.004km^2) and species associated with these habitats will not affect the overall diversity

within this Annex I habitat. This conclusion is pertinent for Subtidal sands and gravels which also cover large areas of the southern North Sea.

The overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

7.6.5.2 Operation

The assessment considers three repair events occurring over the lifetime of GridLink. The objective will be to rebury the cables in the seabed as this offers the best form of protection, but where ground conditions preclude this external cable protection may be required. Any areas of external cable protection will likely be within the areas already identified as challenging for installation. Therefore then the conclusions for installation remain pertinent. The overall significance of the effect has therefore been assessed as **Minor** and **Not Significant**.

7.6.5.3 Decommissioning

During decommissioning there will no deposit of external cable protection. Therefore, there will no effects from physical change to another seabed type.

7.7 Project Specific Mitigation

In addition to the embedded mitigation discussed in Section 7.5, Table 7-17 presents Project Specific Mitigation that will be implemented.

Table 7-17 Project Specific Mitigation – Benthic ecology

ID	Project Specific Mitigation
PS1	London Array crossing design shall incorporate fronded mats either as individual gravity secured mats or as attached to tapered concrete mattresses in conjunction with cable protection to facilitate sediment capture and reduce scour. The objective shall be to cover the external cable protection with sand to minimise fishing disruption to bottom drift netting and trawling and return the seabed to a sand habitat within the Margate and Longsands SAC.
PS2	Subject to agreement with asset owner and thermal calculations consideration shall be given to reducing the crossing angle (from 90 degrees) for the London Array crossing to orientate the crossing with the tidal flow and direction to minimise risk of scour.
PS3	The London Array crossing design shall encourage natural resedimentation of the crossing.
PS4	The Contractors cable burial and protection strategy shall adhere to the following two principles, in order of priority: 1. Achieving Target DOL along the route so External Protection is not required and in particular no use of External Protection in MCZs and SACs 2. Minimise any displacement of seabed which may not recover naturally within 2-3 years of installation (or else include methods to restore or aid the restoration of the seabed where viable).
PS5	The GridLink Submarine Cable Bundle shall be installed along the Marine Installation Route Position. Contractor shall avoid deviation from this Route. If deviation is required, the GridLink Submarine Cable Bundle shall remain inside the Asset Placement Corridor and robust justification for the deviation provided to Gridlink for approval. The Route shall not enter areas within the Asset Placement Corridor identified as "Areas of constraint for Asset Placement" unless robust justification is provided to GridLink as to why there is no alternative.
PS6	All planned anchor placements must be in the Consent Corridor. Contract shall avoid planned anchor placement in 'Areas of Constraint for Anchor Placement'. If planned anchor placement is required in any one of these areas robust justification shall be provided to GridLink as to why there is no alternative.
PS7	Position of planned anchor placements shall be surveyed. Data shall by analysed by both a marine ecological specialist and a marine archaeologist for presence of sensitive habitats and archaeological features respectively. Positions of planned anchor placements shall be adjusted if Sabellaria reef or marine heritage assets are identified at the location.
PS8	A review of the Environmental Habitat Assessment shall be undertaken by acquiring detailed seabed imagery using side scan sonar and multi-beam echo sounder back scatter analysis combined with drop

ID	Project Specific Mitigation
	down camera video acquisition along ten 250m transects located between KP82 to KP92. Along the transects photographs shall be taken every 5 to 10m and / or at areas of interest, with accompanying video recorded. The Environmental Habitat Survey shall be undertaken no greater than 2 years prior to scheduled installation date to ensure baseline data collected remains valid in any future assessment of impact of the cable installation on Annex 1 biogenic reef. The results of the survey shall be used to micro-route the cable to: a) Avoid Sabellaria reef structures wherever practicable b) If avoidance is not possible (e.g. due to extent of reef), minimise the crossing distance across the reef structure c) If different grades of reef are present, select a cable route through the lowest grade reef.
PS48	Within Goodwin Sands MCZ an environmental monitoring plan will be established to monitor colonisation of the external cable protection. Video transects will be run along the external cable protection to record species present, abundance and extent. The objectives of the monitoring will be to establish an evidence base to inform future development within the Goodwin Sands MCZ. Monitoring will be aligned with the condition surveys scheduled for every two years. The monitoring will be undertaken for the first two condition surveys (to cover four-year period in total).
PS49	Environmental monitoring at London Array crossing - The condition surveys will establish (if possible) the depth of sediment cover over the crossing. If the depth of cover is enough to allow sampling, sediment samples will be taken and analysed for particle size. If sufficient sample sizes can be obtained to allow infauna characterisation this will also be undertaken. Data will be reviewed by a benthic specialist and a report compiled and issued to the Marine Management Organisation and Natural England. The environmental monitoring will be undertaken with the first two condition surveys; anticipated for years 2 and 4 post-commissioning.
PS50	Prior to commencement of licensable activities, the Applicant will submit a Technical Note to Marine Management Organisation confirming exact locations for pre-sweeping using a dredger and defining a spoil disposal site. The disposal site shall meet the following conditions: a. Be located within the European site b. Be located on a similar sediment composition as the excavated sediment c. Be within the Application Corridor d. Be outside of the KEIFCA Pan Sands Hole Byelaw Area If a suitable disposal site cannot be identified within the Application Corridor, an external disposal site such as North Edinburgh Channel will be secured. Preference will be given to disposal sites within the Margate and Long Sands SAC. The technical note will confirm that the proposed method and disposal will not have a significant effect on the European site.

7.8 Residual Effects

No Significant effects were identified on habitats of conservation importance identified outside protected sites or within a protected site but which are not a Qualifying Interest/Protected Feature.

Although no significant effects have been identified, additional Project Specific Mitigation has been proposed as best practice for certain pressures which were assessed as Not Significant. These are discussed below.

7.8.1 Penetration and / or disturbance of the substrate below the surface of the seabed, including abrasion

The assessment concluded that the effects from penetration and / or disturbance of the substrate below the surface of the seabed, including abrasion on habitats of conservation importance are **Not Significant**. Without prejudice to this conclusion, as best practice, Project Specific Mitigation has been proposed to ensure that reasonable additional measures are taken to reduce the footprint of the Proposed Development. The objectives of these measures are to minimise the displacement of the seabed (PS4); avoid deviation off the Preferred Cable Route which has been identified as the best route

that balances environmental and social constraints (PS5); and avoid anchor placement on sensitive habitats (PS7).

7.8.2 Physical change (to another seabed type)

The assessment concluded that the effects from physical change (to another seabed type are **Not Significant**. However, it is recognised that the use of external cable protection in the marine environment does have effects which should be appropriately managed and therefore additional Project Specific Mitigation (PS4) has been proposed to minimise the use of external cable protection.

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8. FISH AND SHELLFISH

This chapter describes the existing baseline environment for fish and shellfish, identifies the pressures associated with the Proposed Development on the receptor, presents the findings of the environmental assessment, and describes how significant effects (if any) will be mitigated.

8.1 Data Sources

Baseline conditions have been established by undertaking a desktop review of published information and through consultation with stakeholders (namely Kent and Essex Inshore Fisheries and Conservation Authority (KEIFCA), Leigh Trawlermen Cooperative, Rochester Oystermen and Floating Fisheries (ROFF), Thames Estuary Fishermen's Association (TEFA), Thanet Fishermen's Association (TFA), Whitstable Fishermen's Association, Swale Fishermen Ltd, Harwich Harbour Fishermen's Association, National Federation of Fishermen's Organisation (NFFO), Natural England (NE), Marine Management Organisation (MMO) and the Centre for Environment Fisheries and Aquaculture Science (Cefas)). The key data sources used to inform the baseline description and assessment include, but are not limited to the following:

- Offshore Energy Strategic Environmental Assessment 3 (DECC 2016);
- Fish Sensitivity Maps (Coull *et al.* 1998, Ellis *et al.* 2012);
- Transitional and Coastal Waters (TraC) Fish Monitoring Programme (Environment Agency 2019);
- International Herring Larvae Surveys (ICES 2020);
- Technical Appendix H – Atlantic Herring and Sandeel Assessment; and
- Technical Appendix I – Underwater Noise Modelling;
- Technical Appendix P – Nearshore Environmental Survey Report (MMT 2019);
- Technical Appendix Q – UK Offshore Environmental Survey Report (MMT 2020);

A full list of references used for the assessment are listed in the References Section at the end of this Chapter.

8.2 Consultation

Table 8-1 summarises the relevant consultation responses on fish and shellfish.

Table 8-1 Consultation responses – fish and shellfish

Stakeholder	Summary of Consultation Response	How response has been addressed
MMO	The MMO notes the likely presence of European eel, European smelt and sea lamprey. Recommends use of data from Environment Agency's (TraC) Fish Monitoring Programme.	The Environment Agency's TraC Fish Monitoring Programme data has been used to inform the baseline.
MMO	Requests that the most recent data from the International Herring Larval Survey (IHLS) and particle size data for the cable route is used in the assessment of effects on spawning habitat of Atlantic herring.	The most recent data, between 2010 – 2017, from the ILHS and particle data for the cable route has been used to inform the Technical Appendix H.
MMO	The cable route passes through indicative herring spawning grounds for the Downs herring stock which spawn in the Eastern English Channel throughout November, December and January. The spawning grounds of the Downs herring have not been identified in the documentation supplied nor have they been	Drawing P2172-FISH-004 has been updated to include this information and is provided in this Chapter.

Stakeholder	Summary of Consultation Response	How response has been addressed
	presented within Figure 10-2 (Drawing P2172-FISH-004). This must be provided in the EA.	
MMO	In accordance with the methods of MarineSpace et al. (2013), the MMO would expect the inclusion of a herring potential spawning habitat assessment within the Environmental Appraisal, using the most up-to-date data from the IHLS with indicative abundances of herring larvae to supplement the indicative herring spawning grounds from Ellis et al. (2012). The MMO recommend that the last 10 years of IHLS data are used to inform the assessment (data up to 2018 is currently available). IHLS surveys of the southern North Sea (for the Downs herring stock) are conducted as three surveys; one in the 3rd quarter of each year undertaken by the Netherlands between 16-31 December, and two in the 1st quarter of each year; between 1-15 January undertaken by Germany, and between 16-31 January undertaken by the Netherlands. This assessment, in the form of heat maps overlapping the cable route map, will provide regional context of Atlantic herring spawning habitat suitability and should be provided in the Environmental Appraisal.	A herring and sandeel assessment has been provided as Technical Appendix H and has been used to inform the assessment in this Chapter.
MMO	The MMO note that the cable route is in proximity to the Thames herring spawning grounds at Herne Bay. Thames herring are a discrete population considered separate from the North Sea stock and are the only UK spring-spawning herring stock, spawning from late February to early May (Wood, 1981). There is a sentinel fishery for Thames herring that operates between September and 31st January for monitoring purposes only. Further, the most recent assessment of this stock has found that it is below biomass limits, so the fishery remains closed to the wider fishing community. This should be acknowledged in the Environmental Appraisal. Therefore, based on the previous comment, Thames herring spawning grounds should be mapped and potential impacts to this sub-stock included in the Environmental Appraisal. Please note that although no IHLS data is available for this stock, the best available evidence (i.e. Wood, 1981, Fox, 2001, landings data from the Thames Estuary Fishermen's Association) could be used for future assessment.	Technical Appendix H – Atlantic herring and Sandeel Assessment includes this information and has been used to inform the assessment in this Chapter.
MMO	A table indicating the spawning periods of those fish species that have spawning or nursery grounds within the cable route should be presented in the Environmental Appraisal.	Please see Table 8-2.
MMO	Requested that reference should be made to the Margate and Longsands SAC byelaws	Reference has been included in Chapter 14 - commercial fisheries.
MMO	Requested that assessment considers whether the Proposed Development will affect juvenile seabass or nursery areas in the Medway Estuary.	Spawning and nursery areas for European bass have been considered in this Chapter.
MMO	The cumulative and inter-related effects to marine/estuarine and migratory fish as well as commercial fishing must be scoped into the assessment.	The cumulative effects to marine/estuarine and migratory fish have been assessed within Technical Appendix E (Habitats Regulations Appraisal), and cumulative effects to commercial fishing have been assessed within Chapter 14.

Stakeholder	Summary of Consultation Response	How response has been addressed
MMO	The MMO recommends that the KEIFCA be contacted in relation to data on spawning grounds of three fish species: Thornback Ray, Tope and Seabass.	Cefas have provided information which has been used to inform this Chapter.

8.3 Existing Baseline

8.3.1 General overview

The estuaries and subtidal habitats of the Medway and Thames Estuaries support a variety of fish and shellfish. Fish species present range from adventitious freshwater species, i.e. freshwater species with no estuarine requirement, to marine species either that use estuaries as a spawning and nursery ground or that have no estuarine requirement.

The intertidal area of the Medway Estuary performs a key local, regional and national role as a nursery area for a number of commercial fish stocks, most importantly the European Bass stock. Many of the species listed in Table 8-2 use the intertidal areas of the estuary during juvenile stages (Environment Agency 2010). The Medway Estuary has two protected nursery grounds for European bass (The Bass Order 1990); these are adjacent to the power station outfalls at Kingsnorth and Isle of Grain (Figure 8-1, Drawing P2172-FISH-001). A further designated bass nursery area is also found in the Thames Estuary, at Bradwell Power Station outfall (CEFAS 1999).

The TraC Fish Monitoring Programme undertook surveys at Kingsnorth in the Medway Estuary in 2005 and identified the following species as present sand smelt (*Atherina presbyter),* sea bass (*Dicentrarchus labrax*), anchovy (*Engraulis encrasicolus*), smelt (*Osmerus eperlanus*), Dover sole (*Solea solea*), lesser weaver (*Echiichthys vipera*), scad / horse mackerel (*Trachurus trachurus*), and tub gurnard (*Chelidonichthys lucernus*). Surveys from 1998 through to 2019 have identified in total 61 species within the Medway ranging from freshwater species such as pike through to marine species such as Atlantic herring (Environment Agency 2019).

The Proposed Development directly interacts with spawning and nursery areas for 12 commercially important fish species, as presented in Table 8-2 and Figure 8-2 (Drawing P2172-FISH-004). High intensity spawning grounds for European plaice and common sole and low intensity spawning ground for Atlantic cod and sandeel, and low intensity nursery ground for Atlantic cod, European plaice, sandeel, thornback ray, tope and whiting have been identified. In addition, high intensity nursery grounds for Atlantic herring (Downs population), common sole and European bass have been identified. The Proposed Development lies in areas frequented by lemon sole, Atlantic mackerel and European sprat that use the area as spawning and/or nursing grounds. This first third of the year is also a time that coincides with the peak upstream (inshore) movements of European smelt, sea lamprey and European eel, which are listed under Schedule 4 of the Offshore Conservation of Species and Habitats Regulations and the UK Biodiversity Action Plan (BAP) Priority Species list.

Table 8-2 Fish species with spawning and/or nursery grounds within the Proposed Development

Key		
		Spawning and nursery period
		Nursery period

Species	Spawning aquatic zone	Spawning grounds	Nursery grounds	Spawning & Nursery Periods											
				J	F	M	A	M	J	J	A	S	O	N	D
Atlantic Cod (*Gadus morhua*)	Demersal	Low intensity	Low intensity												
Atlantic herring – Downs stock (*Clupea harengus*)	Demersal	Present	High intensity												
Atlantic herring – Blackwater stock	Demersal	Present	Present												
Lemon sole (*Microstomus kitt*)	Pelagic*	Present	Present												
Atlantic mackerel (*Scomber scombrus*)	Pelagic	No interaction	Present												
European plaice (*Pleuronectes platessa*)	Pelagic*	High intensity	Low intensity												
Sandeel (*Ammodytidae*)	Demersal	Low intensity	Low intensity												
Common sole (*Solea solea*)	Pelagic*	High intensity	High intensity												
European sprat (*Sprattus sprattus*)	Pelagic	Present	Present												
Thornback ray (*Raja clavata*)	Demersal	Insufficient data	Low intensity												
Tope (*Galeorhinus galeus*)	Demersal	Insufficient data - Viviparous	Low intensity - Viviparous												
Whiting (*Merlangius merlangus*)	Pelagic*	No interaction	Low intensity												
European bass (*Dicentrarchus labrax*)	Pelagic*	Insufficient data	High intensity (intertidal)												

Sources: Coull *et al.* 1998, Ellis *et al.* (2012), Kent and Essex IFCA (2015).

* The adults of these species are demersal (bottom dwellers) however they are pelagic spawners – the eggs and lavae are pelagic.

Notes:

1.The terms: present, low intensity, high intensity and insufficient data are used to describe results in terms of occurrence and relative abundance of eggs or juveniles in a given area.

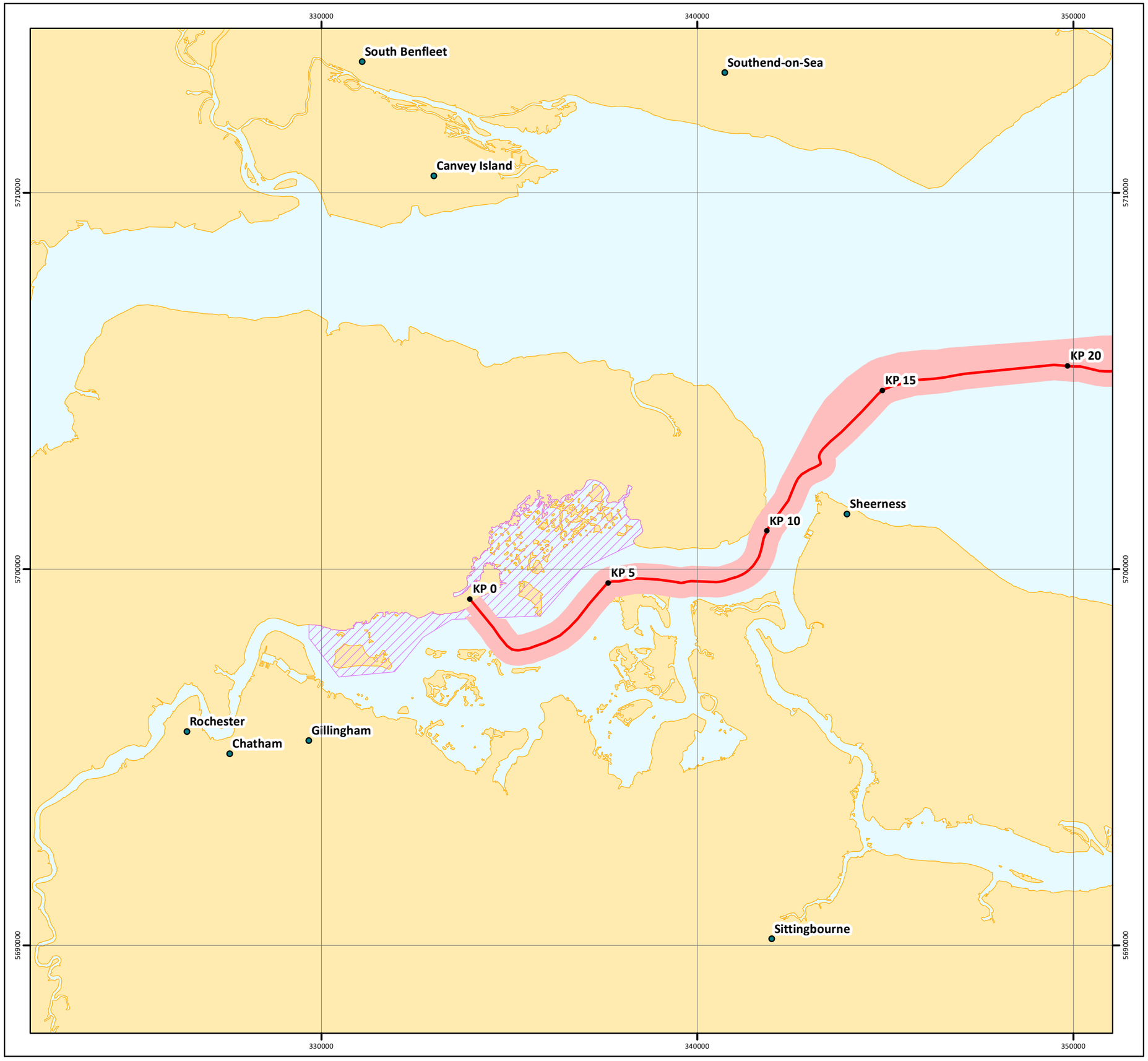
2. Ellis *et al.* (2012) states that there are insufficient data on occurrence of eggs or egg bearing females to delineate spawning grounds but these should broadly overlap with nursery grounds.

3. Viviparous species - Gravid females can be found all year

The Proposed Development lies within approximately 0.1km² of the Blackwater herring spawning grounds (Studhill Bank) (it should be noted that the Preferred Cable Route lies 140m from the edge of the Spawning Ground at its closest point). This is a distinct population, referred to as the Blackwater herring, that spawn on the Eagle Bank off Essex and the Studhill Bank off Kent between February and March.

In addition to the Medway Bass nursery area and Blackwater herring spawning ground, spawning and nursery areas which the Proposed Development crosses are widespread, covering a large area of the southern North Sea (see Figure 8-1, Drawing P2172-FISH-004).

The overall likelihood of presence of juveniles within the first year of their life in the vicinity of the Proposed Development has been determined to be low for all species except whiting, Atlantic herring, Atlantic mackerel, European sprat and common sole which have been determined to be moderate to high (Aires *et al.* 2014). Likelihood of presence of juveniles has been defined with reference to the Random Forest probability of presence scale, low probability is defined as 0 ranging to high probability at around 0.99 (maximum score is dependent on species type and ranges from 0.525 for Atlantic herring to 0.99 for haddock).



GRIDLINK INTERCONNECTOR

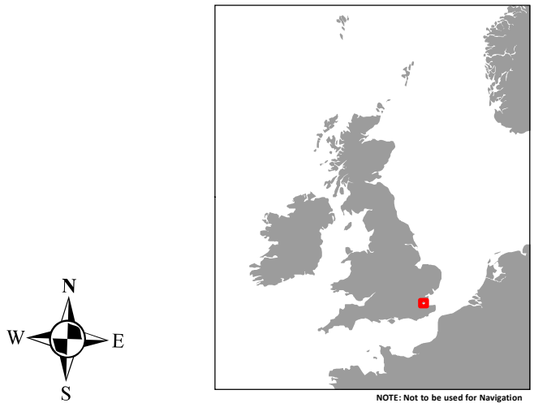
FISH ACTIVITY

Medway Bass Nursery Areas

Drawing No: P2172-FISH-001	B

Legend

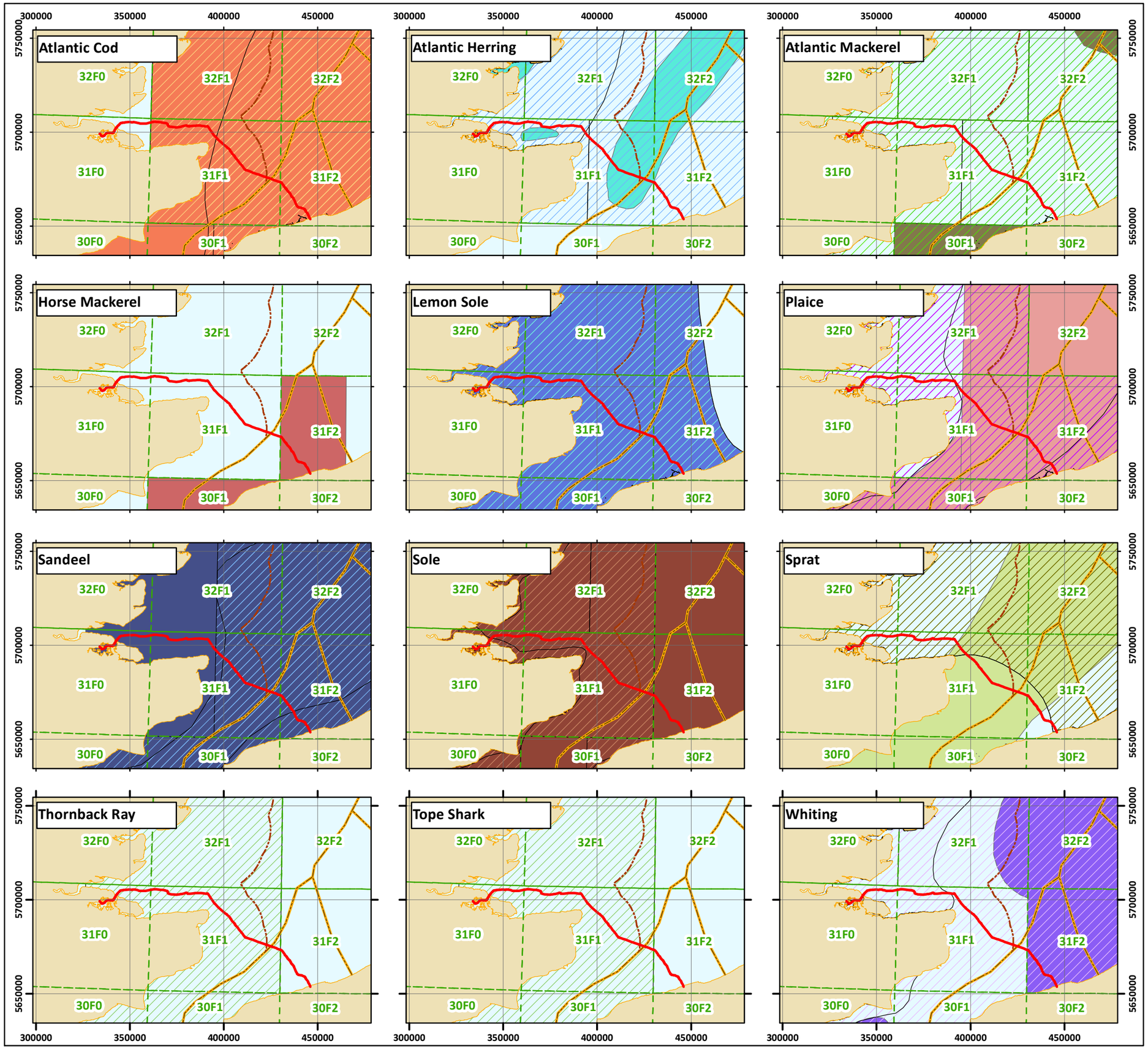
- KP
- GridLink Preferred Cable Route
- Application Corridor
- Medway Bass Nursery Area



NOTE: Not to be used for Navigation

Date	29 May 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	CDA; UKHO; GEBCO; ESRI; KEIFCA; GridLink
File Reference	J:\Gridlink\P2172_Mxd\06_FISH\ P2172-FISH-001.mxd
Created By	Chris Goode
Reviewed By	Chris Carroll
Approved By	Kerri Gardiner

0 1.5 3 4.5 6 km



GRIDLINK INTERCONNECTOR

FISH ACTIVITY

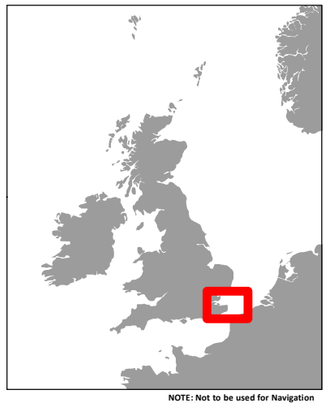
Spatial Patterns of Fish Spawning and Nursing

Drawing No: P2172-FISH-004 | **B**

Legend

- GridLink Preferred Cable Route
- 12nm Territorial Sea Limit
- EEZ Boundary
- ICES Block

Nursery Grounds	Spawning Grounds
Atlantic Cod	Atlantic Cod
Atlantic Herring	Atlantic Herring
Atlantic Mackerel	Atlantic Mackerel
Lemon Sole	Horse Mackerel
Plaice	Lemon Sole
Sandeel	Plaice
Sole	Sandeel
Sprat	Sole
Thornback Ray	Sprat
Tope Shark	Whiting
Whiting	



NOTE: Not to be used for Navigation

Date	22 June 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	MarineRegions; CEFAS; OSOD; ESRI; ICES
File Reference	J:\Gridlink\P2172_Mxd\06_FISH\ P2172-FISH-004.mxd
Created By	Chris Dawe
Reviewed By	Emma Langley
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

Flanders Marine Institute (2019). Maritime Boundaries Geodatabase: Exclusive Economic Zone (EEZ), version 11. Available online at http://www.marineregions.org/. https://doi.org/10.14284/386; Contains Ordnance Survey data © Crown copyright and database right 2013; Contains public sector information licensed under Open Government Licence v3.0. Coull, K.A., Johnstone, R., and S.I. Rogers. 1998. Fisheries Sensitivity Maps in British Waters; Ellis, J.R. et al. (2012) Spawning and Nursery Grounds of Selected Fish Species in UK Waters. CEFAS Lowestoft Science Series Technical Report, 147: 55pp. © ESRI; ©ICES

8.3.2 Marine fish

The majority of marine ray-finned fish known to occur in the vicinity of the Proposed Development are demersal and dwell in or near to seabed habitats ranging from muds and sands to gravels and rocky/hard substrates. As described in Chapter 5, the seabed is variable within the Proposed Development ranging from clayey silt, clay, sand and gravelly sand within the Medway Estuary; clay, silty clayey sand within the Outer Thames Estuary; mud, silt and gravelly sediments within deeper water channels of port approaches to London; and sand and silt dominating offshore areas. Beyond here the seabed primarily consists of very loose silty sand or very loose gravelly sand.

Pelagic species occupy the open waters between the coast and the edge of the continental shelf in depths of 20-400m. These areas are highly productive and supply nutrients for the growth of plankton which forms the food for the smaller pelagic species. These populations provide an important source of food for other fish species, marine mammals, seabirds and man. Pelagic fish are highly mobile and migratory, following their food source, and returning to spawning areas. Outside of their spawning period pelagic fish tend to stay away from coastal waters. Pelagic spawning species such as Atlantic mackerel and European sprat release their eggs into the water column and are therefore less sensitive to the activities associated with the Proposed Development.

The species most likely to be affected by the Proposed Development are those with demersal (bottom dwelling) life stages. These include demersal spawning species which lay their eggs on specific seabed types, such as Atlantic herring and Atlantic cod; larval or juvenile ages; or species that live in contact with the seabed. Demersal fish can be divided into two main types: strictly benthic fish which can rest on the seabed (e.g. flatfish such as European plaice, lemon sole, common sole and flounder) and benthopelagic fish which can float in the water just above the seafloor (e.g. cod and whiting).

The following sub-sections provide further detail on the key demersal species (as identified in Table 8-2) which are known to spawn within the Proposed Development i.e. Atlantic cod, Atlantic herring, lemon sole, European plaice, sandeel, common sole, whiting, and European bass. Of these, Atlantic herring and sandeel are known to be particularly sensitive to seabed disturbance because they spawn in very specific substrates. These species are of particular importance because they play a key ecological role as principal prey items for several larger fish species, marine birds and marine mammals and are protected under the UK BAP (see Section 8.3.6 for more information). In addition, information is provided for flounder (*Platichthys flesus*) as the KEIFCA have identified it is a species in the region that requires a Species Management Plan to determine how to manage the stock or habitat.

8.3.2.1 Atlantic cod

Atlantic cod is a demersal species, distributed in a variety of habitats, from shoreline to depths of 600m (OSPAR Commission 2014). The species feed on a variety of invertebrates and fish (DECC 2016). Atlantic cod form large schools during the day and perform seasonal (spawning and wintering) migrations (OSPAR Commission 2014). They are known to aggregate over specific grounds to spawn, showing a preference to spawn in waters with temperatures between 5-7°C and high salinities, over coarse sand with low tidal flow (DECC 2016).

The southern North Sea is an important area for Atlantic cod spawning, with the main spawning season extending from January to April (DECC 2016). Atlantic cod utilise estuarine habitats and other coastal waters are nursery grounds, reaching sexual maturity between 4-5 years (Ellis *et al.* 2012, DECC 2016). Small numbers of cod (7 in total between 2002 and 2008) have been identified in the TraC Fish Monitoring Programme surveys undertaken in the Medway Estuary (Environment Agency 2019).

8.3.2.2 Atlantic herring

Atlantic herring is a pelagic species which spawns on the seabed. Large numbers of herring have consistently been caught in the TraC Fish Monitoring Programme surveys undertaken in the Medway Estuary mainly around Grain (near the mouth of the Estuary) and Upnor (close to Rochester). At Grain, numbers peaked in 2012 and 2015 with catches of 881 and 825 individuals respectively but have decreased in the last few years to 80 in 2019. At Upnor numbers have slowly risen in surveys from 121 in 2011 to 1671 in 2019 (Environment Agency 2019).

Atlantic herring have a specific habitat preference which limits the spatial extent of their spawning grounds. Eggs adhere to the seabed and can form extensive egg beds, meaning they are particularly sensitive to seabed disturbance. The suitability of the seabed substrate as a spawning habitat for Atlantic herring is a function of:

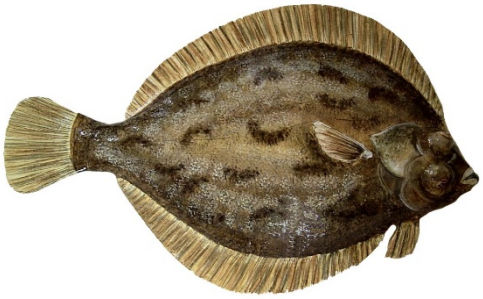
- Particle size – spawning typically occurs on coarse gravel (0.5-5cm) to stone (8-15cm) substrates (ICES 2012);
- Seabed features – preference for crest of ridges and ripples rather than hollows (ICES 2012);
- High oxygenation of sediments e.g. well mixed-waters (Behrens 2007);
- Current speed – prefer reasonably strong tidal currents (1.5 – 3 knots) (Reid *et al.* 1999); and
- Water depth – prefer relatively shallow water (approximately 15-40m deep) (Reid *et al.* 1999).

Atlantic herring numbers fluctuate annually and Atlantic herring often abandon and then return to suitable areas, therefore all suitable areas of Atlantic herring spawning habitat are important to maintain a resilient population.

An Atlantic herring spawning assessment has been completed for the Proposed Development (Technical Appendix H) which identified that:

- The Proposed Development crosses the Downs Spawning Ground between KP87.6 and KP108.8 and continues in French waters to KP114. Spawning in this region occurs from November to January. IHLS data shows a trend that the density of herring spawning is higher towards the end of the spawning period in January, as opposed to nearing the beginning/middle of the spawning period in December.
- The Proposed Development is near the Blackwater Spawning Grounds (Studhill Bank) between KP29 and KP52, and at KP43 approximately 0.1km^2 of the Proposed Development lies within the Blackwater Spawning Ground. Spawning in this region occurs from February to May.
- Review of PSA data identified two locations; KP9.5 and KP104.7, where sediments are classified as 'Prime' herring spawning habitat. Three locations in UK waters, KP39.1, KP101.1 and KP101.8 were classified as 'Sub-Prime' habitat, and two locations in French waters. The Prime and Sub-Prime habitat mainly coincides with the location of the Downs Spawning Ground. However, it indicates that isolated areas outside of known spawning grounds may also be suitable for herring spawning within the Proposed Development.
- In comparison to the average density of larvae at ILHS stations within the English Channel, the spawning density along the Proposed Development may be of lower importance.

8.3.2.3 Lemon sole



Lemon sole is a demersal flat fish which spawns pelagically. Lemon sole are a widespread species in British waters (Maitland and Herdson 2009). They are distributed in a variety of habitats; mainly on coarser sediments, but may also inhabit sediments such as mud, gravel and sand, in depths down to 200m (DECC 2016, Maitland and Herdson 2009). Lemon sole feed on polychaete worms, crustacean and molluscs (Maitland and Herdson 2009).

Lemon sole spawn from April to September in depths of around 100m (DECC 2016). The eggs and larvae are planktonic, while the post larvae are found in mid-water and become bottom living at around 3 cm length (Maitland and Herdson 2009). The larvae, which initially look similar to round fish, undergo metamorphosis whereby one eye migrates round to the same side of the head as the other (NWIFCA 2020). They generally move into deeper waters as they mature, with little movement along the coast taking place (DECC 2016).

Lemon sole have not been recorded in the TraC Fish Monitoring Programme surveys undertaken in the Medway Estuary from 1998 to 2019 (Environment Agency 2019).

8.3.2.4 European plaice

European plaice are a demersal flatfish species commonly found in shallow coastal waters, down to 100m. The young prefer warmer shallow waters whilst the adults show less affinity to this habitat (Lauria *et al* 2011). They live on a variety of seabed types such as sand, gravel and mud (KEIFCA, 2020c), preferring finer sediments which require less energy to bury themselves in (Lauria *et al* 2011). European plaice play an important part in the benthic ecosystem (KEIFCA 2020c), with juveniles feeding on polychaetes and bivalves and adults eating larger epibenthic crustaceans, small fish and echinoderms (Lauria *et al* 2011).

Spawning occurs in January and February. Increased fishing pressure, from mixed beam trawling, has led to an increased mortality of undersized European plaice, thought to have resulted in a reduction in age and size of maturity (KEIFCA 2020c).

European plaice have been recorded consistently in TraC Fish Monitoring Programme surveys undertaken in the Medway Estuary from 1998 to 2019 but in low numbers; peaking at 15 in 2010 (Environment Agency 2019).

8.3.2.5 Sandeel

Sandeel are important both economically as a fishery and as a key prey species; reductions in sandeel populations can result in low breeding success in seabird colonies and reduction in predatory fish stocks. Sandeel have been recorded in the Medway Estuary by the TraC Fish Monitoring Programme in low numbers in 1999 (11 individuals) and 2019 (2 individuals) (Environment Agency 2019).

Sandeel are known to display strong seasonal and diurnal activity patterns. Sandeel hibernate in generally coarse sand or fine gravel in autumn and winter, whilst in spring and summer they exhibit diurnal movements, burying themselves in the seafloor at night and feeding on plankton in the water column above their burrows during the day (Engelhard *et al.* 2008). They are therefore more vulnerable to seabed disturbance during the autumn and winter.

Sandeel emerge from hibernation briefly between December and January to spawn. The sticky eggs are partly buried in the upper centimetres of the sediment and hatch in February to March. The larvae are pelagic for between 2-5 months after which they are thought to over-winter/hibernate in sand (DECC 2016). Sandeel spawning and nursing grounds have been identified along the Proposed Development (Figure 8-2, Drawing P2172-FISH-004). There is thought to be limited movement between sub stock areas (Jensen *et al.* 2011)

Juvenile and adult sandeel are largely resident and rarely disperse over distances greater than 30km (RSPB 2017). Studies have found that sandeel do not migrate between fishing grounds, which may suggest that sandeel are not successful re-colonisers (Jensen *et al.* 2011). This limited movement of sandeel between areas is believed to be associated with the patchy distribution of suitable sandeel habitat (RSPB 2017).

A study by Holland *et al.* (2005) showed that areas which contained a high proportion of medium and coarse sand (particle size 0.25 to 2.0mm) were preferred seabed habitats for sandeel. However, it was found that the fraction of silt was just as critical as the level of coarse and medium sand. A high percentage of the habitat was occupied by sandeel where the silt content was below 2%. Above 4% silt the occupancy and density of sandeel was extremely low. Therefore, an ideal habitat would be a combination of low silt concentrations (<4%) and high fractions of medium and coarse sand (Holland *et al.* 2005). Sandeel may become more widely distributed and occupy a greater range of sediment patched in years of high abundance, when competition for prime habitat is high.

A sandeel habitat assessment has been completed for the Proposed Development (Technical Appendix H) and identified that:

- The Proposed Development crosses a sandeel spawning ground identified in Coull et al (1998) between KP76 and KP108.
- According to Ellis *et al.* (2012) the Proposed Development is in a low intensity spawning ground.
- Review of grab sample data has identified the presence of four Prime and three Sub-Prime spawning habitat locations within the Proposed Development; the majority of which lie between KP94 and KP108. Two areas of Sub-Prime habitat lie at KP45.6 and KP65.8 respectively.

8.3.2.6 Common sole

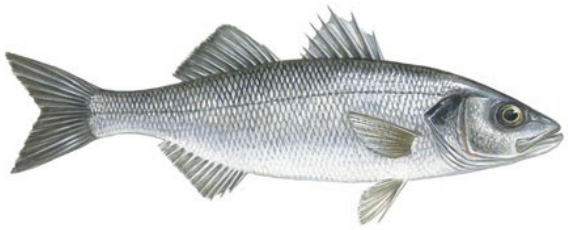
The most abundant of the sole family in European seas (KEIFCA 2020f) common sole is a demersal flatfish that is oval in shape and typically grows to between 30-40cm in length, with specimens being found of up to 70cm in length (Reeve 2007). They are common to sandy and muddy grounds, with adults being found at depths ranging between 10-100m and juveniles between 1-2m (KEIFCA 2020f). Sole typically feed on small crustaceans and worms, supplemented by small fish and molluscs, and are a nocturnal feeder. In occasions of high turbidity, they may feed during daylight hours (KEIFCA 2020f).

Common sole spawns in shallow coastal waters, with the Thames Estuary being an important spawning site for the southern North Sea population (KEIFCA 2020f). The eggs and larvae of the species are pelagic. When the larvae reach approximately 15mm in length they metamorphose into young soles, at which point they transition to their demersal life stage (KEIFCA 2020f).

Common sole has been recorded in the TraC Fish Monitoring Programme surveys undertaken in the Medway Estuary from 1981 to 2019. The average number of individuals caught during this period is between 11 and 12, with individual peaks occurring during trawls in 2005 (1160 individuals), 2014 (638 individuals) and 2009 (348 individuals) (Environment Agency 2019).

8.3.2.7 European bass

European bass is a relatively slow growing demersal species found sub-tidally down to 100m and plays an important part in the food chains of coastal and estuarine waters, feeding on small crustaceans and squid (KEIFCA 2020a). Adults spend winter in deeper waters, forming large shoals to move inshore to spawn from March to June (DECC 2016, KEIFCA 2020a).



Studies show that European seabass spawn offshore in the English Channel and eastern Celtic Sea between February and May (Pawson et al. 2007). For spawning, they are attracted to warm water discharges, and so are common inshore, close to river mouths, particularly around the southern coasts of the UK (DECC 2016). The juvenile stage occurs approximately two months after spawning during which time European bass are transported as planktonic larvae into post-larval habitats in estuaries and shallow coastal waters (Waters and Carroll 2014). Juveniles congregate in inshore waters, dispersing to a range of inshore and deeper offshore habitats as they mature (DECC 2016).

The Medway Estuary has two protected nursery grounds for European bass (The Bass Order 1990); these are adjacent to the power station outfalls at Kingsnorth and Isle of Grain (Figure 8-1, Drawing P2172-FISH-001). A further designated bass nursery area is also found in the Thames Estuary, at Bradwell Power Station outfall (CEFAS 1999). European bass have been recorded consistently in TraC Fish Monitoring Programme surveys undertaken in the Medway Estuary from 1998 to 2019; peaking in 2005 with 1183 individuals before dropping off significantly the next year to 10; although this could be an artefact of the survey data e.g. the surveys locations are not consistent between years; in 2005 surveys focused on Kingsnorth and Stangate whereas in 2006 only Upnor and Borstal were surveyed.

European bass have been placed under special protection measures as scientific advice has identified the need to drastically reduce catches of this species, following an increase in the fishing pressure and a reduction in reproduction (MMO 2018a). Fishing regulations have now been implemented to protect juvenile stocks of European bass (MMO 2018a).

8.3.2.8 Flounder

Flounder is a demersal flatfish, which occupies a limited range within estuarine and mudflat habitats near coastal waters. Flounder spend most of their life in coastal waters. Following sexual maturity, typically 2-3 years, flounder move to deeper open waters to spawn, with larvae being thought to be a key prey for small fish and crustaceans. Larval migration into the estuaries, in May, provides an important food source for plankton. Adult flounder feeding occurs during daylight hours, with prey consisting primarily of invertebrates as well as small fish, present in coastal waters (KEIFCA 2020b).

Flounder have been consistently recorded in the TraC Fish Monitoring Programme surveys undertaken in the Medway Estuary from 1998 to 2019. Numbers on average are low (<50) but peaks have been noted in 2002 (266 individuals), 2004 (111 individuals) and 2010 (146 individuals) (Environment Agency 2019).

8.3.3 Diadromous fish

Diadromous species which migrate between freshwater and marine environments are also known to occur within the vicinity of the Proposed Development. Diadromous species either spawn in fresh water and feed at sea (anadromous) or spawn at sea and feed in fresh water (catadromous).

Species known to occur within the Proposed Development include the European eel (*Anguilla Anguilla)* and European smelt (*Osmerus eperlanus)* both of which have been recorded by the TraC Fish Monitoring Programme as present within the Medway Estuary (Environment Agency 2019).

Sea lamprey (P*etromyzon marinu*s), another diadromous fish has not been recorded as present within the Medway Estuary or the wider Thames region (Environment Agency 2019) and it is therefore unlikely that they will be present within the Proposed Development.

8.3.3.1 European smelt

European smelt is a designated feature of the Medway Estuary Marine Conservation Zone (MCZ), which the Proposed Development crosses. It has been present in TraC Fish Monitoring Programme surveys in the Medway Estuary since 1992, with an average of around 200 individuals caught per survey. Numbers, however, have fluctuated over the period being consistently high between 2013 and 2018 (average for this period 411 individuals per year) but dropping to 2 individuals in 2019 (Environment Agency 2019). However, this drop is likely to be an artefact of the survey data, rather than a population trend.

Smelt is an anadromous midwater species and is rarely found far from the shore. They congregate near rive mouths in winter, ascending the river between February and April, to spawn (MarLIN 2008a). Smelt larvae are transported downstream to the estuary, before fully developing in the sea (Sepulveda *et al*, 1993).

8.3.3.2 European eel

European eel and elvers (juvenile eels) have been recorded by the TraC Fish Monitoring Programme as present in the Medway Estuary in records from 1998 through to 2018. Numbers range from 1 individual (2013, 2017) to 18 individuals (1999) (Environment Agency 2019).

The European eel spends most of its life in freshwater or inshore coastal waters, before migrating across the Atlantic to the Sargasso Sea to spawn in late summer (DECC 2016). The up-river migration of elvers in the Thames occurs between April and October with peak movement of eels in May and June (DECC 2016).

8.3.4 Elasmobranchs (sharks, rays and skates)

Elasmobranchs (sharks, skates and rays) are among the most vulnerable marine fish due to their slow growth rates, late maturity, low fecundity and productivity which limits their capacity to recover from population declines. All sharks and rays are on the OSPAR Commission[1] list of threatened and declining species. Two commercially important species of elasmobranchs have been identified as spawning within the Proposed Development; thornback ray and tope. In addition, KEIFCA has identified the smooth hound (*Mustelus asterias*) as a locally important species.

[1] The Convention for the Protection of the Marine Environment of the north-East Atlantic or OSPAR Convention.

Thornback ray has the potential to use the seabed within the Proposed Development to lay their eggs. While broadscale information on nursery habitats for these species is available (Figure 8-2, Drawing P2172-FISH-004), there is insufficient data on the occurrence of egg cases or egg-bearing females in order to set out specific spawning grounds (Ellis *et al*. 2012). As Figure 8-2 (Drawing P2172-FISH-004) shows, there is an overlap between thornback ray spawning area with the Proposed Development footprint. Despite this overlap, both thornback ray and tope have wide ranging nursery areas within the southern North Sea.

Thornback ray are widespread and the most abundant species of skate in inshore waters around the UK (Seafish 2013). In spring and summer months thornback rays migrate towards the mouth of the Thames estuary to reproduce, laying their egg cases on the seabed. Following this, the rays migrate back into deeper waters in the autumn (Hunter *et al.* 2006). However, KEIFCA (2020g) note that the numbers remaining in the Thames estuary area during winter are increasing with some thought to be resident all year round. Thornback ray juveniles use bays and coastal waters as nursery grounds, moving to deeper water as they grow (Seafish 2013).

Thornback Ray have not been recorded in the TraC Fish Monitoring Programme as present in the Medway Estuary, but they have been caught in the wider Thames region surveys around Blackwater, Thames Middle and Orwell (Environment Agency 2019).

Tope are common in the southern North Sea, south coast, south west, Wales, and along the west coast of Scotland. They are usually found over light mixed ground and sandy shingle areas, usually in places with a strong tidal flow (British Sea Fishing 2019). Tope are ovoviviparous, meaning fertilised eggs develop and hatch in the bodies of females, making it look as if they give birth to live young. Breeding takes place in late winter and spring, with females venturing into fairly shallow bays and estuaries to give birth (British Sea Fishing 2019). Due to the species' preference for spawning in estuaries and large embayment's, while there Is limited data on their movements in the region it is likely that Tope are using the Thames as a pupping ground (CEFAS 2020, pers. comms. 3rd June).

Smooth hound inhabit shallow waters (5m to 50m depth) with sandy bottoms and feed primarily on crustaceans, cephalopods and small bony fish. Smooth hound are viviparous, meaning they give birth to live young, in litters of up to 15 at around 30cm long (KEIFCA 2020e). Although not recorded in the Medway Estuary surveys for the TraC Fish Monitoring Programme they have been caught in the wider Thames region (Environment Agency 2019).

8.3.5 Shellfish

Brown shrimp (*Crangon crangon*), crabs (*Brachyura* spp.), cockle (*Cerastoderma edule*), lobsters (*Nephrops* spp), native oyster (*Ostrea edulis*), Pacific oyster (*Crassostrea gigas*), scallop (*Pectinidae* spp.), whelk (*Buccinum undatum*), and blue mussel (*Mytilus edulis*) are important shellfish within the area of the Proposed Development (DECC 2016). Shellfish typically live on or in the seabed.

A review of Magic maps (Defra 2020) Classified Bivalve Mollusc Harvesting Areas shows shellfish beds are primarily limited to the North Kent Coast between Sheerness and Herne Bay as well as Leigh Beck to Colne Point along the coast of Essex. The Proposed Development extends through classified bivalve mollusc harvesting areas at two places with the potential that native oyster, Pacific oyster and blue mussel shellfish beds could be present in the Proposed Development. A review of the benthic grab samples taken by the GridLink marine survey, closest to the areas where the Proposed Development enters the Classified Bivalve Mollusc Harvesting Areas showed high densities of blue mussels at grab sample station UK012 (approximately KP22.34) and oyster and blue mussel shells were identified at grab sample stations UK022 (KP45.6) and UK023 (KP49.21). However, consultation with local fishing vessels and KEIFCA has confirmed that the beds, although in close proximity, are likely to be outside of the Proposed Development.

8.3.5.1 Blue mussel

Blue mussel (*Mytilus edulis*), also known as common mussel, are suspension feeders that are often occur in dense masses as mussel beds (MarLIN 2008b). They are generally found attached to hard substrates in the intertidal zone but can also be found attached to reefs and man-made structures in shallow waters (DECC 2016). Mussels reach maturity after one year, with each female able to release over 5 million larvae (DECC 2016). Spawning takes place in late spring and the settlement of spat is influenced by a range of factors such as tidal currents and predation (DECC 2016).

8.3.5.2 Brown shrimp

Brown shrimp are commonly encountered in sandy bays and estuaries, in densities up to 60 per m^2 during summer months (Beukema 1992) and buries itself in the sediment to avoid predators (Pinn & Ansell, 1993). They grow quickly and reach sexual maturity within a year. There are two peaks in reproduction between April and September and October to November where females carry up to 4,500 or 2,800 eggs respectively (Boddekke 1982), using tidal flats as nursery areas (Boddeke *et al,* 1986). They actively consume animal material such as polychaetes, small fish molluscs and small arthropods, as well as algae, and are an important food source for seabirds, gadoids and pleuronectids (MarLIN 2008c). The species has been identified around English and Welsh coasts, with populations being kept distinct by water masses which prevent larval mixing (Henderson *et al*, 1990).

Consultation with local fishing vessels has identified that brown shrimp are targeted by commercial trawlers between KP10 and KP40.

8.3.5.3 Cockle

Cockles (*Cerastoderma edule*) live on intertidal beaches of sand, muddy sand and fine gravel, where they inhabit the surface of the sediment, burrowing to a depth of no more than 5cm (Dabouineau and Ponsero 2011). They are active filter feeders, using a syphon tube to feed on material suspended in the water column. They are often abundant in estuaries and sheltered bays, where they have been recorded to reach population densities of 10,000 per m^2 (MarLIN 2007). Cockles reach maturity after 2 years and spawn in spring, with each female producing up to a million eggs. Eggs spend a month in the water column before the larvae (spats) permanently settle and attach to the sediment. Settlement of spats and subsequent recruitment therefore can be highly variable.

Cockle's have a high mortality rate at the low shore, due to high predation from the shore crab (*Carcinus maenas*). Further offshore they are preyed on by shrimp and flatfish, being found to be the dominant food source for flounder (*Platichthys flesus*). During normal years of recruitment predators remove a significant proportion of cockle production (MarLIN 2007).

Data provided by KEIFCA, illustrated in Chapter 12, Figure 12-3 (Drawing P2172-FISH-011), shows the likely cockle beds based on cockle boating positions. These lie on Maplin Sands to the north of KP15 - 30; between Sheerness and Leysdown on Sea to the south of KP15 – KP30; and on the Kentish Flats and Margate Sands to the south of KP45 - KP60. Local fishing vessels have also provided indicative locations for cockle beds more extensively across the region. Also shown on Drawing P2172-FISH-011 a number of these intersect the Proposed Development.

8.3.5.4 Native oyster

The native oyster is a sessile, filter-feeder associated with highly productive estuarine and shallow coastal water habitats (Haelters and Kerckhof 2009). They can be found in large numbers forming extensive beds in shallow waters (generally <10m deep) on fine, muddy sand substrates (JNCC 2015). The species are protandrous alternating hermaphrodites. This means they start off as males and alternate their sex, generally this is twice during a single season (FAO 2019). Native oyster become mature at around 3 years of age, becoming a fully functional female after spawning. Gamete maturation begins in March or April and is in part temperature dependent. Females produce 500,000

to 1 million eggs per spawning. Following an incubation period of 8-10 days, final release into the environment occurs. Larvae then spend 8-10 days as a pelagic stage before settlement (FAO 2019).

Consultation with KEIFCA has indicated that the oyster beds targeted by fisheries lie to the south of KP30 to KP35 as illustrated in Chapter 12, Figure 12-3 (Drawing P2172-FISH-011). To maintain sustainable stocks of the native oyster KEIFCA have implemented a management plan for stocks within the Blackwater, Crouch, Roach and Colne Estuaries MCZs (KEIFCA 2018).

8.3.5.5 Pacific oyster

Pacific oyster are classified as a non-native invasive species. Although they have been legally cultivated there is a trend towards rising growth in wild Pacific oysters as a result of rising sea temperatures. Native to Japan and Korea, it was introduced initially in the UK in Cornwall, Essex and Wales for mariculture.

The current distribution of wild Pacific oyster includes the north Thanet coast of Kent (including Ramsgate and Birchington); and the Blackwater and Swale Estuaries and other estuaries and sheltered harbours in Essex (Herbert et al 2012).

Pacific oyster colonise a range of hard substrate in the intertidal zones of estuaries and sheltered coastal marine habitats (Mills 2016). They are sessile filter feeders known to aggregate in large densities, forming reefs. The Pacific oyster is a successive and irregular protandrous hermaphrodite, reaching sexual maturity as a male one winter after settlement, before switching to become female (Mills 2016). Spawning occurs at water temperatures of 17 – 20°C (during summer and autumn months in the southern North Sea), with each female able to release up to 50 million eggs into the water column (Mills 2016). As larvae they are able to respond to chemical cues released by mature oysters already established in the intertidal zone, and initiate settling behaviours.

8.3.5.6 Scallop

Scallops are filter feeders, found in substrates of fine sand and gravel up to over 100m depth. They are also able to ‘swim’ short distances to avoid predation (KEIFCA 2020d). Adults scallops are hermaphroditic and begin spawning at three years old, with juveniles staying in the water column as a spat for up to one year (KEIFCA 2020d). Scallop are an important part of the lower trophic levels in food chains, forming an important part of the zooplankton in their early life stage and filtering the water column through feeding in later life (KEIFCA 2020d).

8.3.5.7 Whelk

The common whelk (*Buccinum undatum*) is a large carnivorous whelk that grows up to 10cm high and 6cm wide. The species is found occasionally in the intertidal area, but more usually sub-tidally down to approximately 1,200m deep (MarLIN 2008d). Whelk prefer muddy sand, gravel and rock habitats where they feed on polychaete worms and other molluscs, such as bivalves. It also scavenges for carrion, which it detects by ‘smell’ using a 'siphon', which is used to funnel water to the gills, and sensory organs. Breeding takes place from October to May, and they spawn in November. Their eggs attach to rocks, shells and stones in protective capsules grouped together in large masses of over 2000 eggs (DECC 2016).

The species is a key fishery in the Thames Estuary will local variations in seasonality. Potting for whelk occurs between KP0 and KP40 all year except for July and August; and is prevalent between KP80 and KP93 all year.

8.3.6 Species of conservation importance

8.3.6.1 EC Habitats Directive Annex II Species

Eight fish species, listed on Annex II of the EC Habitats Directive, are known to occur in UK waters. Of these the TraC Fish Monitoring Programme has recorded four during surveys within the Thames

Estuary: Allis shad (*Alosa alosa*), Atlantic salmon (*Salmo salar*), Bullhead (*Cottus gobio)* and Twaite shad (*Alosa fallax*). Of these four only the bullhead has been regularly recorded from 1995 to 2017 (average 4 individuals per year, but with lows of 1 individual 1995 – 2000, and a high of 12 individuals in 2011). The others have been recorded as rare individuals (Environment Agency 2019).

8.3.6.2 UK BAP Priority Species

The following species are listed as UK BAP priority species and are known to occur in waters in or near to the Proposed Development. These have been identified as being the most threatened and requiring conservation action to conserve their populations (JNCC 2016).

- Atlantic cod
- European eel
- Atlantic herring
- Atlantic mackerel
- European plaice
- Sandeel
- Sea lamprey
- Smelt
- Common sole
- Tope
- Whiting

8.3.6.3 International Union for Conservation of Nature (IUCN)

On the IUCN Red List of Threatened Species; Atlantic cod and tope shark are listed as vulnerable and sandeel (species *Ammodytes tobianus*) and sole are listed as deficient.

8.3.6.4 OSPAR Listed species

The following species are on the OSPAR List of Threatened and/or declining species and habitats. This list has been developed to fulfil the commitment of the OSPAR Biological Diversity and Ecosystems Strategy to assess the species and habitats that need to be protected (OSPAR Commission 2015).

- Atlantic cod
- European eel
- Sea lamprey
- Thornback ray
- Native oyster

8.4 Potential Pressure Identification and Zones of Influence

A scoping exercise undertaken to inform the content of the Environmental Appraisal has excluded the following pressures from consideration in this topic Chapter. Explanation for the exclusion is provided in Chapter 4, Table 4-1.

- Introduction or spread of non-indigenous species.
- Nutrient enrichment deoxygenation.

For each pressure the assessment considered the different aspects of the Proposed Development during installation, operation (including repair & maintenance) and decommissioning. In order to evaluate the most significant effects, the largest zone of influence from these aspects was selected. The zones of influence are presented in Table 8-3 and will be assessed further.

Table 8-3 Pressure identification and zone of influence – fish and shellfish

Potential Pressure	Aspect	Project Phase	Project Activity	Receptor	Zone of Influence*
Penetration and/or disturbance of the substrate below the seabed including abrasion	Pre-sweeping	Installation	Seabed preparation	Sandeel Atlantic herring Other fish species with demersal life stages Sessile shellfish speciesMobile shellfish species	Select locations as identified in Table 3.4 Maximum of 63m wide.
	PLGR	Installation	Seabed preparation	Sandeel Atlantic herring Other fish species with demersal life stages European bass juveniles Sessile shellfish species Mobile shellfish species	15m wide along entire Preferred Cable Route
	Cable trenching (ploughing and/or jetting)	Installation	Cable burial		
		Operation	Cable maintenance and repair		
		Decommissioning	Cable removal		
Physical change to another seabed type	External cable protection	Installation	Cable burial	Sandeel Atlantic herring Other fish species with demersal life stages Sessile shellfish species Mobile shellfish species	Specific locations as identified in Tables 3.9 and 3.11. Crossings - Maximum 12.5m wide Protection due to ground conditions – Maximum 9.1m wide
Siltation rate changes, including smothering (depth of vertical sediment overburden)	Pre-sweeping, PLGR	Installation	Seabed preparation	Sandeel Atlantic herring Other fish species with demersal life stages Sessile shellfish species Mobile shellfish species	Sand and gravel deposition will occur within 35m of the cable route. Maximum deposition thickness varies depending on particle size distribution and trench depth but will be <5cm. Suspended sediment concentrations above 300mg/l (conservative threshold for significant effects on sensitive shellfish e.g. cockles) will occur within 250m of cable route perpendicular to tidal flow and about 1.4km in the direction of tidal flow. Maximum suspended sediment deposition thickness is 2mm within 75m of cable route perpendicular to tidal flow and about 500m in the direction of tidal flow
			Cable burial		
	Cable trenching (ploughing and/or jetting)	Operation	Cable maintenance and repair		
		Decommissioning	Cable removal		
Changes in suspended solids (water clarity)	Pre-sweeping, PLGR	Installation	Seabed preparation	Sessile shellfish species Mobile shellfish species	
	Cable trenching (ploughing and/or jetting)		Cable burial		
		Operation	Cable maintenance and repair		
		Decommissioning	Cable removal		
Transitional elements and organo-metal contamination	Pre-sweeping, PLGR	Installation	Seabed preparation	Sessile shellfish species Mobile shellfish species	
	Cable trenching (ploughing and/or jetting)		Cable burial		
		Operation	Cable maintenance and repair		
		Decommissioning	Cable removal		
Underwater noise changes – Temporary injury	Impulsive noise	Installation	Geophysical survey – pre-and post-installation.	Hearing specialist species e.g. Atlantic herring and European sprat	Up to 188m radius from Preferred Cable Route
		Operation	Inspection surveys		

Potential Pressure	Aspect	Project Phase	Project Activity	Receptor	Zone of Influence*
		Decommissioning	Survey		
Underwater noise changes – Temporary injury	Impulsive noise	Installation Operation Decommissioning	High order UXO clearance (if required)	All species	1.5km radius from detonation point
Underwater noise changes – Temporary injury	Continuous noise	Installation Operation	Vessel movements. Cable burial. Deposits of external cable protection.	Hearing specialist species e.g. Atlantic herring and European sprat	92m radius from Preferred Cable Route
		Decommissioning	Vessel movements. Cable removal.		
Electromagnetic changes	Magnetic fields (B fields)	Operation	Presence of cables.	Elasmobranchs and demersal species	10m from buried cables

*Zone of influence for underwater noise pressures taken from Technical Appendix I – Underwater Noise Modelling.

Zone of influence for EMF taken from Technical Appendix D – Marine Effects of Electro-Magnetic Fields (EMF).

Zone of influence for siltation rate changes taken from Chapter 5, Table 5-13.

8.5 Embedded Mitigation

The embedded mitigation relevant to fish and shellfish is provided in Table 8-4 below. When undertaking the assessment, it is assumed that these measures will be complied with.

Table 8-4 Embedded mitigation – fish and shellfish

ID	Embedded mitigation measure	Project phase		
		I	O	D
EM2	Horizontal Directional Drilling (HDD) activities shall be conducted in a manner to minimise risk of bentonite breakout from the HDD entry or exit pits	■		
EM3	Submarine cables will be bundled together.	■		
EM4	Deployment of anchors/anchor chains on the seabed will be kept to a minimum in order to reduce disturbance to seabed and will be within the Proposed Development.	■	■	■
EM5	Cable burial and protection design as detailed in the Burial Assessment Study, final crossing designs and planned and remedial final external protection designs shall be within the maximum design parameters detailed in the GridLink Marine Licence Application or robust justification for the deviations provided.	■		
EM6	Cables shall be installed in sand wave troughs wherever practicable, or after pre-sweeping if required, to minimise the risk or exposure by seabed mobility	■		
EM7	External cable protection (rock and/or mattresses) shall only be deployed where it is demonstrated that adequate burial depth cannot be achieved; the footprint of any external protection shall be the minimum required to ensure adequate cable protection and stability	■		
EM9	Cable protection heights and widths shall be minimised, taking into account the requirements to maintain the structural integrity of the berms.	■		
EM36	Project vessels will be equipped with waste disposal facilities (sewage treatment or waste storage) to IMO MARPOL Annex IV Prevention of Pollution from Ships standards.	■	■	■
EM37	Ship Oil Pollution Emergency Plans (SOPEPs) shall be provided by Contractor and implemented covering all vessels in accordance with MARPOL Annex I requirements	■	■	■

ID	Embedded mitigation measure	Project phase		
		I	O	D
EM42	Emergency Spill Response Plan (ESRP) shall be prepared and implemented covering all marine operations			
EM44	A UXO survey will be undertaken within the UXO Survey Corridor to identify anomalies. If any significant UXO is identified, the decision-making hierarchy taking into account environmental sensitivities, safety and technical considerations shall be: 1. Avoid by micro-routeing 2. If the UXO cannot be avoided, undertake clearance to surface or move UXO outside the cable installation corridor 3. If the UXO cannot be safely moved, clearance by on-site deflagration.			

8.6 Significance Assessment

8.6.1 Summary of Assessment

Table 8-5 and Sections 8.6.2 to 8.6.8 presents the assessment conducted on the Proposed Development. Where the assessment concluded the effects are potentially significant, Project Specific Mitigation has been proposed and is described in Section 8.7. Where there is still potential for residual effect after Project Specific Mitigation, this is discussed further in Section 8.8.

Table 8-5 Assessment summary – fish and shellfish

Determination of potential effect						Effect assessment			Consideration of Mitigation	Residual effect assessment		
Section	**Project Phase**	**Aspect**	**Embedded Mitigation (Table 8-4)**	**Potential Pressure**	**Receptor**	**Magnitude**	**Sensitivity**	**Significance**	**Project Specific Mitigation (Table 8-6)**	**Magnitude**	**Sensitivity**	**Significance of Residual Effect**
8.6.2	Installation Operation Decommissioning	Pre-sweeping, PLGR, Cable trenching (ploughing and jet trenching)	EM3, EM4, EM5, EM6	Penetration and/or disturbance of the substrate below the seabed	Sandeel	Low	Medium	Minor	-	Low	Medium	Minor
					Atlantic herring	Low	Medium	Minor	PS43	Low	Medium	Minor
					Shellfish and Other fish species with demersal life stages	Low	Low	Negligible	-	-	-	-
					European bass juveniles	Negligible	Medium	Negligible	-	-	-	-
8.6.3	Installation Operation	External cable protection	EM3, EM5, EM7, EM9	Physical change (to another seabed type)	Sandeel, Atlantic herring, Other fish species with demersal life stages, shellfish	Low	Low	Negligible	PS4	-	-	-
8.6.4	Installation Operation Decommissioning	Pre-sweeping Cable trenching (ploughing and jet trenching) External cable protection	EM6	Siltation rate changes, including smothering (depth of vertical sediment overburden)	Sandeel	Low	Low	Negligible	-	-	-	-
					Atlantic herring	Low	Medium	Minor	-	Low	Medium	Minor
					Elasmobranchs	Low	Low	Negligible	-	-	-	-
					Mobile and sessile shellfish	Low	Medium	Minor	PS26	Low	Medium	Minor
8.6.5	Installation Operation Decommissioning	Pre-sweeping Cable trenching (ploughing and jet trenching)	EM6	Changes in suspended solids (water clarity)	Sessile shellfish species	Low	Medium	Minor	PS24, PS25, PS26, PS27	Negligible	Medium	Negligible

Determination of potential effect						Effect assessment			Consideration of Mitigation	Residual effect assessment		
Section	**Project Phase**	**Aspect**	**Embedded Mitigation (Table 8-4)**	**Potential Pressure**	**Receptor**	**Magnitude**	**Sensitivity**	**Significance**	**Project Specific Mitigation (Table 8-6)**	**Magnitude**	**Sensitivity**	**Significance of Residual Effect**
8.6.6	Installation Operation Decommissioning	Pre-sweeping Cable trenching (ploughing and jet trenching)	EM3 EM6	Transition elements and organo-metal contamination	Shellfish (Mobile and Sessile)	Low	Medium	Minor	-	Low	Medium	Minor
8.6.7	Installation Operation Decommissioning	Impulsive noise – Geophysical survey	-	Underwater noise changes	Hearing specialist species e.g. Atlantic herring and European sprat	Negligible	Negligible	Negligible	-	-	-	-
	Installation Operation Decommissioning	Continuous noise	-	Underwater noise changes	Hearing specialist species e.g. Atlantic herring and European sprat	Negligible	Negligible	Negligible	-	-	-	-
	Installation Operation Decommissioning	Impulsive noise - UXO clearance (if required)	EM44	Underwater noise changes	All species	Low	Medium	Minor	PS28, PS29, PS44	Low	Medium	Minor
8.6.8	Operation	Operation of cables	EM3	Electromagnetic field changes	Demersal species Shellfish (sessile and mobile)	Low	Low	Negligible	-	-	-	-

8.6.2 Penetration and /or disturbance of the substrate below the surface of the seabed, including abrasion

8.6.2.1 Installation

Aspects of the Proposed Development that physically disturb the seabed, e.g. pre-sweeping, PLGR, plough and jet trenching, have the potential to disturb species with demersal life stages, larval or juvenile ages, or fish and shellfish species that live in contact with the seabed. Typically, the extent of this disturbance will be up to 15m wide along the entire Preferred Cable Route (Proposed Development = 108.8km) i.e. equivalent to the width of the installation machinery. At select locations this footprint will be extended e.g. where pre-sweeping is required. The worst-case installation footprint for the Proposed Development is 2.11km^2.

The assessment recognised that certain species or groups of species may be more sensitive to the pressure than others and considered each in turn. However, species have been grouped together in the discussion where the same assessment conclusion has been reached.

Sandeel

A sandeel habitat assessment was conducted to identify the significance of effects on the species. Presented in Technical Appendix H it concluded:

- Sensitivity of sandeel to this pressure is medium because they are substrate specific spawners potentially more susceptible to any effects relating to physical disturbance and temporary habitat loss; the presence of four Prime and three Sub-Prime spawning habitat locations within the Proposed Development, which if disturbed or lost could affect fish recruitment into the area; and sandeel are a UK BAP species which is in decline in the Central and Western North Sea Sandeel Division population.
- Magnitude of the effect is low because the installation footprint within the spawning ground is extremely small (equivalent to 0.001% of the spawning ground). In addition, sandeel populations are documented to show high levels of resilience to habitat disturbance; and the installation phase will be a one-off event with effects limited to immediately after installation; once the habitat has recovered it will be suitable for sandeel again.

The overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

Atlantic herring

An Atlantic herring habitat assessment was conducted to identify the significance of effects on the species. Presented in Technical Appendix H it concluded:

- Sensitivity of Atlantic herring to this pressure is Medium due to the fragility and importance of successful egg hatching and Atlantic herring recruitment. If spawning is interrupted or Atlantic herring eggs are damaged this could lead to a decrease in recruitment for the year, leading to decreased fish stocks and lack of prey availability for the species preying upon Atlantic herring. Data suggests it is possible that Atlantic herring spawning activities may take place within the Proposed Development, and that as indicated by IHLS data from 2017 the Atlantic herring spawning stocks within the transected IHLS survey rectangles are increasing. However, it should be noted that Atlantic herring behaviour shows a lack of site fidelity in terms of annual return to spawning locations. Offshore IHLS data shows the highest densities of Atlantic herring larvae. However, when comparing to larvae density within the English Channel, it is evident the Proposed Development is not a well-used spawning or nursery ground for Atlantic herring.
- The magnitude of the effect has been assessed as low. This is because disturbance is predicted to be limited to the extent of the direct installation footprint (0.568km^2; equivalent to 0.02% of the overall grounds). While prime and sub-prime habitat areas have been identified within the

Proposed Development (based on available particle size data), it is expected that the calculated value of spawning ground affected is conservative as several other aspects such as depth, oxygenation and current speed affect the suitability of a habitat. Disturbance of the seabed will be a semi-isolated activity. Although several aspects will disturb the seabed, they will generally be in quite short succession of each other and affecting the same area. For example, PLGR will proceed cable trenching but will affect the same section of seabed. Gravel sediments will not be removed from the seabed and therefore once installation is complete the previous habitat will remain a viable spawning habitat.

The overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

As best practice, Project Specific Mitigation (PS43) has been proposed with respect to works to be conducted in Herring Spawning Grounds and is presented in Section 8.7.

Shellfish and Other fish species with demersal life stages

Table 8-2 identifies that there are demersal spawning species present in the Proposed Development all year round. In addition, there are a range of shellfish present, many of which are commercially important fishery resources.

The sensitivity of these species to the pressure has been assessed as low for the following reasons:

- Whilst sessile shellfish species would ordinarily have a sensitivity of medium to high to the pressure because they cannot move out of the way of the installation machinery, based on expert judgement it has been reduced to low as:
  - There will be no disturbance to cockle or oyster beds – KEIFCA have identified that the commercial beds lie outside of the Proposed Development (See Figure 12-3 (Drawing P2172-FISH-011) in Chapter 12); and
  - Following consultation with KEIFCA and the local fishing community, other sessile shellfish species beds (e.g. blue mussel, scallop), have been identified as not being present in significant numbers within the Proposed Development (see Section 8.3.5). While limited mortality of some individuals present within the installation footprint may occur entire beds will not be affected.
- Mobile shellfish species (e.g. whelks, crabs and lobsters) in the direct footprint of the cable installation, have the capacity to move away from the disturbance, with a large area of habitat being available for them to relocate too.
- Other demersal fish species / species with demersal life stages will be able to temporarily re-locate to other available habitat to avoid the installation activities.

The magnitude of the pressure has been assessed as low/negligible for the following reasons:

- The installation activities will not result in direct disturbance to cockles or oysters.
- The limited footprint of the installation activities will ensure that any effects are localised to the cable trench; a very narrow strip of seabed.
- Habitat disturbance will be temporary with the seabed able to recover within two to three years of installation. Once the cables are installed the seabed will not be routinely disturbed.
- The Proposed Development is minimal in terms of the extended spawning areas available for fish species within the region.
- Due to the lack of large populations being present within the limited footprint of the installation activities species will not be affected at a population level. Stock recruitment will not be affected.

The overall significance of the pressure has been assessed as **Negligible** and **Not Significant**.

European bass

The sensitivity of the European bass juveniles has been assessed as medium as the species are protected and facing declining populations. Disturbance at a key stage in their life cycle could have significant effects on stock recruitment. The magnitude of the effect has been assessed as negligible. Although the Proposed Development crosses the Medway Estuary Bass Nursery Area (Figure 8-1, Drawing P2172-FISH-001), the installation of the cables in this section will be by horizontal directional drilling under the seabed. This means that the intertidal area, the key nursery ground, will not be disturbed. Combined with the ability of juvenile fish to avoid disturbance and any effects will be extremely localised and unlikely to have population level effects. The overall significance of the effect has been assessed as **Negligible** and is **Not Significant**.

8.6.2.2 Operation

The assessment considers three repair events occurring over the operational lifetime of GridLink. It assumes that for each repair event a 500m section of cable will need to be removed and re-buried. The maximum total seabed footprint is 22,500m^2 (0.023km^2). Should any one of the repair events occur within areas of the Proposed Development identified as Prime or Sub-Prime sandeel habitat or occur within the Downs Herring Spawning Ground then the conclusions for installation remain pertinent. Therefore, in conclusion, the overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

8.6.2.3 Decommissioning

It is assumed that the cable will be removed at decommissioning and it is likely that the seabed footprint of the cable removal will be like that for installation. Therefore, the sensitivity of the species has been assessed as medium, and the magnitude of the effect has been assessed as low. In conclusion, the overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

8.6.3 Physical change (to another seabed type)

8.6.3.1 Installation

External cable protection will be used at crossing locations and where optimal burial depth cannot be achieved, i.e. due to seabed conditions. Where external cable protection is used, the seabed habitat within the footprint of the cable protection will be lost and replaced with potentially harder substrate, changing the seabed type.

Within the Proposed Development there are seven locations where external cable protection is required with an estimated footprint of 9,980m^2. In addition, there are several sections of the Proposed Development where ground conditions will potentially be more challenging to the cable burial campaign where external cable protection may be required. Indicatively this could cover up to 18,595m^2.

Fish and shellfish receptors most vulnerable to this pressure are species which rely on soft sediment, including substrate spawning fish, flatfish such as European plaice and lemon sole and shellfish that live on or within soft sediment.

The sensitivity of sandeel, Atlantic herring, shellfish and other fish species with demersal life stages has been assessed as low for the following reasons:

- The sections of the Proposed Development identified as locations where cable protection will or could be used have not been identified (through analysis of the PSA data) as suitable for sandeel spawning.
- External cable protection, especially rock berm, has the potential to provide functional habitat for Atlantic herring spawning activities.
- External cable protection will not be placed within cockle or oyster beds.

- Project Specific Mitigation (PS1 and PS3) proposed for the London Array Wind Farm export cables crossing will ensure that soft subtidal sediment is re-captured, preserving the habitat for bivalve molluscs.

The magnitude of the pressure has been assessed as low for the following reasons:

- Two locations within the Downs Spawning Ground will require or potentially require external cable protection; the Atlantic Crossing - Seg B1 telecommunication cable (KP96.75 - KP97.05); and an indicative section between KP112 and KP116.8 where ground conditions consist of high strength clay where there is a high chance that the required depth of burial will not be achieved and remedial external cable protection will be required. Combined the two locations with the Downs Spawning Ground have the potential to affect 30,829m^2 (0.03km^2) of seabed; equivalent to <0.001% of the area of the Downs Spawning Ground. This is negligible in relation to the wider extent of habitat available and the possibility that the external cable protection could still be used as a herring spawning substrate
- The effect on sandeel habitats within the Proposed Development is extremely small scale at 0.042km^2. In addition, analysis of EMODnet surface sediment data suggests that the extent of preferred habitat available outside the Proposed Development is broadscale.
- Figure 8-1 and Figure 8-2 (Drawings P2172-FISH-001 and P2172-FISH-004), demonstrate the extensive available habitat for spawning fish species, which will not be significantly reduced by the introduced external cable protection.
- There exists a large area of available habitat for other demersal fish species to utilise for feeding and spawning purposes. Therefore, effects will not be felt at the population level.
- External cable protection will occupy a very limited area in the context of the available habitat for other shellfish, with changes in conditions around the site using fronded mats likely to be short-term.

As such, the significance of this pressure has been assessed as **Negligible** and **Not Significant**.

8.6.3.2 Operation

The assessment considers three repair events occurring over the lifetime of GridLink. It assumes that for each repair event a 500m section of cable will need to be removed and re-buried. The maximum total seabed footprint is 22,500m^2 (0.023km^2). Should any one of the repair events occur within areas of the Proposed Development identified as Prime or Sub-Prime sandeel habitat or occur within the Downs Herring Spawning Ground then the conclusions for installation remain pertinent. Therefore, in conclusion, the overall significance of the effect has been assessed as **Negligible** and is **Not Significant**.

8.6.4 Siltation rate changes, including smothering (depth of vertical sediment overburden)

8.6.4.1 Installation

This section focuses on smothering from sediment either displaced or settling out of suspension following installation activities e.g. pre-sweeping, cable trenching. Chapter 5 concluded the Proposed Development will result in temporary increases in suspended sediment concentrations (SSC). However, calculations indicate the elevated concentrations will be within the range of natural variability expected for the Medway and Thames Estuaries, and transient with sediment plumes dispersing fully on a spring tide within 40 minutes of the cessation of sediment release. Sand and gravel will settle out close to the installation activities, within less than 35m. Silt will be transported a greater distance with the potential full extent of the plume approximately 800m perpendicular to the tidal flow and 14km along the line of the tidal flow, although temporary suspended sediment concentrations above 300mg/l (conservative threshold for significant effects on sensitive shellfish e.g.

cockles) are limited to up to 250m of cable route perpendicular to tidal flow and about 1.4km in the direction of the tidal flow. Over most of the plume the increase in SSC are generally lower than baseline variations (30mg/l) and therefore unlikely to have a significant effect on water quality. The maximum deposition thickness of fine particles depends on the sediment composition, but modelling assuming worst case estimates that within approximately 75m perpendicular to the tidal flow and 500m along the tidal flow deposition thicknesses will exceed 1mm but will be no more than 2mm.

Sandeel

A sandeel habitat assessment concluded that the significance of effects on the species are:

- Sensitivity of sandeel to this pressure is low. At the stock-level, the area where fine sediments may be re-deposited is negligible in the context of the overall distribution of the Southern North Sea stock. If operations were to occur during the spawning season (December to January), the affected area would be very small due to the extremely small settling depth and suspension distance. Therefore, sandeel eggs and juveniles are unlikely to be affected.
- The magnitude of the effect is low due to the low settling levels of fine sediments suspended during installation operations and low settling distances of large grained sediments.

The overall significance of this effect has been assessed as **Negligible** and **Not Significant.**

Atlantic Herring

An Atlantic Herring habitat assessment concluded that the significance of effects on the species are:

- Sensitivity of Atlantic Herring to this pressure is medium as the suspension of fine particles in the water column has the potential to cause visual impairment and clog small larvae's gills and smother eggs if they are present on the seabed.
- Magnitude of the effect is low due to the low settling levels of fine sediments suspended during installation operations; the low settling distances of large grained sediments; and the fact that the change in suspended concentrations will be within the natural variation experienced within the Proposed Development.

The overall significance of this effect has been assessed as **Minor** and **Not Significant.**

Elasmobranchs

The sensitivity of elasmobranchs to siltation rate changes has been assessed as low. Being mobile species, any individual elasmobranchs located within the vicinity of the cable installation activities will be able to temporarily relocate to alternative areas of habitat to avoid any smothering effects. The magnitude of the effect has been assessed as low, due to the minimal distance at which disturbed sediment will settle from the Preferred Cable Route at significant levels. The overall significance of this effect has been assessed as **Negligible** and **Not Significant**.

Mobile and sessile shellfish

The sensitivity of mobile and sessile shellfish has been assessed as medium for the following reasons:

- Oyster beds are known to occur in the Medway Estuary and within the Thames Estuary lie south of the Proposed Development between KP25 and KP40; and at the closest approach lie approximately 400m to the south of KP32. Tidal ellipses presented in Technical Appendix C indicate suspended sediment will be transported towards the oyster beds. Small increases in sediment deposition have been found to reduce growth rates in oysters. Smothering by 5cm of sediment would prevent filter feeding activity and lead to mortality (Perry et al. 2017).
- Cockles are adapted to a sedimentary environment and changes in suspended sediment concentrations (SSC) do not necessarily lead to negative effects. However, a significant negative effect at the wrong time of year i.e. between July and August, can close the cockle beds for the year with major financial consequences for the industry.

The magnitude of the effect has been assessed as low for the following reasons:

- Modelling indicates that the maximum deposition thickness of silt suspended during installation is less than 2mm. As such, for the nearby oyster and cockle beds levels of suspended sediment deposition will not reach sufficient depths to cause smothering of either species.
- Gravel and sand will settle out of suspension within 35m of the Preferred Cable Route. Between KP0 and KP60 the maximum depth of deposition will be less than 3cm (Technical Appendix C, model points 1-5). The is below the pressure benchmark for shellfish species of 5cm at which significant effects are likely.

The overall significance of this effect has been assessed as **Minor** and **Not Significant**.

As best practice, Project Specific Mitigation (PS26) has been proposed with the aim of minimising sediment suspension.

8.6.4.2 Operation

The assessment considers three repair events occurring over the lifetime of GridLink. It assumes that for each repair event a 500m section of cable will need to be removed and re-buried. These events have the same potential for disturbance as trenching during installation, but with potentially a lower magnitude due to scale. As the location of the repair events are not known then the conclusions for installation remain pertinent. Therefore, in conclusion, the overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

8.6.4.3 Decommissioning

It is assumed that the cable will be removed at decommissioning and it is likely that the seabed footprint of the cable removal will be like that for installation. Therefore, the sensitivity of the species has been assessed as medium, and the magnitude of the effect has been assessed as low. In conclusion, the overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

8.6.5 Changes in suspended solids (water clarity)

8.6.5.1 Installation

Cable installation activities will result in sediments found directly within the cable trench being ejected into the water column. While the larger grain sediments such as gravel and sand will settle quickly within metres of the cable trench, finer grain sediment will be dispersed further and remain in the water column for a longer period, potentially reducing water clarity and increasing the concentration of suspended solids over a wider area.

Sessile shellfish species

The sensitivity of sessile shellfish to changes in suspended solids has been driven by the assessment for cockles and oysters. It has been assessed as medium as both shellfish species are sensitive to changes in suspended sediment concentrations, with short-term changes potentially leading to effects. While oysters possess a coping mechanism to remove increased levels of silt from within the mantle, this behaviour is energetically expensive, and may cause a decrease in growth rate of the organism. It is unlikely to cause mortality if the change in SSC is short-term (Perry et al. 2017). Cockles are adapted to a sedimentary environment and changes in SSC do not necessarily lead to negative effects. However, a significant negative effect at the wrong time of year i.e. between July and August, can close the cockle beds for the year with major financial consequences for the industry.

The magnitude of the effect has been assessed as low for the following reasons:

- A conservative threshold of 300mg/l for SSC has been used to determine significance of effects. Cockles can cope with suspended sediment concentrations of between 300 – 400mg/l (Tyler-

Walters 2007, Hewitt et al. 2001); although Hewitt et al. (2001) note that cockles have difficulty coping with SSC over 400mg/l for long periods of time.

- The footprint of the sediment plume for maximum concentrations at 300 mg/l is approximately 250m perpendicular to the tidal flow and 1.4km along the tidal flow, although as this is taken from the maximum concentration plot, this footprint is time independent. This suggests that the zone of influence for maximum concentrations above the sensitivity threshold is limited spatially.
- SSC concentrations will be highest around slack water, due to the lower rates of advection and dispersion, with typical values between 150 mg/l to 250 mg/l, although peak values are up to 1000 mg/l. These peaks are very transitory and reduce quickly as tidal currents increase. Concentrations during peak flows (both ebb and flood tides) reach a maximum of about 60 mg/l.
- Following the end of the release of sediment, concentrations in the plume reduce to below 30 mg/l (approximate typical background level) within 40 minutes, and to below 10 mg/l within 5 hours and 40 mins.
- Although the Proposed Development lies within close proximity to commercial shellfish beds and at some points crosses known cockle beds the suspended sediment concentrations generated by the installation activities will be limited spatially and temporally. As the installation vessel progresses through the region, SSC will rapidly reduce to below 10mg/l. The increase in suspended sediments will therefore be brief.
- The increase in SSC is within the natural range of variability reported for the Thames Estuary (between 10 – 1000 mg/l).

The overall significance of this effect has been assessed as **Minor** and **Not Significant**.

As best practice, Project Specific Mitigation (PS24 - PS27) have been proposed to minimise sediment suspension.

8.6.5.2 Operation

The assessment considers three repair events occurring over the lifetime of GridLink. It assumes that for each repair event a 500m section of cable will need to be removed and re-buried. These events will also elevate SSCs but with potentially a lower magnitude due to scale. As the location of the repair events are not known then the conclusions for installation remain pertinent. Therefore, in conclusion, the overall significance of the effect has been assessed as Minor and is Not Significant.

8.6.5.3 Decommissioning

It is assumed that the cable will be removed at decommissioning and it is likely that the seabed footprint of the cable removal will be like that for installation. Therefore, the conclusions for installation remain pertinent. In conclusion, the overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

8.6.6 Transition elements and organo-metal contamination

8.6.6.1 Installation

Installation activities have the potential to re-suspend sediments. While in suspension, there is the potential for sediment bound contaminants, such as metals and organic pollutants, to be released into the water column and lead to an effect on fish and shellfish. Contaminant analysis was undertaken by MMT (MMT 2020a & 2020b) against marine sediment quality thresholds; the most relevant being CEFAS Action level 1 (AL1) which provides thresholds for sediment disposal in the marine environment.

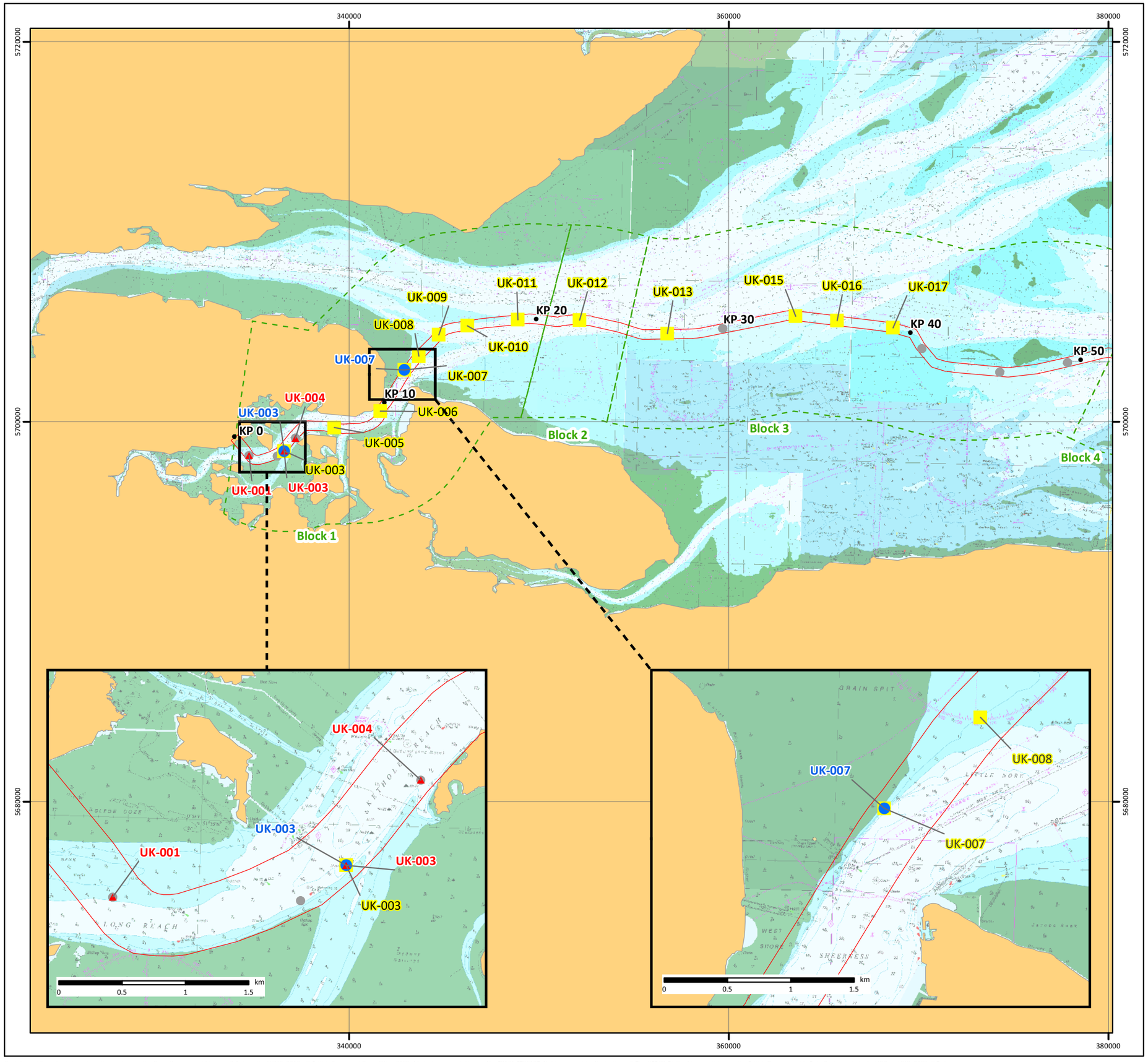
The analysis showed that metal concentrations in sediment samples were below the marine sediment quality thresholds for most of the metals included in the analysis. The only exceptions were Arsenic, Chromium, Nickel and Mercury. Arsenic exceeded one or multiple threshold values at sampling sites

UK-003, UK-005 to UK-013 and UK015 – UK017. Nickel exceeded the Cefas AL1 threshold at sites UK003 and UK007. Mercury exceeded one or multiple threshold values at sites UK001, UK003 and UK004. Locations where thresholds were exceeded are shown on Figure 8-3 (P2172-SURV-003).

GRIDLINK INTERCONECTOR

SURVEY INFORMATION
Environmental Survey Locations
Arsenic, Nickel, and Mercury Exceedances

Drawing No: P2172-SURV-003 | **A**



Legend

- KP
- Asset Placement Corridor
- Survey Blocks

Environmental Grab Sample Location

- Environmental Grab Sample Location
- Mercury Exceedance
- Nickel Exceedance
- Arsenic Exceedance

NOTE: Not to be used for Navigation

Date	21 August 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	UKHO; EuropaTech; GEBCO; ESRI; MMT;
File Reference	J:\Gridlink\P2172_Mxd\11_SURV\ P2172-SURV-003.mxd
Created By	Chris Dawe
Reviewed By	Chris Carroll
Approved By	Kerri Gardiner

km
0 2.5 5 7.5

Mobile and sessile shellfish

The sensitivity of mobile and sessile shellfish to contamination has been assessed as medium for the following reasons:

- Levels of arsenic exceeded the Cefas Action Level 1 (AL1) threshold of 20ug/g at six survey stations between KP22 – KP40, and polycyclic aromatic hydrocarbon (PAH) concentrations exceeded the CEFAS AL1 threshold at KP22.335. Sediments disturbed at these locations could potentially reach the northern edge of the nearby commercial oyster bed.
- The Medway Estuary is home to important shellfish beds. Elevated contaminant levels identified in the Medway Estuary could be disturbed and transported to these beds. It should be noted that while contaminant levels in the Medway Estuary are elevated, the contamination is likely of anthropogenic origin and historic to the area. The levels only exceed CEFAS AL1 criteria, and in another context would be suitable for being disposed of at sea as dredged spoil.

The magnitude of the pressure has been assessed as low for the following reasons:

- Arsenic is a natural component of seawater and rocks and given the lack of variability between samples across the Proposed Development, it is expected that the values are of natural origin rather than anthropogenic.
- The total estimated sediment deposition near the site of elevated PAH concentration (KP22) will be between 2.7cm and 1.2cm (total for sand, gravel and fines). Sand and gravel deposition will be restricted to within 25m of the Preferred Cable Route. Suspended fines will settle out over a wider but deposition thickness outside of approximately 75m perpendicular to the tidal flow and 500m along the line of the tidal flow will be less than 1mm and not noticeable against background variations in suspended sediment. Given that the contamination is restricted to one location, the deposition of suspended sediments over the oyster beds will be limited and within background levels associated with the region, it is considered any release of contaminants into the water column from trenching would be undetectable from baseline conditions.
- The Medway Estuary is already typically exposed to high levels of turbidity, with large movements of sediment, and thus the historic contaminants found within them, being the baseline condition within which the existing shellfish beds exist in.
- The subtidal sediments outside of the Medway Estuary are primarily coarse sand and gravels, therefore the likelihood of organo-metals being mobilised is low. Following disturbance, the majority of resuspended sediments are expected to redeposit within close proximity of the works resulting in the potential release of sediment bound contaminants being small and localised in extent.
- The release of contaminants such as arsenic, chromium, nickel and mercury from the proportion of fine sediments within the Medway Estuary are likely to be rapidly dispersed with the tide and therefore increased bio-availability resulting in adverse toxicological effects are not anticipated. The concentrations found within grab samples are comparable to the wider region background levels and are not considered to result in significant effect if made bioavailable. The elevated SSC caused by installation activities will be short-term, with SSC quickly returning to its baseline after activities have ceased.

As such, the significance of this effect has been assessed as **Minor** and **Not Significant**.

8.6.6.2 Operation

The assessment considers three repair events occurring over the lifetime of GridLink. It assumes that for each repair event a 500m section of cable will need to be removed and re-buried. The likelihood of mobilising sediment-bound transition elements and organo-metals is considered lower that than reported for installation. As maintenance and repairs are only likely to occur at discrete locations, the

potential volume of sediment disturbed and therefore potential volume of transition elements and organo-metals mobilised will be of a considerably lower volume. The magnitude of the effect is considered negligible and the sensitivity of the receptors remains medium, so the significance of effect has been assessed as **Negligible** and is **Not Significant**.

8.6.6.3 Decommissioning

It is assumed that the cable will be removed at decommissioning and it is likely that the seabed footprint of the cable removal will be like that for installation. Therefore, the conclusions for installation remain pertinent. In conclusion, the overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

8.6.7 Underwater noise changes

8.6.7.1 Installation, Operation (including maintenance and repair) and Decommissioning

In general, most fish hear well in the range within which most energy from anthropogenic noise sources is emitted i.e., relatively low frequency sound below 1kHz with peak perception between approximately 100-400Hz. Sound pressure is only detected by those species possessing a swim bladder. The otolith organ acts as a particle motion detector and where linked to the swim bladder, converts sound pressure into particle motion, which is detected by the inner ear.

Popper et al. (2014) classifies sensitivity of fish species to underwater sound based on the presence of absence of a swim bladder. In the most sensitive species (specialist hearing species) to underwater noise such as Atlantic herring and European sprat, the swim bladder and inner ear are intimately connected and can detect frequencies to over 3kHz; with optimum sensitivity between 300Hz-1kHz (Nedwell *et al.* 2007). Species such as Atlantic cod and European eel have a swim bladder but no specialisation of the auditory apparatus and their sensitivity to sound is lower than the specialist hearing species. Species with no swim bladder e.g. European bass, Atlantic cod and flat fish such as European plaice, are not thought to be sensitive to underwater sound changes.

Most activities operate within frequencies above the audible range for hearing specialist fish however disturbance and injurious effects can occur from the sudden change in pressure generated by activities. The greater the sound pulse the greater the likely effects to hearing specialist fish. There is also potential for some fish and shellfish species to be vulnerable to impulsive activities during sensitive life stages, for example during the egg and larvae development stages.

Marine cable installation, operation and decommissioning will generate two distinct types of sound: impulsive and continuous.

- Vessel movements including the use of thrusters for dynamic positioning, and cable installation activities such as trenching, deposit of external cable protection and pre-sweeping will all produce continuous sound over a period of 24 hours.
- Geophysical survey and if required, UXO detonation will produce either a discrete pulse or a series of pulses. Impulsive sounds are generally transient and brief, but in the case of geophysical survey could also be near continuous where the repetition of pulses is considered a series of multiple discrete acoustic events within a 24 hour period[2].

Technical Appendix I presents the results of underwater noise modelling carried out for the Proposed Development. This presents the expected sound levels, injury thresholds, and calculated zones of influence for each aspect of the Proposed Development. Key information relevant to the assessment is summarised below.

[2] Through consultation with the Joint Nature Conservation Committee (JNCC) and the Centre for Environment, Fisheries and Aquaculture Science (Cefas) it has been agreed to treat geophysical survey activities as impulsive noise.

The sensitivity of species to noise has been assessed as low for continuous noise sources and geophysical survey but medium for UXO detonation (if required).

Continuous noise sources

Popper et al. (2014) identified that there is no direct evidence of permanent injury to fish species from shipping and other continuous noise (such as the cable installation). The Oslo and Paris (OSPAR) Commission (2012) consider that the potential for likely significant effects to fish from cable installation activities is minor.

Different fish species react differently to sound. Behavioural responses may include small movement or escape responses, based on studies conducted in laboratories (The University of Rhode Island 2017).

Continuous sound is detectable by fish species, and it is possible that this could lead to masking. However, masking and behavioural changes in fish from continuous sound is currently unknown (Popper et al. 2014).

To determine the magnitude of the effect, Intertek used an in-house geometric spreading calculation to determine the propagation of underwater sound from activities that generate continuous noise. The spreading model assumes that sound is spread geometrically away from the source with an additional frequency-dependent absorption loss. This provides conservative estimates for sound attenuation as it does not take into consideration the conditions within the area, such as bathymetry, water depth or sediment type and thickness; all which increase attenuation. Popper et al (2014) provides thresholds at which onset of a temporary threshold shift in a fishes hearing capacity could be expected. The thresholds are provided as sound exposure levels (SEL) which assumes that a receptor has to be exposed to a certain level of sound for a specified duration. The geometric spreading model then calculates the distance (in metres) at which the SEL threshold is exceeded. This distance assumes that to experience the sound levels sufficient to cause injury or disturbance effects the animal must remain within the area for at least 24-hours. It doesn't take into consideration the instinct of the animal to flee from the activity. Technical Appendix I presents the approach, thresholds and results.

The magnitude of the effect has been assessed as negligible. This is because Technical Appendix I calculated that fish will need to remain within 92m of project vessels (as a radial distance from the vessel) for 48-hours to experience temporary hearing loss. Given that either the vessels involved in construction activities will move or fish will avoid activity it is extremely unlikely that fish will experience effects from continuous noise.

In conclusion, the effect from continuous noise is **Negligible** and **Not Significant**.

Geophysical survey

Geophysical survey techniques will be used during pre-installation surveys and post-installation inspection surveys (see Chapter 3). Most noise from a geophysical survey is likely to be generated at frequencies greater than 1kHz, above the auditory capacity of fish (generally between 0.2Hz to 1kHz). In addition, sound from survey equipment is targeted towards the seabed, meaning that effects to fish are only expected if they are within the immediate zone of ensonification below the survey vessel.

The magnitude of effect has been assessed as low because Technical Appendix I concluded that for geophysical survey (including the use of a sub-bottom profiler) the onset of a temporary threshold shift is reached at 188m from the source. This zone of effect is transient as it moves slowly in a constant direction along the principal survey line orientation. It is expected that fish will avoid the area once operations have started and are extremely unlikely to move towards the sound source. Therefore, it is extremely unlikely that fish will experience a significant effect other than temporary displacement from the immediate area surrounding the survey activity.

No conclusive records of a decline in catch rates have been noted following geophysical survey activities (Thompson *et al.* 2014), which suggests that fish return to areas after the temporary displacement.

The overall significance of the effect has been assessed as **Negligible** and is **Not Significant**.

UXO detonation (if required)

It is unknown how many, if any, UXO detonations will be required within the Proposed Development. Ten detonations have been applied for within the Marine Licence Application as a precaution, however only two detonations are predicted throughout the installation period. UXO encounters are predicted to be frequent, based on the experience of previous cable projects in the region, and results from the cable engineering survey. This is due to the Proposed Development crossing through previous World War I (WWI) and WWII sea mine fields, alongside areas of aerial bombing and military engagements.

The primary objective will be to avoid encountered potential UXO by micro-routeing within the Asset Placement Corridor (EM16). Typically, a standoff distance of 15-25m relative to potential UXO and depending on the nature of the UXO and installation method, is considered safe for cable installation purposes.

If re-routeing around a particular potential UXO appears not to be possible, this potential UXO will be investigated. If visual inspection confirms a UXO, then if it is safe to do so the UXO will be removed, or as a last resort disposal measures will be undertaken.

The potential for high order UXO detonation has been assessed as a worst case and all steps will be taken to avoid it occurring. If more than one UXO detonation is required, the Contractor shall seek to place the UXO together at one location so that one detonation can take place, or will programme the detonations so that the smaller charge is detonated first similar to a soft-start procedure.

The sensitivity of the all fish species has been assessed as medium because disturbance and injury can result from a sudden change in pressure associated with detonation. Underwater explosion produces a pressure waveform with rapid oscillations from positive pressure to negative pressure which results in rapid volume changes in gas-containing organs. Damage to visceral organs is most often the cause of fish mortality following exposure to underwater explosions. The most commonly injured organs are those with air spaces that are affected by the explosion's shock wave passing through the body of the fish, these include the body cavity, the pericardial sack and gut, however injuries of the swim bladder are most common. The swim bladders are subject to rapid contraction and overextension in response to explosive shock waveforms. Clupeids such as Atlantic herring and European sprat, as well as European eels and European bass will be most sensitive to an explosion as they all have swim bladders. Species which do not possess a swim bladder or have small swim bladders are likely to be more resistant to noise generated from explosions (Keevin and Hempen 1997).

To understand the potential effects of a high order UXO detonation on sensitive receptors two charge sizes (1.54kg, and 705kg) were modelled at three locations (Location 1 at KP30; Location 2 at KP70; and Location 3 at KP100). These locations cover the range of environments present along the Proposed Development. Location 1 represents typical conditions within the shallower parts of the Thames Estuary. Location 2 represents slightly deeper, coastal areas and Location 3 is within the Southern North Sea SAC for harbour porpoise so represents the most sensitive area for marine mammals. The modelling, presented in Technical Appendix I, concluded that sound will attenuate faster in summer, resulting in marginally smaller zones of influence compared to winter. Sound propagates slightly further at the coastal locations (Location 1 and Location 2) compared to in the open sea around Location 3.

High order detonations of UXO results in one of the of the loudest sources of underwater noise. Consultation with Cefas and JNCC with respect to UXO detonation identified that project specific

mitigation in the form of noise abatement, temporal restrictions and acoustic deterrents will need to be considered for any high order detonations.

This is reinforced by the results of the underwater modelling. The 705kg charge was modelled principally to demonstrate the zone of influence for a high order detonation and therefore what effect mitigation (in the form of noise abatement i.e. low order detonation) will have in reducing the zone of influence for injury. The 1.5kg charge size modelled is representative of a low order detonation using deflagration - whereby the explosive in the UXO is burnt out rather than blown up, in effect neutralizing the charge. The deflagration process is described in Cheong et al. (2020) as *"the UXO casing is penetrated by a shaped charge that generates insufficient shock to detonate. The explosive material inside the UXO reacts with a rapid burning rather than a chain reaction that would lead to a full explosion. Deflagration is a much less energetic process and anecdotal evidence has suggested that it is "quieter" than traditional high-order detonation."*

The modelling assessment concluded that for a high order detonation the zone of influence for injury is 1.5km from the source. This is reduced to 0.5km if a low order detonation is used. The explosion will be brief, with the shock waves attenuating rapidly in the water column, thus resulting in a restricted lethal zone (Continental Shelf Associates, Inc 2004). The magnitude of the effect has been assessed as low because of the small spatial scale of the effect.

The magnitude of the effect will still be low even if the UXO detonation occurs during an Atlantic herring spawning season on the Downs Spawning Ground or near the Blackwater Spawning Ground. UXO deflagration will be undertaken under controlled conditions, however, there is the possibility for mortal injury within the immediate zone surrounding the detonation if Atlantic herring are present. The area affected by a 1.54kg deflagration is equivalent to 0.02% of the Downs Spawning Ground and 0.35% of the Blackwater Spawning Ground (Studhill Bank). At the stock-level, the small spatial scale is unlikely to affect significant numbers of individuals or eggs to cause population effects.

In conclusion, the overall effect of UXO detonation (if required) on fish species has been assessed as **Minor** and is **Not Significant**.

Shellfish and crustaceans

It should be noted that little is known about how crustacean species are affected by underwater sound changes. Unlike fish species, crustaceans do not have an air-filled chamber; therefore, they are unlikely to detect sound pressure but can be sensitive to particle motion (Tidau and Briffa 2016). Results from studies into the effects of seismic airguns sounds have been varied with avoidance behaviour demonstrated in the lab tests but not in field studies on shrimp species and American lobster. These studies identified a large array of responses to underwater sound pressure, from an increase in behaviour (for example an increase in food intake in lobsters), stress responses, slower or reduced behaviour, change in foraging habitats etc. The current knowledge on how these reactions are displayed however is based on a limited range of studies (Tidau and Briffa 2016). There is no threshold for the assessment of sound exposure for crustaceans (Tidau and Briffa 2016).

Sensitive shellfish beds have been identified in the area surrounding the Proposed Development. Due to the commercial sensitivity of the grounds, and the uncertainty surrounding the potential for effects, additional Project Specific Mitigation (PS28 and PS29) has been proposed to ensure the physical effects of a UXO detonation e.g. seabed disturbance do not affect the beds.

8.6.8 Electromagnetic changes

8.6.8.1 Operation

When operating, the buried cables will generate an electromagnetic field (EMF) comprising two components: firstly, an electric field (E field) contained within the cable by armouring and, secondly,

a magnetic field (B field) that can be detected outside of the cable (Gill 2001). The effect will be present along the entire Preferred Cable Route.

Technical Appendix D - Marine Effects of Electro-Magnetic Fields (EMF) Technical Note presents the findings of an assessment on the potential effects of EMF generated by the GridLink operational cable system. The conclusions of the assessment can be summarised as follows:

- The operation of the GridLink interconnector cable will generate electromagnetic fields (EMF) which are made up of two fields, an electric (E field) and a magnetic field (B Field).
- The design of the cables, including lead sheathing and armoured cores, prevents the propagation of the electric (E) fields into the surrounding environment, therefore there will be no electric fields outside the cable directly caused by the power flow.
- The materials used in the design of the cables which prevent propagation of the electric fields, are permeable to the magnetic (B) field which emanate into the environment and attenuate with distance (horizontally and vertically).
- Movement through the generated magnetic fields by either water currents or swimming marine organisms creates induced electric (iE) fields.
- The predominant groups of marine organisms that are electroreceptive are elasmobranchs (sharks, skates and rays) and holocephalans (chimaeras such as ratfish). They sense electric fields to detect prey, predators and conspecifics (organisms of the same species).
- Magnetically sensitive species include teleosts (bony fishes; e.g. salmon and eel), crustaceans (lobsters, crabs, prawns and shrimps) and molluscs (snails, bivalves and cephalopods), and can use magnetic cues, such as the earth's geomagnetic field, to orientate themselves during migration.
- Calculations for the Gridlink system indicate that:
  - The bundled submarine cables will result in significant cancellation of the EMF.
  - The generated B fields and therefore the iE fields will return to background levels (50µT) within 10 m distance from the cable.
  - The threshold for avoidance by elasmobranchs from iE fields (>400 µV/m), will not be exceeded at the seabed.
- The GridLink cable will be situated at a distance greater than 150m from the BritNed Interconnector cable. Given that the generated B fields and therefore the iE fields will return to background levels (50µT) within 10 m distance from the cable, there will be no cumulative EMF effects from the two cables.
- No significant effects on either fish and shellfish or cetaceans are anticipated from the emission of EMF of the GridLink cables.

In conclusion, the sensitivity of all fish and shellfish to the Proposed Development has been assessed as low. The magnitude of the effect has been assessed as low. Overall the significance of the effect has been assessed as **Negligible** and is **Not Significant**.

8.7 Project Specific Mitigation

In addition to the embedded mitigation outlined in Section 8-5, Table 8-6 presents Project Specific Mitigation that will be incorporated into the Proposed Development.

Table 8-6 Project specific mitigation – commercial fisheries

ID	Project Specific Mitigation Measure
PS4	The cable burial and protection strategy shall adhere to the following principles, in order of priority: 1. Achieving Target DOL along the route so External Protection is not required and in particular no use of External Protection in MCZs and SACs. 2. Minimise any displacement of seabed which may not recover naturally within 2-3 years of installation (or else include methods to restore or aid the restoration of the seabed where viable).
PS24	Marine operations shall be avoided or at the least minimised as far as reasonably practicable within route sections KP15 - KP30 and KP45 - KP60 during June to October (exact timing to align with Cockle fishery opening dates as announced by KEIFCA for specific year) to minimise the disruption to commercial cockle fishing activities.
PS25	Mass flow excavation shall be prohibited in route sections KP15 to KP30 and KP45 to KP60 during the period June to October (exact timing to align with Cockle fishery opening dates as announced by KEIFCA for specific year).
PS26	Cable lay operations shall minimise sediment suspension in the water column or smothering of the seabed between KP0 to KP30 and KP45 to KP60 by selection of the cable installation and burial methods, vessels and tools and incorporation of appropriate mitigation measures into marine operations
PS27	Between KP0-30 and KP45-60, sediment plumes generated by cable installation shall be monitored either by a vessel that is independent of the cable-lay spread or using sensors mounted on a frame on the seabed. Water quality (specifically heavy metal concentrations) and suspended sediment concentrations will be measured. Monitoring will be undertaken prior to installation to provide a baseline against which measured values can be compared; will continue throughout installation and through to a period (to be defined) post-installation to demonstrate a return to pre-installation conditions. The monitoring plan, selection of the vessel and monitoring protocols shall be coordinated with KEIFCA. Should any sediment plumes from cable installation be identified as causing a risk of non-compliance with the marine environmental assessment, the cable-lay vessel shall be informed and marine operations, cable installation and/or burial methods shall be reviewed and additional measures identified to reduce the sediment plume. Details of the cause of the sediment plume and additional mitigation measures shall be notified to KEIFCA.
PS28	The locations of any UXO requiring clearance by deflagration shall be notified with the FLO to determine any fisheries sensitivities and whether consideration should be given to moving the deflagration point to avoid seabed disturbance that could permanently affect fishing activity.
PS29	The clearance of any UXO by deflagration between KP15 to KP30 and KP45 to KP60 shall be notified to the FLO, TEFA and KEIFCA, and consideration shall be given to moving the UXO to a safe location away from cockle beds prior to deflagration.
PS43	Intrusive seabed works shall be minimised in the Downs Atlantic Spawning Ground (KP87.5 to KP114) between November and December and if feasible intrusive seabed works shall be avoided in January.
PS44	Deflagration charges will be used on all UXO.

8.8 Residual Effect

No Significant effects were identified on fish and shellfish.

Through consultation with the fishing industry, it has been identified that additional project Specific Mitigation would be welcomed, as best practice, for certain pressures which were assessed as Not Significant. These pressures and measures are discussed below.

8.8.1 Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion

The assessment identified that although effects on Atlantic herring will not be significant, as the Proposed Development crosses the Downs Spawning Grounds taking a precautionary approach it would be prudent to seek to minimise intrusive seabed works from KP87.5 to KP114 between

November and December and if feasible avoid intrusive seabed works in January (Project Specific Mitigation PS43). Despite this measure the sensitivity and magnitude of the pressure-receptor pathway is unchanged, as it cannot be guaranteed that works can be programmed to avoid the spawning period. As such, the residual effect remains Minor and is **Not Significant**.

8.8.2 Siltation rate changes, including smothering (depth of vertical sediment overburden) and Changes in suspended solids (water clarity)

Project Specific Mitigation id codes PS24 through to PS27 are aimed at reducing the effects of elevated SSC's on shellfish beds (principally cockles) within proximity to the Preferred Cable Route between KP0 - KP30 and KP45 - KP60. The measures seek to minimise SSC concentrations and provide assurance through monitoring that the cockle beds will not be significantly affected.

Through minimising SSCs the magnitude of the pressure changes in suspended solids (water clarity) will be reduced from low to negligible and the overall significance of the residual effect will be reduced to Negligible which is **Not Significant**.

The measures will not change the assessment of magnitude and sensitivity for the pressure siltation rate changes and therefore the residual effect remains Minor which is **Not Significant.**

8.8.3 Underwater noise changes

The assessment identified that if UXO detonation is required, there is the potential for minor effects which are Not Significant on fish within the immediate vicinity. UXO detonation will only be used once all other options are exhausted, as per embedded mitigation measure EM44, and deflagration will be used to minimise the zone of effect (PS44). Project Specific Mitigation id codes PS28 and PS29 provide assurance to the fishing industry that prior to activities any potential UXO detonation sites will be discussed with the GridLink Fisheries Liaison Officer, Thames Estuary Fishermen's Association and the Kent and Essex Inshore Fisheries and Conservation Authority to ensure that key shellfish grounds will not be affected by the detonation. However, mitigation will not reduce fish sensitivity further and the residual effect remains Minor and is **Not Significant**.

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9. MARINE BIRDS

This Chapter describes the existing baseline environment for marine birds, identifies the pressures associated with the Proposed Development on the receptors, presents the findings of the environmental assessment and describes how significant effects (if any) will be mitigated.

The Proposed Development crosses several protected sites designated for bird features. Therefore, this Chapter focuses on these sites as the most sensitive to effects.

9.1 Data Sources

Baseline conditions have been established by undertaking a desktop review of published information. The data sources used to inform the baseline description and assessment include, but are not limited to the following:

- Kingsnorth Power Station overwinter bird surveys 2018-2020 (RSK 2019 and 2020);
- GridLink Interconnector Winter Bird Survey (AECOM 2020);
- Technical Appendix E - GridLink Marine Habitat Regulations Assessment (HRA); and
- Site documents for the Medway Estuary Special Protection Area (SPA)/ Site of Special Scientific Interest (SSSI)/Ramsar; Outer Thames Estuary SPA; Thames Estuary and Marshes SPA; Thames Estuary and Marshes Ramsar; and Foulness (mid-Essex coast phase 5) SPA.

Other data sources are listed in the References at the end of the chapter.

9.1.1 Winter Bird Surveys

9.1.1.1 AECOM Wintering Bird Survey – 2019/2020

A desk study and extended Phase 1 habitat survey undertaken by AECOM in June 2019 identified habitats within and adjacent to the GridLink Site (e.g. intertidal mudflats, coastal grassland and scrub) which could potentially support a range of wintering bird species, including specially protected species for which the Medway Estuary and Marshes SPA and Ramsar is designated. Between October 2019 and March 2020, AECOM undertook a wintering bird survey comprising a series of 12 survey visits (one low tide and one high tide visit per month). The site surveyed is located immediately north of the Medway Estuary in Kent, within the former Kingsnorth coal-fired power station site (now demolished).

Survey limitations

No significant survey limitations were identified. Results from the winter bird surveys are considered to be indicative of the bird assemblages present in the survey area.

9.1.1.2 Kingsnorth Power Station Winter Bird Survey's – 2018/2019 and 2019/2020

Areas surrounding the Kingsnorth Power Station have been subject to wintering bird surveys, undertaken during winter months, December 2018 – March 2019 (RSK 2019) and October 2019 – March 2020.

The ornithological interest of the shore south of the Kingsnorth Power Station was assessed, concentrating on bird populations in selected key habitats. The key habitats included estuary mudflats and marshes around the River Medway, Damhead Creek and surrounding marshland habitat, which is known to support internationally and nationally important numbers of feeding and roosting wildfowl and waders. All birds observed at each survey location were counted and recorded with the main aims of obtaining peak counts for all species and locating significant feeding and/or roosting assemblages.

Survey Limitations

The wintering bird surveys did not produce a comprehensive list of all wintering birds using the site, as it was limited by factors that influence their presence (e.g. activity timing, migration, disturbance levels, and crypsis[1].

The 2018/2019 survey report noted that the absence of surveys in September, October, November and early December may have impacted on number of species recorded.

It is important to note that bird counts represent a 'snapshot' of bird numbers during a count session, so in general and taking into account all potential sources of error, resulting data are regarded to be underestimates of population size. In addition, the surveys concentrated on birds associated with the estuary habitats and therefore anecdotal sightings of passerines (song birds or perching birds) were not recorded.

9.2 Consultation

Table 9-1 summarises the relevant consultation responses on birds.

Table 9-1 Consultation responses – Marine Birds

Stakeholder	Summary of Consultation Response	How response has been addresses
Comments received on MMO Scoping Opinion		
Marine Management Organisation (MMO)	The MMO requests that consideration of light pollution from operational activities is scoped into the Environmental Appraisal and HRA.	Light pollution has been assessed in the onshore assessment.
Comments received from NE in advice / meetings		
Natural England (NE)	Evidence has shown that red throated diver has been displaced by windfarm activities and the species is not in a favourable condition. NE requests that the following are considered: ▪ Seasonality of this species - the conservation advice packages for the site recommend avoidance of activities between October and April. ▪ In-combination effects – new activities in the Outer Thames Estuary SPA are planned and need consideration. Although NE acknowledged ongoing shipping in the background in this region.	An assessment (including in-combination effects) of red throated diver has been provided in the GridLink Marine HRA (Technical Appendix E).
NE	Advised that although marsh harrier (*Circus aeruginosus)* is not a designated feature of the Medway Estuary and Marshes SSSI, SPA or Ramsar as it is listed on Schedule 1 of the Wildlife and Countryside Act, assessment should be undertaken as to whether an offence could be caused. It is an offence to intentionally or recklessly disturb breeding and nesting birds.	An assessment (including in-combination effects) on marsh harrier has been provided in the GridLink Marine HRA (Technical Appendix E).

[1] The ability of an animal to avoid observation or detection by other animals i.e. camouflage

9.3 Existing Baseline

9.3.1 General overview

The Medway Estuary, Outer Thames Estuary and English Channel and the adjacent coastlines are important for a wide range of nationally and internationally important estuarine and seabird populations, acting as both breeding sites and foraging areas.

Distribution is influenced by various factors, probably the most important of which is the availability of food. The distribution and abundance of all marine and coastal species varies throughout the year with areas of high densities changing between seasons.

The Kingsnorth landfall is sited within the Medway Estuary and Marshes SPA and Ramsar site, and the Medway Estuary and Marshes SSSI. The intertidal area adjacent to the converter station site is an expanse of mudflats important as a feeding ground for the Qualifying Interest features of the sites. Wintering bird surveys have been undertaken of the intertidal mudflats at Kingsnorth, which is within the Medway Estuary and Marshes SPA/ Ramsar; Section 9.3.2 provides a summary of the 2018/2019 and 2019/2020 overwintering bird surveys.

Section 9.3.3 summarises information on European Sites designated for marine birds which were assessed within the GridLink Marine HRA (Technical Appendix E). Within these European sites a range of overwintering and breeding birds are protected; including wading birds, waterfowl and seabirds.

9.3.2 Landfall survey results

9.3.2.1 Wintering bird survey's

A total of 43 bird species were recorded during the 2018/2019 and 69 were recorded during the 2019/2020 winter bird survey at Kingsnorth Power Station (RSK 2019 and 2020). During the 12 wintering bird survey visits undertaken by AECOM, a total of 60 species were recorded within the survey area (AECOM 2020). Table 9-2 below provides the peak count of bird species recorded during the 2018/2019 and 2019/2020 surveys for species which are designated within the Medway Estuary and Marshes SPA/Ramsar. This table also provides information on the number of breeding pairs, population levels and seasonal presence. An overwintering bird survey was also undertaken by Ramboll Environ in 2017, in the months of January, February and March. Six locations around the Medway Estuary were chosen as central points for surveys, overlooking the Proposed Development. Data from this survey is also presented in Table 9-2.

No breeding birds surveys were undertaken on the intertidal area, as this is not a breeding habitat.

As can be seen from this table most birds use the SPA for overwintering and the period at which the fewest species are present is May to September; in September only one designated feature is present in significant numbers (non-breeding avocet). It should be noted that avocet were recorded in nationally or internationally important numbers during the 2018/2019 (RSK 2019) overwintering survey. No species were recorded in national or international numbers during the 2019/2020 RSK (2020) and AECOM 2019/ 2020 overwintering surveys.

Table 9-2 Medway Estuary and Marshes SPA/Ramsar population estimate and seasonality presence

Bird species	Season	Estimated Population*	Ramboll Environ 2017 Overwintering Surveys**	RSK 2018 -2019 Overwintering Surveys***	RSK 2019 -2020 Overwintering Surveys****	AECOM Wintering Birds survey (2019/2020)*****	J	F	M	A	M	J	J	A	S	O	N	D
Pied Avocet (*Recurvirostra avosetta*)	Breeding	150 breeding pairs observed on the Chetney peninsula in 2006, 104 pairs in 2007. 2008 194 individuals counted with some breeding	No individuals recorded	Peak count of 173 birds	Peak counts of 57 birds	Peak count of 4 birds												
	Non-breeding	70 individuals were observed on classification in 1993. This has increased in recent year to 1,005 individuals in 2012/13.	Peak count of 11/50 birds															
Black-tailed godwit (*Limosa limosa islandica*)	Non-breeding	5,547 individuals (five-year peak mean 1991/92 – 1995/96)	No individuals recorded	Peak count of 333 birds	Peak counts of 110 birds	Peak count of 150 birds												
Dark-bellied Brent goose (*Branta bernicla bernicla*)	Non-breeding	4,130 individuals observed upon classification in 1993. Since declined to 3,205 individuals in 1995/6 and further to 1,349 individuals in 2012/13.	51-500 individuals	No individuals observed	Peak counts of 750 birds	Peak count of 571 birds												
Dunlin (*Calidris alpina alpina*)	Non-breeding	The observed population count upon classification in 1993 was 22,900 individuals, this has decreased since to only 6,847 individuals in 2012/13	Peak counts of 51-500 birds	Peak counts of 1090 birds	Peak counts of 300 birds	Peak count of 39 birds												
Knot (*Calidris canutus*)	Non-breeding	Since classification in 1993 the population observed was 3,690 individuals. This has dramatically fluctuated since, with 541 individuals observed in 1991/2, to 1 individual observed in 1995/6 and most recently 2,407 individuals in 2012/13.	No individuals recorded	No individuals observed	No individuals observed	No individuals observed												
Grey plover (*Pluvialis squatarola*)	Non-breeding	4,810 individuals were observed upon classification in 1993. This has since declined to 919 individuals in 2012/13.	Peak counts of 1-10 birds	Peak counts of 15 birds	Peak counts of 12 birds	No individuals observed												
Little tern (*Sterna albifrons*)	Breeding	The latest information on population density for this species is from classification in 1993, at which point 24 pairs were observed	No individuals observed	No individuals observed	No individuals observed	No individuals observed												
Northern Pintail (*Anas acuta*)	Non-breeding	980 individuals were observed in 1993 upon classification. This declined to 697	Peak counts of 11-50 birds	No individuals observed	No individuals observed	No individuals observed												

Bird species	Season	Estimated Population*	Ramboll Environ 2017 Overwintering Surveys**	RSK 2018 -2019 Overwintering Surveys***	RSK 2019 -2020 Overwintering Surveys****	AECOM Wintering Birds survey (2019/2020)*****	J	F	M	A	M	J	J	A	S	O	N	D
		individuals in 1995/6 and further to 537 individuals in 2012/13.																
Redshank (*Tringa totanus*)	Non-breeding	4,180 individuals were observed upon classification in 1993, this has since decreased to 3,690 in 1995/6 and further to 825 individuals in 2012/13.	Peak counts of 51-500 birds	Peak counts of 355 birds	Peak counts of 537 birds	Peak count of 61 birds												
Ringed plover (*Charadrius hiaticula*)	Non-breeding	740 individuals were observed upon classification in 1993. Populations rose slightly to 768 individuals in 1995/6, however dramatically declined to 128 individuals in 2012/13.	No individuals observed	Peak counts of 1 bird	Peak counts of 6 birds	Peak count of 1 bird												
Shelduck (*Tadorna tadorna*)	Non-breeding	5,900 individuals observed in 1993. This has since declined to 1,863 individuals in 2012/13.	Peak counts of 51-500 birds	Peak counts of 235 birds	Peak counts of 167 birds	Peak count of 363 birds												

Note: *Sources for estimated population: NE SPA site account last updated 13 September 2019, NE Advice on Seasonality for assemblage features last updated 20 March 2017 (Natural England 2017). **Ramboll Environ 2017 Overwintering Surveys, *** RSK 2018 – 2019 overwintering surveys. **** RSK 2019 – 2020 overwintering surveys. ***** AECOM Winter Bird Surveys 2019/2020.

9.3.3 European Sites

The most important national and international marine bird populations are protected within designated sites including, SPAs and Ramsar sites. The GridLink Marine HRA (Technical Appendix E) identified 14 sites designated for the protection of bird species within 10km of the Proposed Development. Whilst it is acknowledged that some marine birds can forage long distances and therefore have the potential to travel to the Proposed Development from sites beyond 10km, as the distance from the Proposed Development increases, so does the area of alternative foraging sites available to these birds. In turn, the probability of significant numbers of individuals being present within the Proposed Development from protected sites further afield gets lower as the distance increases.

Table 9-3 identifies the Qualifying Features of the 14 sites assessed during Stage 1 Screening of the HRA process.

Table 9-3 SPA, Ramsar and SSSI sites assessed in the HRA Stage 1 Screening

Site name and code	Area of site	Distance to Proposed Development	Distance of Proposed Development within site	Qualifying features
Medway Estuary and Marshes SPA (UK9012031)	46.84km²	Within	Within	**Qualifying Features:** **On passage:** ▪ Common ringed plover (*Charadrius hiaticula*) **Over winter:** ▪ Pied avocet (*Recurvirostra avosetta*); ▪ Black-tailed godwit (*Limosa limosa islandica*); ▪ Dark-bellied Brent goose (*Branta bernicla bernicla*); ▪ Dunlin (*Calidris alpina alpine*); ▪ Grey plover (*Pluvialis squatarola*); ▪ Northern pintail (*Anas acuta*); ▪ Redshank (*Tringa tetanus*); ▪ Common ringed plover; and ▪ Common shelduck (*Tadorna tadorna*).
Medway Estuary and Marshes SSSI	47.48km²	Within	Within	**Breeding:** Marsh harrier (*Circus aeruginosus*).
Medway Estuary and Marshes Ramsar (Site No. 645)	46.97km²	Within	Within	**Ramsar Criterion 3a:** Internationally important waterfowl assemblage **Ramsar Criterion 3c:** Overwintering internationally important birds: ▪ Dark-bellied Brent goose; ▪ Dunlin; ▪ Grey Plover; ▪ Red knot (*Calidris canutus*); ▪ Northern pintail; ▪ Redshank; ▪ Common ringed plover; and ▪ Common shelduck.

Site name and code	Area of site	Distance to Proposed Development	Distance of Proposed Development within site	Qualifying features
Outer Thames Estuary SPA (UK9020309)	3792km²	Within	49km	**Non-breeding:** ▪ Red-throated diver (*Gavia stellata*) **Breeding:** ▪ Common tern (*Sterna hirundo*); and ▪ Little tern.
Thames Estuary and Marshes SPA (UK9012021)	48.38km²	Within	1.5km	**Qualifying Features:** **Over winter:** ▪ Pied avocet; and ▪ Hen harrier (*Circus cyaneus*). **On passage and over winter** ▪ Common ringed plover.
Thames Estuary and Marshes Ramsar (Site No. 1025)	52.89km²	Within	1.5km	**Ramsar Criterion 5:** Assemblages of waterfowl of international importance – species with peak counts in winter **Ramsar Criterion 6:** Species/populations occurring at levels of international importance include: *Peak Counts in Spring/Autumn:* ▪ Common ringed plover; and ▪ Black-tailed godwit. *Peak Counts in Winter:* ▪ Common redshank. ▪ Dunlin; ▪ Grey plover; and ▪ Red knot.
Benfleet and Southend Marshes SPA (UK9009171)	22.51km²	3.4km	N/A	**Qualifying Features:** **Over winter:** ▪ Black-tailed godwit; ▪ Common ringed plover; ▪ Dark bellied Brent goose; ▪ Dunlin; ▪ Grey plover; and ▪ Red knot.
Benfleet and Southend Marshes Ramsar (Site No. 648)	22.51km²	3.4km	N/A	**Ramsar Criterion 5:** Assemblages of waterfowl of international importance – species with peak counts in winter **Ramsar Criterion 6:** Species/populations occurring at levels of international importance include: *Peak Counts in Spring/Autumn:* ▪ Dark-bellied Brent goose. ▪ Peak Counts in Winter: ▪ Grey plover; and ▪ Red knot. **Species Identified Subsequent to Designation for Possible Future Consideration under Criterion 6** *Peak Counts in Winter:* ▪ Dunlin.

Site name and code	Area of site	Distance to Proposed Development	Distance of Proposed Development within site	Qualifying features
The Swale SPA (UK9012011)	65.15km²	4.5km	N/A	**Qualifying Features:** **Breeding Bird Assemblage:** The grazing marshes support a typical assemblage of breeding species including – ▪ Common shelduck ▪ Coot (*Fulica atra*) ▪ Lapwing (*Vanellus vanellus*), ▪ Mallard (*Anas platyrhynchos*), ▪ Moorhen (*Gallinula chloropus*) ▪ Redshank ▪ Reed bunting (*Emberiza scheniculus*) ▪ Reed warbler (*Acrocerphalus scirpaceus*)
The Swale Ramsar (Site No. 299)	65.15km²	4.5km	N/A	**Ramsar Criterion 5:** Assemblages of waterfowl of international importance **Ramsar Criterion 6:** Species/populations occurring at levels of international importance include: *Species Identified Subsequent to Designation for Possible Future Consideration under Criterion 6:* *Peak Counts in Spring/Autumn:* ▪ Ringed Plover. *Peak Counts in Winter:* ▪ Black-tailed godwit; ▪ Eurasian wigeon; ▪ Northern pintail; and ▪ Northern shoveler (*Anas clypeata*).
Foulness (mid-Essex Coast Phase 5) SPA (UK9009246)	109.7km²	2.9	N/A	**Qualifying Features:** **Breeding:** ▪ Pied avocet; and ▪ Common ringed plover ▪ Common tern; ▪ Little tern; and ▪ Sandwich tern (*Sterna sandvicensis*). **Over Winter:** ▪ Bar-tailed godwit; ▪ Dark-bellied Brent goose; ▪ Grey plover; ▪ Hen harrier. ▪ Red knot; and ▪ Oystercatcher (*Haematopus ostralegus).* **On passage:** ▪ Redshank
Foulness (mid-Essex Coast Phase 5) Ramsar (Site No. 861)	109.7km²	2.9	N/A	**Ramsar Criterion 3a:** Assemblages of wildfowl of international importance **Ramsar Criterion 3c:** Overwintering internationally important birds: *Peak Counts in Spring/Autumn:* ▪ Bar-tailed godwit; ▪ Dark-bellied Brent goose;

Site name and code	Area of site	Distance to Proposed Development	Distance of Proposed Development within site	Qualifying features
				▪ Grey Plover; ▪ Knot; ▪ Oystercatcher; and ▪ Redshank
Thanet Coast and Sandwich Bay SPA (UK9012071)	18.7km^2	4.8km	N/A	**Qualifying Features:** **Over winter:** ▪ Golden plover; and ▪ Turnstone (*Arenaria interpres*) **Breeding:** ▪ Little tern
Thanet Coast and Sandwich Bay Ramsar	21.69km^2	4.8km	N/A	**Ramsar Criterion 3a:** Assemblages of wildfowl of international importance **Ramsar Criterion 3c:** Overwintering internationally important birds: *Peak counts in Spring/Autumn:* ▪ Bar-tailed godwit; ▪ Dark-bellied Brent goose; ▪ Grey plover; ▪ Knot; ▪ Oystercatcher; and ▪ Redshank. **Ramsar Criterion 6:** Species/populations occurring at levels of international importance include: *Peak Counts in Winter:* Ruddy turnstone (*Arenaria interpres interpres*),

9.4 Potential Pressure Identification and Zone of Influence

A scoping exercise undertaken to inform the content of the Environmental Appraisal has excluded the following pressures from further consideration in this topic Chapter and HRA. Explanation for the exclusion is provided in Chapter 4, Table 4-1.

- Hydrocarbon and PAH contamination; and
- Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion.

Table 9-4 lists the pressures which were assessed within the GridLink Marine HRA (Technical Appendix E). For each pressure the assessment considered the different aspects of the Proposed Development during installation, operation (including repair and maintenance) and decommissioning. In order to evaluate the most significant effects, the largest zone of influence from these aspects was selected. The zones of influence are presented in Table 9-4.

Table 9-4 Pressure identification and zone of influence – birds

Potential Pressure	Aspect of Proposed Development	Phase	Zone of Influence*	Search Area and Justification
Visual disturbance	Project vessels HDD Onshore works	Installation, operation and decommissioning	Radial distances from Proposed Development ▪ 4km divers and sea ducks ▪ 2km all other species	**10km** It is recognised that some seabirds from other SPAs will forage and loaf in the ZOI. However, disturbance will be limited in extent and duration and there is sufficient space in the surrounding environment for birds to temporarily relocate. Therefore, only sites within 10km of the Proposed Development have been screened for qualifying bird features.
Above water noise	Project vessels Onshore works e.g. HDD	Installation, operation and decommissioning	There is no prescribed zone of influence for above water noise. Therefore, the ZOI for above water noise is assessed within the same ZOI for visual disturbance.	
Changes to supporting habitat and prey availability	Cable burial, external cable protection and cable removal	Installation, operation and decommissioning	Proposed Development	

*Zone of Influence radial distances derived from JNCC recommendations as outlined in JNCC (2017).

9.5 Embedded Mitigation

The embedded mitigation relevant to marine birds is provided in Table 9-5 below. When undertaking the assessment, it is assumed that these measures will be complied with.

Table 9-5 Embedded mitigation

ID	Embedded mitigation measure	Project phase		
		I	O	D
EM1	Intertidal zone of the Medway Estuary at the Kingsnorth shore crossing shall be crossed by horizontal directional drilling (HDD) to avoid disturbance to the surface sediments and habitats. HDD must exit beyond the mean low water springs mark to avoid the Medway Estuary and Marshes SPA and Medway Estuary and Marshes SSSI.	■		
EM2	HDD drilling activities shall be conducted in a manner to minimise risk of bentonite breakout from the HDD entry or exit pits	■		
EM36	Project vessels will be equipped with waste disposal facilities (sewage treatment or waste storage) to IMO MARPOL Annex IV Prevention of Pollution from Ships standards.	■	■	■
EM37	Ship Oil Pollution Emergency Plans (SOPEPs) shall be provided by Contractor and implemented covering all vessels in accordance with MARPOL Annex I requirements	■	■	■
EM39	Hazardous chemicals and materials shall be managed in accordance with applicable standards and guidelines, including maintenance of an inventory of such substances that are used and/or stored, provision of Material Safety Data Sheets (MSDSs), preparation of Chemical Risk Assessments and storage in designated, secure facilities with suitable spill protection and control	■	■	■
EM41	Environmental Management Plan (EMP) shall be prepared and implemented covering all marine operations	■	■	■

ID	Embedded mitigation measure	Project phase		
		I	O	D
EM42	Emergency Spill Response Plan (ESRP) shall be prepared and implemented covering all marine operations			

9.6 Significance Assessment

9.6.1 HRA conclusions

14 relevant sites were assessed within the HRA Stage 1 Screening to determine if there is a possible pressure-receptor pathway between the Proposed Development and the site. Seven of the 14 sites were screened out because either a pathway between the Proposed Development and the Primary and Qualifying Features could not be identified or a pathway exists but there is no physical overlap of the pressure being considered and the Primary and Qualifying Feature. The seven sites screened out were:

- Foulness (mid-Essex Coast Phase 5) Ramsar;
- Benfleet and Southend Marshes SPA;
- Benfleet and Southend Marshes Ramsar;
- The Swale SPA;
- The Swale Ramsar;
- Thanet Coast and Sandwich Bay SPA; and
- Thanet Coast and Sandwich Bay Ramsar.

Initial screening identified seven sites were a possible pressure-receptor could be identified. These sites were examined further to determine whether the pressure either alone or in combination with other plans or projects could result in a likely significant effect on the Qualifying Feature(s). A summary of the assessment conclusions is provided in Table 9-6.

The onshore works associated with the building of the converter station will be within the Medway Estuary and Marshes SPA/Ramsar/SSSI, therefore the potential for intra-project effects were also assessed.

Stage 1 Screening concluded for each of the seven sites that there was no potential for a likely significant effect from the Proposed Development either alone or in-combination with other plans or projects and Appropriate Assessment is not required.

Table 9-6 HRA Stage 1 Screening Conclusions

Site Name and Code (where applicable)	Applicable Qualifying Feature	Potential Pressure on Site	Conclusion
Medway Estuary and Marshes SPA (UK9012031)	**On passage:** Ringed plover (*Charadrius hiaticula*) **Over winter:** Avocet (*Recurvirostra avosetta*); Black-tailed godwit (*Limosa limosa islandica*); Dark-bellied Brent goose (*Branta bernicla bernicla*);	Visual disturbance	No potential for LSE, AA is not required
		Smothering and siltation rate changes	No potential for LSE, AA is not required
		Above water noise	No potential for LSE, AA is not required

Site Name and Code (where applicable)	Applicable Qualifying Feature	Potential Pressure on Site	Conclusion
	Dunlin (*Calidris alpina alpine*); Grey plover (*Pluvialis squatarola*); Northern pintail (*Anas acuta*); Redshank (*Tringa tetanus*); Ringed plover; and Shelduck (*Tadorna tadorna*). **Breeding Season:** Little tern (*Sterna albifrons*); Avocet.		
Medway Estuary and Marshes Ramsar	**Ramsar Criterion 3a:** Internationally important waterfowl assemblage **Ramsar Criterion 3c:** Overwintering internationally important birds: Dark-bellied Brent goose; Dunlin (*Calidris alpine alpine*); Grey Plover; Knot (*Calidris canutus*); Pintail (*Anas acuta*) Redshank; Ringed plover; and Shelduck	Visual disturbance	No potential for LSE, AA is not required
Medway Estuary and Marshes SSSI	Breeding Marsh Harrier *Circus aeruginosus*	Visual disturbance	No potential for LSE, AA is not required
		Above water noise	No potential for LSE, AA is not required
Outer Thames Estuary SPA (UK9020309)	**Non-breeding:** Red-throated diver (*Gavia stellata*),	Visual disturbance	No potential for LSE, AA is not required
		Smothering and siltation rate changes	No potential for LSE, AA is not required
		Above water noise	No potential for LSE, AA is not required
Thames Estuary and Marshes SPA (UK9012021)	**Over winter:** Avocet; and Hen harrier (*Circus cyaneus*). **On passage and over winter** Ringed plover	Visual disturbance	No potential for LSE, AA is not required
		Above water noise	No potential for LSE, AA is not required
Thames Estuary and Marshes Ramsar	**Ramsar Criterion 6:** Species/populations	Visual disturbance	No potential for LSE, AA is not required

Site Name and Code (where applicable)	Applicable Qualifying Feature	Potential Pressure on Site	Conclusion
	occurring at levels of international importance include: *Peak Counts in Spring/Autumn:* Ringed plover; and Black-tailed godwit *(Limosa limosa islandica).* *Peak Counts in Winter:* Grey plover; Red knot; Dunlin; and Common redshank.	Above water noise	No potential for LSE, AA is not required
Foulness (mid-Essex Coast Phase 5) SPA (UK9009246)	**Breeding:** Common tern (*Sterna hirundo*); Little tern (*Sterna albifrons*); and Sandwich tern (*Sterna sandvicensis*).	Visual disturbance	No potential for LSE, AA is not required
		Above water noise	No potential for LSE, AA is not required

9.7 Project Specific Mitigation

In addition to the embedded mitigation discussed in Section 9.5, Table 9-5 presents Project Specific Mitigation that will be implemented.

Table 9-7 Project Specific Mitigation – Birds

ID	Project Specific Mitigation
PS9	No HDD works to be undertaken in the Medway Estuary between 01 October and 31 April (to avoid effects on overwintering birds).

9.8 Residual Effects

Although the HRA concluded effects will be **Not Significant**, and without prejudice to this conclusion, the Applicant has proposed that no HDD works will be undertaken in the Medway Estuary between 01 October to 31 April (to further mitigate effects on overwintering birds).

Residual effects have been assessed as **Not Significant**.

REFERENCES

1 AECOM. (2020). GridLink Interconnector. Ecology Report Volume 3 – Wintering Bird Survey Report.

2 JNCC (2017). Joint SNCB (Statutory Nature Conservation Bodies) Interim Displacement Advice Note 2017.

3 Natural England. (2017). Medway Estuary and Marshes SPA Advice on Seasonality. [Online]. Available at: https://designatedsites.naturalengland.org.uk/Marine/Seasonality.aspx?SiteCode=UK9012031&SiteName=medway%20estuary&SiteNameDisplay=Medway+Estuary+and+Marshes+SPA&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=&NumMarineSeasonality=11 (Accessed May 2020)

4 RSK (2019) Kingsnorth Power Station – Uniper Bird Survey – 2018/2019 Overwintering bird survey.

5 RSK (2020) Kingsnorth Power Station – Uniper Bird Survey – 2019/2020 Overwintering bird survey.

10. MARINE MAMMALS AND MARINE REPTILES

This Chapter describes the existing baseline environment in terms of marine mammals and marine reptiles, identifies the pressures associated with the Proposed Development on the receptors, presents the findings of the environmental assessment, and describes how significant effects (if any) will be mitigated.

10.1 Data Sources

Baseline conditions have been established by undertaking a desktop review of published information. The data sources used to inform the baseline description and assessment include, but are not limited to the following:

- Offshore Energy Strategic Environmental Assessment (DECC 2016a);
- Atlas of cetacean distribution in northwest European waters (Reid *et al*. 2003);
- Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III (Hammond *et al*. 2017);
- The identification of discrete and persistent areas of relatively high harbour porpoise density in the wider UK marine area (Heinänen and Skov 2015);
- Updated seal usage maps: The estimated at-sea distribution of grey and harbour seals (Russell et al. 2017);
- Sea Watch Foundation sightings data (Sea Watch Foundation 2020); and
- Documents relating to the Southern North Sea Special Area of Conservation (SAC) e.g. JNCC (2017a, 2019d).

Other data sources are listed at the end of the Chapter.

10.2 Consultation

Table 10-1 summarises the relevant consultation responses on marine mammals and marine reptiles.

Table 10-1 Consultation responses – marine mammals and marine reptiles

Stakeholder	Summary of Consultation Response	How response has been addressed
Marine Management Organisation (MMO)	Details of underwater noise mitigation methods must be included in the ER.	Mitigation measures are provided in Sections 10.5 and 10.7.
MMO	Where practicable UXO detonations and cable-laying activities with the potential to affect marine mammals must be scheduled to minimise the likelihood of marine mammal presence along the cable route.	If required, UXO detonation will be undertaken between 01 April and 31 September (to avoid effects on harbour porpoise). See Section 10.7, Project Specific Mitigation PS10.
MMO	The Proposed Development must not exclude harbour porpoises from more than 20% of the relevant area (summer or winter area) within the southern North Sea Special Area of Conservation (SAC) on any given day. Further, the Proposed Development must not individually or in combination, exclude harbour	Please see Section 10.6.2 for an assessment of the area of SAC effected by underwater noise.

Stakeholder	Summary of Consultation Response	How response has been addressed
	porpoises from more than an average of 10% relevant area of the aforementioned SAC over a season.	

10.3 Existing Baseline

10.3.1 General overview

Marine mammals present in the Proposed Development include cetaceans (whales, dolphins and porpoises) and pinnipeds (seals). No otters have been recorded along the Proposed Development.

In terms of diversity in UK waters, 28 species of cetacean (DECC 2016a) have been recorded. Most cetaceans are wide-ranging, and individuals encountered within British waters form part of a much larger biological population whose range extends into North Atlantic and North West European waters. As a result, management units (MUs) have been outlined for seven of the common regularly occurring species, following advice from the Sea Mammals Research Unit and the International Council for the Exploration of the Sea (ICES) (DECC 2016a). These provide an indication of the spatial scales at which effects of anthropogenic activities should be taken into consideration. The relevant MUs for species identified within the Proposed Development are shown in Table 10-2. All cetaceans are protected from deliberate injury and disturbance, no matter their location by The Conservation of Offshore Marine Habitats and Species Regulations 2017 and The Conservation of Habitats and Species Regulations 2017, as European Protected Species.

Two species of seals can be found in UK waters, the harbour seal (*Phoca vitulina*) and the grey seal (*Halichoerus grypus*), representing 5% and 40% of the world's population respectively (JNCC 2019a; JNCC 2019b). Both species are abundant throughout all UK waters, with notable populations along the Scottish and West Wales coasts alongside The Wash, Norfolk. While there are haul-out sites for both grey and harbour seal throughout the UK, they are only protected when within the boundary of a designated European Site.

Sightings of marine reptiles (turtles) in the North Sea and around the Proposed Development are rare.

10.3.2 Cetaceans

Cetaceans found within the southern North Sea are low in diversity and abundance compared to other areas of UK waters (DECC 2016a). Table 10-2 lists species which may be present in the Proposed Development and provides an appraisal of the frequency of sightings. Generally, the greatest numbers of cetacean species are present in coastal waters within the summer months.

Table 10-2 identifies that eight species of cetacean have been recorded in the waters surrounding the Proposed Development. The most frequently sighted species in nearshore waters are harbour porpoise (*Phocoena phocoena*) (Sea Watch Foundation 2012) with common bottlenose dolphin being recorded as an occasionally sighted species. Offshore, harbour porpoise are recorded frequently, whilst white-beaked dolphin (*Lagenorhynchus albirostris*), short-beaked common dolphin (*Delphinus delphis*) and minke whale (*Balaenoptera acutorostrata*) are recorded occasionally (DECC 2016b; Galloper Windfarm Limited 2011).

Sperm whale (*Physeter macrocephalus*), humpback whale (*Megaptera novaeangliae*), northern bottlenose whale (*Hyperoodon ampullatus*), killer whale (*Orcinus orca*), fin whale (*Balaenoptera physalus*), long-finned pilot whale (*Globicephala melas*), Risso's dolphin (*Grampus griseus*), Atlantic white-sided dolphin (*Lagenorhynchus acutus*), and striped dolphin (*Stenella coeruleoalba*) are uncommon visitors to the southern North Sea (Reid *et al*. 2003; DECC 2009).

Harbour porpoise are the most abundant and commonly sighted species in the area. The Proposed Development crosses the Southern North Sea Special Area of Conservation (SAC) which has recently been designated to conserve harbour porpoise.

Other toothed whales (e.g. short-beaked dolphin and long-finned pilot whale) are sighted in low numbers, most frequently between summer and autumn. The most frequently sighted baleen whale is the minke, with peak sightings taking place between May to September (DECC 2016b)

The Sea Watch Foundation (www.seawatchfoundation.org.uk) has 201 records of cetacean sightings near the Proposed Development for the period March 2018 to December 2019. Species identified include harbour porpoise; common bottlenose dolphin; short-beaked common dolphin; white-beaked dolphin; fin whale; humpback whale; long-finned pilot whale; and minke whale. Observations have been included in Table 10-2.

Table 10-2 Cetacean species whose distribution includes the Proposed Development

Species	Frequency of sightings*	Sea Watch Foundation sightings (March 2018 – December 2019)**	Estimation of density (animals/km²)***	Applicable MU****	Abundance of animals in MU****
Toothed whales (odontocetes)					
Harbour porpoise	Common in low numbers year-round but highest sightings from December to April and in August and October	Sightings all year round. Individuals and up to 15 animals.	0.607	North Sea	110,433
Common bottlenose dolphin	Occasional and irregular sightings in the southern North Sea.	April to October. Individuals and up to 25 animals.	No data available.	North Sea	No data available.
White-beaked dolphin	Irregular and occasional offshore sightings	April. Pod of 4-5 sighted.	No data available.	Celtic & Greater North Seas	15,895 Considered rare in SNS.
Short-beaked common dolphin	Recorded occasionally in the SNS.	March – September, November. Individuals and up to 100 animals.	No data available.	Celtic & Greater North Seas	56,556
Killer whale	No recorded sightings in SNS.	No sightings recorded.	No data available.	N/A	No data available.
Atlantic white-sided dolphin	No recorded sightings in SNS .	No sightings recorded.	No data available.	Celtic & Greater North Seas	69,293
Striped dolphin	No recorded sightings in SNS .	No sightings recorded	No data available.	N/A	No data available.
Risso's dolphin	No recorded sightings in SNS .	No sightings recorded	No data available.	Celtic & Greater North Seas	No data available.
Long-finned pilot whale	Occasional sightings in SNS	July. 2 pods of between 8 and 10 sighted from Sussex.	No data available.	N/A	No data available.
Baleen whales (mysticetes)					
Minke whale	Occasional sightings in SNS.	July and August. Individual and pair sighted.	No data available.	Celtic & Greater North Seas	23,528

Species	Frequency of sightings*	Sea Watch Foundation sightings (March 2018 – December 2019)**	Estimation of density (animals/km²)***	Applicable MU****	Abundance of animals in MU****
Humpback whale	No recorded sightings in SNS	February. Individual sighted from Dover, Kent.	No data available.	N/A	No data available
Fin whale	No recorded sightings in SNS	July. Individual sighted from Wolla Bank, Lincolnshire.	No data available.	N/A	No data available
Sperm whale	No recorded sightings in SNS	No sightings recorded	No data available.	N/A	No data available.

Sources: * Reid *et al* (2003), ** Sea Watch Foundation (2020), *** Hammond *et al* (2017) ****ICES Management Units L (North Sea) and DECC (2016b).

The baseline description below focuses on harbour porpoise as this species is the most abundant in the area and is the Primary Feature of the Southern North Sea SAC.

10.3.2.1 Harbour porpoise

Harbour porpoise is the most common cetacean in UK waters, it is wide-ranging and abundant, both coastally and offshore, with the most sightings occurring in the coastal area, close to islands and headlands with strong tidal currents (DECC 2016). Harbour porpoise generally prefer coarser sediments (sand and gravel) which is the habitat of sandeel, a known prey species (DECC 2016b; JNCC 2017a). Many sightings of harbour porpoise have been recorded by the SeaWatch Foundation for south east England (Table 10-2).

The Proposed Development crosses the Greater North Sea marine mammal MU. Harbour porpoise survey data was analysed and modelled to determine areas of high porpoise density within the MU. These areas were then considered in order to identify a network of SACs recommended for the protection of harbour porpoise. Within the Greater North Sea MU there is currently one SAC; the Southern North Sea (SNS) SAC, which the Proposed Development crosses between KP86.1 and KP108.7; a distance of 22.6km. This European Marine Site along with others along the west coast of the UK will contribute towards maintaining the favourable conservation status of the wider population of harbour porpoise (JNCC 2017a).

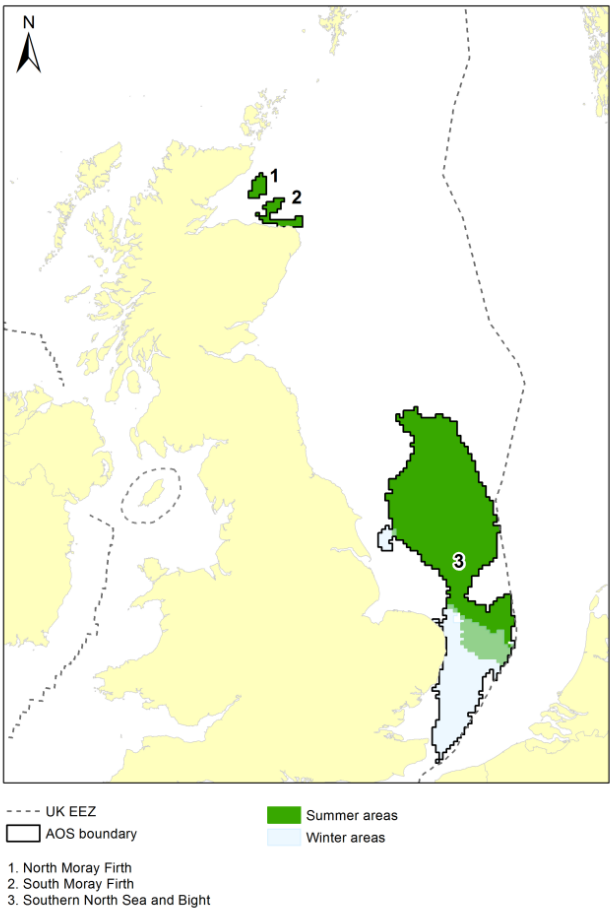
The SNS SAC is very large, covering an area of 36,951km^2, stretching from the central North Sea north of the Dogger Bank southwards to the Strait of Dover. It is estimated the SNS SAC supports at least 18,500 individuals for at least part of the year; representing approximately 17.5% of the population within the UK part of the North Sea MU (JNCC 2017a). The site's selection assessment document (JNCC 2017a) notes that harbour porpoise within the MU prefer water depths between 30 and 50m and that lower densities are observed in areas with high levels of shipping activity (based on a threshold of approximately 80 ships per day) (JNCC 2017a).

Within the MU animals are thought to move latitudinally between preferred summer and winter grounds. The southern part of the SNS SAC has been identified as important for harbour porpoise during winter months[1], while the northern part of the SNS SAC has been identified as important for harbour porpoise during summer months (Figure 10-1). The Proposed Development crosses the

[1] Defined by the JNCC as 01 October to 31 March.

southern area of the SNS SAC. The southern winter ground covers an area of approximately 12,500km² km², equivalent to 34% of the entire SAC (36,951km²).

Figure 10-1 Overview of seasonal movements of harbour porpoise within the Southern North Sea SAC

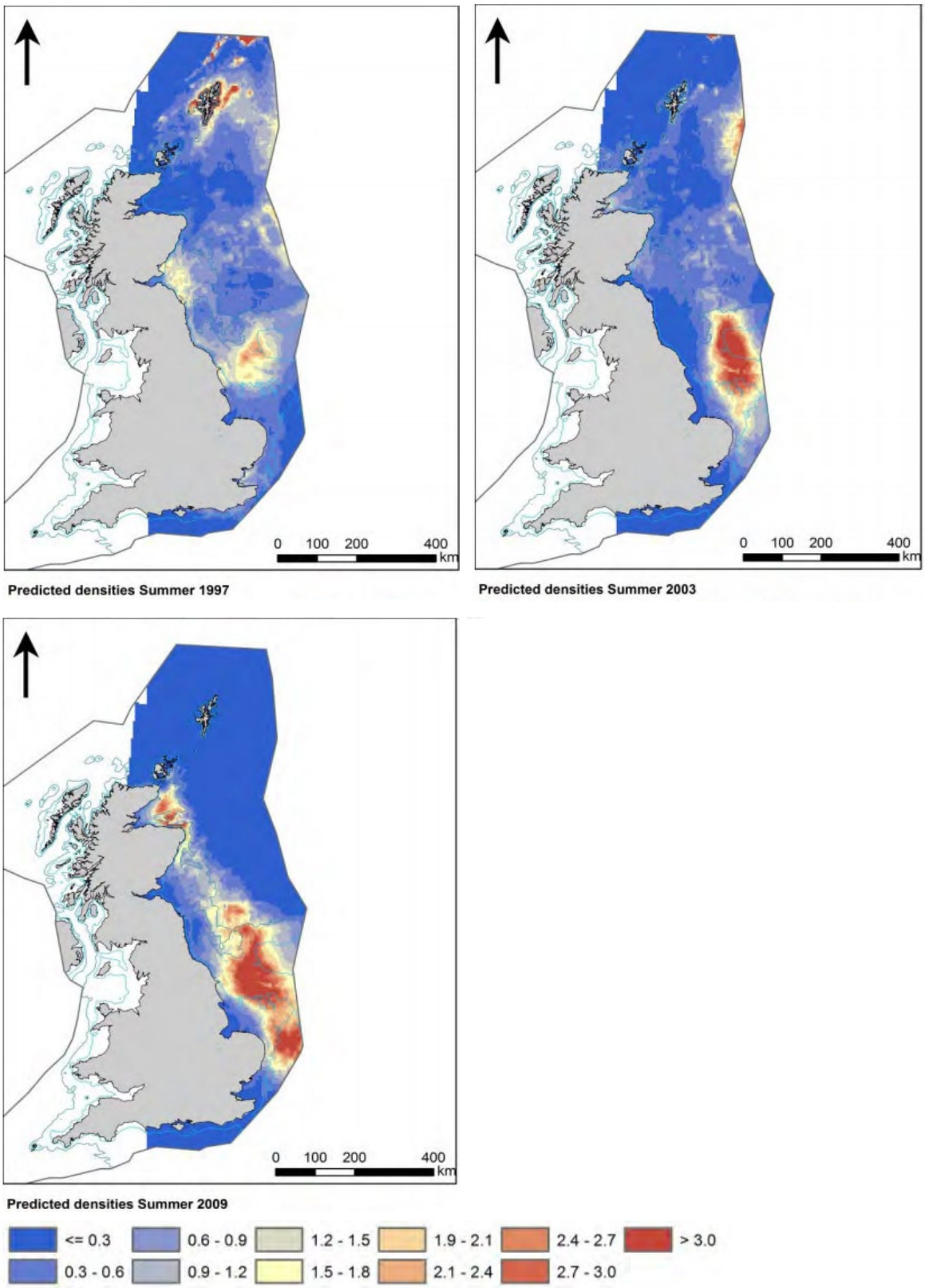


Source: IAMMWG (2015).

Harbour porpoise distribution maps published by Heinanen and Skov (2015), Figures 10-2 and 10-3, indicate that observed densities of harbour porpoise in the region surrounding the Proposed Development during summer are estimated to be <0.3 animals per km^2 for the period 1997 – 2009. In winter, predicted densities increase to >3 animals per km^2 (modelled data for 1997, 2003/2004 and 2009). Table 10-2 indicates that harbour porpoise density could be as high as 0.607km^2 noting that this figure is based on one year of survey data, rather than an average.

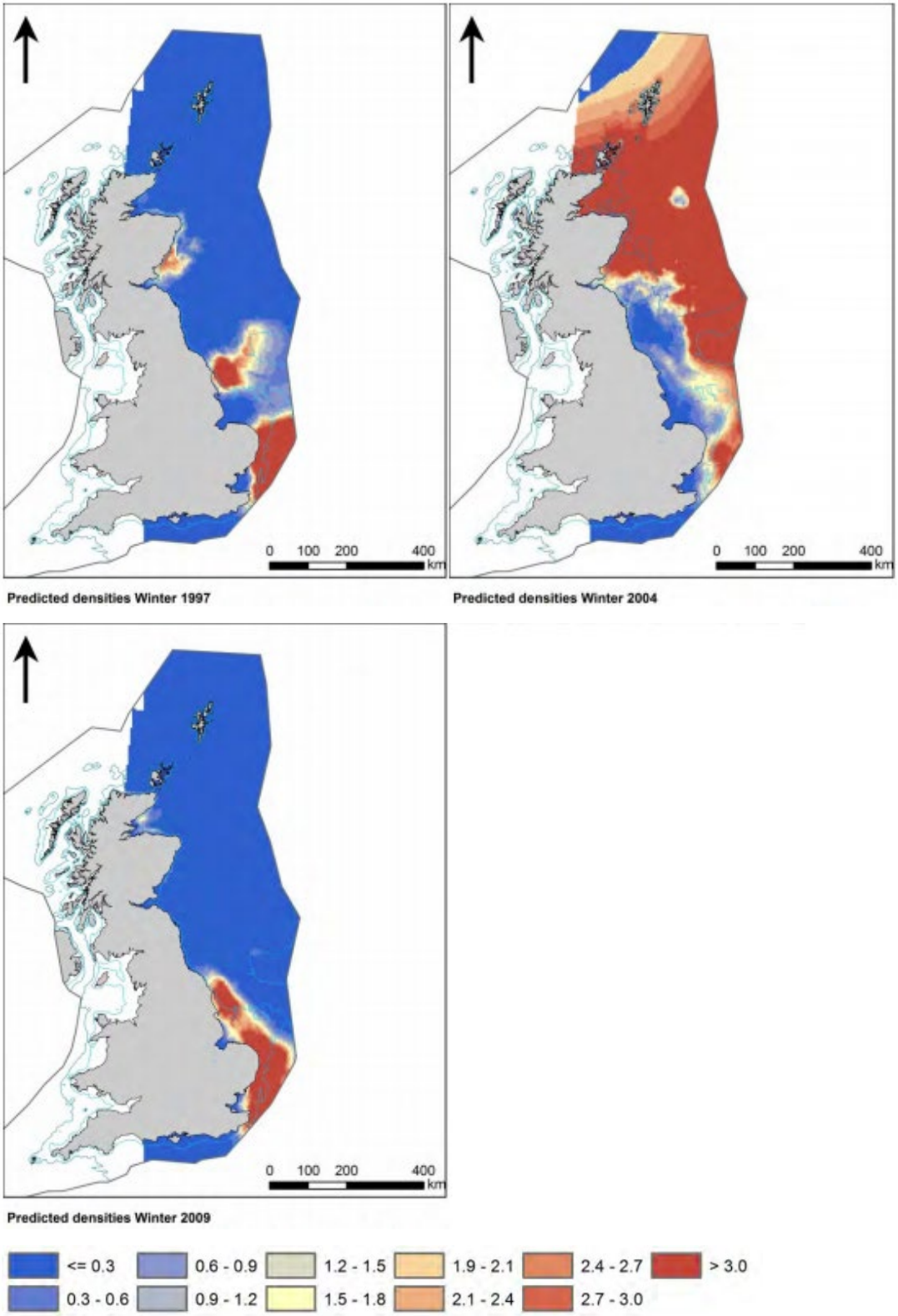
To summarise, harbour porpoise is likely to be present within the Proposed Development in low numbers throughout the year, but densities will be higher during winter months (October to March, inclusive).

Figure 10-2 Estimated densities of harbour porpoise in the Greater North Sea MU during summer months



Source: Heinanen and Skov (2015)

Figure 10-3 Estimated densities of harbour porpoise in the Greater North Sea MU during winter months



Source: Heinanen and Skov (2015)

10.3.3 Pinnipeds

Grey seals (*Halichoerus grypus*) and harbour seals (*Phoca vitulina*) (also called common seals) live and breed in UK waters. Both species breed at haul out sites along the Kent coast, Thames Estuary and Norfolk coast (Reiss *et al.* 2010). There is a haul-out site used by both grey and harbour seals on Goodwin Sands, a series of sandbanks which lie approximately 6.5km southeast of the Proposed Development at the closest point. The sandbanks are within the Goodwin Sands Marine Conservation Zone (MCZ); which the Proposed Development crosses from ~KP82 to ~KP92 (a distance of 10km).

There are an estimated 1,000 seals in the south and southeast regions, two thirds of which are grey seal with a smaller number of harbour seal (Balanced Seas 2011). The Special Committee on Seals (SCOS) (2015) (Reiss *et al.* 2010) reports an increase in grey seal pup production in colonies in southeast England and a stable population of harbour seal.

10.3.3.1 Grey seal

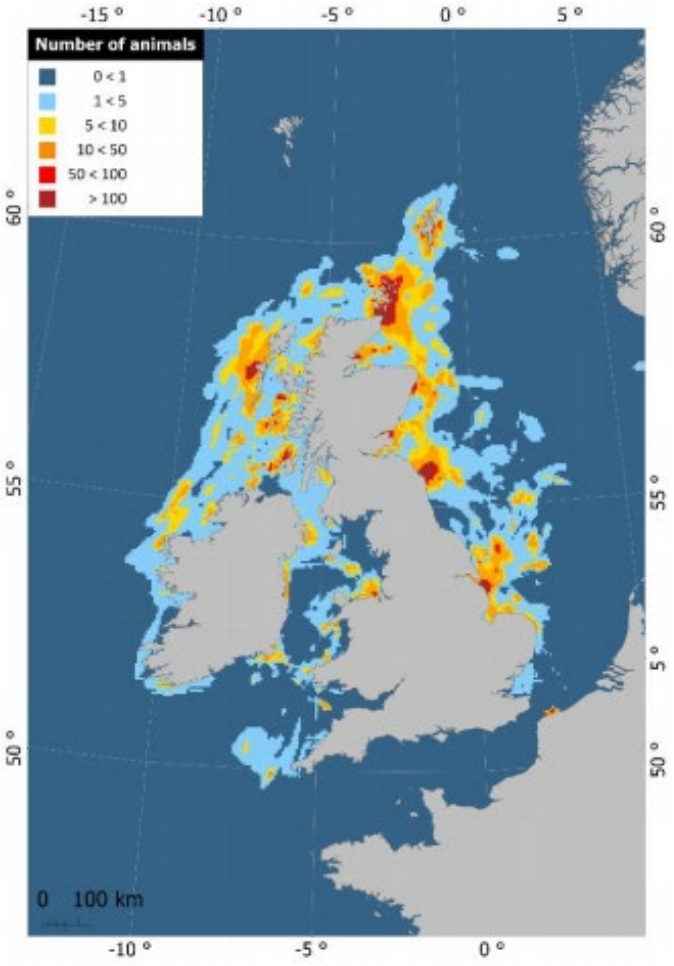
Grey seal are widespread around the shores of the UK, but population density varies greatly from place to place with low numbers recorded at many sites. Grey seal are mainly distributed around and between haul-out sites and foraging areas and are more commonly seen in the central and northern North Sea than in the southern North Sea (DECC 2016b). Seal populations within the Thames Estuary are rising. Barker et al. (2014) observed a sharp increase in the density of grey seal at the Goodwin Sands haul-out site, rising from 143 individuals in 2013, to 347 individuals in 2014.

Foraging trips can range up to an excess of 100 km from haul-out sites. Sightings of grey seal along the Proposed Development are infrequent (1- 5 individuals per 5km^2), as illustrated in Figure 10-4. No conservation areas have been designated for protection of grey seal within 100km of the Proposed Development.

10.3.3.2 Harbour seal

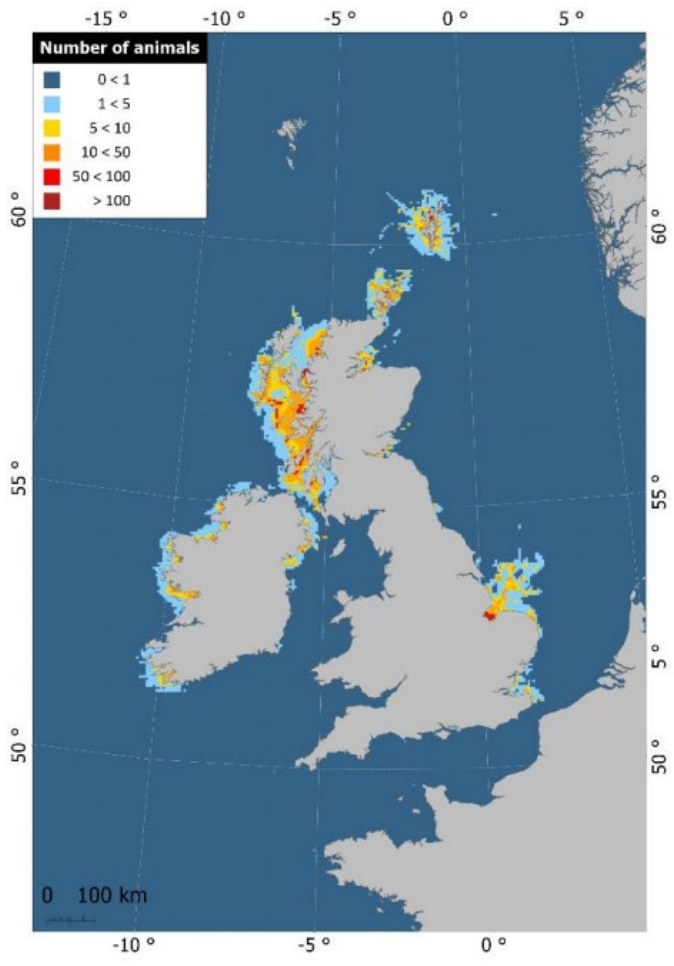
Harbour seal are present in coastal waters around the Proposed Development throughout the year. The population size estimate is approximately 5,000 individuals in Southeast England. The distribution of harbour seal at sea is usually within their foraging range of 50km from the preferred haul out site, however, is limited by the need to return to land periodically. Pupping time occurs during summer from June until August and moulting at haul outs generally occurs in August (Galloper Wind Farm Limited 2011). During this time animals are more frequently observed at haul out sites and are less likely to be offshore. Sightings of harbour seal around the Proposed Development are generally infrequent (up to 5 to 10 individuals per 5 km^2), as illustrated in Figure 10-5. There are important breeding and haul out sites for harbour seal around the SNS. The closest known haul-out sites to the Proposed Development are Goodwin Sands, 6.5km southeast and Horse Sands, at the mouth of the Swale estuary (Russel *et al.* 2017), approximately 8.5km from the Proposed Development. No conservation areas have been officially designated for the protection of harbour seals within 50km of the Proposed Development.

Figure 10-4 Grey seal at-sea usage: mean



Source: Russell *et al* (2017)

Figure 10-5 Harbour seal at-sea usage: mean



Source: Russell *et al* (2017)

10.3.4 Marine reptiles

There are seven marine turtle species throughout the world's oceans, of these, five have been recorded in UK waters;

- Leatherback turtle (*Dermochelys coriacea*);
- Loggerhead turtle (*Caretta caretta*);
- Kemp's ridley turtle (*Lepidochelys kempii);*
- Green sea turtle (*Chelonia mydas*); and
- Hawksbill turtle (*Eretmochelys imbricata*).

The leatherback turtle is the most commonly sighted reptile in the UK (accounting for 88% of sightings) with an average of 33 sightings a year. However, most turtle sightings are on the west and south coasts of Ireland, southwest England, south and northwest Wales, the west coast of Scotland, Orkney and Shetland. There have only been two recorded sightings from 2000-2011 in the marine area surrounding the Proposed Development (DECC 2016b). In December 2019, there was a stranding in Mundon Creek, along the Essex coast (approximately 50km from the Proposed Development) reported on by news outlets (BBC 2019). It is considered unlikely that marine turtles will be found along the Proposed Development and they have therefore been scoped out of the significance assessment.

10.3.5 Protected species and species of conservation importance

10.3.5.1 Legislative protection

There is legislation in place which protects marine mammals in UK waters. Table 10-3 summarises key legislation and how it applies to the species identified as present in the Proposed Development.

Table 10-3 Legislation protecting marine mammals

Legislation / Convention		Cetaceans	Pinnipeds
The Conservation of Offshore Marine Habitats and Species Regulations 2017	Include the necessary legal measures to fulfil the requirements of: ▪ The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention); and ▪ EC Habitats Directive (particularly in relation to European Protected Species)	✓	*
The Conservation of Habitats and Species Regulations 2017		✓	*
Wildlife and Countryside Act 1981 – Schedule 5		✓	*
Convention on International Trade in Endangered Species of Wild Fauna and Flora (1975)		✓	*
OSPAR (Convention for the Protection of the Marine Environment of the North-East Atlantic) list of threatened and/or declining species		Harbour porpoise	
Conservation of Seals Act 1970	Section 1 protects all seals from 0 to 12 nautical miles		✓
Conservation of Seals Order 1999	Protected all year round from being killed, injured or taken on the south-east English coast		✓

* Listed as animals which may not be taken or killed in certain ways

All cetaceans are listed on Annex IV of the EC Habitats Directive as European Protected Species. It is an offence to deliberately kill, injure or disturb animals classed as EPS.

The Southern North Sea SAC, designated for harbour porpoise, is the only protected site within the vicinity of the Proposed Development with a marine mammal as a designating feature.

10.3.5.2 UK Biodiversity Action Plan (BAP) Priority Species

The following species are listed as UK BAP priority species[2]. Species on the UK BAP list have been identified as being the most threatened in UK waters and require conservation action to conserve their populations (JNCC 2019c). Only those in bold below have previously been sighted throughout waters in, or near to, the Proposed Development:

- **Minke whale**
- **Common short-beaked dolphin**
- **Long finned pilot whale**
- Risso's dolphin
- Atlantic white-sided dolphin
- **White beaked dolphin**
- Killer whale
- **Harbour seal**
- **Harbour porpoise**
- Striped dolphin
- **Common bottlenose dolphin**

10.4 Potential Pressure Identification and Zone of Influence

A scoping exercise undertaken to inform the content of the EA has excluded the following pressures from further consideration in this topic Chapter. Explanation for the exclusion is provided in Chapter 4, Table 4-1.

- Hydrocarbon and PAH contamination
- Temperature changes (local)
- Visual disturbance
- Death or injury by collision

Review of the baseline has identified that marine reptiles are unlikely to be present within the Proposed Development, and therefore they will not be assessed in the following sections.

The pressures listed in Table 10-4 will be assessed further. For each pressure the assessment considered the different aspects of the Proposed Development during installation, operation (including repair & maintenance) and decommissioning. In order to evaluate the most significant effects, the largest zone of influence from these aspects was selected. The zones of influence are also presented in Table 10-4.

Table 10-4 Pressure identification and zone of influence – marine mammals and marine reptiles

Potential Pressure	Aspect	Project Phase	Project Activity	Receptor	Zone of Influence (m)*
Underwater noise changes - physical injury	Continuous noise	Installation	Vessel movements. Cable burial. Deposit of external cable protection	Cetacean	133m
				Pinniped	1m
Underwater noise changes - disturbance		Operation		Cetacean Pinniped	1.2km
		Decommissioning	Vessel movements. Cable removal		
Underwater noise changes – physical injury	Impulsive noise	Installation	Geophysical survey pre- and post-installation	Cetacean	93m
				Pinniped	18m
		Operation	Inspection survey	Cetacean	924m

[2] Included on the 2007 list: JNCC (2019c)

Potential Pressure	Aspect	Project Phase	Project Activity	Receptor	Zone of Influence (m)*
Underwater noise changes - disturbance		Decommissioning	Survey	Pinniped	
Underwater noise changes - physical injury	Impulsive noise	Installation	Unexploded ordnance detonation (if required)	Cetacean	2.3km
				Pinniped	1.3km
Underwater noise changes - disturbance		Operation		Cetacean	5.9km
				Pinniped	
Electromagnetic changes – impairment of navigation or orientation	Magnetic fields (B fields)	Operation	Presence of cables	Cetaceans	10m from buried cables

* Zone of influence for underwater noise pressures taken from Technical Appendix I – Underwater Noise Modelling. Zone of influence for EMF taken from Technical Appendix D – Marine Effects of Electro-Magnetic Fields (EMF).

10.5 Embedded Mitigation

The embedded mitigation relevant to marine mammals and marine reptiles is provided in Table 10-5 below. When undertaking the assessment, it is assumed that these measures will be complied with.

Table 10-5 Embedded mitigation

ID	Embedded mitigation measure	Project phase		
		I	O	D
EM3	Submarine cables will be bundled together		■	
EM34	All vessels (exceeding 20m) shall not exceed 14 knots during operations within the Marine Licence Application Area to protect marine mammals from ship strikes.	■	■	■
EM43	Sub-bottom profiling and multi-beam and echo-sounder surveys shall comply with the JNCC guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys (JNCC 2017) (or subsequent amendments).	■	■	■
EM44	A UXO survey will be undertaken within the UXO Survey Corridor to identify anomalies. If any significant UXO is identified, the decision-making hierarchy taking into account environmental sensitivities, safety and technical considerations shall be: 1. Avoid by micro-routeing 2. If the UXO cannot be avoided, undertake clearance to surface or move UXO outside the cable installation corridor 3. If the UXO cannot be safely moved, clearance by on-site deflagration	■		
EM45	UXO clearance by deflagration shall comply with the JNCC guidelines for minimising the risk of injury to marine mammals from using explosives (JNCC 2010, or as updated), including: a) Establishment of a default 1km mitigation zone for marine mammal observation, measured from the explosive source and with a circular coverage of 360 degrees b) Provision of two trained marine mammal observers (MMO) to implement the JNCC guidelines c) Provision of a Passive Acoustic Monitoring (PAM) to be operated by a suitably trained and experienced MMO to support visual observations. d) Commencement of explosive detonations only during daylight hours and good visibility	■	■	

ID	Embedded mitigation measure	Project phase		
		I	O	D
	e) Accurate determination of the amount of explosive required for the operation, so that the amount is proportionate to the activity and not excessive. f) If necessary, planning of a sequence of multiple explosive discharges so that, wherever possible, the smaller charges are detonated first to maximise the 'soft-start' effect. g) if the UXO identified is greater than 10kg then a soft-start procedure shall be used whereby charges of 50g, 100g, 150g, and 200g will be deployed at 5 minute intervals with a further 5 minute interval before the detonation of the UXO.			
EM46	The GridLink Marine Mammal Mitigation Plan will be implemented for all marine operations and UXO deflagrations.			

10.6 Significance Assessment

10.6.1 Summary of Assessment

Table 10-6 and Sections 10.6.2 to 10.6.3 presents the assessment conducted on the Proposed Development. Where the assessment concluded the effects are potentially significant, Project Specific Mitigation has been proposed and is described in Section 10.7. Where there is still potential for residual effects after Project Specific Mitigation, this is discussed further in Section 10.8.

Table 10-6 Assessment Summary – Marine mammals

Determination of potential effect						Assessment			Consideration of mitigation	Residual effect assessment		
Section	**Project Phase**	**Aspect**	**Embedded mitigation (Table 10-5)**	**Pressure**	**Receptor**	**Magnitude**	**Sensitivity**	**Significance**	**Project Specific Mitigation (Table 10-11)**	**Magnitude**	**Sensitivity**	**Significance of Residual Effect**
10.6.2	Installation	Impulsive noise - UXO detonation	EM44, EM45, EM46	Underwater noise changes - injury	Harbour porpoise	Medium	High	Major	PS10, PS11, PS44, PS45	Low	Medium	Minor
					Other EPS and pinnipeds	Medium	High	Major		Low	Medium	Minor
				Underwater noise changes - disturbance	Harbour Porpoise	Low	High	Moderate		Low	Medium	Minor
					Other cetaceans and pinnipeds	Low	High	Moderate		Low	Medium	Minor
	Installation Operation Decommissioning	Impulsive noise – Geophysical survey	EM43, EM46	Underwater noise changes - injury	Harbour porpoise	Negligible	High	Negligible	-	-	-	-
					Other cetaceans and pinnipeds	Negligible	High	Negligible	-	-	-	-
				Underwater noise changes - disturbance	Harbour porpoise	Negligible	High	Negligible	-	-	-	-
					Other cetaceans and pinnipeds	Negligible	High	Negligible	-	-	-	-
	Installation Operation Decommissioning	Continuous noise	-	Underwater noise changes - injury	Harbour porpoise	Negligible	High	Negligible	-	-	-	-
					Other cetaceans and pinnipeds	Negligible	High	Negligible	-	-	-	-
				Underwater noise changes - disturbance	All cetaceans and pinnipeds	Negligible	High	Negligible	-	-	-	-
10.6.3	Operation	Magnetic field (B fields)	EM3	Electromagnetic changes – impairment of navigation or orientation	All cetacean species	Negligible	Negligible	Negligible	-	-	-	-

10.6.2 Underwater noise changes

10.6.2.1 Installation, Operation (including maintenance and repair) and decommissioning

One of the most important environmental concerns related to the installation, operation (including maintenance and repair) and decommissioning of the Proposed Development, is the potential effects of underwater sound. Sound inputs to the marine environment will be generated by geophysical survey; vessel movements; drilling the shore crossing; sand wave preparation (pre-sweeping); cable trenching; deposit of external cable protection; and if required, UXO detonations.

Both cetaceans and pinnipeds have evolved to use sound as an important aid in navigation, communication and hunting (Richardson *et al*. 1995). It is generally accepted that exposure to anthropogenic sound can induce a range of behaviour effects to permanent injury in marine mammals. Loud and prolonged sound above background levels is considered to be noise and may have an effect on marine life. This may mask communicative or hunting vocalisations, preventing social interactions and effective hunting.

High intensity noises such as those from UXO detonation can cause temporary or permanent changes to animals' hearing if the animal is exposed to the sound in close proximity and, in some circumstances, can lead to the death of the animal (Richardson *et al*. 1995). Where the threshold of hearing is temporarily damaged, it is considered a temporary threshold shift (TTS), and the animal is expected to recover. If there is permanent damage (permanent threshold shift (PTS)) where the animal does not recover, social isolation and a restricted ability to locate food may occur, potentially leading to the death of the animal (Southall *et al*. 2007). In addition to auditory damage, the pressure front resulting from an underwater explosion can cause trauma (direct or indirect blast wave effect injury) such as crushing, fracturing, hemorrhages, and rupture of body tissues caused by the blast wave, resulting in immediate or eventual mortality.

Behavioural disturbance from underwater sound sources is more difficult to assess than injury and is dependent upon many factors related to the circumstances of the exposure (Southall *et al*. 2007, NFMS 2018). An animal's ability to detect sounds produced by anthropogenic activities depends on its hearing sensitivity and the magnitude of the noise compared to the amount of natural ambient and background anthropogenic sound. In simple terms for a sound to be detected it must be louder than background and above the animal's hearing sensitivity at the relevant sound frequency. The direction of the sound is also important.

Introduced sound may cause behavioural responses in animals, such as individuals moving away from the zone of disturbance and remaining at a distance until the activities have passed. There may also be changes in foraging, migratory or breeding behaviours; all factors that can affect the local distribution or abundance of a species. Introduced sound may also cause masking or disruption of the animal's own signals, whether used for communication, foraging or other purposes. This may in turn affect foraging and reproductive opportunities. Behavioural disturbance to a marine mammal is hereafter considered as the disruption of natural behavioural patterns, for example: feeding, migration, breeding and nursing.

To calculate the zone of influence for both levels of effect (injury and disturbance) an assessment has been conducted which combines literature review with underwater sound modelling. Sound propagation modelling was used to determine the range at which the received sound attenuates to levels below defined thresholds for injury and disturbance. The assessment has used the recently published Southall et al (2019) thresholds for the onset of PTS and TTS. These reflect the current peer-reviewed published state of scientific knowledge.

The sound levels, injury and disturbance thresholds, the modelling approach and the resulting zones of influence are described and provided in full in Technical Appendix I – Underwater Noise Modelling; the key information relevant to the assessment is summarised below.

Southall et al (2019) separate marine mammals into auditory groups based on their functional hearing sensitivity as summarised in Table 10-7.

Table 10-7 Marine mammal groups based on auditory bandwidth

Group (based on auditory bandwidth)	Species observed along the Proposed Development	Auditory range
Low-frequency cetaceans (LF)	Minke whale, Humpback whale, Fin whale	7Hz - 35kHz
High frequency cetaceans (HF)	Short-beaked common dolphin, Common bottlenose dolphin, White-beaked dolphin, Long-finned pilot whale, Northern bottlenose whale	150Hz – 160kHz
Very high frequency cetaceans (VHF)	Harbour porpoise	275Hz - 160kHz
Phocid carnivores in water (PCW)	Grey seal, harbour seal	56Hz - 86kHz

Underwater sound is classified into two distinct types: impulsive and continuous (i.e. non-pulse). Activities undertaken during the three phases of the Proposed Development fall into both categories. Table 10-8 summarises the zones of influence for each sound category, activity and marine mammal auditory group as calculated in Technical Appendix I. It should be noted that these zones of influence represent the conservative worse case, excluding consideration of existing background noise level so should be used for information rather than prescriptively as explained in the discussion below.

Table 10-8 Zones of influence for each sound category, activity and marine mammal group (excluding consideration of background noise)

Type of Noise	Activity	I	O	D	Zone of influence				
					Injury (onset of TTS)				Disturbance
					LF	HF	VHF	PCW	All auditory groups
Impulsive	UXO deflagration	✓	✓		1.3km	0.7km	2.3km	1.3km	5.9km
	UXO deflagration – SNS SAC	✓	✓		1.0km	0.6km	1.9km	1.0km	5.6km
	Geophysical survey	✓	✓	✓	14m	2m	93m	18m	924m
Continuous	Vessel movements. Cable trenching. Deposit of external cable protection	✓	✓	✓	4m	4m	133m	1m	1.2km

Key: I = Installation, O= Operation (including maintenance and repair), D = Decommissioning

Between KP86.1 and KP 108.7 (a distance of 22.6km) the Proposed Development crosses the Southern North Sea SAC; designated to conserve harbour porpoise. The Conservation Objectives and Advice on Operations published by the JNCC (2019d) for the SAC suggests:

"noise disturbance within a SAC from a plan/project individually or in combination is significant if it excludes harbour porpoises from more than:

1. *20% of the relevant area of the site in any given day, and*
2. *An average of 10% of the relevant area of the site over a season."*

The potential for underwater noise from the Proposed Development to have a significant effect on the integrity of the Southern North Sea SAC has been assessed within the GridLink Marine Habitats

Regulations Assessment (HRA) (provided as Technical Appendix E) using the above thresholds. The conclusions reached by the HRA are referenced as appropriate in the following sections.

Continuous sound – injury and disturbance effects

There is little information on potential effects of sound on marine mammals, resulting from the installation and operation of subsea cables; research has typically focused on high intensity impulsive sound sources such as seismic survey and piling. The Oslo and Paris (OSPAR) Convention (2012) considered that sound associated with the installation, removal or operation of submarine cables is less harmful compared to impulsive sound activities such as seismic surveys, military activities or construction work involving pile driving (OSPAR Convention 2012). However, frequent noise exposure can lead to longer term effects associated with continuous stress (National Research Council 2003). Chronic stress in marine mammals can result in infectious, neoplastic, allergic, inflammatory and autoimmune diseases, and also can reduce reproduction; however, stress-induced reactions are hard to identify (National Research Council 2003).

Intertek used an in-house geometric spreading calculation to determine the propagation of underwater sound from activities that generate continuous noise. The spreading model assumes that sound is spread geometrically away from the source with an additional frequency-dependent absorption loss. This provides conservative estimates for sound attenuation as it does not take into consideration the conditions within the area, such as bathymetry, water depth or sediment type and thickness; all which increase attenuation. The source level (SL) measured in RMS is time independent i.e. it is generated continuously at this level. For marine mammals exposed to non-impulsive noise e.g. continuous noise, Southall et al. (2019) provides thresholds at which PTS and TTS occur as sound exposure levels (SEL). The thresholds for SEL assumes that a receptor has to be exposed to a certain level of sound for a specified duration. Southall et al. (2019) does not provide the duration for the SEL thresholds however, NMFS (2016) specify 24-hour exposure for the same threshold values expressed as dB re 1µPa^{-2}s.

Table 10-8 summaries the distances calculated in Technical Appendix I within which animals could experience sound levels sufficient to cause the onset of injury or disturbance, assuming that they remained in the area for at least 24-hours.

Injurious effects

Technical Appendix I concluded that for all distances calculated for injurious effects (PTS and TTS) animals will be able to move away from the area where injurious noise levels could be experienced within minutes[3]; therefore avoiding all injurious effects. For example, the greatest zone of effect for TTS is 133m for VHF cetaceans e.g. harbour porpoise. It will take a harbour porpoise swimming at 1.5m/s less than 90 seconds to swim out of the 133m radius area. The sound exposure level (SEL) exposure thresholds assume that to experience TTS the harbour porpoise would have to remain within 133m of the source level for 24-hours. Therefore, the risk of actual injurious effects from any of the continuous noise sources is negligible.

Disturbance effects

With respect to disturbance effects, calculations suggest animals will have to be within 1.2km of a rock dump vessel for 24-hours for disturbance level effects to occur. Assuming a swim speed of 1.5m/s animals could leave the area within 15 minutes. This also assumes that vessel will be operating at maximum noise levels for 24-hours. In reality, rock placement is unlikely to be a continuous activity over 24-hours. At crossings, rock placement is likely to take approximately 3 hours. If rock berm is required for external cable protection (due to ground conditions preventing burial in sediment) it is

[3] It is assumed that all marine mammals except for minke whale will swim at a speed of 1.5m/s from a source level (Otani et al. 2000, Lepper et al. 2012); and that minke whale will swim at a speed of 3.25 m/s. This is a conservative estimate as there is data (McGarry et al. 2017, Kastelein et al. 2018, van Beest et al. 2018) to suggest that animals will swim at much higher speeds (e.g. harbour porpoise at 1.9m/s (Kastelein et al. 2018), at least initially.

possible that rock placement activities would take longer; potentially with vessel(s) present for extended periods. However, it is likely that the actual deposition would be sporadic, with breaks in the activity as vessel(s) would require re-loading and positioning, rather than continuous.

The deposit of external cable protection will occur at discrete locations, associated with third-party asset crossings and ground conditions unsuitable for burial. At any given location, assuming a 1.2km radius zone of influence, animals within approximately 4.5km^2 of the deposition location may be disturbed. For a location within the SNS SAC, this is equivalent to 0.01% of the whole site on any given day. Although the disturbance may be repeated on more than one day over the season it will still not exceed the 10% threshold for Significant disturbance in a season (as defined by JNCC 2019d)[4].

Behavioural impacts to marine mammals from project-related vessel noise are expected but are not extensive, severe or biologically significant. Impacts could include temporary disruption of communication or echolocation from auditory masking; behaviour disruptions of individual or localized groups of marine mammals; or limited, localized, and short-term displacement of individuals of any species from the immediate area around the vessels. These impacts will pass as the vessel moves through the area and normal behaviour will be re-established quickly.

It is important to note that the exceedance of the threshold for the onset of disturbance does not mean that disturbance will occur. It is also worth noting that the activities and noise sources modelled are temporary and transitory.

The sensitivity of all auditory groups has been assessed as high recognising that all animals will be sensitive to a change in underwater noise; and the status of cetaceans as EPS.

The magnitude of effect has been assessed as negligible. This is based on the discussion above which concludes that animals will be able to move out of the zone of influence within minutes avoiding all injurious effects; that Significant disturbance will not occur within the SNS SAC; and that animals are likely already habituated to higher levels of underwater noise due to the natural and anthropogenic noise in the region.

Conclusion

The overall significance of the effect has been assessed as **Negligible and Not Significant** for all cetaceans and pinnipeds.

<u>Impulsive sound: geophysical survey – injury and disturbance effects</u>

Geophysical survey conducted during the installation, operation and decommissioning phases will be limited in extent. The cable route surveys (already conducted) aquired data over a 500m wide area; any future surveys will be focused on the cable centerline and out to 50m either side. These types of survey are standard practice and are required to identify obstructions and debris along the centerline; confirm the seabed level pre- and post-installation; identify an UXO, sensitive habitats or seabed features that require micro-routeing around; and confirm the cables remain protected throughout the operational life-time.

Technical Appendix I indicates that in general noise levels generated by the chirper (sub-bottom profiler) will have a negligible effect on marine mammals, with most values not exceeding the thresholds for the onset of injury (PTS). Cetaceans in the auditory category VHF cetaceans such as harbour porpoise may experience noise levels at which the onset of TTS could occur within 2m of the vessel; but will be very unlikely to be in that zone as evidence (e.g. Stone and Tasker 2006, Stone et al. 2017) demonstrates animals move from the survey area.

The largest zone of influence, as reported in Table 10-8, will be generated by the multibeam echosounder. VHF cetaceans may experience noise levels at which the onset of TTS could occur within

[4] For the 10% threshold to be exceeded external cable protection would need to be deposited along a linear stretch approximately 230km in length. As the cable route within the SNS SAC is only 22.6km this threshold cannot be exceeded.

93m of the source level. Noise levels at which the onset of disturbance could occur are generated out to 924m from the survey equipment.

Evidence of the effects of geophysical surveys on cetaceans is limited but BEIS (2018) summarises the results of a study carried out in the Moray Firth that observed responses to a 10-day 2D seismic survey. The 2D seismic survey took place in September 2011 and exposed a 200km^2 area to noise throughout that period. A 470 cubic inch airgun array was used, which generated peak-to-peak source levels of 242-253 dB re-1µPa @ 1m[5]. A relative decrease in density of harbour porpoise within 10km of the survey vessel was reported. However, these effects were short-lived, with porpoise returning to the area within 19 hours after cessation of activities. BEIS (2018) also states that "information on the potential effects of other geophysical surveys (e.g. sub-bottom profilers) is currently very limited and the most recent UK Offshore Energy Strategic Environmental Assessment (DECC 2016a) concluded that effects are negligible but with a high degree of uncertainty".

For geophysical survey it is best practice to follow the JNCC guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys (JNCC 2017b). Adherence to the guidelines has been incorporated into the Proposed Development as embedded mitigation EM43. JNCC (2017b) affirms that adherence to the guidelines constitutes best practice and will, in most cases, reduce the risk of injury to marine mammals to negligible levels.

The sensitivity of all auditory groups has been assessed as high recognising that all animals will be sensitive to a change in underwater noise generated by geophysical survey; and the status of cetaceans as EPS.

For all cetaceans and pinnipeds, the magnitude of the effect has been assessed as negligible. Modelling has indicated that the marine mammals will have to be within a few metres of the survey vessel for injurious effects to occur, which is highly unlikely. Adherence to the JNCC guidelines will reduce the risk of injurious effects occurring. The proposed geophysical surveys would be restricted in duration and will progress slowly along the cable centreline within the Proposed Development. Animals will have sufficient time to avoid the survey vessel, and it is unlikely that they will swim over operating equipment. Animals may actively avoid the survey but as demonstrated by research in the Moray Firth will return to the area once the survey has passed through i.e. within a day if not hours. The surveys would therefore not act as a barrier to migration routes or cause significant short-term disturbance.

For harbour porpoise, the conclusion of negligible for the magnitude of the effect took into consideration the potential seasonality of the effect. Although the spatial extent of the effect will not change between summer and winter, the number of animals effected could change significantly given the seasonal use of the region in winter. There is the potential for high numbers of animals between KP86 and KP108 i.e. within the SNS SAC, during winter months. The Proposed Development crosses the SNS SAC for 22.6km. A geophysical survey of this distance can be completed within one day. Within that day approximately 41.8km^2 of the SNS SAC will experience noise levels at which the onset of disturbance may occur. This represents 0.11% of the area of the whole SAC and is below the threshold for 'Significant' disturbance as defined by JNCC (2019d).

The overall significance of the effect has been assessed as **Negligible and Not Significant** for all cetaceans and pinnipeds.

<u>Impulsive sound: UXO detonation (if required) – injury and disturbance effects</u>

It is unknown how many, if any, UXO detonations will be required within the Proposed Development. Ten detonations have been applied for within the Marine Licence Application as a precaution, however

[5] In comparison Technical Appendix G identifies that the highest sound pressure level will be generated by the MBES and will be 232 dB0-peak re 1µPa2-s

only two detonations are predicted throughout the installation period[6]. UXO encounters are predicted to be frequent, based on the experience of previous cable projects in the region, and results from the cable engineering survey. This is due to the Proposed Development crossing through previous World War I (WWI) and WWII sea mine fields, alongside areas of aerial bombing and military engagements.

The primary objective will be to avoid encountered potential UXO by micro-routeing within the Asset Placement Corridor (EM44). Typically, a standoff distance of 15-25m relative to potential UXO and depending on the nature of the UXO and installation method, is considered safe for cable installation purposes.

If re-routeing around a particular potential UXO appears not to be possible, this potential UXO will be investigated. If visual inspection confirms a UXO, then if it is safe to do so the UXO will be removed, or as a last resort detonation measures will be undertaken.

The potential for UXO detonation has been assessed as a worst case.

If UXO detonation is required, the Contractor shall comply with the JNCC guidelines for minimising the risk of injury to marine mammals from using explosives (JNCC 2010, or as updated) (EM45). This includes requirements to ensure that there are no marine mammals in the direct vicinity of the detonation e.g. visual searches of an established mitigation zone, only commence operations during daylight hours and good visibility; and soft-start procedures (as listed in Table 10-5).

If more than one UXO detonation is required, the Contractor shall seek to place the UXO together at one location so that one detonation can take place, or will programme the detonations so that the smaller charge is detonated first similar to a soft-start procedure.

Should UXO be found which require clearance by detonation it is assumed that there would be a relatively large release of impulsive sound energy, creating high amplitude shock waves (von Benda-Beckmann *et al.* 2015). Peak source levels would depend on the quantity and nature of explosive material. At close range there would be risk of mortality as relatively small quantities of explosive can result in significant sound pressure levels, e.g. Richardson et al. (1995) reported that 0.5kg of TNT was associated with a peak of 267dB re 1µPa @ 1m.

The GridLink UXO desk-based assessment (6 Alpha Associates 2019) identified a range of UXO likely to be encountered based on current and historical use of the area. These ranged from 5kg Allied Artillery Projectiles to 705kg German LMB mines.

To understand the potential effects of a UXO detonation on marine mammals two charge sizes (1.54kg, and 705kg) were modelled at three locations (Location 1 at KP30; Location 2 at KP70; and Location 3 at KP100). These locations cover the range of environments present along the Proposed Development. Location 1 represents typical conditions within the shallower parts of the Thames Estuary. Location 2 represents slightly deeper, coastal areas and Location 3 is within the Southern North Sea SAC for harbour porpoise so represents the most sensitive area for marine mammals. The modelling, presented in Technical Appendix I, concluded that sound will attenuate faster in summer, resulting in marginally smaller zones of influence compared to winter. Sound propagates slightly further at the coastal locations (Location 1 and Location 2) compared to in the open sea around Location 3.

High order detonations of UXO results in one of the of the loudest sources of underwater noise. Consultation with Cefas and JNCC with respect to UXO detonation identified that project specific mitigation in the form of noise abatement, temporal restrictions and acoustic deterrents will need to be considered for any high order detonations.

[6] This assumption is based on recent experience on NEMO Link were Intertek understand two detonations were required.

The 705kg charge was modelled principally to demonstrate the zone of influence for a high order detonation and therefore what effect mitigation (in the form of noise abatement i.e. low order detonation) will have in reducing the zone of influence for injury. The 1.5kg charge size modelled is representative of a low order detonation using deflagration - whereby the explosive in the UXO is burnt out rather than blown up, in effect neutralizing the charge. The deflagration process is described in Cheong et al. (2020) as *"the UXO casing is penetrated by a shaped charge that generates insufficient shock to detonate. The explosive material inside the UXO reacts with a rapid burning rather than a chain reaction that would lead to a full explosion. Deflagration is a much less energetic process and anecdotal evidence has suggested that it is "quieter" than traditional high-order detonation."*

Table 10-9 presents the results for both a high order detonation and a low order detonation in summer and winter and the 3 locations modelled. The zone of influence for a high order detonation is approximately 50% larger than for a lower order detonation for auditory injury (PTS and TTS) and 20% larger for disturbance effects.

Table 10-9 Zones of influence (metres) – high order detonation versus low order detonation

Auditory group		LF		HF		VHF		PCW		All cetaceans
Location	**Scenario**	**PTS**	**TTS**	**PTS**	**TTS**	**PTS**	**TTS**	**PTS**	**TTS**	**Disturbance**
Summer										
1	Low order (1.54kg)	815	1,131	420	615	1,731	2,151	865	1,166	5,848
1	High order (705kg)	1,941	2,346	1,261	1,596	3,032	3,402	2,006	2,406	7,114
2	Low order (1.54kg)	925	1,231	465	685	1,871	2,251	965	1,276	5,808
2	High order (705kg)	2,056	2,436	1,391	1,751	3,112	3,512	2,111	2,501	7,144
3	Low order (1.54kg)	744	1,013	356	544	1,553	1,917	788	1,057	5,623
3	High order (705kg)	1,733	2,105	1,133	1,453	2,805	3,218	1,793	2,165	7,012
Winter										
1	Low order (1.54kg)	845	1,116	425	625	1,756	2,126	890	1,156	5,903
1	High order (705kg)	1,936	2,281	1,246	1,621	2,967	3,317	2,011	2,331	7,379
2	Low order (1.54kg)	945	1,251	490	715	1,926	2,291	985	1,301	5,913
2	High order (705kg)	2,116	2,501	1,411	1,791	3,172	3,507	2,176	2,546	7,229
3	Low order (1.54kg)	724	984	356	544	1,525	1,893	764	1,033	5,559
3	High order (705kg)	1,705	2,065	1,125	1,425	2,777	3,178	1,769	2,129	6,928

The sensitivity of all auditory groups has been assessed as high recognising that all animals will be sensitive to a change in underwater noise generated by UXO detonation; and the status of cetaceans as EPS.

Injurious effects

The magnitude of the effect for injurious effects has been assessed as medium. Although the frequency of the impact from a high order detonation is brief i.e. change in sound pressures will last a few seconds and less than ten detonations may occur; the spatial extent is reasonably localised (3.5km); the effect of the change could be long-lasting. Depending on the timing of the detonation, with winter being more sensitive, large numbers of animals could be present in the zone of influence. For example, during winter densities of harbour porpoise within the SNS SAC exceed 3 animals per km^2. A high order detonation during this season has the potential to injure approximately 115 harbour porpoise. This figure could be reduced to between 12 and 24 animals if the UXO is detonated in summer when densities are between 0.3 and 0.6 animals per km^2. The loss of this number of animals has the potential to have a short- to medium-term effect on the population structure of the harbour porpoise within the SAC, such that it will take time for the population to recover from a loss of animals. In addition, it is an offence to deliberately injure an EPS under The Conservation of Offshore Marine Habitats and Species Regulations 2017 and The Conservation of Habitats and Species Regulations 2017.

For **injurious effects**, it is concluded that the overall effect of a high order UXO detonation (if required) is **Major and Significant** and that project specific mitigation in the form of noise abatement, seasonal restrictions and acoustic deterrents is necessary.

Disturbance effects

With respect to disturbance, the magnitude of the effect has been assessed as low. For any locations within the Thames Estuary, assuming a 7.4km radius zone of influence (based on the worst-case of a high order detonation during winter), animals within approximately 172km^2 of the detonation site may experience noise levels that could cause disturbance, if high order UXO detonation is used. The zone of influence is reduced to 7.0km within the SNS SAC, giving an approximate zone of influence of 154km^2. When considering the JNCC, NE and DEARA (2020) thresholds for significant disturbance, this is equivalent to 0.4% of the entire SNS SAC and 1.2% of the winter area which is below the threshold for 'Significant' disturbance as defined in the guidance. Using the EDR of 26km the area affected increases to 2124km^2; equivalent to 5.75% of the SAC; and 17% of the winter area. This is still below the 20% threshold for significant disturbance in any one day.

Although the impulsive noise generated by the UXO detonation is brief, it is not a sound that animals can move away from, as is the case with continuous noise sources. The pressure wave associated with the UXO detonation will pass quickly though the area after the detonation. To be able to avoid disturbance, animals must be pre-warned and encouraged to leave the area ahead of the detonation. For this reason, although it is below the threshold for significant disturbance as defined by JNCC (2019d) it is considered appropriate that the overall significance of the disturbance effect is **Moderate and Significant**, and additional mitigation should reduce the potential for effects.

The Stage 1 Screening identified that there is the potential for a Likely Significant Effect (LSE) on Harbour porpoise within the SNS SAC from: underwater noise changes resulting from the high order detonation of UXO and in combination effects.

In light of the conclusion of Significant effects, Project Specific Mitigation has been proposed in Section 10.7 and an assessment of the significance of the residual effect post-mitigation is provided in Section 10.8.

10.6.3 Electromagnetic changes

Technical Appendix D provides a detailed assessment (based on scientific evidence) of the potential effects of electromagnetic fields on cetaceans. It establishes a threshold of sensitivity for cetacean of 460 µV/m for induced electrical (iE) fields.

The cables will be buried to a minimum of 1.5m below the seabed. The calculated induced electrical (iE) fields at the seabed are between 34 µV/m and 89 µV/m. This is well below the 460 µV/m sensitivity threshold for cetaceans.

It is expected that cetaceans will be unaffected by magnetic fields from the GridLink cables for the following reasons:

- Owing to their predominantly pelagic existence.
- The increase in magnetic field at the seabed above the cable is within the natural variation in the Earths geomagnetic field.
- Rapid attenuation of the B field to background levels or below within 10 m of the cables.
- The water depth greater than 10m over most of the route.
- Lack of evidence of effects upon cetaceans.

In conclusion, the magnitude of the effect has been assessed as negligible and it is very unlikely that marine mammals will be exposed to fields which could cause behavioural effects. As cetaceans are EPS the receptor value could have been categorised as high. However, expert judgement has reduced this to negligible as a classification of high would suggest that the cetacean have low tolerance to the change and they would not recover, effectively resulting in injurious effects to the population. The assessment has concluded that it is highly unlikely that cetaceans will be sensitive to the localised change and therefore a classification of negligible is more appropriate; as the species population viability will not be affected by the pressure. The assessment therefore concluded that the significance of the effect will be **Negligible and Not Significant**.

There is no current evidence to suggest that pinnipeds are directly influenced by, sensitive to, or use the Earth's magnetic fields for navigation, therefore no effect on seal species is expected.

10.7 Project Specific Mitigation

In addition to the embedded mitigation outlined in Table 10-5, Table 10-10 presents Project Specific Mitigation that will be implemented.

Table 10-10 Project Specific Mitigation – marine mammals

ID	Project Specific Mitigation Measure
PS10	If required, UXO deflagration will be undertaken between 01 April and 31 September (to avoid effects on harbour porpoise).
PS11	Lofitech AS seal scarer acoustic deterrent device (ADD) or similar will be used prior to UXO deflagration in accordance with the GridLink Marine Mammal Mitigation Plan for all UXO deflagrations.
PS44	Deflagration charges will be used on all UXO.
PS45	With respect to UXO deflagration, GridLink will ensure that UXO deflagration for the project in UK and French sectors will not occur on the same day and will liaise with the MMO to: 1. Inform the MMO of potential UXO clearance requirements and proposed schedule. 2. Confirm with the MMO if any projects in the region will be undertaking piling or UXO detonation/deflagration that overlaps with the proposed schedule. 3. Confirm if UXO deflagration should be coordinated with other developers in the region to reduce potential cumulative effects within the SAC

10.8 Residual Effect

The assessment presented in Section 10.6 identifies that the pressure underwater sound changes could have significant effects, with respect to the detonation of UXO (if required). The significance of

this pressure was re-assessed taking into consideration the Project Specific Mitigation outlined in Section 10.7 to determine if a significant residual effect remains.

10.8.1 Underwater noise changes

10.8.1.1 UXO detonation (if required)

If high order UXO detonation is required it is concluded that there will be a Significant effect on marine mammals, which may include physical injury or death from exposure to large and sudden pressure changes at close range. In addition, it cannot be ruled out that a potential cumulative or transboundary effect will occur.

The GridLink Marine HRA screening identified that there was a potential LSE on the SNS SAC Primary Feature 'Harbour porpoise' from underwater noise changes resulting from the high order detonation of UXO either alone or in-combination with other plans and projects in the region. In addition, there is the potential for a likely significant transboundary effect on the Primary Features harbour porpoise, grey seal and common seal of the Bancs des Flandres SAC in France. Appropriate Assessment for both European sites is therefore required.

There are three main categories of noise mitigation which can be applied to UXO detonation namely:

1. Noise abatement / reduction i.e. methods that reduce the sound energy emitted into the environment, namely:

- Deflagration which reduces the source level.
- Barrier methods which attenuate the emitted sound, for example bubble curtains.

2. Spatial – temporal restrictions i.e. dictating when the activity can take place to minimise effects on sensitive receptors, including:

- Real time restrictions for example, halting the activity temporarily in response to detection of marine mammals using visual or passive acoustic monitoring.
- Seasonal restriction based on known density distributions of sensitive species.

3. Acoustic deterrents i.e. methods that introduce additional noise of lower intensity before the more harmful noise with the intention of dispersing animals, including:

- Use of acoustic deterrent devices (ADD).
- Use of small scare charges (often referred to as soft-start charges) deployed before the main charge is initiated.

With respect to the above categories, the noise abatement, spatial and temporal restrictions and acoustic deterrents as described below are proposed. The range of industry standard best practice mitigation which has been proposed has proven successful on similar projects across the Southern North Sea and UK.

1. Avoid the need for detonation

The most effective mitigation is to avoid the need for detonation completely. Embedded mitigation EM44 seeks to do this by establishing a decision-making strategy in which UXO detonation is the last option.

This decision-making strategy will be supported by a UXO survey, to be carried out prior to installation. The survey typically covers an area of seabed 50m either side of the proposed centreline, although this may be refined by specific constraints. The survey will identify magnetic anomalies within the Asset Placement Corridor which will be categorised depending on their attributes as likely or potential UXO. If anomalies cannot be avoided by routeing, a visual inspection of the anomaly will be made.

Visual inspections will be made by a suitably qualified survey contractor and Explosives Ordnance Detonation (EOD) expert. For each confirmed UXO a disposal strategy will be determind with detonation only considered as the last resort.

If UXO detonation is the only feasible option, the target may either be detonated in-situ (typically the preferred option for health and safety reasons), or relocated on the seabed and then detonated. Relocation will occur when detonating in-situ would compromise the safety of vessels, third party assets, or the public; where the detonation site is located close to a sensitive receptor e.g. a shellfishery; or where one UXO is relocated close to another to allow a single detonation to take place.

If a UXO detonation is required, the Marine Mammal Mitigation Plan (embedded mitigation EM46) will be updated to consider the exact UXO size and location to confirm the risk.

2. Noise abatement - Use of deflagration for all charge sizes

Deflagration (low order detonation) will be used on all charge sizes that require in-situ disposal (PS44).

Deflagration is a much less energetic process and anecdotal evidence has suggested that it is "quieter" than traditional high-order detonation." Cheong et al. (2020) reports that US test studies show that low-order detonation procedures are very effective in reducing blast effects with a yield reduction exceeding 97% in comparison to the equivalent high-order detonation. This is supported by the underwater noise modelling presented in Technical Appendix I which shows an approximate 50% decrease in the zone of influence in comparison to a high order detonation.

Cheong et al. (2020) reports the results of an experimental trial conducted in Limehillock Quarry, Scotland to study the acoustic characteristics of underwater explosions, including low order detonation by deflagration. The study observed more than 20dB reduction in peak sound pressure levels (SPL) and sound exposure levels (SEL) between high-order detonations and low-order detonations of the same charge size. The data clearly showed that low-order detonations "offer a much lower amplitude of peak sound pressure than high-order detonations (by a factor of approximately 10 [in our trials])" Cheong et al. (2020). The study concluded that low-order deflagration is an effective mitigation measure.

Deflagration involves the selection of an appropriate charge size based on the size of the UXO, however it is understood that the maximum deflagration charge size is equivalent to 1.54kg. This significantly reduces the potential zone of effect for injurious and temporary auditory effects. Technical Appendix I concluded that for harbour porpoise, the zone of influence for a 1.54kg charge ranges from 1.6km to 1.9km for PTS and 1.9km to 2.6km for TTS depending on the location within the Proposed Development. For grey and harbour seal the ranges are 0.79km to 0.97km for PTS and 1.1km to 1.3km for TTS.

3. Seasonal restriction

Any UXO detonation shall be carried out between 01 April and 31 September (to avoid effects on harbour porpoise). No UXO detonation will be undertaken between 01 October and 31 March.

This Project Specific Mitigation (PS10) recognises the increased densities of harbour porpoise likely to be present between KP86.1 and KP108.7 during winter i.e. associated with the seasonal distribution of harbour porpoise within the SNS SAC. However, it should be noted that PS10 applies to the whole Proposed Development and not just the section within the SNS SAC. Although the SNS SAC is the focal point for increased densities, numbers in the wider region are also likely to increase and therefore it is prudent for the restriction to be applied more widely.

The seasonal restriction will reduce the numbers of animals that could potentially be affected by UXO deflagrations (if required).

4. Use of an Acoustic Deterrent Device (ADD)

Given the potential for high densities of marine mammals within the Proposed Development animals may need encouragement to leave the mitigation zone prior to the detonation. The use of ADDs combined with marine mammal observations will be more effective than traditional passive mitigation methods for this purpose.

It is proposed that the Lofitech seal scarer, acoustic deterrent devices (ADDs) will be deployed ahead of any UXO detonation (PS11).

ADDs are used to exclude animals from a mitigation zone and are used in conjunction with visual and / or acoustic monitoring and are normally be used for as short period as necessary to minimise the introduction of additional noise. These devices emit medium to high frequency sounds that deter animals from injury zones. They have been widely used by offshore industries during pile-driving, and at windfarms for UXO clearance activities (McGarry *et al.* 2017. McGarry *et al.* (2017) observed that fleeing minke whale individuals were at least 1.5km from the sound source when exposed to the ADD for 15 minutes. Based on a swimming speed of 1.5m/s (Otani *et al.* 2000) harbour porpoise are likely to be able to reach a distance of 2.6km in 29 minutes. It is therefore proposed that an ADD will be activated for 30 minutes after the visual observations and prior to the soft start.

5. Visual observation of the mitigation zone by at least two trained marine mammal observers

As per JNCC guidelines, implementation of which is embedded mitigation EM45, at least two trained marine mammal observers will establish a 1km mitigation zone around the proposed UXO detonation site. This area will be visually monitored for the presence or absence of marine mammals. Detonation will not take place until it is confirmed that for a period of 20-minutes no marine mammals have been present within the mitigation zone.

6. Use of Passive Acoustic Monitoring (PAM) systems to support visual observations

As per JNCC guidelines, implementation of which is embedded mitigation EM45, a PAM system will be used to support the marine mammal visual observations. PAM is a software system that utilises hydrophones to detect the vocalisations of marine mammals. It will enable the marine mammal observers to monitor the presence or absence of cetaceans within the mitigation zone prior to detonating any UXO. It is useful during periods of darkness, poor visibility or when the sea state is not conducive to visual mitigation. It will be operated by a suitably trained and experienced marine mammal observer. The PAM system typically comprises signal processing equipment located in a control room, an intermediary deck cable, and a towing cable terminating with a hydrophone array. The PAM system will be optimised for the real-time detection (i.e. live visual display and audible output) of marine mammals know to be present within the Proposed Development.

7. Soft start

If the UXO identified is great than 10kg than a soft-start procedure will also be used in combination with the ADDs. This will follow the guidance set-out by JNCC (embedded mitigation EM45). In this scenario, the marine mammal observers will conduct a pre-start search, the ADDs would be activated and then a sequence of small to large charges will be implemented to allow additional time for marine mammals to leave the area of potential effect. Typically, charges of 50g, 100g, 150g and 200g would be deployed 5 minutes after the deactivation of the ADD and would be sequenced to commence at 5-minute intervals, with the a further 5-minute interval before the detonation of the UXO.

This soft start procedure would give a minimum deterrence time of 25 minutes (excluding any deterrence time achieved by the ADDs) prior to detonation. Based on a swimming speed of 1.5m/s (Otani *et al.* 2000) marine mammals should clear a radius of 2.25km over this duration. This is a conservative estimate as there is data (Kastelein et al. 2018) to suggest that animals will swim at much higher speeds (1.9m/s) at least initially. Combined with the use of ADDs a soft start will provide the best level of deterrence.

8. Implementation of Marine Mammal Mitigation Plan

For UXO deflagration it is best practice to follow the JNCC guidelines for minimising the risk of injury to marine mammals from using explosives (JNCC 2010, or as updated) (embedded mitigation EM44).

The procedures outlined in the guidance and the additional site specific measures outlined above have been incorporated into a Marine Mammal Mitigation Plan, provided as Technical Appendix N.

The MMMP:

- Outlines the mitigation measures that will be implemented to avoid or reduce injury and disturbance effects to marine mammals;
- Provides the procedures to be followed to implement the mitigation measures effectively and in line with current guidelines and best practice;
- Sets out the roles and responsibilities of key personnel who will implement the MMMP; and
- Describes the reporting protocol in place to demonstrate that the MMMP has been successfully implemented.

9. Coordinate noisy activities

Once the UXO survey has been carried out and the location of potential UXO has been identified, the Applicant will liaise with the MMO to:

- Inform the MMO of potential UXO clearance requirements and proposed schedule.
- Confirm with the MMO if any projects in the region will be undertaking piling or UXO detonation that overlaps with the proposed schedule.
- Confirm if UXO detonation should be coordinated with other developers in the region to reduce potential cumulative effects within the SAC.

The Applicant will ensure that UXO detonations are not carried out in French and UK waters on the same day. For the UXO detonations, the Applicant will apply for an EPS License to disturb marine mammals.

Bubble curtains (not selected)

It has been considered whether the use of bubble curtains would be appropriate mitigation if UXO deflagration was required. Bubble curtains will <u>not</u> be proposed as suitable mitigation for the reasons outlined below.

A bubble curtain consists of walls of bubbles rising from a nozzle or porous pipe that is secured to the seabed and connected to an air compressor. Bubble curtains can consist of one or two hoses lined up parallel to each other. When utilised as a noise abatement technique, the principle is for the bubbles to change the physical condition of the water and the outward propagation of the acoustic/shock waves.

An assessment of the technical applicability of bubble curtains in the MMMP for UXO Clearance for the Moray East Offshore Windfarm (MOWL 2018) highlights that although commonly used within Europe to mitigate long lasting operations such as percussive piling, the high frequency pulse of noise and pressure released from a UXO detonation has not been shown to be sufficiently reduced by bubble curtain technology (Ordtek 2018 in MOWL 2018).

It is considered that the proposed mitigation, including the use of low order detonation, seasonal restrictions, ADDs, and 'soft-start' detonation along with marine mammal observer/PAM monitoring will be effective and sufficient in displacing marine mammals from the vicinity of any UXO detonations, without having to also implement bubble curtain technologies, which are not proven and may be of limited use. The deployment of bubble curtains is also highly influenced by the prevailing metocean conditions at the UXO detonation site thus limiting its deployment and/or effectiveness.

The use of noise abatement in the form of low order detonation is considered to be a more effective method. It is therefore considered that the proposed mitigation without the use of bubble curtains is sufficient.

The proposed mitigation measures have proven successful for similar projects in UK waters and they are proven effective at reducing the magnitude of the effect by reducing the numbers of animal exposed to the noise levels that may cause injurious effects. The sensitivity of the receptor is also reduced as the animal is encouraged to move out of an area and therefore the pathway for the effect is reduced.

Conclusion

In conclusion, implementation of the combined embedded mitigation and Project Specific Mitigation will reduce the significance of the effect from Major for injurious effects and Moderate for disturbance to **Minor,** which is **Not Significant** for both types of effect.

It will also reduce the potential for transboundary effects on the Banc des Flandres SAC and intra-project effects.

The Marine HRA concluded that with the successful implementation of the mitigation measures, that the Proposed Development will not have an adverse effect on the integrity of the Southern North Sea SAC either alone or in combination with other plans or projects.

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11. NAVIGATION RISK ASSESSMENT

11.1 Introduction

Intertek was commissioned by the Applicant to conduct a Navigational Risk Assessment (NRA) of the Proposed Development. This is provided as Technical Appendix J.

The scope of works was to identify and assess potential risks to shipping and navigation arising from the installation of the cables and related infrastructure e.g. external cable protection, that will exist during the operational life of the Proposed Development. This could be risks to shipping activities including fishing and recreational activities, or navigational features.

The NRA has been prepared in accordance with current guidance, including:

- Maritime and Coastguard Agency (MCA) MGN 543 (Merchant and Fishing) Safety of Navigation Offshore Renewable Energy Installations (OREIs) – Guidance on United Kingdom (UK) Navigational Practice, Safety and Emergency Response (MCA 2016) and industry best-practice
- Marine Guidance Note "Offshore Renewable Energy Installations (OREIs) - Guidance to Mariners operating in the vicinity of UK OREIs"
- Methodology for Assessing the Marine Navigational Safety Risks & Emergency Response of Offshore Renewable Energy Installations
- International Maritime Organisation (IMO) Guidelines for Formal Safety Assessment (FSA) – MSC-MEPC.2/Circ.12/Rev.2

Where applicable, further consideration has been given to:

- Port Marine Safety Code (PMSC) (Dept. for Transport & Maritime and Coastguard Agency Nov 2016)
- Guide to Good Practice on Port Marine Operations (GtGP) (Dept. for Transport & Maritime and Coastguard Agency Feb 2018)

Consultation with the MCA and other key stakeholders has been used to inform this assessment as set out in Chapter 4.

This chapter provides a summary of the conclusions.

11.2 Baseline - overview

An overview of the baseline data collection including review of anonymised Automatic Identification System (AIS) data, vessel density grids, existing infrastructures and navigational features and anchoring along the Proposed Development is summarised below:

- A total of 16,556 unique ships were recorded in the dataset for the area of assessment within 2017[1].
- Most vessels operating were cargo (44%) and recreational and tanker vessels which accounted for 23% and 17% respectively.

[1] This is no longer the latest available dataset as Marine Traffic have since released the annualised data set of AIS Derived Track Lines for the year of 2018. However, comparison of vessel density data published by EMODnet for the years 2017 and 2018 has been undertaken to determine the difference in vessel activity in the area between the two years. The comparison (presented in the NRA) concluded there are no significant differences in vessel density between the 2017 and 2018 datasets within the vicinity of the Proposed Development.

- The Proposed Development passes 22.8km (between KP 0.0 – KP 22.8) through the Peel Ports authority area; and 38.9km (between KP 22.8 – KP 61.7) through the Port of London Authority area.
- The total length of the Proposed Development within restricted navigational areas is 29.79 km. The Proposed Development does not pass through any anchoring areas.
- The Proposed Development has 13 – 15 planned infrastructure crossings within the study area. One of the planned crossings (with Atlantic Crossing – Seg B) is situated in the Dover Strait Traffic Separation Scheme (TSS).
- The Proposed Development passes through 24.1 km of recreational general boating areas.
- The seabed sediments along the Proposed Development mainly consist of sand and coarse sediments.

11.3 Hazard Identification

Marine operations and their associated hazards have been identified and listed in Table 11-1. A hazard has been assigned to each aspect of the marine operation including the zone of influence, resulting in a worst-case assessment. The zones of influence are also presented in the table below.

Table 11-1 Marine operations and identified hazards

Marine Operation	Hazards	Receptor	Zone of Influence
Survey UXO removal Route preparation Cable installation Cable repair Cable removal	1. Displacement of shipping vessels due to the avoidance of Project vessels 2. Disruption to right of passage 3. Collision risk 4. Presence of unburied cable causing accidental anchoring on unburied cable 5. Anchor snagging and cable drag including emergency anchoring 6. Change in water depth - affecting safe navigation 7. Electromagnetic changes – deviation in magnetic compasses and Interference with inertial navigation (INS) and global positioning systems (GPS) 8. Project Vessels blocking navigational features and anchorages 9. Extreme weather conditions	Commercial shipping, recreational boating, fishing vessels	Defined individually for each activity using Table 6-2 and Table 6-3. Takes into consideration an advisory 500m exclusion zone will be applied to Project Vessels due to their restricted manoeuvrability

11.4 Embedded Mitigation

The cable route has been developed through an iterative process that sought to avoid major shipping routes or reduce potential disruption to navigation.

In addition, the embedded mitigation relevant to navigation risk is summarised in Table 11-2 below.

Table 11-2 Embedded mitigation for navigational risks

ID	Embedded mitigation
EM3	Submarine cables will be bundled together.

ID	Embedded mitigation
EM5	Cable burial and protection design as detailed in the Burial Assessment Study, final crossing designs and planned and remedial final external protection designs shall be within the maximum design parameters detailed in the GridLink Marine Licence Application or robust justification for the deviations provided.
EM6	Cables shall be installed in sand wave troughs wherever practicable, or after pre-sweeping if required, to minimise the risk or exposure by seabed mobility
EM7	External cable protection (rock and/or mattresses) shall only be deployed where it is demonstrated that adequate burial depth cannot be achieved; the footprint of any external protection shall be the minimum required to ensure adequate cable protection and stability
EM8	External cable protection (excluding crossing locations) shall not reduce chart datum by more than 5%, unless agreed with the MCA and appropriate navigation authorities. If external cable protection at any location including crossings does impact on navigable depth, such locations shall be marked in accordance with Trinity House requirements and suitably marked on navigation charts
EM9	Cable protection heights and widths shall be minimised, taking into account the requirements to maintain the structural integrity of the berms.
EM10	Cable protection shall be designed to minimise snagging hazards, for example by minimising height above seabed, smooth and shallower profiles, grade used for rock placement, type of rock (e.g. smoother edges).
EM11	In-service third party asset crossings shall not be carried out in buoyed navigable areas with water depths <10m
EM12	London Array crossing design shall not exceed 1.76m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).
EM13	London Array crossing design shall comprise one continuous cable protection across all four cables (rather than four individual cable crossings) to minimise eddy currents causing scour at end of berms
EM14	London Array crossing design shall ensure vertical separation between the cables is preserved against long term settlement whilst minimising total berm height.
EM15	Thanet Windfarm North crossing design shall not exceed 2.11m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).
EM16	Thanet Windfarm South crossing design shall not exceed 2.11m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).
EM17	NEMO Interconnector crossing design shall not exceed 1.96m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).
EM19	PEC crossing design shall not exceed 2.11m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).
EM20	Atlantic Crossing - Seg B1 crossing design shall not exceed 2.01m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).
EM21	Tangerine crossing design shall not exceed 2.11m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).
EM22	BT North Sea JOSS crossing design shall not exceed 2.21m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).
EM23	Cutting of out-of-service cables shall be carried out in accordance with ICPC recommendation 1
EM24	Out-of-service cables shall be cut in a manner to avoid spragging/fraying of cable ends or other snagging hazards to fishing nets
EM25	Cut cable end locations and clump weights shall be accurately recorded and charted and positions passed to the FLO at the earliest opportunity.
EM26	Cable installation works shall not encroach on any recognised anchorage that is charted or noted in nautical publications
EM27	All material disturbed by the Pre-Lay Grapnel Run (PLGR) shall be recovered (unless there is a valid reason why an item cannot be safely recovered)

ID	Embedded mitigation
EM28	The size of the Pre-Lay Grapnel shall be optimised for the expected duty and seabed obstacles to be cleared; over-sized PLG shall not be used
EM29	Effective channels of communication shall be established and maintained between GridLink and commercial fishing interests. This will include the continued appointment of an onshore Fisheries Liaison Officer (FLO) and if necessary, offshore FLOs. Offshore FLOs should have experience of the Thames Estuary, east Dover Straits and Falls Bank area.
EM30	Notices shall be given to other sea users in the area of operations via Notice to Mariners, Kingfisher Bulletins, NAVTEX, and NAVAREA warnings; particular attention shall be paid to ensuring the following organisations receive the notifications: Peel Ports, Port of London Authority (PLA), Thamesport, MCA, Royal Yachting Association (RYA), Vattenfall, London Array, Estuary Services Ltd (Pilots), Trinity House, ROFF, Thanet Fishermen's Association, Whitstable Fishermen's Association, Swale Fishermen Ltd, Harwich Harbour Fishermen's Association, Thames Estuary Fishermen's Association and Leigh Trawlermen Cooperative and individual local fishermen as identified by the FLO.
EM31	FLO shall be included on distribution list for all daily reports from Project vessels.
EM32	Vessels shall take all reasonable efforts to ensure they do not anchor where there is significant navigational traffic or in shipping lanes when waiting on weather. If it is required, the vessels will notify and coordinate with relevant authority.
EM33	All vessels shall have passage planning procedures, holding positions (e.g. if waiting on weather), traffic monitoring (e.g. radar, AIS and visual), means of communication with third party vessels and emergency response plans in the event a third party vessel approaches on a collision course
EM35	Project vessels will comply with the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs) (as amended) Marking and UK Standard Marking Schedule for Offshore Installations Marking, particularly with respect to the display of lights, shapes and signals.
EM48	Information related to the as built cable will be provided to navigation and fishing stakeholders as required.
EM49	As-built co-ordinates of the cable route shall be recorded and submitted to the UK Hydrographic Office (UKHO) via a H102 hydrographic note and KIS-ORCA Service; 'as-built' cables shall be marked on Admiralty Charts and fisherman's awareness charts (paper and electronic format)
EM51	Post-installation compass deviation surveys shall be carried out where the cables are not bundled together due to the shore crossing (KP0.0 and KP1.0) or other reason and water depths are <10m; the results of any compass deviation shall be provided to UKHO and MCA.
EM52	Post-installation inspection surveys shall be carried out every two years (the survey frequency may be reduced only when the depth of burial and seabed restoration has been sufficiently validated).
EM53	Any post-lay cable exposure for whatsoever reason shall be published in the Kingfisher Information System, Notified to Fishermen and guarded until remedial works are completed
EM55	Vessels are advised in the Mariners Handbook not to anchor within 0.25nm (500m) of cables
EM56	Coordination of timings will be sought from the ports during marine operations to reduce disruption on existing shipping

11.5 Project Specific Mitigation

In addition to the embedded mitigation outlined in Table 11-2, Table 11-3 presents Project Specific Mitigation that will be implemented.

Table 11-3 Project specific mitigation for navigational risks

ID	Project Specific Mitigation
PS5	The GridLink Submarine Cable Bundle shall be installed along the Marine Installation Route Position. Contractor shall avoid deviation from this Route. If deviation is required, the GridLink Submarine Cable Bundle shall remain inside the Asset Placement Corridor and robust justification for the deviation provided

ID	Project Specific Mitigation
	to Gridlink for approval. The Route shall not enter areas within the Asset Placement Corridor identified as "Areas of constraint for Asset Placement" unless robust justification is provided to GridLink as to why there is no alternative.
PS6	All planned anchor placements must be in the Consent Corridor. Contract shall avoid planned anchor placement in 'Areas of Constraint for Anchor Placement'. If planned anchor placement is required in any one of these areas robust justification shall be provided to GridLink as to why there is no alternative.
PS16	Guard vessels shall be deployed where the cable installation vessel is using anchors (indicatively between KP0 and KP55), and in any areas where there is significant navigational traffic to warn shipping, recreational and fishing vessels of the presence of the cable installation spread
PS17	Guard vessels shall be deployed wherever the cable is insufficiently protected (e.g. between cable lay and burial, where required DOL has not been achieved) to warn shipping and fishing vessels of the potential temporary snagging hazard (subject to safe weather conditions). Guard vessels will be required until the cable is sufficiently protected as agreed by GridLink.
PS18	Guard vessels shall be designed to an appropriate specification for the specified duty, expected weather conditions and other operating requirements, and the captain(s) and crew(s) shall have suitable and sufficient local knowledge and experience of the cable route. Preference should be given to securing guard vessels from the NFFO and the local fishing fleet.
PS30	Time delay between sequential cable installation operations, e.g. cable-lay and post-lay burial, shall be minimised to a short as reasonably practicable.
PS31	Preferred location of any cable joint shall be between KP50 to KP51 or KP53 to KP55.5 (rev3 - GridLink preferred cable route), and/or be located so as to minimise adverse effects on navigation during cable jointing works
PS32	If temporary removal of a Trinity House buoy is required, this shall be communicated and arrange between GridLink and Trinity House in plenty of time.
PS33	Prior to works commencing GridLink shall arrange a meeting with Peel Ports and PLA to provide anchor patterns and a briefing of the works to be undertake in Harbour Authority Waters; confirm timescales; confirm lines of communication; and understand what activity will be undertaken during the period.
PS34	GridLink will apply for a Peel Ports River Works Licence, and a Port of London Authority River Works Licence for all installation / construction, repair and maintenance activities undertaken within the relevant Harbour Authority Waters.
PS35	Written notice of commencement of any works to be carried out in Harbour Authority Waters will be provided to Peel Ports and Port of London Authority (PLA) a minimum of two weeks prior to works (e.g. survey, installation, repair or maintenance).
PS36	During activity within the Harbour Authority Waters, or within close proximity, daily briefings shall be provided to Peel Ports and PLA that will cover: name of vessel(s) involved and exact location of works for the day.
PS37	Daily communication with the PLA and relevant working pilot vessel captains shall be established during all marine operations for the duration of the works.
PS38	An up to date route position list of the survey corridor and route centre line shall be provided to PLA during the relevant marine operations.
PS41	On completion of final planned and remedial external protection designs GridLink shall confirm with the MCA (in agreement with Trinity House) whether any aids of navigation such as marker buoys may be required where external protection has been installed.
PS42	Prior to works commencing GridLink shall arrange a meeting with yacht clubs in the area including Lower Halstow Yacht Club and the Medway and Swale Estuary Boating Association to provide anchor patterns and a briefing of the works to be undertake in Harbour Authority Waters; confirm timescales; confirm lines of communication; and understand what activity will be undertaken during the period.

ID	Project Specific Mitigation
PS47	Coordination with the Channel Navigation Service and Dover Coastguard Operations centre to provide 24-hour radio and radar coastal vessel traffic information which helps vessels navigate safely to help prevent collisions at sea.

11.6 Risk Assessment

11.6.1 Approach

The Navigation Risk Assessment follows a different assessment methodology to the rest of the environmental report as it focuses on risk. The risk analysis introduces the concept of risk in a qualitative way in order to prioritise the hazards identified during the hazard identification process and assess their impact on navigational safety.

In the risk assessment, the hazard has been ranked by expected risk, based on the estimated frequency and consequence with no mitigation measures applied creating a 'Inherent Risk' to the project. The exercise was repeated with Embedded Mitigation (Table 11-2) and Project Specific Mitigation (Table 11-3) which results in a residual risk that is reduced to as low as reasonably practicable (ALARP).

The risk assessment uses a risk matrix, as shown in Table 11-4.

Table 11-4 Risk Matrix

		Consequence				
		Minor	Significant	Severe	Serious	Catastrophic
Frequency	Extremely Remote	1	2	3	4	5
	Remote	2	4	6	8	10
	Probably	3	6	9	12	15
	Very Probable	4	8	12	16	20
	Frequent	5	10	15	20	25

At the low end of the scale, frequency is extremely remote and consequence minor; risk can be said to be negligible. At the high end, where hazards are defined as frequent and the consequence catastrophic, then risk is intolerable.

The result of using this matrix approach is to ensure that the level of risk is reduced to ALARP for the effects that the Proposed Development has on the baseline shipping environment. The risk assessment is undertaken prior to any mitigation. Project Specific Mitigation will then be applied to reduce any significant risks to ALARP.

Definitions of the risk levels are provided in Table 11-5 below.

Table 11-5 Definitions of risk levels with respect to vessel displacement

Score	Classification	Definition
1-2	Negligible	A hazard which causes noticeable changes in the navigation environment but without effecting its sensitivities. Generally considered as insignificant.
3-4	Minor	A hazard that alters the character of the navigation environment in a manner that is consistent with existing baseline. Hazards are generally considered as minor and adequately controlled by best practice and legal controls. Opportunities to reduce hazards further through mitigation may be limited and are unlikely to be cost effective.
5-9	Moderate	A hazard which, by its frequency and consequence alters the aspect of the navigation environment. Generally considered as Moderate but effects are those, considered to be tolerable. However, it is expected that the hazard has been subject to feasible and cost-effective mitigation and has been reduced to as low as reasonably practicable (ALARP) and that no further measures are feasible.
10-14	Major	An effect which, by its frequency and consequence alters most of the aspects of the navigation environment. Generally regarded as unacceptable prior to any mitigation measures being considered.
15-25	Intolerable	Regarded as unacceptable prior to any mitigation measures being considered.

11.6.2 Summary of risk assessment

Tables 11-6 to 11-13 present the risk assessment conducted on the marine operations and associated hazards, divided by the different marine operations. All hazards have reached a risk level that is tolerable to the project through the ALARP process.

11.6.2.1 Geophysical Survey

Table 11-1 Risk Assessment – Geophysical Survey

Hazard	Inherent Risk							Risk Mitigation	Residual Risk						
	Frequency	Consequence			Risk Rating				Frequency	Consequence			Risk Rating		
		Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)	Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)			Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)	Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)
Presence of Project vessels	3	1	1	2	**3**	**3**	**6**	EM5, EM7, EM8, EM11, EM26, EM29, EM30, EM31, EM32, EM33, EM35, EM49, EM51, EM55, PS5, PS6, PS16, PS17, PS18, PS30, PS31, PS32, PS33, PS34, PS35, PS36, PS37,PS38, PS42, PS47	3	1	1	1	**3**	**3**	**3**
Disruption to right of passage	3	1	1	2	**3**	**3**	**6**		3	1	1	1	**3**	**3**	**3**
Collision risk	2	5	5	3	**10**	**10**	**6**		1	5	5	2	**5**	**5**	**2**
Blockage of navigational features and anchorages	3	1	1	2	**3**	**3**	**6**		1	1	1	1	**1**	**1**	**1**
Extreme weather conditions	2	2	2	2	**4**	**4**	**4**		2	1	1	1	**2**	**2**	**2**

11.6.2.2 UXO Clearance

Table 11-2 Risk Assessment – UXO Clearance

Hazard	Inherent Risk							Risk Mitigation	Residual Risk						
	Frequency	Consequence			Risk Rating				Frequency	Consequence			Risk Rating		
		Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)	Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)			Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)	Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)
Presence of Project vessels	3	1	1	2	**3**	**3**	**6**	EM5, EM7, EM8, EM11, EM26, EM29, EM30, EM31, EM32, EM35, EM49, EM51, EM54, PS5, PS6, PS16, PS18, PS30, PS31, PS32, PS33, PS34, PS35, PS36, PS37, PS38, PS42, PS47	3	1	1	1	**3**	**3**	**3**
Disruption to right of passage	3	1	1	2	**3**	**3**	**6**		3	1	1	1	**3**	**3**	**3**
Collision risk	2	5	5	3	**10**	**10**	**6**		1	5	5	2	**5**	**5**	**2**
Blockage of navigational features and anchorages	3	1	1	2	**3**	**3**	**6**		1	1	1	1	**1**	**1**	**1**
Extreme weather conditions	2	2	2	2	**4**	**4**	**4**		2	1	1	1	**2**	**2**	**2**

11.6.2.3 Route Preparation (PLGR, OOS Cable Removal & Sandwave Pre-Sweeping)

Table 11-3 Risk Assessment – Route Preparation

Hazard	Inherent Risk							Risk Mitigation	Residual Risk						
	Frequency	Consequence			Risk Rating				Frequency	Consequence			Risk Rating		
		Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)	Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)			Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)	Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)
Presence of Project vessels	3	1	1	2	**3**	**3**	**6**	EM5, EM7, EM8, EM11, EM26, EM29, EM30, EM31, EM32, EM35, EM49, EM51, EM54, PS5, PS6, PS16, PS18, PS30, PS31, PS32, PS33, PS34, PS35, PS36, PS37, PS38, PS42, PS47	3	1	1	1	**3**	**3**	**3**
Disruption to right of passage	3	1	1	2	**3**	**3**	**6**		3	1	1	1	**3**	**3**	**3**
Collision risk	2	5	5	3	**10**	**10**	**6**		1	5	5	2	**5**	**5**	**2**
Blockage of navigational features and anchorages	3	1	1	2	**3**	**3**	**6**		1	1	1	1	**1**	**1**	**1**
Extreme weather conditions	2	2	2	2	**4**	**4**	**4**		2	1	1	1	**2**	**2**	**2**

11.6.2.4 Cable Installation – Cable Laying

Table 11-4 Risk Assessment – Cable Installation – Cable Laying

Hazard	Inherent Risk							Risk Mitigation	Residual Risk						
	Frequency	Consequence			Risk Rating				Frequency	Consequence			Risk Rating		
		Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)	Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)			Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)	Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)
Presence of Project vessels	4	1	1	2	**4**	**4**	**8**	EM5, EM7, EM8, EM11, EM26, EM29, EM30, EM31, EM32, EM35, EM49, EM51, EM54, EM55, PS5, PS6, PS16, PS18, PS30, PS31, PS32, PS33, PS34, PS35, PS36, PS37, PS38, PS42, PS47	3	1	1	2	**3**	**3**	**6**
Disruption to right of passage	4	1	1	2	**4**	**4**	**8**		3	1	1	2	**3**	**3**	**6**
Collision risk	2	5	5	4	**10**	**10**	**8**		1	5	5	3	**5**	**5**	**3**
Accidental anchoring on unburied cable	2	3	3	3	**6**	**6**	**6**		1	3	3	3	**3**	**3**	**3**
Anchor snagging and cable drag including emergency anchoring	2	3	3	3	**6**	**3**	**6**		1	3	3	3	**3**	**3**	**3**
Blockage of navigational features and anchorages	4	1	1	3	**4**	**4**	**12**		4	1	1	2	**4**	**4**	**8**
Extreme weather conditions	2	2	2	2	**4**	**4**	**4**		2	1	1	1	**2**	**2**	**2**

11.6.2.5 Cable Installation – Cable Burial

Table 11-5 Risk Assessment – Cable Installation – Cable Burial

Hazard	Inherent Risk							Risk Mitigation	Residual Risk						
	Frequency	Consequence			Risk Rating				Frequency	Consequence			Risk Rating		
		Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)	Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)			Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)	Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)
Presence of Project vessels	4	1	1	2	**4**	**4**	**8**	EM5, EM7, EM8, EM11, EM26, EM29, EM30, EM31, EM32, EM35, EM49, EM51, EM54, EM55, PS5, PS6, PS16, PS18, PS30, PS31, PS32, PS33, PS34, PS35, PS36, PS37, PS38, PS42, PS47	3	1	1	2	**3**	**3**	**6**
Disruption to right of passage	4	1	1	2	**4**	**4**	**8**		3	1	1	2	**3**	**3**	**6**
Collision risk	2	5	5	4	**10**	**10**	**8**		1	5	5	3	**5**	**5**	**3**
Accidental anchoring on unburied cable	2	3	3	3	**6**	**6**	**6**		1	3	3	3	**3**	**3**	**3**
Anchor snagging and cable drag including emergency anchoring	2	3	3	3	**6**	**6**	**6**		1	3	3	3	**3**	**3**	**3**
Blockage of navigational features and anchorages	4	1	1	3	**4**	**4**	**12**		4	1	1	2	**4**	**4**	**8**
Extreme weather conditions	2	2	2	2	**4**	**4**	**4**		2	1	1	1	**2**	**2**	**2**

11.6.2.6 Cable Installation – Construction of Third Party Cable Crossings

Table 11-6 Risk Assessment – Cable Installation – Cable Crossings

Hazard	Inherent Risk							Risk Mitigation	Residual Risk						
	Frequency	Consequence			Risk Rating				Frequency	Consequence			Risk Rating		
		Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)	Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)			Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)	Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)
Presence of Project vessels	3	1	1	3	**3**	**3**	**9**	EM5, EM7, EM8, EM11, EM26, EM29, EM30, EM31, EM32, EM35, EM49, EM51, EM54, EM55, PS5, PS6, PS16, PS18, PS30, PS31, PS32, PS33, PS34, PS35, PS36, PS37, PS38, PS42, PS47	2	1	1	3	**2**	**2**	**6**
Disruption to right of passage	3	1	1	3	**3**	**3**	**9**		2	1	1	3	**2**	**2**	**6**
Collision risk	2	5	5	4	**10**	**10**	**8**		1	5	5	3	**5**	**5**	**3**
Accidental anchoring on unburied cable	2	3	3	3	**6**	**6**	**6**		1	3	3	3	**3**	**3**	**3**
Anchor snagging and cable drag including emergency anchoring	2	3	3	3	**6**	**6**	**6**		1	3	3	3	**3**	**3**	**3**
Blockage of navigational features and anchorages	4	1	1	3	**4**	**4**	**12**		4	1	1	2	**4**	**4**	**8**
Extreme weather conditions	2	2	2	2	**4**	**4**	**4**		2	1	1	1	**2**	**2**	**2**

11.6.2.7 Cable Operation – Change in Water Depth and Electromagnetic Interference

Table 11-7 Risk Assessment – Cable Operation

Hazard	Inherent Risk							Risk Mitigation	Residual Risk						
	Frequency	Consequence			Risk Rating				Frequency	Consequence			Risk Rating		
		Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)	Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)			Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)	Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)
Electromagnetic changes, – deviation in magnetic compasses	2	1	1	1	**2**	**2**	**2**	-	2	1	1	1	**2**	**2**	**2**
Electromagnetic changes – Interference with inertial navigation (INS) and global positioning systems (GPS)	2	1	1	1	**2**	**2**	**2**		2	1	1	1	**2**	**2**	**2**
Change in Water Depth - affecting safe navigation	3	5	5	5	**15**	**15**	**15**	EM5, EM6, EM7, EM8, EM9, EM12, EM14, EM15, EM16, EM17, EM19, EM20, EM21, EM22, EM30, EM49, EM51, EM54, PS33, PS34, PS35, PS36, PS41	1	5	5	5	**5**	**5**	**5**

11.6.2.8 Cable Maintenance and Repair (including survey operations)

Table 11-8 Risk Assessment – Cable Maintenance and Repair

Hazard	Inherent Risk							Risk Mitigation	Residual Risk						
	Frequency	Consequence			Risk Rating				Frequency	Consequence			Risk Rating		
		Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)	Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)			Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)	Effect on Human Safety	Effect on Ship(s)	Displacement of Vessel(s)
Presence of Project vessels	4	1	1	2	**4**	**4**	**8**	EM5, EM7, EM8, EM11, EM26, EM29, EM30, EM31, EM32, EM35, EM49, EM51, EM54, EM55, PS5, PS6, PS16, PS18, PS30, PS31, PS32, PS33, PS34, PS35, PS36, PS37, PS38, PS42, PS47	3	1	1	2	**3**	**3**	**6**
Disruption to right of passage	4	1	1	2	**4**	**4**	**8**		3	1	1	2	**3**	**3**	**6**
Collision risk	2	5	5	4	**10**	**10**	**8**		1	5	5	3	**5**	**5**	**3**
Accidental anchoring on unburied cable	2	3	3	3	**6**	**6**	**6**		1	3	3	3	**3**	**3**	**3**
Anchor snagging and cable drag including emergency anchoring	2	3	3	3	**6**	**3**	**6**		1	3	3	3	**3**	**3**	**3**
Blockage of navigational features and anchorages	4	1	1	3	**4**	**4**	**12**		4	1	1	2	**4**	**4**	**8**
Extreme weather conditions	2	2	2	2	**4**	**4**	**4**		2	1	1	1	**2**	**2**	**2**

11.7 Residual Risk

The assessment presented in Technical Appendix J identified that all hazards have been reduced to ALARP.

However, even with risk control measures in place to mitigate the frequency and/or consequence of a hazard, several of the hazards remain with a Moderate risk classification. These are discussed below.

11.7.1 Displacement of shipping vessels from the area surrounding the project vessel spread and disruption to right of passage

The assessment concluded that the presence of the project vessels during cable installation, operations (including cable repair) and decommissioning has the potential to have a Probable and Significant effect, in particular with respect to:

- Route clearance and pre installation work through the Dover TSS and Medway Estuary
- Geophysical Survey and Cable installation through the Dover TSS and Medway Estuary
- Cable crossing construction within the Dover TSS
- Operations (including cable repair) within the Dover TSS and Medway Estuary

To reduce the risk, additional Project Specific Mitigation has been proposed. This includes a communications protocol with Peel Ports and Port of London Authorities (PS34, PS35, PS36, PS37 and PS38), Trinity House (PS32) and yacht clubs in the area, including Lower Halstow Yacht Club and the Medway and Swale Boating Association (PS42) to ensure disruption is minimised. Further communication protocols with Channel Navigation Service and Dover Coastguard Operations centre (PS47) have also been proposed.

Although these additional measures will facilitate the management of disruption, thereby reducing the risks to shipping, the assessment concluded that there will still be temporary loss of access that will require a temporary re-routing of existing shipping. The overall residual risk therefore remains as a **Moderate risk** during the marine campaign**.**

With respect to a residual effect on general shipping and navigation, given the short duration and temporal spatial effects of the marine campaign once the installation is complete the hazard to shipping is removed and there will be **no residual effects** on shipping and navigation.

11.7.2 Collision Risk

The assessment concluded that the collision risk from cable installation and the operation (including repair) of the cable is Remote, even within high vessel traffic area or navigable confinements such as the Dover TSS and Medway Estuary, as it is considered that there is available sea room in the area for passing vessels to route around additional marine operations traffic and cable laying vessels.

To reduce the risk, additional Project Specific Mitigation has been proposed. This includes a communications protocol with Peel Ports and Port of London Authorities (PS34, PS35, PS36, PS37 and PS38) and Trinity House (PS32) during the construction, operations and decommissioning phases of the project. Further communication protocols with Channel Navigation Service and Dover Coastguard Operations centre (PS47) have also been proposed.

While the consequence remains as Serious, these additional measures will facilitate the risk control of collision, therefore, the overall classification is a **Moderate risk** during the marine campaign**.**

With respect to a residual effect on shipping and navigation, given the short duration and temporal spatial effects of the marine campaign once the installation is complete the hazard to shipping is removed and there will be **no residual effects** on shipping and navigation.

11.7.3 Blockage of navigational features and anchorages

The assessment concluded that the risk of blocking existing navigational features and anchorages as a result of the cable installation and operations (including cable repair) is Very Probably, especially with respect to port authority areas.

To reduce the risk, additional Project Specific Mitigation has been proposed. This includes a communications protocol with Peel Ports and Port of London Authorities (PS34, PS35, PS36, PS37 and PS38) and Trinity House (PS32) during the construction, operations and decommissioning phases of the project.

While the consequence remains as Significant, these additional measures will facilitate the risk control of blocking navigational features and anchorages, therefore, the overall classification is a **Moderate risk** during the marine campaign**.**

With respect to a residual effect on shipping and navigation, given the short duration and temporal spatial effects of the marine campaign once the installation is complete the hazard to shipping is removed and there will be **no residual effects** on navigational features and anchorages.

11.7.4 Reduction in water depth impeding safe navigation

The assessment concluded that the operation of the cable has the potential to have a Moderate risk.

To reduce the risk, additional Project Specific Mitigation has been proposed. This includes consultation with the MCA once final designs for rock berms are complete and a communication protocol with Peel Ports and Port of London Authorities (PS34, PS35, PS36, PS37 and PS38) and with Trinity House (PS32) during the construction, operations and decommissioning phases of the project.

In addition, based on recommendations from the MCA, aids to navigation such as marker buoys will be provided in areas where external protection may impede safe navigation (PS41).

Although these additional measures will facilitate the management of the reduction in water depth impeding safe navigation, as a precaution the assessment concluded that the consequence of the hazard remains as Serious. The overall classification therefore remains a **Moderate risk.**

With respect to a residual effect on shipping and navigation, the localised reduction in water depth may represent a permanent hazard to shipping. However, given that the locations are outside of the main shipping channels, are extremely small, in relation to the surrounding sea area, and there is sufficient room to allow safe navigation around the feature the assessment concluded a **Minor residual effect** at specific locations.

12. COMMERCIAL FISHERIES

This Chapter describes the existing baseline environment in terms of commercial fisheries, identifies the pressures associated with the Proposed Development on the receptor, presents the findings of the environmental assessment, and describes how significant effects (if any) will be mitigated.

12.1 Data Sources

Baseline conditions have been established by undertaking a desktop review of published information complemented by consultation with key local, regional and national fishing organisations. The data sources used to inform the baseline description and assessment include, but are not limited to:

- Marked up Admiralty charts provided by 27 individual boats from Ramsgate, Leigh, Whitstable, Queenborough and Margate to GridLink Fisheries Liaison Officer (FLO) showing areas fished and gear used.
- Consultation meetings with Kent and Essex Inshore Fisheries and Conservation Authority (KEIFCA), the National Federation of Fishermen's Organisations (NFFO), Rochester Oyster and Floating Fishery (ROFF), Thanet Fishermen's Association (TFA), Thames Estuary Fishermen's Association (TEFA), Leigh Trawlermen's Cooperative, Whitstable Fishermen's Association, Harwich Harbour Fishermen's Association and Swale Fishermen Ltd.
- Marine Management Organisation UK Sea Fisheries Statistics 2018 (MMO 2019a,b).

12.2 Consultation

Consultation with local Thames Estuary fishermen has been undertaken throughout the preparation of the environmental assessment by the Applicant, Intertek and GridLink's Fisheries Liaison Officer (FLO). A list of key meetings is provided in Technical Appendix B.

Table 12-1 summarises the relevant consultation responses on commercial fisheries.

Table 12-1 Consultation responses – Commercial fisheries

Stakeholder	Summary of Consultation Response	How response has been addressed
Marine Management Organisation (MMO)	A recent fisheries byelaw has been brought into the Margate and Long Sands Special Area of Conservation (SAC), to avoid impacts to the most sensitive and diverse communities based in the site. The cable route must avoid the most sensitive biotopes.	Restricted Fishing Areas in the region are identified in Section 12.3.4. Assessment of effects on benthic communities is provided in Chapter 6.
MMO	The MMO requested that the limitations of Automatic Identification System (AIS) data and Vessel Monitoring System (VMS) data to identify fisheries in the region should be recognised within the assessment.	A statement indicating the limitations of this data can be found in Section 12.3.
MMO	The MMO are aware that the London Array export cables cross the BritNed cable at the corner of the Princes Channel, with rock berm being the chosen protection for the crossing point. Thanet Fisherman's Association has informed us that the rock berm protection has affected the drift ground in that area with scour being a serious concern for them. We highlight the need for engagement with commercial fishermen regarding the cable crossing point.	The Applicant has taken a proactive approach with respect to crossing design and effects on commercial fisheries. Each crossing location has been examined by the GridLink FLO and in discussion with local fishing organisations preference for the type of external cable protection has been indicated. This preference takes into consideration the type of fishing activity at any given location. Given the bottom drift netting undertaken in the vicinity of the London Array crossing position, the fishing industry has indicated a preference for fronded concrete mats as the external cable protection choice. Concrete mats may not be feasible at this location because of the protection required to mitigate the external threat to the cables presented by shipping. Concrete mats will not provide adequate protection from the risk of an anchor strike. However, GridLink have sought to incorporate frond mats into the rock berm design with the objective of returning the seabed to a sand habitat that will still allow fishing gear to use the crossing location.
MMO	The MMO recommend that the KEIFCA be consulted regarding commercial fishing that takes place near the area where the cables separate to enter the HDD ducts in shallow water. This is to confirm the view that electromagnetic changes will not pose a great risk to navigation at this specific location.	Consultation meetings have been held with KEIFCA and ROFF (who have fishing rights at the HDD exit point). An assessment of the effects on EMF on fish and shellfish is provided in Chapter 8. The effects of EMF on navigation is presented in Technical Appendix J – Navigation Risk Assessment and summarised in Chapter 11.
MMO	It has been noted by Thanet Fisherman's Association that the surveillance methods used for the collection of baseline data provide a poor representation of the under 10m fleet. The MMO therefore recommend that increased effort should be made to gather further information from this fleet of vessels in the Thames Estuary.	The GridLink FLO has undertaken extensive liaison with local organisations and vessels in the region. Vessels directly affected by the Proposed Development have identified on charts where and how they use the Proposed Development. This information has been used to inform the baseline, assessment, and project specific mitigation.
MMO	The MMO notes that the preferred cable route will cut through multiple types of fishing ground and as such will go through ground used for trawling and bottom drifting. Therefore, mitigation measures to reduce the navigational risk to bottom trawling gear must be considered and proposed in the Environmental Report.	Project specific mitigation is proposed in Section 12.7 and has been agreed in consultation with local fishing organisations and vessels.

Stakeholder	Summary of Consultation Response	How response has been addressed
MMO	The MMO notes that the KEIFCA has reservations about the proposed cable route, stating that the local inshore fishing fleet have major concerns regarding the loss of fishing grounds. Consultation must be undertaken with local fishing representatives so all concerns can be taken into consideration.	Extensive and regular consultation has been undertaken by the Applicant, Intertek and the GridLink FLO (staring in June 2019) with national and local fishing organisations and vessels. Technical Appendix B lists key meetings held.
MMO	The MMO note that the Environmental Report will not include an assessment of snagging risk. However, potential effects must be considered in any routeing proposal and as part of a cable burial risk assessment. Consultation with the fishing industry would be beneficial in supplementing these activities.	The cable burial risk assessment considered the types of fishing activity being undertaken in the region, the potential for snagging gear and anchors and has prescribed a recommended target depth of lowering to ensure the cables and third parties are sufficiently protected. This assessment was supplemented by information gathered through consultation with local fishing organisations and vessels. Snagging risk has been assessed by the Navigation Risk Assessment provided as Technical Appendix J and summarised in Section 12.6.6.
MMO / NFFO	Section 10.3 of the SR lists mitigation measures for commercial fisheries. A fisheries co-existence plan must be prepared that details how installation works would be managed to minimise disruption to the fishing industry and apply long term mitigation measures.	Given the extensive fishing activity in the region, the Applicant agrees with the requirement to prepare a fisheries co-existence plan. A draft plan has been prepared by the GridLink FLO and is provided as Technical Appendix M.
MMO	The following mitigation measures must be included: ▪ Efforts must be undertaken to minimise the requirement for additional cable protection measures by pursuing cable burial remedial measures e.g. mass flow excavation; ▪ If protective measures are required, these must be selected in consultation with fishing interests and take account of snagging risks that may vary depending on the nature of fishing activity taking place in the vicinity of the measures; and ▪ The results of post installation surveys must be communicated to the fishing industry to provide assurance and to communicate information on residual safety risks.	Consultation with local fishing organisations and vessels has identified a preference for installation techniques that do not cause large levels of suspended sediment e.g. mass flow excavation. As a priority, the Applicant will seek to minimise the use of external cable protection, preferring burial in sediment as the best protection. External cable protection will be used at third-party asset crossings where burial in sediment is not feasible. Each crossing location has been examined by the GridLink FLO and in discussion with local fishing organisations preference for the type of external cable protection has been indicated. This preference takes into consideration the type of fishing activity at any given location. Although this preference is noted it cannot be guaranteed that the final crossing designs will be able to match the preference given the high level of shipping activity in the region. A commitment to communicating the results of post-installation surveys to the local fishing industry has been included in Embedded Mitigation EM20 in Section 12.5.
MMO	Cable protection measures must be considered fully as part of the Environmental Report with regard to commercial fishing and the impacts they can have along the GridLink cable route. The MMO also highlight the need for engagement with commercial fishermen in order to mitigate the impacts of cable protection, ensuring it does not indirectly impact fishermen.	The direct and indirect effects of external cable protection have been assessed in Sections 12.6.3, 12.6.4, and 12.6.6.
MMO	Due to whelks' importance to both Kent and Essex fishermen, the species must be included in the Environmental Assessment.	Important areas for whelk potting have been identified through consultation with local vessels and included in this Chapter.

Stakeholder	Summary of Consultation Response	How response has been addressed
Rochester Oyster and Floating Fishery (ROFF)	ROFF have expressed concerns over their ability to trawl over any cable protection measures implemented, along with concerns over any potential sediment dispersal as a result of the project which could negatively impact their shellfish stock.	No external cable protection will be deposited in ROFF waters. The effect on suspended sediments because of cable installation has been assessed in Section 12.6.5.
Thanet Fishing Association (TFA)	Concerns have been raised over change in underwater noise causing disruption to local fish stocks, with the indirect effect of stocks vacating the area.	Chapter 8 concluded that underwater noise will have a negligible and therefore not significant effect for all fish species, aside from spawning herring and sprat for which the effect was assessed as minor and not significant. Migration pathways will not be impeded by the Proposed Development and it is expected that fish will return quickly to an area once the installation spread has passed through. No short, medium or long-term effects on fish stocks are anticipated.
TFA	Requested that the cumulative impact assessment considers the wider south-east marine region and projects from the last 15 years. Suggested that areas where fishing activity is restricted is highlighted to inform the assessment of disruption.	This comment has been addressed in Chapter 14.
TFA	Concerns have been raised over the use of installation techniques that cause high levels of suspended sediment.	Calculations have been undertaken to determine worst-case distances for suspended sediment transport – Technical Appendix C. The assessment is presented in Section 12.6.5. Project specific mitigation is proposed in Section 12.7.
TFA	Requested that GridLink consider whether concrete mattress handling loops could be cut to avoid safety concerns for small vessels. Practice has been undertaken on other export cable projects.	Rock placement is considered the optimum cable protection at third party crossings due to the assurance of protection from ships anchors. They also represent a conservative case in terms of the footprint and height of the cable crossing design. However, if concrete mattresses are feasible, the cutting of handling loops or other measures to minimise the risk of snagging will be implemented.
TFA / National Federation of Fishermen's Organisations (NFFO)	Request to consider using an alternative to clump weights in areas where drift nets are utilised.	Through consultation with local vessels, the GridLink FLO has a strong understanding of where bottom drift nets are used across the Proposed Development. Each crossing has been examined in light of this information to determine if an alternative to clump weights are required. It has been concluded that clump weights will not be required in any areas of active bottom drift netting. Project Specific Mitigation is proposed in Section 12.7 in relation to clump weights.
TFA	Request for the areas between KP50 – KP62 and KP15 -KP35 to be subject to bottom trawl surveys, and for mitigation measures to mention plans for cable exposure events.	Project Specific Mitigation (Section 12.7) has been included to address both concerns.
NFFO	Request to include Belgian fishermen in communications (i.e. not just French & British).	GridLink FLO will engage with Belgian fishermen during pre-installation consultation activities.
NFFO	Concerns raised over lack of detail on post-installation monitoring plans.	Post-installation monitoring plans have been added as Embedded Mitigation EM20 in Section 12.5.

Stakeholder	Summary of Consultation Response	How response has been addressed
NFFO	Suggested that an offshore FLO might be useful for Falls area which is extensively fished by French & Belgians (particularly for squid).	Recommendation included within Project Specific Mitigation, Section 12.7.
NFFO	Recommended that where safe to do so live UXO is moved away from shellfish beds prior to detonation.	Recommendation included within Project Specific Mitigation, Section 12.7
NFFO	Requested that the timing of installation activity takes into consideration peak fishing season(s) to avoid disruption. Noting that cocklers would prefer no seabed disturbance from March onwards to ensure sediment deposition is not an issue when cockle beds open in April.	Recommendation included within Project Specific Mitigation, Section 12.7
Harwich Harbour Fishermen's Association	Requested that the project description is expanded to provide information on the risk profiles that have led to the selection of the crossing heights.	Addressed in Chapter 3.
Harwich Harbour Fishermen's Association	Requested that the Applicant include a timescale for the completion of post-installation trawl surveys	Project specific mitigation PS20 and PS21 updated to include timescale.
TFA	Include assessment of potential loss of fishing area due to marker buoys at crossings and investigate non-physical methods of marking hazards.	Addressed in Section 12.6.2. Trinity House advised that the use of marker buoys is determined on a case by case basis, with the preference to avoid a physical marking where possible to prevent additional hazards in the marine environment. Although there are non-physical methods of marking hazards i.e. using AIS warnings, these are generally not advised as not all vessels will be equipped with the necessary means of receiving them, and/or digital data layers can be turned off and therefore missed.
Leigh Trawlermen's Cooperative	Provide additional information on cumulative effects of EMF from multiple cable projects.	Addressed in Chapter 8, Section 8.6.8.
Thames Estuary Fishermen's Association (TEFA)	Requested that Applicant expands PS27 to provide more detail with respect to how sediment plumes will be monitored	Project specific mitigation PS27 updated to include further detail.

12.3 Existing Baseline

This section provides a summary of the baseline environment. It describes the key commercial fisheries along the Proposed Development; the local fishing fleet; any fishing restrictions; and provides landings data to contextualise the value of the fishing industry in the region.

The section has been informed by the latest publicly available catch statistics available from the MMO (MMO 2019a), automatic identification system (AIS) and vessel management system (VMS) data and consultation undertaken by Intertek and the GridLink FLO with local fishing organisations and vessels. It should be noted that AIS, VMS and landings data derived from MMO catch statistics only provide a general overview of fishing effort, and do not reflect accurately the effort in the region i.e. not all vessels will carry AIS, and smaller vessels do not directly report landings data to the MMO. However, Intertek is confident that the consultation undertaken to inform the environmental assessment provides an accurate picture of fishing use affected by the Proposed Development.

12.3.1 Commerical Fisheries

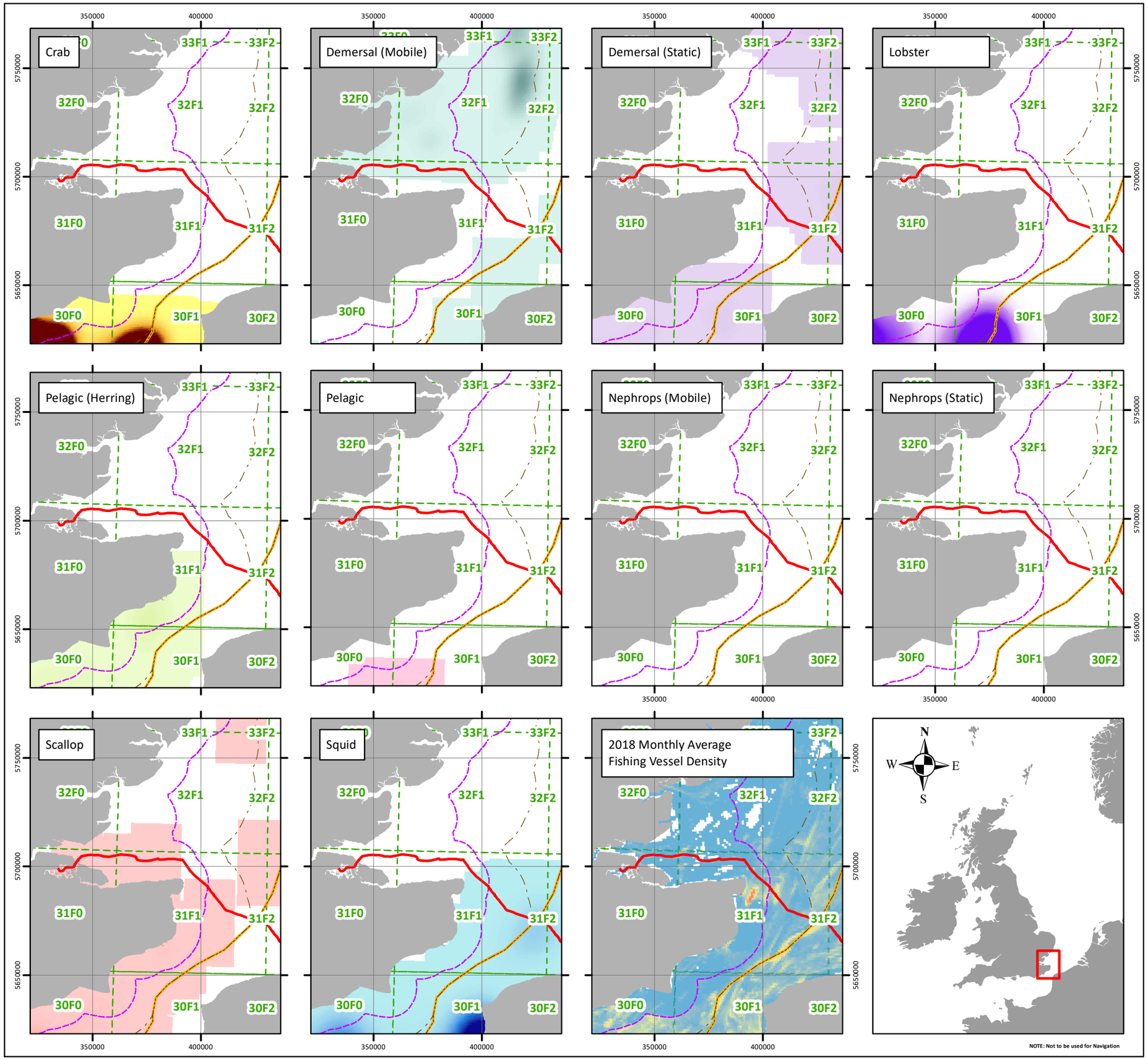
12.3.1.1 English Fisheries

Commercial fishing is widely distributed throughout the North Sea. In English waters, key shellfish target species include scallops, crabs, lobsters and whelks, whilst the most landed demersal species include cod, plaice and monkfish/anglers. Pelagic fish landings from English waters are mainly of sardines, mackerel and herring. In 2018, English vessels landed a total of 188 thousand tonnes of sea fish (including shellfish) which represents 27% of the quantity of landings by the UK Fleet. The English fleet operates from ports all around England, with the three key ports being outside of the Thames Estuary region in Newlyn, Brixham and Shoreham; Newlyn being the most important in terms of quantity; and Brixham most important in terms of value.

Within this context, most of the Proposed Development is within the UK territorial waters 12-mile fishery limit. Around 76% of the Proposed Development is inside the UK 6-mile fishery limit and falls within the fisheries district of Kent and Essex Inshore Fisheries and Conservation Authority (KEIFCA).

Leigh-on-Sea is the main landing port in the Thames Estuary region with total demersal, whitefish and shellfish landings for 2018 amounting to approximately £2.7 million (MMO 2019b). A large part of the value landed into Leigh-on-Sea can be attributed to the cockle fishery. Excluding cockle landings, the key port for demersal, whitefish and shellfish in the region is Ramsgate with landings for 2018 amounting to approximately £744,000 (MMO 2019b).

Figure 12-1 (Drawing P2172-FISH-007) shows fishing intensity, based on VMS data (Kafas et al. 2012) for the Kent and Essex region. This shows the spatial patterns of offshore fisheries and demonstrates the presence of demersal, scallop and squid fisheries in the region. It should be noted that for the Kent and Essex region there are significant limitations to the data. VMS is only required on vessels over 12m in length. As most of the fleet in the region are 10m or less in length they are not legally required to carry VMS. This means the effort in the region is not accurately captured in Figure 12-1 (Drawing P2172-FISH-007). Therefore, the lack of a specific fishery presence on the Figure cannot necessarily be indicative of the absence of the fishery in the region.



GRIDLINK INTERCONNECTOR

FISHING ACTIVITY

Average Fishing Intensity (Hours) 2009-2013

Drawing No: P2172-FISH-007 | **A**

Legend

- GridLink Preferred Cable Route
- 6nm Fisheries Limit
- 12nm Territorial Sea Limit
- EEZ Boundary
- ICES Rectangle

Vessel Density
hours/month/km²
High : 100
Low : 0

Amalgamated VMS Intensity 2009 - 2013 - by Species

Crab High : 0.96 Low : 0

Nephrops static High : 19.86 Low : 0

Demersal mobile High : 0.47 Low : 0

Pelagic - Herring High : 0.73 Low : 0

Demersal static High : 1.19 Low : 0

Pelagic - Mackerel High : 1.69 Low : 0

Lobster High : 2.22 Low : 0

Squid High : 5.33 Low : 0

Nephrops mobile High : 0.62 Low : 0

Scallop High : 0.81 Low : 0

Date	29 May 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	MarineRegions; UKHO; GEBCO; MS: ICES; Esri
File Reference	J:\Gridlink\P2172_Mxd\06_FISH\ P2172-FISH-007.mxd
Created By	Chris Dawe
Reviewed By	Emma Langley
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

0 25 50 75 100 km

12.3.1.2 Overview of Fisheries along the Proposed Development

Travelling from the UK landfall at Kingsnorth, through the Medway Estuary, the Thames Estuary and the east Dover Straight to the UK/French EEZ boundary, the Proposed Development crosses several different commercial fishing areas.

The Medway Estuary is a nursery ground for commercially important fish species, including bass. Fishing in the River Medway is limited to a small number of fishermen from the ROFF guild. Demersal trawling, static gear potting and oyster dredging is carried out commercially in the Medway Estuary (between KP0 and KP10) by authorised registered vessels operated by Freemen from the guild. Guild members also partake in recreational fishing using similar techniques and training ROFF apprentices in their craft.

The Outer Thames Estuary in conjunction with the Medway and Essex estuaries constitutes one of the most important spawning areas in the North Sea, helping to produce fish larvae that support important commercial Channel and southern North Sea fish stocks (Halcrow Group Limited 2010). Parts of the seabed in the region are also classified as Shellfish Waters, being designated for the protection of shellfish growth and production. There exists a well-established cockle fishery in the region, one of the largest such fisheries in the UK, with other shellfish fished for here including blue mussel and Pacific and native oyster.

Fishing activity in the Thames Estuary (KP10 to approximately KP80) is characterised by inshore demersal and shellfish fishing by the local Thames Estuary fishing fleet. Six key fisheries have been identified along the Proposed Development as described in Table 12-2.

Table 12-2 Key fisheries that spatially overlap with the Proposed Development

Fishery	Gear type	Target species	KP points - spatial overlap between the fishery and the Proposed Development
1	Pots	Whelk	KP0 – KP40, KP80 – KP93
2	Pots	Lobster and crab	KP12 – KP26, KP28 – KP34, KP65 – KP82
3	Bottom drift netting	Dover sole	KP15 - KP20, KP35.5 - KP36.5, KP38 - KP51.8, KP 55 - KP59, KP64.5 - KP69, KP94 - KP95
4	General demersal trawl and beam trawling, anchored nets	Whitefish (Dover sole, skate, plaice, brill, cod, bass)	KP10 – KP70
5	Trawling	Shrimp	KP10 – KP40
6	Suction dredging	Cockles	Adjacent to KP15 – KP30, and KP45 – KP60

Through consultation with local fishing organisations and vessels, it has been determined where each of the six fisheries spatially overlaps with the Proposed Development. This is shown in Figure 12-2 (Drawing P2172-FISH-008). It should be noted that fishery 6 – suction dredging for cockles does not occur within the Proposed Development; instead Figure 12-2 (Drawing P2172-FISH-008) indicates the sections of the Proposed Development for which the cockle industry has expressed concern that sediment plumes from cable burial could affect the regional cockle beds. Data provided by KEIFCA, illustrated in Figure 12-3 (Drawing P2172-FISH-011), shows the likely cockle beds.

Fishing in the east of the Dover Straights (KP80 to the UK/France EEZ boundary) is dominated by offshore demersal trawling by Belgian, Dutch, French and UK registered vessels; although there is still static nets and potting used in shallower water depths. Species typically targeted in this region are Dover sole, whelks and other miscellaneous whitefish and shellfish.

The fishing activity can be summarised as follows:

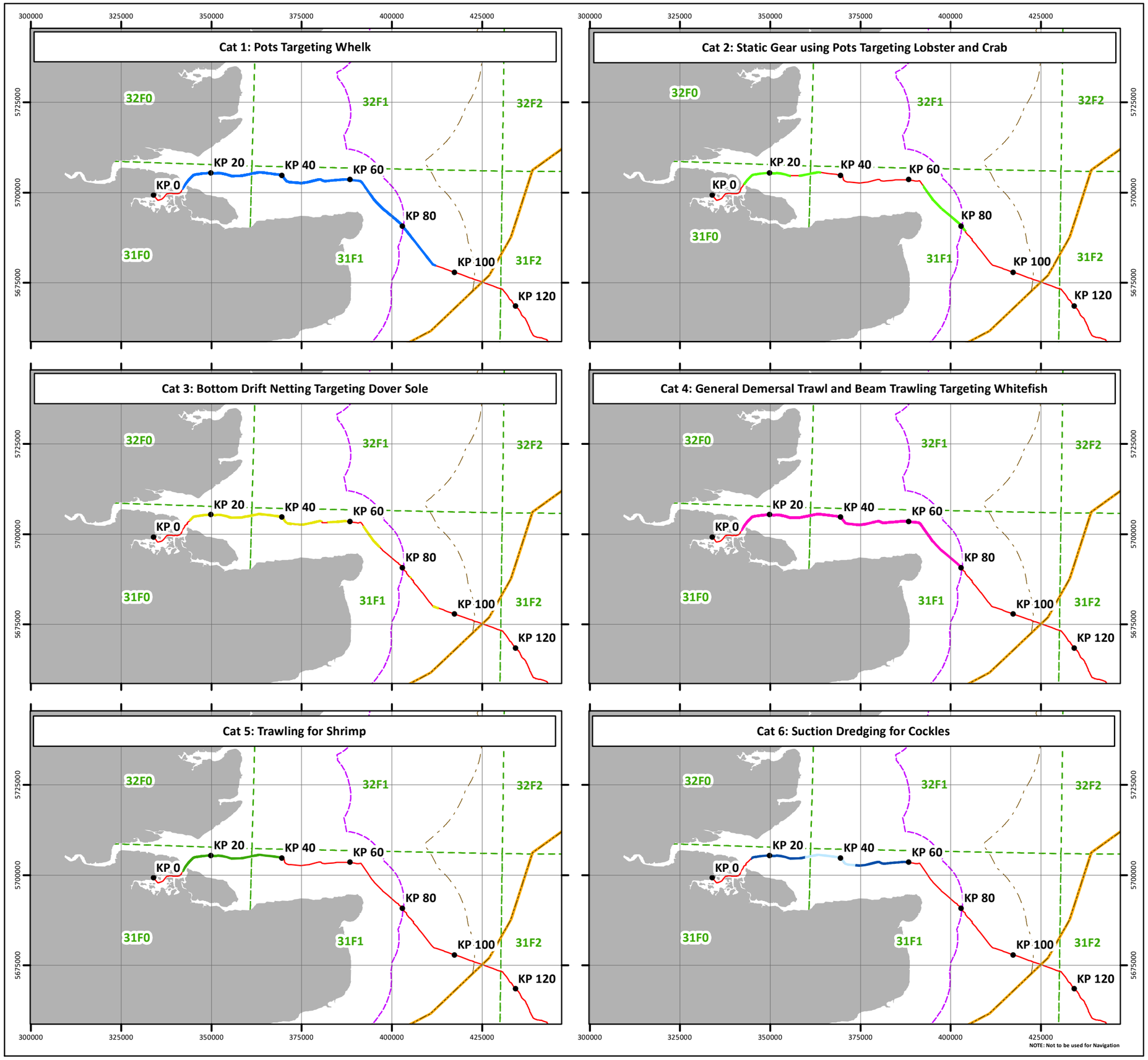
- Most fishing effort (consisting of demersal trawling) is considered to take place in the east Dover Straights and outside (east) of the UK 6-mile fishery limit i.e. east of KP80.
- Inshore demersal trawling and bottom drift net fishing takes place mostly to the west of KP60; and
- Static gear fishing occurs mostly to the east of KP30.

A summary of the key seasons for commercially important species by gear type is displayed in Table 12-3 below.

Table 12-3 Key seasons for commercially important species within the Proposed Development

Fishery	Gear type	Target species	J	F	M	A	M	J	J	A	S	O	N	D
1	Static	Whelk (KP0 – KP40)												
1	Static	Whelk (KP80 – 93)												
2	Potting	Lobster & crab												
6	Dredging	Cockle												
3, 4	Bottom drift netting / trawling, anchored netting	Whitefish (Dover sole, skate, plaice, brill, cod, bass)												
4	Trawling, anchored netting	Upper Thames Estuary Dover Sole												
5	Trawling	Shrimp												

The following sections provide further information on the different fisheries.



GRIDLINK INTERCONNECTOR

FISHING ACTIVITY

Commercial Fishing Activity within the Cable Corridor

Drawing No: P2172-FISH-008 | **A**

Legend

- KP
- GridLink Preferred Cable Route
- 6nm Fisheries Limit
- 12nm Territorial Sea Limit
- EEZ Boundary
- ICES Rectangle
- Category 1 - Static, Whelk
- Category 2 - Static, Lobster & Crab
- Category 3 - Bottom Drift, Dover Sole
- Category 4 - General Trawl, Whitefish
- Category 5 - Trawling, Shrimp
- Category 6 - Suction Dredging, Cockles
- Potential
- Confirmed

N W E S

Date	16 June 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	MarineRegions; FLO; UKHO; GEBCO; ICES; © Esri
File Reference	J:\Gridlink\P2172_Mxd\06_FISH\ P2172-FISH-008.mxd
Created By	Chris Dawe
Reviewed By	Emma Langley
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

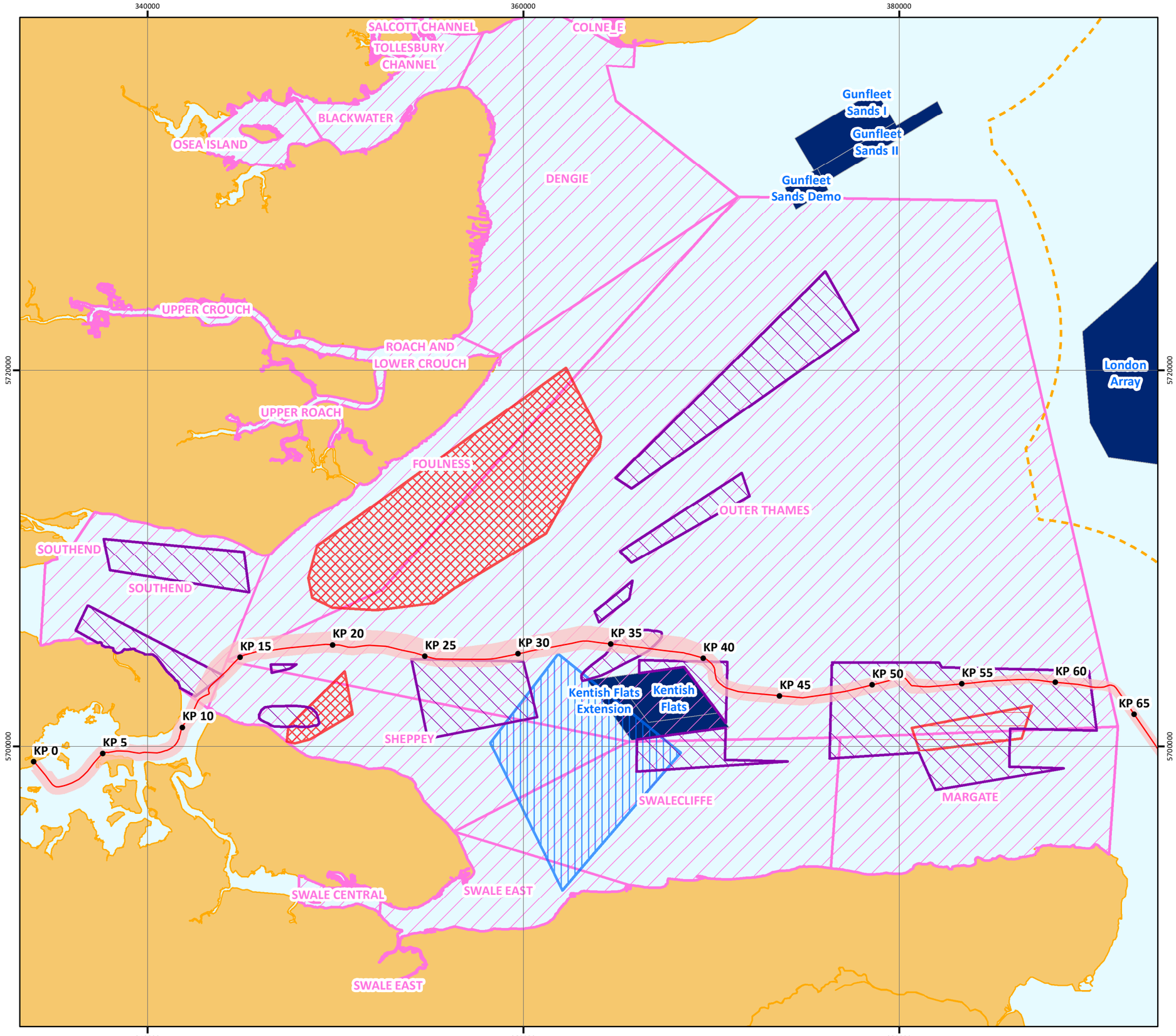
intertek

0 10 20 30 40 km

GRIDLINK INTERCONNECTOR

FISHING ACTIVITY
Indicative Areas of Cockle and Oyster Fishery

Drawing No: P2172-FISH-011	C



Legend

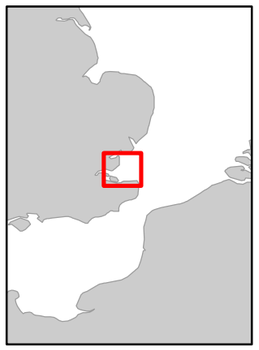
- KP
- 6nm Fishery Limit (KEIFCA Boundary)
- GridLink Preferred Cable Route
- Application Corridor
- Area Classified for Cockles

KEIFCA Data

- Cockle Area
- Cockle Boat Sightings
- Oyster Boat Sightings
- Designated Shellfish Water

Offshore Windfarm

- Active/In Operation



NOTE: Not to be used for Navigation

Date	22 September 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	TCE; EEA; TEFA; UKHO; ONS; ESRI; EuropaTech
File Reference	J:\Gridlink\P2172_Mxd\06_FISH\ P2172-FISH-011.mxd
Created By	Chris Dawe
Reviewed By	Emma Langley
Approved By	Anna Farley

0 2.5 5 7.5 10 km

12.3.1.3 Shellfish

Most of the local Thames Estuary fishermen that target whelks, crabs and lobsters rely heavily on static gear fishing. The static gear fishing in the Thames Estuary and east Dover Straights is characterised by the use of pots to catch crab and whelks on the sandy seabed and lobsters on the hard, rocky grounds.

The static whelk landings peak between January and March and an increase in the amount of static gear vessels suggest non-local/nomadic fishermen coming to the region during this period. Static gear shellfish landings for lobster and crab are the highest between May and July.

Cockle fishing is an important and highly valuable part of the commercial fishing industry in the Thames Estuary and the main landing ports for cockles are Leigh-on-Sea, Queenborough and Whitstable. The Thames Estuary Cockle Fishery is regulated by the KEIFCA and only 14 vessels are permitted to dredge for cockles in the area. The cockle fishermen are restricted to a limited cockle dredging season (specified period between mid-June and start of October) and by a total allowable catch (TAC) set for the year.

The cockle beds over which cockle boats have been sighted by KEIFCA are illustrated in Figure 12-3 (Drawing P2172-FISH-011) and are on Maplin Sands to the north of KP15 - 30; between Sheerness and Leysdown on Sea to the south of KP15 – KP30; and on the Kentish Flats and Margate Sands to the south of KP45 - KP60. Local fishermen have also provided locations of other areas within the region which are either classified for cockles or are known cockle beds. The importance of these beds may grow over the next few years. Some of these areas overlap with Proposed Development; specifically around KP35, and between KP40 and KP62.

Dredging for oysters is also known to occur in the region but data provided by KEIFCA illustrated in Figure 12-3 (Drawing P2172-FISH-011) indicates that it occurs south of KP30 to KP35.

12.3.1.4 Demersal fish

A variety of demersal (bottom contact) trawl gear methods are used in the Thames Estuary and east Dover Straights to target demersal whitefish species such as Dover sole, skate, plaice, lemon sole, brill and cod. The Proposed Development crosses fishing grounds where inshore demersal fishing is regularly carried out by the local Thames Estuary fishing fleet and offshore demersal trawling activity is carried out by Belgian, Dutch, French and UK registered vessels.

Beam trawling is used in the outer Thames Estuary and east Dover Straights sections of the Proposed Development by Belgian, Dutch and UK-registered vessels. Local inshore trawlers and Belgian trawlers also use twin-rig otterboard gear to fish the Thames Estuary and east Dover Straight, but the popularity of this fishing method has considerably declined due to depleted fish stocks and fish quota restrictions on Dover sole. Fly seine netting is a more recent alternative to the traditional heavy beam trawling. This fishing method is used regularly by large Dutch, French and UK-registered vessels in the east Dover Straights and occasionally near the Proposed Development.

Bottom drift nets are widely used by the local inshore fleet in the inshore waters of the Thames Estuary and east Dover Straights. This method is particularly used by the Ramsgate-based fleet for catching sole. Bottom drift nets are used on isolated areas with a clean, clear seabed. Consultation with local vessels has identified where specific bottom drifts intersect the Proposed Development.

Static fishing gear gill nets are also used in the Thames Estuary to catch demersal whitefish species such as Dover sole, skate, plaice, brill, cod and bass. Because surface drift netting for bass is currently prohibited, local fishermen are instead using set nets which are currently permitted, except during a two-month ban on bass fishing in February and March.

Analysis of landing data (MMO 2019a,b) for Ramsgate port, the most important port for demersal whitefish in the region, suggests that demersal fish landings peak during the period from August to December.

12.3.1.5 Pelagic Fish

The local Thames Estuary inshore fleet uses pelagic drift nets to target shoaling fish species such as herring, mackerel and sprats.

In the past, locally based trawl fishermen have fished with pelagic (mid-water) trawl gear, but the use of this method has strongly declined in recent years. Larger UK and other EU member state offshore pelagic trawlers are permitted to fish UK waters and occasionally operate in the east Dover Straights region in the 6-12 miles fishery zone.

12.3.2 Local fishing fleet

UK vessels of less than 17 metres in length and with less than 300hp (221kW) are permitted to fish inside the 6-mile fishery limit, with some fishing restrictions. Fishing effort within the KEIFCA district is, therefore, limited to inshore fishing activity by vessels of under 17 metres in length and under 300hp (221kW). Most of the current Kent and Essex based fishing fleet is made up of small under-10 metre class of vessels with an average of around 88hp.

Based on the MMO's UK Fishing Vessel Registry list, it estimated that there is a total of 134 registered and licensed fishing vessels that operate in the vicinity of the Proposed Development. This number includes 14 designated cockle dredgers and of the remaining vessels only 96 are considered to be commercially active (identified through FLO consultation).

In depth analysis of the MMO 2018 fish landing data suggest that only 48 vessels operate on a full-time basis. A total of 27 vessels have indicated to the GridLink FLO that they actively fish within the Proposed Development on a full-time basis, consultation indicates however, this number is likely higher. The fishing effort of the local inshore fleet is evenly split between static gear fishing activity and mobile fishing methods.

Large Belgian, Dutch, French and UK-registered offshore trawlers regularly fish the east Dover Straights grounds and in the vicinity of the Proposed Development beyond KP80 (UK 6-mile fishery limit) and across to the French coast. The GridLink fisheries study indicates that some 22 offshore demersal trawlers regularly operate in the vicinity of the Proposed Development in the east Dover Straights sea area. These vessels include six Belgian beam trawlers and two Belgian twin-rig trawlers, four Dutch beam trawlers, four Dutch fly seiners, four French otterboard trawlers and two UK-registered fly seiner/twin-rig trawlers.

EU member state registered fishing vessels, and UK fishing vessels of over 17 metres in length with more than 300hp (221kW), are not permitted to fish inside the UK 6-mile fishery limit off the Kent coast.

12.3.3 Overview of Landings Data

12.3.3.1 Landings by Weight and Value

The Proposed Development is located within the International Council for the Exploration of the Sea (ICES) fisheries rectangles 31F0 and 31F1. A high-level review of landings data from 2014 to 2018 provided information on the economic importance of different commercial fish species.

Over the 5-year period 20,658 tonnes of fish were landed with a value of over £21.6 million (Table 12-4). Of this value, £9 million was landed by <10 m vessels with the remaining £12.6 million landed by the >10m fleet. 91% of the total value of landings from 31F0 and 60% from 31F1 were represented by shellfish. This data highlights the importance of shellfish fisheries in the area of the Proposed Development.

Table 12-4 Annual catch value from 2014 - 2018

Year	Live weight (tonnes)	Value (£)	Value per tonne (£/tonne)	ICES rectangle division
2014	5,829	5,190,320	890	31F0 and 31F1
2015	4,000	3,433,563	858	31F0 and 31F1
2016	3,347	4,046,272	1,209	31F0 and 31F1
2017	3,941	4,703,958	1,194	31F0 and 31F1
2018	3,541	4,294,445	1,213	31F0 and 31F1
Total for 5-yr period	**20,658**	**21,668,559**	**-**	**31F0 and 31F1**
Average	**4,132**	**4,333,712**	**1,073**	**31F0 and 31F1**

MMO (2019)

In terms of quantity landed and commercial value, within 31F0 and 31F1 cockles were the species with the greatest weight of landings, with whelks and herring also featuring prominently in landings (Table 12-5). Within 31F0 brown shrimp, despite no recorded landings in 2015, was among the species with the highest landings and value. Within 31F1, there was a greater variety of fish species with horse mackerel and red mullet being among the species with the highest landings and value.

Table 12-5 Top five landed species by value (£) in 2018

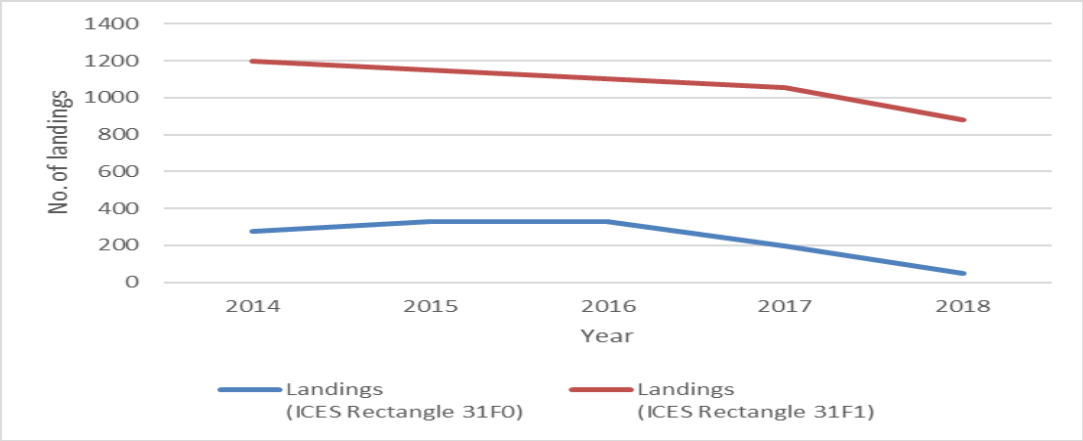
		ICES Rectangle	
		31F0	31F1
Landed Species	1	Cockles	Cockles
	2	Sole	Horse mackerel
	3	Thornback ray	Herring
	4	Brown shrimp	Squid
	5	Bass	Whelks

MMO (2019)

12.3.3.2 Temporal trends

In terms of intra-annual variation, the number of fleet landings in both ICES rectangles declined between 2014 and 2018 as illustrated in Figure 12-5. Within 31F0, the number of recorded landings increased to 329 in 2015, but then dropped to only 49 in 2018. Within 31F1 the number of landings was recorded at 1199 in 2014, but gradually dropped over the next four years to 879 in 2018.

Figure 12-4 Landing trends in ICES rectangles 31F0 and 31F1 from 2014 – 2018 (MMO 2019)



Despite a reduction in vessel numbers over the last decade and reductions in fish quotas for all EU member state fishing fleets, it is unlikely that there will be any significant change to fishing effort and activity in the Thames Estuary and east Dover Straights fishing grounds and in the vicinity of the Proposed Development in the near future.

There is still considered to be some over-capacity and over-fishing taking place in some EU/UK fisheries sectors outside of the UK 6-mile fishery limit, particularly by the Belgian and Dutch demersal trawling fleets operating in the southern North Sea. Some of the traditional fish stocks in the Thames Estuary are reported by some local fishermen to be at an all-time low. Fisheries regulations and reduced fish quota allocations have also contributed to the decline in demersal trawling for whitefish in the Thames Estuary by the local fleet.

The majority of the local Thames Estuary fishing fleet rely on potting for shellfish and whelks and netting for Dover sole and bass. Dover sole is an EU quota species however and bass is now restricted to seasonal fishing, with strict new fishing regulations detailing methods and landing quantities. As a result, coastal waters have seen an increase in the deployment of static gear.

12.3.4 Restricted Fishing Areas

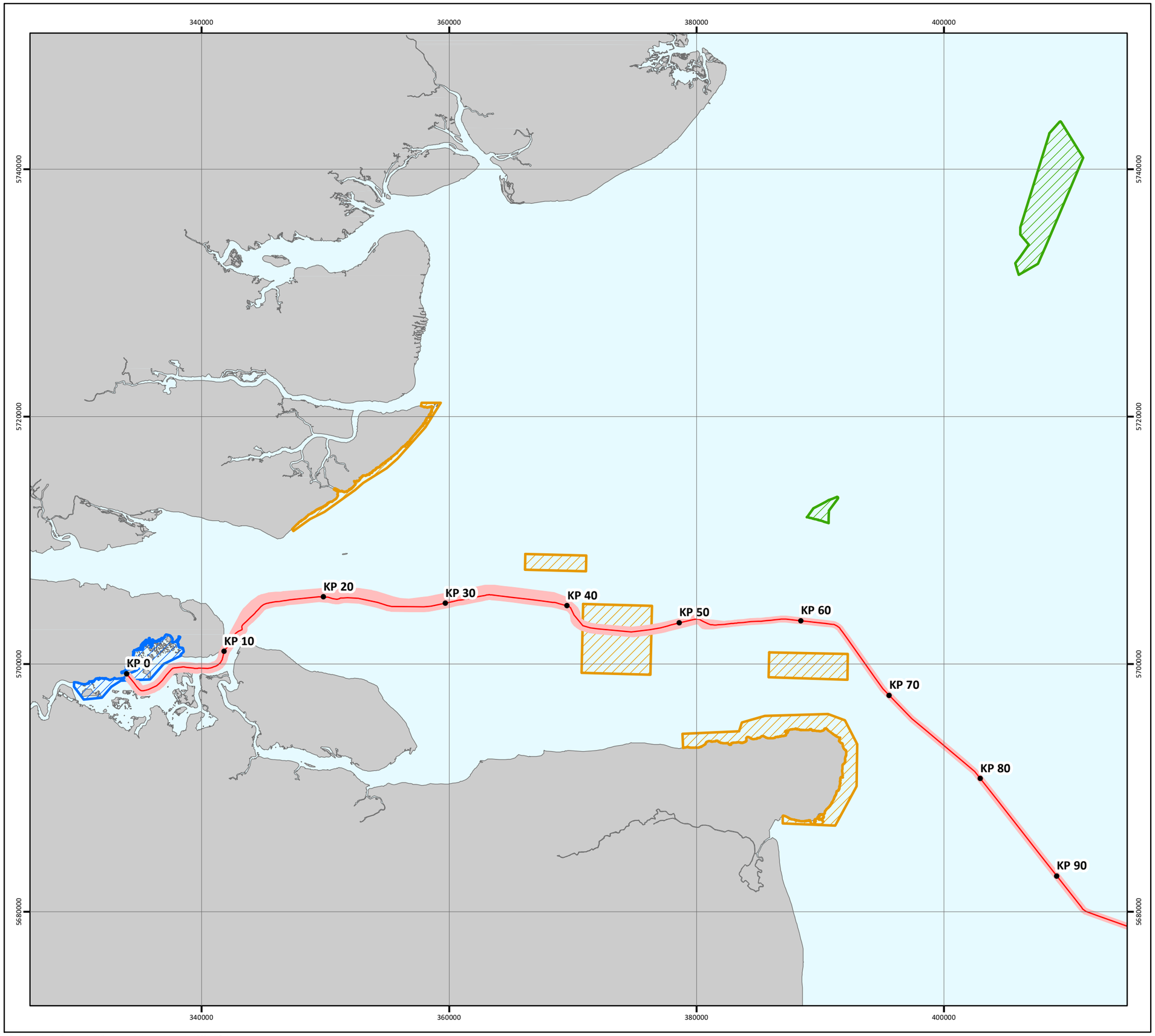
12.3.4.1 KEIFCA Byelaw Areas

In 2017 KEIFCA passed a byelaw prohibiting the use of bottom towed fishing gear in six areas across the KEIFCA District. Bottom gears include the use of "any beam trawl, otter trawl, multi-rig trawl, pair trawl, anchor seine, Scottish seine, dredge or other similar fishing instrument designed to take or disturb sea fisheries resources on the seabed" (KEIFCA 2017).

Of the six Prohibited Areas, the Proposed Development crosses the Pan Sand Hole Prohibited Area (illustrated in Figure 12-6, Drawing P2172-FISH-005). This site is located within the Margate and Long Sands Special Area of Conservation (SAC), which is designated for the Annex I habitat 'sandbanks which are slightly covered by sea water all the time'. A primary reason for the designation of the Pan San Hole byelaw was the presence of the biotope SS.SCS.ICS.SLan 'dense *Lanice conchilega* and other polychaetes in tide-swept infralittoral sand and mixed gravelly sand'. The byelaw seeks to prevent damage or deterioration of the site because of repeated bottom trawling.

12.3.4.2 Margate and Long Sands Byelaw Area

Within the Margate and Long Sands SAC, the MMO introduced The Margate and Long Sands European Marine Site (Specified Areas) Bottom Towed Fishing Gear Byelaw 2017 which prohibits the use of bottom-towed fishing gear to protect two areas of subtidal sandbank communities. Referred to as Area A and B in the byelaw both areas lie to the north of the Proposed Development as illustrated in Figure 12-5, Drawing P2172-FISH-005.



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GRIDLINK INTERCONNECTOR

FISHERIES INFORMATION
Fishing Bylaw Areas

Drawing No: P2172-FISH-005	C

Legend

- KP
- GridLink Preferred Cable Route
- Application Corridor
- Medway Bass Nursery Area
- Margate & Long Sands Bottom Towed Fishing Bylaw
- KEIFCA Fishing Bylaw

N W E S

NOTE: Not to be used for Navigation

Date	22 June 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	KEIFCA; MCA; OSOD; ESRI
File Reference	J:\Gridlink\P2172_Mxd\06_FISH\ P2172-FISH-005.mxd
Created By	Chris Dawe
Reviewed By	Emma Langley
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

0 5 10 15 20 km

12.4 Potential Pressure Identification and Zone of Influence

A scoping exercise undertaken to inform the content of the environmental assessment excluded the pressure 'electromagnetic changes' from further consideration in this topic chapter. Explanation for the exclusion is provided in Chapter 4, Table 4-1.

The pressures listed in Table 12-6 will be assessed further. For each pressure the assessment considered the different aspects of the Proposed Development during installation, operation (including repair & maintenance) and decommissioning. In order to evaluate the most significant effects, the largest zone of influence from these aspects was selected. The zones of influence are also presented in Table 12-6.

The assessment also considered the estimated duration of vessel activities as identified in Table 12-7 and illustrated in Figure 12-6 (Drawing P2172-INST-002).

Table 12-6 Pressure identification and zone of influence

Potential Pressure	Aspect	Project Phase	Project Activity	Receptor[1]	Zone of Influence
Temporary displacement of fishing activity (including required static gear clearance) / Restricted access to fishing grounds	Presence of installation vessels & equipment	Installation	Cable burial	Fisheries 1 – 5.	Temporally defined individually for each activity using Table 12-7. The Application Corridor has been split into the following 3 sectors[2]: - KP1 - KP12 Medway Estuary - KP12 - KP56 Thames Estuary - KP56 - KP108 Southern North Sea
		Operation	Repair		Up to 10 days. 500m radius around vessels engaged in repair activities
		Decommissioning	Cable removal		Temporal timescales similar to installation. The Application Corridor has been split into the following 3 sectors[2]: - KP1 - KP12 Medway Estuary - KP12 - KP56 Thames Estuary - KP56 - KP108 Southern North Sea
Physical change (to another seabed type)	External cable protection	Installation	Cable burial	Fisheries 1 - 5	Specific locations as defined in Tables 3-9 and 3-11. Maximum width of 12.5m wide for external cable protection used at crossings [3] Maximum width of 9.1m wide for external cable protection used due to ground conditions.
		Operation	Cable repair		7m wide x 500m long (potentially at 3 discrete locations)
Temporary habitat disturbance affecting spawning, nursery or recruitment to stocks	Pre-sweeping	Installation	Seabed preparation	Fisheries 1, 2, 3, 4 and oysters	Select locations as identified in Table 3-4. Maximum of 63m wide.
	Pre-lay grapnel run, plough & jet trenching		Cable burial	Fisheries 1 - 5	15m wide x length of Preferred Cable Route Potentially up to 20m wide at London Array crossing if frond mats are placed around perimeter of crossing
	Plough & jet trenching	Operation	Repair & maintenance operations		15m wide x 500m long (potentially at 3 discrete locations)
		Decommissioning	Cable removal		15m wide x length of Preferred Cable Route
	External cable protection	Installation	Cable burial	Fisheries 1 - 5	Specific locations as defined in Tables 3-9 and 3-11.

Potential Pressure	Aspect	Project Phase	Project Activity	Receptor[1]	Zone of Influence
Permanent habitat loss affecting spawning, nursery or recruitment to stocks					Maximum width of 12.5m wide for external cable protection used at crossings [3] Maximum width of 9.1m wide for external cable protection used due to ground conditions.
		Operation	Repair		7m wide x 500m long (potentially at 3 discrete locations)
Changes in suspended sediments (water clarity) indirectly leading to effects on commercially targeted species	Pre-sweeping, cable burial	Installation	Seabed preparation, Cable burial	Fisheries 3, 6 and oysters	Sand and gravel deposition within 35m of cable route. Maximum deposition thickness varies depending on particle size distribution and trench depth but will be <5cm. Concentrations of suspended fines (silt and clay) will be above 300mg/l (conservative threshold for significant effects on sensitive shellfish e.g. cockles) within 250m of the cable route perpendicular to tidal flow and about 1.4km in the direction of tidal flow. Silt deposition thicknesses above 1mm will occur within 75m perpendicular to tidal flow and 500m in the direction of tidal flow but will not exceed 2mm. [4]
	Cable burial	Operation	Repair & maintenance operations		
	Plough & jet trenching	Decommissioning	Cable removal		
Snagging resulting from obstruction on the seabed	PLGR. Anchoring. Exposed cable on seabed.	Installation	Cable burial	Fisheries 3, 4, 5	15m wide x length of Preferred Cable Route
	Exposed cable on seabed. External cable protection.	Operation	Repair & maintenance operations		Specific locations as defined in Tables 3-9 and 3-11. Maximum width of 12.5m wide for external cable protection used at crossings [3] Maximum width of 9.1m wide for external cable protection used due to ground conditions. Entire length of Preferred Cable Route for snagging on cable.
	Exposed cable on seabed. External cable protection.	Decommissioning	Cable left in-situ		Entire length of Preferred Cable Route for snagging on cable.
Underwater noise changes	Continuous noise: vessel movements, equipment & machinery	Installation	Marine survey. Seabed preparation. Cable burial.	Fisheries 1 - 5	92m radius from Vessel [5]
		Operation	Marine survey. Repair & maintenance operations		

Potential Pressure	Aspect	Project Phase	Project Activity	Receptor[1]	Zone of Influence
		Decommissioning	Marine survey. Cable removal.		
Underwater noise changes	Impulsive noise: geophysical survey.	Installation	Marine survey	Fisheries 1 - 5	188m radius from Vessel [5]
		Operation			
		Decommissioning			
Underwater noise changes	Impulsive noise: high order UXO detonation (if required)	Installation	Seabed clearance	Fisheries 1 - 5	1.5km radius from detonation [5]
		Operation	Repair – seabed clearance		
Change in water depth	External cable protection	Operation	Operational cables	All fisheries	Specific locations as defined in Tables 3-9 and 3-11.
Transition elements and organo-metal contamination	Pre-sweeping, cable burial	Installation	Seabed preparation, Cable burial	Fishery 6	Sand and gravel deposition within 35m of cable route. Maximum deposition thickness varies depending on particle size distribution and trench depth but will be <5cm. Concentrations of suspended fines (silt and clay) will be above 300mg/l (conservative threshold for significant effects on sensitive shellfish e.g. cockles) within 250m of the cable route perpendicular to tidal flow and about 1.4km in the direction of tidal flow. Silt deposition thicknesses above 1mm will occur within 75m perpendicular to tidal flow and 500m in the direction of tidal flow but will not exceed 2mm. [4]
	Cable burial	Operation	Repair & maintenance operations		

Notes:

1. Fisheries are identified in Section 12.3.1.2, Table 12-2 but in summary: 1 = Static and anchored gear targeting whelk; 2 = static gear targeting crab and lobster; 3 = bottom drift netting for Dover sole; 4 = general demersal and beam trawling for whitefish; 5 = shrimp trawling; 6 = cockle dredging

2. It is assumed that the route will be divided into these blocks during installation with fishermen requested to remove static gear from these areas for a specified period whilst survey or installation passes through.

3. Berm widths at crossings range from 9.8m to 12.5m. The maximum berm width associated with the planned Mercator / Joss crossing has been used for the zone of influence.

4. Values taken from Technical Appendix C.

4. Values taken from Technical Appendix I.

Table 12-7 Estimated duration of project vessel activities

Section	KP range	Estimated Duration of Cable Installation activities (days)[1]		Cable Jointing activities (days)[2]	Cable Crossings and Removal activities (days)	Total
1	0 to 12	3.8: Shallow Cable Lay	7.5: Burial with Jetter	-	0.75 (x3 OOS)	12.05
Sub-total		**3.8**	**7.5**	**0**	**0.75**	**12.05**
2A	12 to 34	6.9: Shallow Cable Lay	15.5: Burial with Plough	8	0.5 (x2 OOS)	30.9
2B	34 to 56	5.0: Shallow Cable Lay	15.5: Burial with Plough	8	4.5 (2x OOS x4 IS)	33.0
Sub-total		**11.9**	**31.0**	**16**	**5**	**63.9**
3A	56 to 76	1.4: Deep Cable Lay	4.2: Burial with Plough	-	1.75 (x7 OOS)	7.35
3B	76 to 84	0.6: Deep Cable Lay	5.6: Burial with Plough	-	4.5 (x3 OOS and x4 IS)	10.7
3C	84 to 90	0.4: Deep Cable Lay	4.2: Burial with Plough	-	1.0 (x1 IS)	5.6
3D	90 to 97	0.7: Deep Cable Lay	4.9: Burial with Plough	-	1.0 (x1 IS)	6.6
3E	97 to 105	0.6: Deep Cable Lay	5.6: Burial with Plough	-	1.0 (x1 IS)	7.2
3F	105 to 108.8	0.2: Deep Cable Lay	2.2: Burial with Plough	-	-	2.4
Sub-total		**3.9**	**26.7**	**0**	**9.25**	**39.85**
Total		**19.6**	**65.2**	**16**	**15**	**115.8**

[1]Assuming:

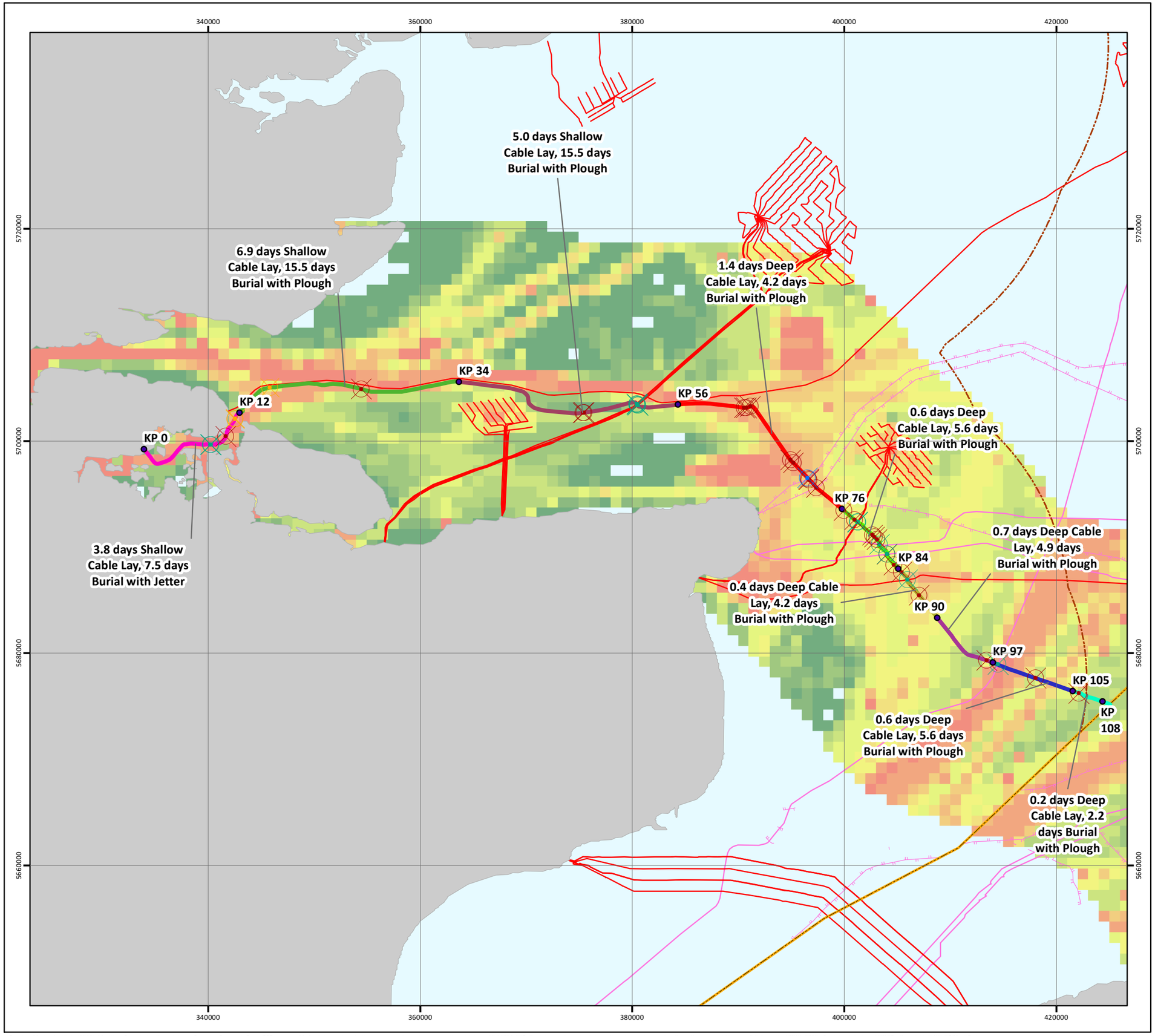
- Shallow water cable lay: working hours of 16 hours a day due to tides at a rate of 4.8km/day
- Shallow water burial with jetter: working hours of 16 hours a day due to tides at a rate of 2.4km/day
- OOS cable removal = 0.25 days per cable. IS cable crossing = 1 day per crossing
- Deep water cable lay: working hours of 20 hours a day at a rate of 12km/day
- Deep water burial with plough: working hours of 20 hours a day at a rate of ~1.7km/day
- Does not include allowance for weather delays

[2]Assuming up to 2 jointing activities within Application Corridor, 4 days per joint on two cables

GRIDLINK INTERCONNECTOR

INSTALLATION
Estimated Duration of Cable Installation Activities

Drawing No: P2172-INST-002 | **B**



Legend

- KP
- Route Installation Section
  - KP 0 to KP 12
  - KP 12 to KP 34
  - KP 34 to KP 56
  - KP 56 to KP 76
  - KP 76 to KP 84
  - KP 84 to KP 90
  - KP 90 to KP 97
  - KP 97 to KP 105
  - KP 105 to KP 108.8
  - 12nm Territorial Sea Limit
  - EEZ Boundary
- Vessel Density (All Vessels)
  - vessel hours per year per 1km²
  - <1
  - 1 - 2
  - 2 - 5
  - 5 - 10
  - 10 - 25
  - 25 - 50
  - 50 - 75
  - 75 - 100
  - 100 - 150
  - 150 - 200
  - 200 - 500
  - >500
- Crossing Location
  - In-Service
  - Abandoned but In-service
  - Out-of-Service (Assumed)
  - Planned
- Cables
  - Power
  - Telecom
  - Telecom (Disused)

N W E S

NOTE: Not to be used for Navigation

Date	29 May 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	MarineRegions; UKHO; KISCA; ESRI; OSOD; MarineTraffic; Intertek
File Reference	J:\Gridlink\P2172_Mxd\04_INST\P2172-INST-002.mxd
Created By	Chris Dawe
Reviewed By	Chris Carroll
Approved By	Emma Storey

GRIDLINK INTERCONNECTOR intertek

0 5 10 15 20 km

12.5 Embedded Mitigation

The embedded mitigation relevant to commercial fisheries is provided in Table 12-8 below. When undertaking the assessment, it is assumed that these measures will be complied with.

Table 12-8 Embedded mitigation

ID	Embedded mitigation measure	Project Phase		
		I	O	D
EM2	HDD drilling activities shall be conducted in a manner to minimise risk of bentonite breakout from the HDD entry or exit pits			
EM3	Submarine cables will be bundled together.			
EM4	Deployment of anchors/anchor chains on the seabed will be kept to a minimum in order to reduce disturbance to seabed and will be within the Proposed Development.			
EM5	Cable burial and protection design as detailed in the Burial Assessment Study, final crossing designs and planned and remedial final external protection designs shall be within the maximum design parameters detailed in the GridLink Marine Licence Application or robust justification for the deviations provided.			
EM6	Cables shall be installed in sand wave troughs wherever practicable, or after pre-sweeping if required, to minimise the risk or exposure by seabed mobility			
EM7	External cable protection (rock and/or mattresses) shall only be deployed where it is demonstrated that adequate burial depth cannot be achieved; the footprint of any external protection shall be the minimum required to ensure adequate cable protection and stability			
EM8	External cable protection (excluding crossing locations) shall not reduce chart datum by more than 5%, unless agreed with the MCA and appropriate navigation authorities. If external cable protection at any location including crossings does impact on navigable depth, such locations shall be marked in accordance with Trinity House requirements and suitably marked on navigation charts			
EM9	Cable protection heights and widths shall be minimised, taking into account the requirements to maintain the structural integrity of the berms.			
EM10	Cable protection shall be designed to minimise snagging hazards, for example by minimising height above seabed, smooth and shallower profiles, grade used for rock placement, type of rock (e.g. smoother edges).			
EM11	In-service third-party asset crossings shall not be carried out in buoyed navigable areas with water depths <10m			
EM12	London Array crossing design shall not exceed 1.76m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).			
EM13	London Array crossing design shall comprise one continuous cable protection across all four cables (rather than four individual cable crossings) to minimise eddy currents causing scour at end of berms			
EM14	London Array crossing design shall ensure vertical separation between the cables is preserved against long term settlement whilst minimising total berm height.			
EM15	Thanet Windfarm North crossing design shall not exceed 2.11m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).			
EM16	Thanet Windfarm South crossing design shall not exceed 2.11m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).			
EM17	NEMO Interconnector crossing design shall not exceed 1.96m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).			
EM19	PEC crossing design shall not exceed 2.11m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).			

ID	Embedded mitigation measure	Project Phase		
		I	O	D
EM20	Atlantic Crossing - Seg B1 crossing design shall not exceed 2.01m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).			
EM21	Tangerine crossing design shall not exceed 2.11m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).			
EM22	BT North Sea JOSS crossing design shall not exceed 2.21m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).			
EM23	Cutting of out-of-service cables shall be carried out in accordance with ICPC recommendation 1			
EM24	Out-of-service cables shall be cut in a manner to avoid spragging/fraying of cable ends or other snagging hazards to fishing nets			
EM25	Cut cable end locations and clump weights shall be accurately recorded and charted and positions passed to the FLO at the earliest opportunity.			
EM27	All material disturbed by the Pre-Lay Grapnel Run (PLGR) shall be recovered (unless there is a valid reason why an item cannot be safely recovered)			
EM28	The size of the Pre-Lay Grapnel shall be optimised for the expected duty and seabed obstacles to be cleared; over-sized PLG shall not be used			
EM29	Effective channels of communication shall be established and maintained between GridLink and commercial fishing interests. This will include the continued appointment of an onshore Fisheries Liaison Officer (FLO) and if necessary, offshore FLOs. Offshore FLOs should have experience of the Thames Estuary, east Dover Straits and Falls Bank area.			
EM30	Notices shall be given to other sea users in the area of operations via Notice to Mariners, Kingfisher Bulletins, NAVTEX, and NAVAREA warnings; particular attention shall be paid to ensuring the following organisations receive the notifications: Peel Ports, Port of London Authority (PLA), Thamesport, MCA, Royal Yachting Association (RYA), Vattenfall, London Array, Estuary Services Ltd (Pilots), Trinity House, ROFF, Thanet Fishermen's Association, Whitstable Fishermen's Association, Swale Fishermen Ltd, Harwich Harbour Fishermen's Association, Thames Estuary Fishermen's Association and Leigh Trawlermen Cooperative and individual local fishermen as identified by the FLO.			
EM31	FLO shall be included on distribution list for all daily reports from Project vessels.			
EM32	Vessels shall take all reasonable efforts to ensure they do not anchor where there is significant navigational traffic or in shipping lanes when waiting on weather. If it is required, the vessels will notify and coordinate with relevant authority.			
EM33	All vessels shall have passage planning procedures, holding positions (e.g. if waiting on weather), traffic monitoring (e.g. radar, AIS and visual), means of communication with third party vessels and emergency response plans in the event a third-party vessel approaches on a collision course			
EM35	Project vessels will comply with the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs) (as amended) Marking and UK Standard Marking Schedule for Offshore Installations Marking, particularly with respect to the display of lights, shapes and signals.			
EM36	Project vessels will be equipped with waste disposal facilities (sewage treatment or waste storage) to IMO MARPOL Annex IV Prevention of Pollution from Ships standards.			
EM37	Ship Oil Pollution Emergency Plans (SOPEPs) shall be provided by Contractor and implemented covering all vessels in accordance with MARPOL Annex I requirements			
EM38	Ballast water discharges from all vessels shall be managed under the International Convention for the Control and Management of Ships' Ballast Water and Sediments standard			
EM39	Hazardous chemicals and materials shall be managed in accordance with applicable standards and guidelines, including maintenance of an inventory of such substances that are used and/or stored, provision of Material Safety Data Sheets (MSDSs), preparation of Chemical Risk Assessments and storage in designated, secure facilities with suitable spill protection and control			
EM40	Biosecurity Plan (BSP) shall be prepared and implemented covering all marine operations, taking into account applicable guidance from the GB non-native species secretariat (2015)			

ID	Embedded mitigation measure	Project Phase		
		I	O	D
EM42	Emergency Spill Response Plan (ESRP) shall be prepared and implemented covering all marine operations			
EM44	A UXO survey will be undertaken within the UXO Survey Corridor to identify anomalies. If any significant UXO is identified, the decision-making hierarchy taking into account environmental sensitivities, safety and technical considerations shall be: 1. Avoid by micro-routeing 2. If the UXO cannot be avoided, undertake clearance to surface or move UXO outside the cable installation corridor 3. If the UXO cannot be safely moved, clearance by on-site deflagration.			
EM48	Information related to the as built cable will be provided to navigation and fishing stakeholders as required.			
EM49	As-built co-ordinates of the cable route shall be recorded and submitted to the UK Hydrographic Office (UKHO) via a H102 hydrographic note and KIS-ORCA Service; 'as-built' cables shall be marked on Admiralty Charts and fisherman's awareness charts (paper and electronic format)			
EM50	Electro-magnetic fields generated by the cable system shall not cause greater than a three degrees deviation on ships' compasses for 95% of the cable route; for the remaining 5% of the cable route, a maximum of five degrees deviation must be attained unless approved by the MCA			
EM51	Post-installation compass deviation surveys shall be carried out where the cables are not bundled together due to the shore crossing (KP0.0 and KP1.0) or other reason and water depths are <10m; the results of any compass deviation shall be provided to UKHO and MCA			
EM52	Post-installation inspection surveys shall be carried out every two years (the survey frequency may be reduced only when the depth of burial and seabed restoration has been sufficiently validated).			
EM53	Any post-lay cable exposure for whatsoever reason shall be published in the Kingfisher Information System, Notified to Fishermen and guarded until remedial works are completed			

12.6 Significance Assessment

12.6.1 Summary of Assessment

Table 12-9 and Sections 12.6.2 to 12.6.10 presents the assessment conducted on the Proposed Development. Where the assessment concluded the effects are potentially significant, Project Specific Mitigation has been proposed and is described in Section 12.7. Where there is potential for residual effects after Project Specific Mitigation, this is discussed further in Section 12.8.

Table 12-9 Assessment summary – commercial fisheries

Determination of potential effect						Effect assessment			Consideration of Mitigation	Residual Effect Assessment		
Section	**Project Phase**	**Aspect**	**Potential Pressure**	**Embedded Mitigation (Table 12-8)**	**Receptor**	**Magnitude**	**Sensitivity**	**Significance**	**Project Specific Mitigation (Table 12-11)**	**Magnitude**	**Sensitivity**	**Significance of Residual Effect**
12.6.2	Installation Operation Decommissioning	Presence of installation vessels & equipment	Temporary displacement of fishing activity / Restricted access to fishing grounds	EM3, EM5, EM7, EM8, EM11, EM26, EM29 - EM32, EM35, EM48, EM49, EM53	Fisheries 1 – 5.	Low	Medium	Minor	PS5, PS6, PS12, PS16, PS18, PS19, PS30	Low	Medium	Minor
12.6.3	Operation	External cable protection	Physical change (to another seabed type)	EM3, EM5, EM7, EM9, EM10, EM12 – EM22,	Fisheries 1 - 5	Medium	Medium	Moderate	PS1, PS2, PS3, PS4, PS20, PS21, PS22, PS23	Low	Medium	Minor
12.6.4	Installation	Pre-sweeping	Temporary habitat disturbance	EM3, EM6	Fisheries 1, 2, 3, 4 and oysters	Low	Medium	Minor	PS43	Low	Medium	Minor
	Installation Operation Decommissioning	Pre-lay grapnel run, plough & jet trenching		EM3, EM4, EM5	Fisheries 1 - 5							
12.6.5	Operation	External cable protection	Permanent habitat loss affecting spawning, nursery or stock recruitment	EM3	Fisheries 1 - 5	Low	Low	Negligible	-	-	-	-
12.6.6	Installation Operation	Pre-sweeping, cable burial,	Changes in suspended	EM3	Fisheries 3, 6 and oysters	Low	Medium	Minor	PS24, PS25, PS26, PS27	Negligible	Medium	Negligible

Determination of potential effect						Effect assessment			Consideration of Mitigation	Residual Effect Assessment		
Section	**Project Phase**	**Aspect**	**Potential Pressure**	**Embedded Mitigation (Table 12-8)**	**Receptor**	**Magnitude**	**Sensitivity**	**Significance**	**Project Specific Mitigation (Table 12-11)**	**Magnitude**	**Sensitivity**	**Significance of Residual Effect**
	Decommissioning	cable removal	sediments (water clarity)									
12.6.7	Installation Operation Decommissioning	PLGR. Anchoring. Exposed cable on seabed. External cable protection	Snagging resulting from obstruction on the seabed	EM3, EM4, EM5, EM6, EM10, EM13, EM23, EM24, EM25, EM27, EM28, EM30, EM35, EM48, EM49, EM52, EM53	Fisheries 3, 4, 5	Low	Medium	Minor	PS4, PS13, PS14, PS15, PS16, PS17, PS18, PS21, PS22, PS23, PS46	Low	Medium	Minor
12.6.8	Installation Operation Decommissioning	Continuous noise: vessel movements, equipment & machinery	Underwater noise changes	-	Fisheries 1 - 5	Low	Low	Negligible	-	-	-	-
12.6.8	Installation Operation	Impulsive noise: geophysical survey.	Underwater noise changes	-	Fisheries 1 - 5	Low	Low	Negligible	-	-	-	-
12.6.8	Installation	Impulsive noise: UXO detonation (if required)	Underwater noise changes	EM44, PS44	Fisheries 1 - 5	Low	Medium	Minor	PS28, PS29	Low	Medium	Minor
12.6.9	Operation	External cable protection	Change in water depth	EM3, EM5, EM6, EM7, EM8, EM9, EM12, EM14 - EM17, EM19 - EM22, EM30,	All fisheries	Medium	Medium	Moderate	PS1, PS2, PS3, PS4, PS41	Medium	Medium	Moderate

Determination of potential effect						Effect assessment			Consideration of Mitigation	Residual Effect Assessment		
Section	**Project Phase**	**Aspect**	**Potential Pressure**	**Embedded Mitigation (Table 12-8)**	**Receptor**	**Magnitude**	**Sensitivity**	**Significance**	**Project Specific Mitigation (Table 12-11)**	**Magnitude**	**Sensitivity**	**Significance of Residual Effect**
				EM48, EM49, EM53								
12.6.10	Installation Operation Decommissioning	Pre-sweeping, cable burial, cable removal	Transition elements and organo-metal contamination	EM2, EM3	Fishery 6, oysters	Negligible	Medium	Negligible	PS24 – PS28	-	-	-

12.6.2 Temporary displacement of fishing activity (including required static gear clearance) / restricted access to fishing

12.6.2.1 Installation

The Proposed Development has the potential to affect commercial fishing activity (both static and mobile gear) during installation via temporary displacement and temporary restricted access to fishing grounds.

Table 12-7 provides an estimate of the duration of cable lay and cable burial for each section of the Preferred Cable Route. However, it should be noted cable lay and cable burial may not be sequential and there could be a gap of between a few hours to a few weeks between the two activities.

Ahead of the installation vessels arriving on site, fisherman will be asked to move static gear away from the section of the cable route to be subject to marine operations. This will be done through the GridLink FLO (embedded mitigation EM29) in accordance with the Fisheries Co-existence Plan (Draft provided as Technical Appendix M). In addition, vessels will also be requested to say outside of the section of the cable route to be subject to marine operations if the cable is unprotected e.g. between cable lay and burial or between cable lay and the deposit of external cable protection. Depending on how the Installation Contractor sequences activities this could be a period of weeks to months for select sections. The Installation Contractor and FLO will ensure that all local fishing organisations and local vessels receive Notices to Mariners detailing the upcoming activities (embedded mitigation EM30), and the FLO will be provided with daily updates from the Project vessels of work to be undertaken that day and in the following week (embedded mitigation EM31). The Applicant's objective is to minimise disruption and therefore will seek to remove any restrictions on vessel movements at the earliest opportunity by dividing the cable route into sections that can be returned to commercial fishing as soon as marine operations in that section are completed.

The sensitivity of the receptor has been assessed as medium. All fisheries have key seasons within which limited access to traditional grounds would cause disruption and potentially financial costs to the vessels affected. Through consultation with local vessels, Table 12-10 has been compiled which indicates for each fishery the months that they would wish to avoid being disrupted within. It can be clearly seen from the table that there is no one month in which at least one fishery would not be affected. However, the period July to October (inclusive) would potentially have the most disruptive effect should installation works be carried out in this time.

Table 12-10 Fisheries sensitivity to disruption

Level of disruption	Low		Medium		High	

Cumulative sensitivity to disruption	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Fishery Category	J	F	M	A	M	J	J	A	S	O	N	D
1 Static gear using pots (whelk)												
1 Static gear using pots (whelk)												
2 Static gear using pots (crab & lobster)												
4 General demersal trawl and beam trawling (whitefish)												
5 Trawling (Shrimp)												
6 Suction dredging (cockles)												

The magnitude of the effect has been assessed as low. Reduction in fishing grounds will be temporary but additional effort will be required to relocate static gear or fish in unfamiliar waters. It is recognised that much of the fishing fleet is small (<10m) vessels which will be sensitive to weather and sea state and may be limited to where they are able to relocate to, especially given the highly developed nature of the Thames Estuary with busy shipping lanes and several offshore windfarms. However, the Applicant has already well-established communication with the local fishing industry and individual fishermen outside of organised industry bodies in the region of the Proposed Development are known and in contact with the GridLink FLO. The commercial fishing industry has previously cooperated with gear clearance and avoidance of the Application Area to facilitate the marine surveys in 2019.

Although Table 12-7 indicates that the likely duration of the cable lay and burial works is approximately 115.8 days, the temporary exclusion zones will be mobile, moving with the installation spread. It is fully understood that individual fishermen have preferred fishing grounds, whether that be due to gear type, ground conditions, target species or vessel capabilities, but it is unlikely that any individual vessel would be displaced for the full estimated 115.8 days. Sections 2a and 2b have the longest durations around ~30 days each. There is the possibility that, for example, the general demersal trawls could be displaced from one section for 31 days and then from the next section for the next 33 days. However, vessels using mobile fishing gear will more easily be able to avoid the temporary restriction, while static gear can be re-deployed once operations in the area are complete. Disruption is therefore expected to be short-term and there will be no long-term restrictions with respect to access to grounds.

In conclusion, the overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

As best practice and based on consultation with stakeholders, Project Specific Mitigation (PS5, PS6, PS12, PS16, PS18, PS19, PS30) has been proposed and is presented in Section 12.7.

12.6.2.2 Operation

The assessment considers three repair events occurring over the lifetime of GridLink. It assumes that for each repair event a 500m section of cable will need to be removed and re-buried. There will also be the requirement to undertake inspection surveys of the Preferred Cable Route. The magnitude of these effects will be lower than for installation due to the localised nature of such repair events and the speed of the survey an existing asset (in comparison to the pre-installation engineering surveys). However, given the seasonal sensitivities in the region, and the uncertainty as to when a repair event may occur, the assessment concluded that the overall significance of effect should remain as **Minor** and is **Not Significant** for the reasons given for the installation phase.

Section 12.6.9 identifies that at specific locations the presence of external cable protection could reduce water depth. If in consultation with the MCA and Trinity House this is considered to impede safe navigation marker buoys may be introduced. The introduction of marker buoys could present a hazard to fishermen, extending the area over which the external cable protection presents a disruption to trawling or bottom drift net fishing. Trinity House advised that the preference is to avoid physical markings if possible, because of the additional hazard they present in the marine environment. However, they also advised that they prefer not to use virtual digital markings (e.g. through AIS) as these can be easily missed. For the purposes of a worst-case assessment, it has to be assumed that some form of physical marking may be required. However, any restrictions will be extremely localised, likely to affect a small number of vessels. It will not prevent fishing practices occurring but may cause very local disruption. Therefore, the overall significance of the effect is **Minor** and is **Not Significant**.

12.6.2.3 Decommissioning

Cables will either be retrieved or left safely in-situ buried to below the natural seabed level. In terms of disruption, removal will require a similar but potentially shorter campaign of works as installation. Therefore, any effects that could arise due to the decommissioning phase of the Proposed Development will be of a comparable magnitude to those assessed above for cable installation.

With respect to the option to leave cables in-situ, this has the potential to cause displacement pressures if the cable becomes unburied. In this event the local fishing fleet may potentially need to avoid some areas of the cable route over a longer period than experienced during installation. The effect of this potential method of decommissioning on commercial fishery receptors has been assessed here as **Minor** and **Not Significant**.

12.6.3 Physical change (to another seabed type)

12.6.3.1 Operation

Where external cable protection is required, e.g. at the crossing locations, and in areas where burial in sediment cannot be achieved, there will be a localised change in seabed sediment type. The cables will be laid bundled in one trench (embedded mitigation EM3), which will reduce the potential spatial footprint of the change. Outside of crossing locations external cable protection will only be deployed where it is demonstrated that adequate burial depth cannot be achieved; the footprint of any external protection shall be the minimum required to ensure adequate cable protection and stability (embedded mitigation EM7).

All potential places where external cable protection may be required have been identified as a conservative assumption. Up to 0.068km^2 of seabed could be affected, if external cable protection is required at all indicative locations.

The Installation Contractors cable burial and protection design shall be within the maximum design parameters established as embedded mitigation (EM5).

External cable protection will likely consist of rock in the size range of 2-22cm. Rock berms have been designed to have a slope profile of 1:3 ratio with a crest height of 1m. Embedded mitigation EM9 and EM10 require the Installation Contractor make all reasonable efforts to minimise cable protection heights and widths and minimise snagging hazards. Embedded mitigation EM12 through to EM22 outline the design parameters for individual crossings which shall not be exceeded.

Fishery categories 1 through to 5 are present in the areas where external cable protection will be required. Of these fisheries, bottom drift netting (fishery 3) and general demersal and beam trawling (fishery 4) and shrimp trawling (fishery 5) are the most sensitive to a change in seabed conditions and/or the presence of a physical structure on the seabed; as fishing gear can become snagged on the structure. Fisheries 1 and 2 both deploy static gear which is less sensitive to the presence of a protection structure although it is recognised that its presence may require fishermen to alter an established string or fleet line.

Consultation, through the GridLink FLO, was carried out with local organisations and vessels to identify any preferences for the type of external cable protection to be used as crossings. For each crossing the type of gear was considered and a preference indicated. These preferences are listed in Table 3-9. The industry recognises that cable protection structures are required but their objective is to be able to continue to fish over the ground without snagging once the structures are in place.

At several crossings, the preference indicated is for tapered concrete mattresses. Although the Applicant has noted this preference the assessment focuses on a rock berm as this presents the worst-case with respect to spatial footprint and potential effects. In addition, the Cable Burial Risk Assessment has identified high shipping densities for most of the Preferred Cable Route and the cable protection must be able to withstand the impact of an anchor drag across the cables. It is not thought that concrete mattressing can offer the required level of protection from an anchor drag.

The most sensitive crossing for fisheries is London Array, followed in order of sensitivity by the planned Joss telecoms cable, Thanet Offshore Windfarm export cables, Nemo Link and finally Tangerine and PEC. This is based on the type of fishing gear deployed at each location. The grounds surrounding the

Atlantic Crossing – Seg B1 telecoms cable crossing at KP96.8 is targeted primarily by foreign trawling vessels.

London Array crossing

The location of the London Array crossing is currently used for general demersal and beam trawling (fishery 4); and static gear using pots targeting whelk (fishery 1). Although bottom drift netting (fishery 3) is undertaken in the area, consultation with individual vessels has identified that the drift lines do not intersect the crossing location. Demersal and beam trawling are sensitive to rock berms as steep profiled berms can be difficult to trawl over. Although the berm profile (ratio 1:3) proposed is a standard over-trawlable design and therefore should not significantly disrupt the fishery, there is still concern amongst local vessels that due to their small size (<10m) they will not be able to tow over large berms. It should be noted that it is unlikely that the berm profile at this location could be reduced, as this will widen the footprint of the external cable protection. The crossing is within a Special Area of Conservation, the Primary Feature of which is sandbanks. Increasing the deposit of rock berm above that technically required for protection is not a favourable environmental solution with respect the conservation objectives of the European site.

Static gear can be relatively easily deployed around a rock berm without significant long-term disruption.

The sensitivity of the receptor has been assessed as medium, driven by the sensitivity of the individual vessels within the general demersal and beam trawling fishery that target his area. There is the potential that the external cable protection will act as a local barrier causing long-term disruption. However, fishing grounds will not be lost and there are acceptable alternatives e.g. the berm could either be avoided or gear lifted to cross it. For the static fishery, the sensitivity is low as activities may be disrupted but access to the established grounds will not be altered.

The magnitude of the effect has been assessed as low as the individual vessels affected can use large areas of the Thames region and the Proposed Development and will not be restricted by making small adjustments to avoid the cable protection.

In conclusion, prior to the implementation of any Project Specific Mitigation the overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

Consultation with the industry has identified Project Specific Mitigation which has been proposed in Section 12.7 (PS1, PS2, PS3, PS4, PS20, PS21, PS22, PS23).

Joss telecoms, Thanet OWF export cables, NEMO Link, Tangerine and PEC

The location of the Joss telecoms and Thanet OWF export cables crossings is currently used by fisheries 1 (static gear), 2 (static gear) and 4 (general demersal and beam trawling), whilst the location of the Nemo Link crossing is only targeted by fishery 1. The grounds around the Tangerine and PEC telecoms crossings are targeted are fisheries 1 and 2 which deploy static gear. The sensitivity of the fisheries to the presence of the cable protection has been assessed as low as activities may be disrupted but access to the established grounds will not be altered. The magnitude of the effect is low as the fisheries can use large areas of the Thames region and the Proposed Development and will not be restricted by making small adjustments to avoid the cable protection. In conclusion, the overall significance of the effect at these crossing points has been assessed as **Minor** and is **Not Significant**.

External cable protection due to ground conditions (Zone 43)

Table 3-11 identifies seven locations within the Proposed Development where ground conditions may prove unsuitable for burial and external cable protection may be required. Of these locations, only one Zone 42 between KP68.89 and 69.9 is located within an area targeted by fishery 3 bottom drift netting. Ground conditions at this location indicate high strength clay underlying 0.7m of loose sand.

Bottom drift netting is the most sensitive to a change in the seabed as the technique requires an obstruction free seabed for successful deployment. The deposition of a rock berm at this location has the potential to permanently stop a drift line, requiring the fishing vessel to permanently relocate to ground that may be less suitable, or is already under pressure from other vessels.

The sensitivity of the receptor has been assessed as medium, driven by the sensitivity of individual bottom drift netting vessels. This is a precautionary assessment as it has not been confirmed whether drift lines cross the locations where cable protection may be required. If they do, the presence of cable protection could cause localised loss of access to the established drift net grounds. There are acceptable alternatives, but the potential disruption could cause financial loss to the small number of vessels involved.

The magnitude of the effect has been assessed as medium for the few vessels involved. The effect on specific drift lines will be permanent, but to put this into context the spatial extent of the effect is extremely localised. It will affect selected drift lines, but not the whole fishery. There are alternative locations, but it is acknowledged that loss of even only 1 or 2 drift lines will put pressure on other areas.

The assessment concluded the potential for effects which are **Moderate** and **Significant**. This is a precautionary assessment, only a small number of drift lines could be lost relative to the size of the area available for drift netting. This effect will therefore be targeted at the one or two vessels where traditional drift runs intersect zone 43. Approximately 60 drift lines have been identified that could cross the cable route but not all drift lines intersect zone 43.

Consultation with the industry has identified Project Specific Mitigation which has been proposed in Section 12.7 to reduce the significance of the effect (PS4, PS21, PS22, PS23). The mitigation includes bottom drift net surveys to be undertaken prior to marine operations to establish the number of lines that could be affected (PS21 and PS22) if cable protection is used in this zone.

The residual effect has been re-assessed in Section 12.8 taking account of the mitigation.

12.6.4 Temporary habitat disturbance

12.6.4.1 Installation

Several aspects of the Proposed Development will disturb the seabed e.g. PLGR, pre-sweeping, cable burial (jet-trenching and ploughing), anchor placement. Each aspect has the potential to result in an indirect effect to commercial fisheries target species as a result of disturbance to spawning and nursery ground habitat affecting stock recruitment and/or temporary displacement of fish from the wider area.

Potential effects upon fish receptors, including potential effects on spawning and nursery grounds of commercially targeted species are assessed within Chapter 8. Taking into consideration, embedded mitigation which seeks to minimise the footprint of the Proposed Development on the seabed (EM3, EM4, EM5, EM6) the assessment concluded:

- It is likely that herring spawning takes place within the Proposed Development on the Downs Spawning Ground between KP87.5 and KP108 (continuing in French waters to KP114) between November and January.
- The Blackwater Herring Spawning Ground will not be disturbed by the Proposed Development.
- Eight locations within the Proposed Development have been identified as suitable habitats for sandeel spawning activity. However, the spawning grounds outside of the Proposed Development are extensive and the temporary habitat disturbance is unlikely to significantly reduce the spawning stock biomass numbers and numbers of recruits to the fishing grounds.

- Fishermen have identified that areas classified for cockle intersect the Proposed Development. The footprint of the Preferred Cable Route within these areas will be very small, and will not affect the ability of the area to recover after installation.
- The potential effects on other species with demersal life stages, including mobile shellfish, thornback ray and European bass, has been assessed as **Not Significant** as these mobile species will be able to temporarily relocate to other available habitat and disturbance will be temporary and localised.
- The significance of effects on fish species has been assessed as Minor and Not Significant.

Another concern raised by the industry was the anecdotal experience that disturbance by cable installation causes an increase of predatory species such as echinoderms which feed on animals disturbed by the installation spread. Significant increases in echinoderms can weigh down the trawl nets causing problems raising the nets. The footprint of the installation will be very small. Although the installation machine can be up to 15m wide, the actual trench created by the machine is less than 1m. The machines typically sit on skids or tracks which are pulled along the seabed. Therefore, although for the purposes of assessment a 15m wide corridor of disturbance has been assumed, realistically disturbance will be limited to narrow strips. Chapter 6 concluded that habitat disturbance will be limited in temporal extent with recovery expected within two to three years and effects on benthic habitats will not be significant. Therefore, any potential increase in predatory species as a result of cable installation will be short term (2-3 years) and localised (limited to narrow strips of the installation corridor).

Noting the above conclusion, the consequent effect on commercial fisheries has been assessed as **Minor** and **Not Significant** as no large-scale changes in distribution or type of target species or stock recruitment are envisaged via this localised temporary habitat disturbance either in the short-term or longer-term.

As best practice, Project Specific Mitigation (PS43) has been proposed with respect to works to be conducted in Herring Spawning Grounds and is presented in Section 12.7.

12.6.4.2 Operation

The assessment considers three repair events occurring over the lifetime of GridLink. It assumes that for each repair event a 500m section of cable will need to be removed and re-buried. The maximum total seabed footprint is 22,500m^2 (0.023km^2). Should any one of the repair events occur within areas of the Proposed Development identified as Prime or Sub-Prime sandeel habitat or occur within the Downs Herring Spawning Ground then the conclusions for installation remain pertinent. Therefore, in conclusion, the overall significance of the effect has been assessed as **Minor** and is **Not Significant.**

12.6.4.3 Decommissioning

It is assumed that the cable will be removed at decommissioning and it is likely that the seabed footprint of the cable removal will be like that for installation. Therefore, the sensitivity of the species has been assessed as medium, and the magnitude of the effect has been assessed as low. In conclusion, the overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

12.6.5 Permanent habitat loss affecting spawning, nursery or stock recruitment

12.6.5.1 Operation

Where external cable protection is deposited the localised change in seabed and resultant permanent habitat loss has the potential to adversely affect stock recruitment if significant areas of spawning or nursery grounds are lost. Taking into consideration, embedded mitigation EM3 and EM7, Chapter 8 concluded:

- The seabed footprint of the external cable protection is minimal in the context of the wider area available within the region for fish spawning and nursery.
- External cable protection will not be placed within cockle or oyster beds.
- Effects on sandeel and herring spawning grounds will be Negligible and Not Significant.
- There will be no population level loss or effects on spawning and nursery grounds.
- The significance of effects on fish species has been assessed as Negligible and Not Significant.

Noting the above conclusion, the consequent effect on commercial fisheries has been assessed as **Negligible** and **Not Significant** as no large-scale changes in distribution or type of target species or stock recruitment are envisaged via this localised permanent habitat loss either in the short-term or longer-term.

12.6.6 Changes in suspended sediments (water clarity) leading to effects on commercially targeted species

12.6.6.1 Installation

Seabed preparation (pre-sweeping) and cable burial (ploughing and/or jetting) will briefly change suspended sediment concentrations (SSC) (increasing turbidity). As the sediment settles out of suspension and is deposited on the seabed there is the potential it could smother sensitive commercial receptors such as shellfish beds, or clog fishing gear.

Chapter 5 establishes the baseline for SSC. It concludes that within the Medway Estuary, SSC's generally range between 0.1mg/l to 30mg/l. However, SSC's in the Thames Estuary are typically higher, ranging from 100mg/l to 1000mg/l. SSC's in the Southern North Sea rarely exceed 20mg/l (CEFAS 2016) but vary seasonally, with concentrations increasing in autumn and winter. Long term SSC averages within the wider Thames Estuary (including the Medway Estuary) are >30mg/l, with considerable (order of magnitude) temporal variability (Silva et al 2016 and Mott MacDonald 2018). A study has found that SSC can exceed 100mg/l during high water and in winter months (Mott MacDonald 2018).

The extent of suspension, dispersion and re-deposition is to a large extent a function of the sediment being disturbed as follows:

- Sand and gravel disturbed during the cable burial operations will settle back to the seabed very swiftly and the footprint is unlikely to extend any great distance from the Preferred Cable Route.
- Silts, clay and chalk particles will remain in suspension for a greater time period and will be dispersed over a much greater distance, depending upon the strength of tidal currents. However, the depth of deposition over such a large area is very small.

Intertek have utilised an existing in-house hydrodynamic model (NSCMS) covering the area of interest to estimate the likely extent and duration of elevated SSC due to the cable trenching activity, and the footprint and thickness of the disturbed sediment following deposition on the seabed. The NSCMS model has been used to model a moving discharge of sediment, released into the water column over a 24-hour period, to represent the disturbed sediment due to cable trenching activity along a discrete section of the Preferred Cable Route. A section between KP19 and KP21.4 was selected due to the proximity to two sensitive shellfish areas as identified by cockle boat sightings provided by KEIFCA.

The results from this modelled section of the Preferred Cable Route can be extrapolated along the Proposed Development to provide an indication of the likely resulting SSC and sedimented material along the Preferred Cable Route. However, it should be acknowledged that the hydrodynamic conditions will vary along the route. For this reason, current velocities have been extracted from the NSCMS at seven other locations along the Preferred Cable Route in order to provide an estimate of

the likely orientation and extent of SSC plumes and deposition footprints throughout the Proposed Development. These current speeds have also been used to estimate the distance sediments suspended by cable trenching are likely to travel before settling out of suspension.

Technical Appendix C presents the findings of the modelling exercise. It concludes that:

- Sands and gravels
  - Do not form part of the suspended sediment load and will settle very quickly (within about a minute for sand and seconds for gravel).
  - Deposition will occur within a short distance of the Preferred Cable Route; approximately 35m for sand and up to 4m for gravel.
  - The maximum deposition thickness along the Preferred Cable Route is calculated as 10.5mm for sand and 50.5mm for gravels (see Table 12-11).
- Fine fractions (silt and clay)
  - Disturbed silt and clay size particles are likely to remain in suspension over periods of hours to days, depending on particle size.
  - The full extent of the plume is approximately 800 m perpendicular to the tidal flow and 14 km in each direction along the line of the tidal current, but that over most of the plume the increase in SSC are generally lower than baseline variations (<30mg/l) and therefore unlikely to have a significant effect on water quality.
  - Concentrations are highest around slack water, due to the lower rates of advection and dispersion, with typical values between 150 mg/l to 250 mg/l, although peak values are up to 1000 mg/l. These peaks are very transitory and reduce quickly as tidal currents increase. Concentrations during peak flows (both ebb and flood tides) reach a maximum of about 60 mg/l.
  - The footprint of the plume for maximum concentrations at 300 mg/l is approximately 250 m by 1.4 km, although as this is taken from the maximum concentration plot, this footprint is time independent.
  - Following the end of the release of sediment, concentrations in the plume reduce to below 30 mg/l (approximate typical background level) within 40 minutes, and to below 10 mg/l within 5 hours and 40 mins.
  - The modelled deposition thicknesses are small. The footprint of 1 mm of silt deposition covers an area of approximately 500 m by 75 m, with a maximum thickness of 1.3mm.
  - Within the Medway Estuary, due to a deeper trench the maximum deposition thickness for fine sediment is likely to be in the range of 2mm.

The Proposed Development will result in temporary increase in SSC's. The magnitude of the increase will be dependent on the seabed conditions. However, calculations indicate the concentrations will be within the range of natural variability expected for the region, will be limited in extent and brief in nature. Chapter 5 concluded that the overall significance of the change in SSC in terms of the physical baseline is Negligible and is Not Significant.

Table 12-11 Median settling distance and layer depth for suspended gravel, sand and silt during installation

Point	KP	Tidal currents Average / Peak speeds (m/s)	Sediment fractions (%)			Estimated Deposition Thickness (mm)			
			Fines (Silt and Clay)	Sand	Gravel	Fines *Note 1*	Sand	Gravel	Total
1	11	0.92 / 1.33	70	26	4	1.2	2.5	3.4	7.1
2	15	0.62 / 0.85	25	74	1	0.4	10.5	1.3	12.2
3	30	0.69 / 1.02	38	44	18	0.7	5.6	20.5	26.8
4	52	0.82 / 1.11	26	72	2	0.4	7.7	1.9	10.0
5	63	0.67 / 0.84	26	72	2	0.4	9.5	2.3	12.2
6	77	0.91 / 1.27	51	16	33	0.9	1.6	28.5	31.0
7	90	0.98 / 1.54	26	11	63	0.4	1.0	50.5	51.9

Note 1 – Estimated deposition thickness has been scaled from the maximum modelled fine deposition thickness (1.3mm) which was based on 76% fine material, to account for the lower proportion of fines.

Note 2 - Grey rows depict areas close to cockle beds.

Fisheries 3 (bottom drift netting) and 6 (cockle dredging) and the commercial species oysters are most sensitive to a change in SSC. These are considered in turn below:

Fishery 3 - Bottom drift netting

The concern for bottom drift netting is that SSC in the water column will cause clogging of the nets. The sensitivity of the receptor has been assessed as medium as Drawing P2172-FISH-008 identifies that bottom drift netting is undertaken between KP15 and KP70 and therefore has the potential to be affected by increased SSCs.

The magnitude of the effect has been assessed as low. The modelling identifies that the highest suspended sediment concentrations (>300mg/l) will be limited in spatial extent and will not extend further than 1.4km from the cable route. Peaks will be transitory, highest at slack water and reduce quickly as tidal currents increase. As fishing vessels will be requested to remain at least 500m from the installation spread for safety reasons it is unlikely that bottom drift netting will spatially overlap with the sediment plume close to the installation spread. As sediment travels further away from the Preferred Cable Route it will be dispersed by tidal currents and wave action, decreasing the SSC.

It is recognised that the installation spread will progress along the Preferred Cable Route and as operations will be continuous (24-hours) a sediment plume will be present if burial is underway. However, as Chapter 5 concluded that silt will settle out of suspension within 5.6 hours and therefore effects will be brief, with baseline conditions expected to return within a tidal cycle once the installation spread has passed through the area. In addition, the SSC estimated from installation are within the natural variation of SSCs within the Thames Estuary and therefore a brief elevation within this range will have no long-term effects.

In conclusion, the overall significance of the effect on bottom drift netting has been assessed as **Minor** and is **Not Significant**

Fishery 6 – Cockle dredging

The concern for the cockle fishery is that increased suspended sediments will alter the condition and therefore quality of cockles and/or deposition of sediments will smother the cockle beds.

The sensitivity of cockles to changes in suspended sediment has been assessed as medium. Cockles are adapted to a sedimentary environment and changes in SSC do not necessarily lead to negative effects. However, a significant negative effect at the wrong time of year i.e. between July and August, can close the cockle beds for the year with major financial consequences for the industry.

The magnitude of the effect has been assessed as low for three reasons:

1. Although elevated levels of suspended sediments generated by the Proposed Development may exceed the threshold at which declines in cockle health are noted but these peaks are very transitory and reduce quickly as tidal currents increase.
2. Levels of sediment deposition on the cockle beds will not reach sufficient depths to cause smothering of cockles. Estimates of suspended sediment deposition thicknesses vary between location but do not exceed 2mm.
3. Where the Preferred Cable Route crosses known areas classified for cockles, the total deposition thickness of sediments (gravel, sand and fines) will not exceed 3cm.

These points are explained and justified below:

Effects of elevated suspended sediment depends on factors such as the concentrations; the length of exposure; the size range of the particles; the food content of the suspended sediment; and the level of contamination of the particles. Cockles can cope with suspended sediment concentrations of between 300 – 400mg/l (Tyler-Walters 2007, Hewitt et al. 2001); although Hewitt et al. (2001) note that cockles have difficulty coping with SSC over 400mg/l for long periods of time.

Conservatively, if it is assumed a threshold of 300mg/l is the level after which filtration abruptly declines in cockles then modelling shows that for most of the sediment plume the level of SSC generated by the Proposed Development will not affect cockle quality. Peaks where the threshold is exceeded may be experienced but these will be transitory and will reduce quickly as the tidal currents increase. They do not persist in one place for longer than a tide. Background levels of SSC within the outer Thames Estuary fluctuate between 10mg/l and 1000mg/l. Therefore, the peaks associated with the installation are within the normal range of SSC that cockles within the region are exposed to.

With respect to smothering Tyler-Walters (2007) notes that cockle burrow quickly to the surface if covered by 2cm of sediment and in tests most animals buried to a depth of 5cm burrowed to the surface, but few animals buried to 10cm could reach the surface. The modelling and Table 12-11 concluded that for silt suspended during installation the estimated deposition later is less than 2mm. This suggests that cockles will not be affected by smothering from the Proposed Development. Where areas classified for cockles directly intersect the Preferred Cable Route the total estimated deposition thickness does not exceed 3cm which is within the range which cockles can bury through successfully, without any adverse effects.

In conclusion, the overall significance of the effect has been assessed as **Minor** and is **Not Significant.**

Through consultation with KEIFCA and Thames Estuary Fishermen's Association best practice Project Specific Mitigation (PS24, PS25, PS26, PS27) has been identified and proposed in relation to the cockle fishery due to the recognised commercial sensitivity of the beds. This is listed in Section 12.7 and discussed in Section 12.8.

Oysters – Medway Estuary

As for the cockle fishery, the concern for oyster beds is that increased suspended sediments will alter the condition and therefore quality of oysters and/or deposition of sediments will smother them.

The sensitivity of the receptor has been assessed as medium as oyster beds are known to be present within the Medway Estuary and are targeted by guild members of ROFF.

The magnitude has been assessed as low as trenching will be spatially limited and short term in duration. While trenching is undertaken a sediment plume will be generated continuously, but it will move with the location of the cable spread. The plume will naturally disperse with silt sediments settling out of suspension within 6 hours. It is estimated that trenching in the Medway water body will take 8 days and therefore a sediment plume within the water body will not be present for longer than a spring neap cycle.

The cable trench within the Medway Estuary will be deeper (3.5m) than the cable trench in the outer Thames Estuary (1.7m – 2.5m). Technical Appendix C estimates that sands and gravel will be deposited within 35m of the trench, with a total deposition thickness of 2.3cm. Deposition thicknesses for suspended fine particles will be <1cm and is likely to be in the range of 2mm maximum thickness.

The average SSC caused by installation has been estimated as 47mg/l, but recognising that similar to installation in the outer Thames Estuary there is likely to be peaks close to the machinery especially at slack tide. Long term SSC averages within the wider Thames Estuary (including the Medway estuary) are >30mg/l, with considerable (order of magnitude) temporal variability (Silva et al 2016 and Mott MacDonald 2018). A study has found that SSC can exceed 100mg/l during high water and in winter months (Mott MacDonald 2018). The calculated SSCs from marine operations are therefore within the natural range of variability for suspended sediments that oysters are currently exposed to.

In conclusion, the changes in SSC and deposition of fines are not expected to impact commercially targeted oysters within the Medway. This conclusion also applies to other commercially targeted species within the Medway Estuary. The overall significance of the effect on oysters in the Medway Estuary has been assessed as **Minor** and is **Not Significant**

Oysters – Thames Estuary

The sensitivity of the receptor has been assessed as medium as KEIFCA have indicated that oyster beds lie south of the Proposed Development between KP25 and KP40; and at the closest approach lie approximately 400m to the south of KP32. Tidal ellipses presented in Technical Appendix C demonstrate that at KP30 and KP52 the sediment plume from installation is likely to be transported towards the west-south-west and therefore will likely overlap with the oyster beds.

The magnitude of the effect has been assessed as low. Unlike cockles, oyster cannot burrow to escape sedimentation as they are fixed to the seabed. Small increases in sediment deposition have been found to reduce growth rates. Smothering by 5cm of sediment would prevent filter feeding activity and lead to mortality (Perry et al. 2017). However, Technical Appendix C concluded that suspended sediment deposition thicknesses will not exceed 2mm and is likely to be less than 1mm. This suggests that the level of suspended sediment deposition will not significantly affect the oyster beds. In addition, the SSC estimated from installation are within the natural variation of SSCs within the Thames Estuary, that oysters are typically exposed to, and therefore a brief elevation within this range will have no long-term effects.

In conclusion, the overall significance of the effect has been assessed as **Minor** and is **Not Significant.**

The Project Specific Mitigation proposed for the cockle fishery will also be applicable to the oyster beds. This is listed in Section 12.7 and discussed in Section 12.8.

12.6.6.2 Operation

The assessment considers three repair events occurring over the lifetime of GridLink. It assumes that for each repair event a 500m section of cable will need to be removed and re-buried. The maximum total seabed footprint is 22,500m^2 (0.023km^2). Any effects of sediment plumes and deposition during repair works are likely to be on a significantly smaller scale than those assessed above for installation. However, should any one of the repair events occur in one of the sensitive sections of the Proposed Development as discussed above, there is the potential for similar levels of effect to installation.

Therefore, in conclusion, the overall significance of the effect has been assessed as **Minor** and is **Not Significant.**

12.6.6.3 Decommissioning

It is assumed that the cable will be removed at decommissioning and it is likely that the seabed footprint of the cable removal will be like that for installation. Therefore, the sensitivity of the species has been assessed as medium, and the magnitude of the effect has been assessed as low. In conclusion, the overall significance of the effect has been assessed as **Minor** and is **Not Significant**.

12.6.7 Snagging resulting from obstruction on the seabed

12.6.7.1 Installation

Several aspects of the Proposed Development have been identified as having the potential to create snagging hazards on the seabed; namely PLGR; cutting of out-of-service cables and clump weights used to secure cut ends; anchoring; cable burial; sections of exposed cable; and external cable protection.

The sensitivity of the receptor has been assessed as medium for three fisheries operating in the Proposed Development; fishery 3 (bottom drift netting), fishery 4 (general demersal and beam trawling) and fishery 5 (shrimp trawling). Snagging on an obstruction has the potential to cause damage to gear with financial consequences, or in the case of bottom drift netting an obstruction on an established drift line can effectively close that line requiring the vessel to move to alternative grounds.

Measures have been built into the design of the Proposed Development to ensure that the generation of snag hazards are reduced. This include factors such as bundling the cables together to reduce the footprint of seabed disturbance (embedded mitigation EM3); minimising the deployment of anchors (EM4); ensuring the final cable burial and protection design is within the maximum design parameters (EM5); burying cables into sandwave troughs to minimise risk of exposures (EM6); and ensuring cable protection is designed to minimise snagging hazards (EM10).

Oversized PLGs will not be used and all material disturbed by the PLGR will be recovered (EM27, EM28). The 'as-laid' position of the cables will be marked on Admiralty charts and fishermen's awareness charts (through the KIS-ORCA service) (EM49).

Three specific aspects of the Proposed Development were highlighted as of specific concern to commercial fisheries. The magnitude of the effects of these aspects is discussed below:

Cutting out-of-service cables

The Proposed Development crosses 22 out-of-service telecoms cables in UK waters as confirmed by the marine survey. As a precaution it is assumed that other cables identified in desk-based searches but not confirmed by the survey are still present and will need cutting ahead of cable installation. Cutting will be done in accordance with ICPC Recommendation 1 (EM23). Cables will be cut in a manner that avoids sprigging/fraying and the ends will be weighed down by flat clump weights (EM24, EM25). Although the design constraints are in line with best practice which are recommended to minimise the spatial effect on fisheries, even the presence of clump weights on a drift line could act as a snagging obstruction.

The magnitude of the effect has been assessed as low to medium.

It is estimated that 45-60 drift lines are in proximity to the Preferred Cable Route, some of which may intersect at locations where an out-of-service cable will require cutting. Without mitigation, drift lines that do intersect the point where an out-of-service cable is cut could potentially be obstructed in the long-term. This would either reduce the length of the drift, requiring the fleet to be retrieved early or set later or would stop the drift line from being used. It is recognised that for the vessel using an affected drift line the magnitude of the effect could be medium leading to an overall effect that is

significant, requiring a change in behaviour such as re-location. Due to ground conditions and other snagging hazards in the Thames Estuary the location of drift lines can be limited. If one drift line is obstructed additional pressures would be put on other locations.

With respect to the total bottom drift-net fishery the magnitude of the effect has been assessed as low due to the small number of drift lines affected in the regional context. The environmental assessment concluded that in the context of the total bottom drift-net fishery the obstruction of individual drift lines will lead to an effect that is **Minor** and **Not Significant.**

Project Specific Mitigation PS13, PS14 and PS15 has been proposed with respect to this pressure to reduce the significant of the effect to individual vessels. This is presented in Section 12.7 and discussed in Section 12.8.

Exposed cable

The primary protection method for the cables will be to bury them in the seabed. A cable burial risk assessment has been completed for the Proposed Development. This prescribes a recommended target depth of lowering for the cables to ensure they and third parties are sufficiently protected from the risk of snagging. The assessment considered the risks posed by shipping and fishing to the cables and the soil conditions along the Proposed Development. The TDOL is generally 1.7m but it does vary along the Preferred Cable Route; increasing at locations where there is the presence of extremely low strength clay (within which anchors will penetrate very deeply) combined with high traffic densities. The maximum TDOL is 3.5m between KP0 and KP7.1 (in the Medway Estuary).

The sensitivity of the receptor has been assessed as medium. During cable installation there may be a period between cable lay and burial where the submarine cables are left exposed on the seabed. Without appropriate mitigation there is the risk that vessels could anchor over the cables, or fishing gear /anchors could snag on the unburied cables.

The magnitude of the effect has been assessed as low as fishing vessels will be requested to remain at least 500m from the Project vessels and through the FLO all vessels will be appraised of locations and period when the cable is exposed on the seabed. It is therefore unlikely that a vessel will be near the unburied section to cause damage through anchoring or gear snagging. Regular Notice to Mariners will be issued to keep the commercial fishing industry informed (EM30).

It is expected that the risk of snagging on an unburied cable will be minimal and the assessment concludes that the effect is **Minor** and **Not Significant**. However, it is recognised that there have been recent occurrences in the region of fishing vessels snagging unburied cables and therefore in consultation with the industry Project Specific Mitigation has been proposed including the use of guard vessels (PS16, PS17 and PS18) to further reduce the risks.

External cable protection

Consultation with local fisheries has identified that should external cable protection be used within Zone 43 of the Preferred Cable Route due to ground conditions, there is the potential it could disrupt established bottom drift netting lines. Bottom drift netting is the most sensitive to a change in the seabed as the technique requires an obstruction free seabed for successful deployment. The deposition of rock berm in this area has the potential to permanently stop a drift line, requiring the fishing vessel to permanently relocate to ground that may be less suitable, or is already under pressure from other vessels.

The sensitivity of the receptor has been assessed as medium, driven by the sensitivity of individual bottom drift netting vessels. This is a precautionary assessment as it has not been confirmed whether drift lines cross the locations where cable protection may be required. If they do, the presence of cable protection and the associated risk of snagging nets and gear damage would cause individual fishermen to relocate the established drift lines. There are acceptable alternatives, but the potential disruption could cause financial loss to the small number of vessels involved.

The magnitude of the effect has been assessed as medium for the few vessels involved. The effect on specific drift lines will be permanent, but to put this into context the spatial extent of the effect is extremely localised. It will not affect the whole fishery, just selected drift lines. There are alternative locations, but it is acknowledged that loss of 1 or 2 drift lines will put pressure on other areas.

The assessment concluded that the significance of the effect is significant for individual vessels but in the context of the total bottom drift-net fishery will be **Minor** and **Not Significant.** Only a small number of drift lines could be lost relative to the size of the area available for drift netting. This effect will therefore be targeted at the one or two vessels where traditional drift runs intersect zone 43. Approximately 60 drift lines have been identified that could cross the Preferred Cable Route but not all drift lines intersect zone 43. In addition, there are areas outside of the Proposed Development that can be used by the fishery.

Consultation with the industry has identified Project Specific Mitigation which has been proposed in Section 12.7 to reduce the significance of the effect to individual vessels (PS4, PS21, PS22, PS23). The mitigation includes bottom drift net surveys prior to marine operations to establish the number of lines that could be affected (PS21 and PS22) if cable protection is used in this zone. The residual effect has been re-assessed in Section 12.8 taking account of the mitigation.

12.6.7.2 Operation

Once installed the 'as-laid' coordinates of the cables will be recorded (EM49) and circulated to the UK Hydrographic Office (UKHO) and KIS-ORCA Service. The cables will be marked on admiralty charts and fishermen's awareness charts (electronic and paper) (EM49). Effective channels of communication have been established between GridLink and commercial fishing interests and these will be maintained through the continued appointment of a FLO (EM29). Fishermen in the area will have been aware of the installation activities and the embedded mitigation will ensure that commercial fisheries are aware of the new infrastructure.

During the operational phase of the cables lifespan, inspection surveys will be undertaken every two years across the cable route to ensure the cable remains buried (EM52). It is the intention that any post-lay cable exposure for whatsoever reason shall be published in the Kingfisher Information System, Notified to Fishermen and guarded until remedial works are completed (EM53). It is recognised however, that should an unburied section of cable not be quickly identified that this would present a risk to commercial fishing vessels sensitive to snagging.

Although the likelihood of an identified exposure occurring is low, taking a precautionary approach, the sensitivity has been assessed as medium due to the risk an exposure event is not immediately identified. The magnitude has been assessed as low due to the likely minimal spatial and temporal extent of such an exposure event. The overall significance of the effect during the operation phase has been assessed as **Minor** and is **Not Significant**.

12.6.7.3 Decommissioning

Leaving the cable in-situ would be the worst-case scenario for commercial fisheries in the area, presenting the greatest ongoing risk in the event the cable becomes unburied at any point after the end of its' operational lifespan. However, as described for the operational case, any exposure events are likely to be minimal in spatial extent due to cable burial depth (1.7m minimum). As such the sensitivity has been assessed as medium and the magnitude as low and it is concluded that the overall significance of the effect is **Minor** and **Not Significant**.

12.6.8 Underwater noise changes

12.6.8.1 Installation

The ability of fish to hear noise is dependent on their hearing structures, which indicate their sensitivity to sound. Higher sensitivity hearing species include clupeids (Atlantic herring and European sprat) are

known to occur in the Proposed Development and therefore the assessment focused on these species as the worst-case.

There will be three main categories of sound source during installation:

- Continuous noise generated by project vessels;
- Impulsive noise generated by marine survey; and
- Impulsive noise generated by UXO detonation (if required).

A full assessment of the potential effects of underwater noise on fish is presented in Chapter 8 which concluded:

Continuous noise sources and impulsive noise generated by marine survey

- The magnitude of effect for both continuous noise sources and impulsive noise generated by marine survey will be low. Atlantic herring will demonstrate temporary avoidance behaviour early on and remain outside the zone of influence (up to 188m for geophysical survey) but the works will not lead to any long-term displacement and individuals are expected to return to the area once the works have passed through. The sensitivity has been assessed as low as calculations that activities will not cause physical injury. The overall effect has been assessed as **Negligible** and is **Not Significant**.

Impulsive noise generated by UXO detonation (if required)

- The sensitivity has been assessed as medium because disturbance and injury can result from a sudden change in pressure associated with the detonation.
- High order detonations of UXO results in one of the of the loudest sources of underwater noise. Consultation with Cefas and JNCC with respect to high UXO detonation identified that project specific mitigation in the form of noise abatement, temporal restrictions and acoustic deterrents will need to be considered for any high order detonations.
- This is reinforced by the results of the underwater modelling (Technical Appendix I). The modelling assessment concluded that for a high order detonation the zone of influence for injury is 1.5km from the source. This is reduced to 0.5km if a low order detonation is used. The explosion will be brief, with the shock waves attenuating rapidly in the water column, thus resulting in a restricted lethal zone (Continental Shelf Associates, Inc 2004). The magnitude of the effect has been assessed as low because of the small spatial scale of the effect.
- At the stock-level, the small spatial scale is unlikely to affect significant numbers of individuals or eggs to cause population effects.
- The overall effect on fish species has been assessed as **Minor** and is **Not Significant.**

Sensitive shellfish beds have been identified in the area surrounding the Proposed Development. Due to the commercial sensitivity of the grounds, additional Project Specific Mitigation (PS28 and PS29) has been proposed to ensure the physical effects of a UXO detonation e.g. seabed disturbance do not affect the beds.

12.6.8.2 Operation

The assessment considers three repair events occurring over the lifetime of GridLink and assumes that in each repair event a 500m section of cable will need to be removed and re-buried. It also considers regular inspection surveys of the cables In line with installation, the assessment concludes:

- For geophysical survey – the species sensitivity and magnitude of effect have both been assessed as low. The overall significance of the effect has been assessed as **Negligible** and is **Not Significant**.

12.6.8.3 Decommissioning

There is no requirement for UXO detonation or geophysical survey during the decommissioning phase.

12.6.9 Change in water depth

12.6.9.1 Operation

This pressure looks at two effects from the deposition of external cable protection which have the potential to change water depth: the direct presence of the berm which will reduce water depth; and the indirect effect of scour which could potentially increase water depth.

Reduction in water depth due to presence of external cable protection

There is potential that the presence of the external cable protection at third-party asset crossings and where data analysis has indicated that burial in sediment may not be feasible will affect fishing vessels. The UK Maritime and Coastguard Agency (MCA) specify that any cable protection works must allow for safe vessel navigation both in the present and future. It is commonly accepted that reductions in water depth of in excess of 5% will only be accepted in circumstances where developers are able to demonstrate that risks to safe navigation have been satisfactorily mitigated (MCA 2016).

One crossing, the planned BT North Sea JOSS telecom crossing, and six locations where it has been indicated that external cable protection may be required due to ground conditions, have the potential to impede safe navigation of fishing vessels – refer to Technical Appendix J for full assessment. This is primarily because the water depth is shallow at these locations.

The planned BT North Sea JOSS crossing will incur an 11.6% reduction in water depth; exceeding the under-keel clearance for safe navigation. The water depth at this location (16.4m) is sufficient for the dynamic draught, but not for the safety clearance of the maximum vessel draughts (12.3m) at this location. Therefore, this may limit safe navigation for the largest vessels in this area.

For the ground condition zones where external cable protection may be required, the assessment indicates water depth reduction exceeds the under-keel clearance for safe navigation. The water depths for all zones, except for zone 10 (KP13.3 – KP13.9), is sufficient for the dynamic draught, but not the safety clearance of the maximum vessel draughts (1.25m) in these locations.

The potential water depth reduction for zone 10 is not sufficient for the dynamic draught of the maximum vessel draughts in this location. Therefore, if protection is required here it may restrict the largest vessels that pass through this zone. However, there is sufficient space to safely navigate around the feature.

The magnitude of effect has been assessed as medium. The sensitivity has been assessed as medium, particularly for the planned BT North Sea JOSS crossing and zones that have been identified as worse case for external cable protection due to ground conditions. The overall significance of the effect has been assessed as **Moderate** and is **Significant.**

Project specific mitigation (PS41) has been proposed to reduce the significance of the residual effect and is presented in Section 12.7.

Scour

Chapter 5 identified that the presence of external cable protection on the seabed has the potential to change water flow, leading to the localised development of pits, roughs or depressions in the seabed sediment around the leading edge of the external cable protection.

To reduce the likelihood of scour occurring, GridLink have incorporated measures into the design of the London Array crossing. The crossing at a water depth of 15.8-17.2m shall comprise one continuous cable protection across all four cables (rather than four individual cable crossings) to minimise eddy currents causing scour at the end of berms (embedded mitigation EM13). In addition, the London Array crossing design shall ensure vertical separation between the cables is preserved against long

term settlement whilst minimising total berm height (embedded mitigation EM14). This will be achieved by using a cable separation system such as URADUCT.

The sensitivity of fisheries to the effect has been assessed as medium as significant changes in seabed topography could hinder the fishing gear types that use the crossing location e.g. trawling and static gear, requiring vessels to make changes to established fishing areas. The magnitude of the effect has been assessed as low. Should scour develop GridLink would have to undertake remedial measures to ensure the integrity of the crossing is maintained meaning that significant scour would not be allowed to prevail. However, in the short-term it is likely that trawling could be hindered.

The overall significance of the effect has been assessed as **Minor** and is **Not Significant.**

Project specific mitigation (PS1, PS2, PS3 and PS4) has been proposed to reduce the significance of the residual effect and is presented in Section 12.7.

12.6.10 Transition elements and organo-metal contamination

12.6.10.1 Installation

Two fisheries are sensitive to contamination; Fishery 6 (cockle dredging) and the oyster fishery. Both fisheries lie outside of the Proposed Development, but the concern is that sediments containing transition elements and organo-metals, suspended during pre-sweeping or cable trenching (jetting or ploughing) could be deposited onto the beds affecting the quality of the meat.

The Proposed Development crosses a number of areas identified as qualifying cockle areas and is within close proximity to others cockle and oyster beds. Sediment suspended by the installation will settle over classified cockle areas, but the deposition thickness will be less than 2mm. Where the cable route passes directly through a qualifying area sand and gravel will be deposited in thicknesses of up to 3cm within 35m of the cable trench. Section 12.6.6 concluded that suspended sediment will not significantly affect shellfish beds.

Sediment samples taken during the cable route survey were tested for metal, organics and polycyclic aromatic hydrocarbons (PAH) concentrations. The concentrations were compared to various thresholds including Cefas Action Level 1 which relates to the disposal of dredged material. Between KP22 and KP40, sediment samples were collected from six survey stations (namely UK012, UK013, UK014, UK015, UK016 and UK017). Table 5-6 indicates that the only metal that exceeds any of the threshold values at these stations is arsenic. At all stations the Cefas Action Level 1 threshold of 20ug/g is exceeded, but the Cefas Action Level 2 of 100ug/g is not. Arsenic is a natural component of seawater and rocks and given the lack of variability between samples across the Proposed Development, it is expected that the values are of natural origin rather than anthropogenic.

With respect to polycyclic aromatic hydrocarbon (PAH) concentrations, only the sample from UK012 exceeds the Cefas Action Level 1 threshold, indicating an elevated background compared to a 'clean seabed'. All other samples are below the threshold, potentially indicating a localised source of contamination at UK012. Given that the contamination is restricted to one location, the deposition of suspended sediments over the shellfish beds will be limited and within background levels associated with the region, it is considered any release of contaminants into the water column from trenching would be undetectable from baseline conditions and the magnitude of the effect would be negligible.

The sensitivity of the receptor has been assessed as medium. Although the oyster and cockle beds are economically valuable suggesting a receptor value of high, expert judgement has reduced this to medium as the zone of influence indicates that only small proportions of the beds will likely be affected. Any decline in quality, if it occurs, will be restricted. In addition, it is considered unlikely that the small volumes of suspended sediment will lead to significant changes in contamination levels.

The overall significance of the effect has been assessed as **Negligible** and is **Not Significant.**

Project Specific Mitigation (PS25 – PS27) proposed to reduce the significance of effects from changes in suspended sediments (Section 12.6.6) will also be effective for this pressure.

12.6.10.2 Operation

The assessment considers three repair events occurring over the lifetime of GridLink. It assumes that for each repair event a 500m section of cable will need to be removed and re-buried. Cable burial will lead to localised increased suspended sediments. However, like installation the magnitude of effect and sensitivity of the receptor will depend on the location of the works. For the reasons discussed under the installation phase the assessment concluded the overall significance of effect is **Negligible** and is **Not Significant**.

12.6.10.3 Decommissioning

If the cables are left in-situ there will be no effect on sediments during decommissioning and therefore no effects on commercial fisheries. However, if the option to remove the cables is selected, this process would essentially be the same as installation activities but in reverse. Therefore, any effects that could arise due to the decommissioning phase of the Proposed Development will be of a comparable magnitude to those assessed above for cable installation and so the effect has been assessed as **Negligible** and is **Not Significant.**

12.7 Project Specific Mitigation

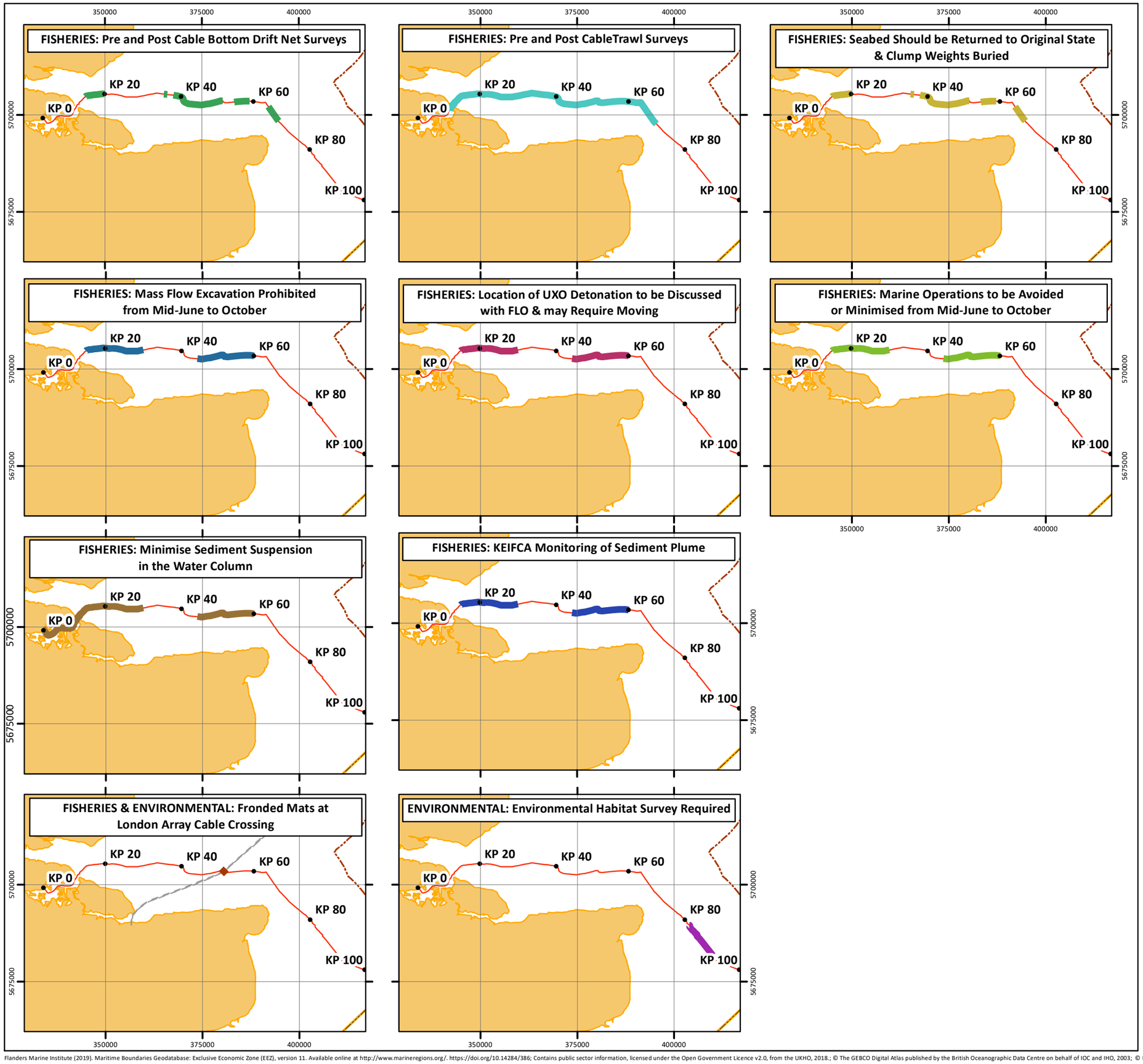
In addition to the embedded mitigation outlined in Section 12-5, Table 12-11 presents Project Specific Mitigation. Much of the Project Specific Mitigation is targeted to specific sections of the Preferred Cable Route as it references locations where particular sensitivities to a certain fishery have been identified. To assist in the visualisation of the mitigation measures Figure 12-8 (Drawing P2172-FISH-009) presents the project specific mitigation which is defined by KPs.

Table 12-12 Project specific mitigation – commercial fisheries

ID	Project Specific Mitigation Measure
PS1	London Array crossing design shall incorporate fronded mats either as individual gravity secured mats or as attached to tapered concrete mattresses in conjunction with cable protection to facilitate sediment capture and reduce scour. The objective shall be to cover the external cable protection with sand to minimise fishing disruption to trawling and return the seabed to a sand habitat within the Margate and Longsands SAC.
PS2	Subject to agreement with asset owner and thermal calculations consideration shall be given to reducing the crossing angle (from 90 degrees) for the London Array crossing to orientate the crossing with the tidal flow and direction to minimise risk of scour.
PS3	The London Array crossing design shall encourage natural resedimentation of the crossing.
PS4	The cable burial and protection strategy shall adhere to the following two principles, in order of priority: 1. Achieving Target DOL along the route so External Protection is not required and in particular no use of External Protection in MCZs and SACs 2. Minimise any displacement of seabed which may not recover naturally within 2-3 years of installation (or else include methods to restore or aid the restoration of the seabed where viable).
PS12	The GridLink Fisheries Coexistence Plan shall be implemented throughout all marine operations.
PS13	Cable cut and recovery shall comprise a minimum cut section of 100m (50m either side of centreline). Where cable cuts are within drift netting areas (defined as KP15 to KP20, KP35.5 to KP36.5, KP38 to KP51.8, KP55 to KP59, KP64.5 to KP69, and KP94 to KP95) the following principle shall be respected: Proven drift lines across the cable route shall not be impeded by seabed disturbance caused by the cable cut and recovery e.g. seabed should be returned to original state. If necessary, and in consultation with the FLO, the cutting location shall be extended as far as reasonably practicable within the Application Corridor, and cut ends located to minimise snagging hazards to the drift nets.

ID	Project Specific Mitigation Measure
PS14	'Flat' clump weights shall be used with cut cables - chain weights are not permitted.
PS15	Where cable cuts are within bottom drift net areas (defined as KP15 to KP20, KP35.5 to KP36.5, KP38 to KP51.8, KP55 to KP59, KP64.5 to KP69, and KP94 to KP95) clump weights used for cut cable ends shall be buried.
PS16	Guard vessels shall be deployed where the cable installation vessel is using anchors (indicatively between KP0 and KP55), and in any areas where there is significant navigational traffic to warn shipping, recreational and fishing vessels of the presence of the cable installation spread
PS17	Guard vessels shall be deployed wherever the cable is insufficiently protected (e.g. between cable lay and burial, where required DOL has not been achieved) to warn shipping and fishing vessels of the potential temporary snagging hazard (subject to safe weather conditions). Guard vessels will be required until the cable is sufficiently protected as agreed by GridLink.
PS18	Guard vessels shall be designed to an appropriate specification for the specified duty, expected weather conditions and other operating requirements, and the captain(s) and crew(s) shall have suitable and sufficient local knowledge and experience of the cable route. Preference should be given to securing guard vessels from the NFFO and the local fishing fleet.
PS19	Marine operations shall be planned and organised so as to minimise disruption to commercial fishing during the peak fishing season between April and October as far as reasonably practicable.
PS20	A trawl survey shall be carried out between KP10 to KP70 to determine any material changes to the seabed as a result of cable installation activities that affects trawl fishing; the objective of the surveys is to determine if trawl fishing that is able to clear the seabed prior to any intrusive works is able to continue post-cable installation. To prioritise fishing access and minimise disruption, post-installation trawl surveys will be undertaken at the earliest opportunity, with the cable route being sectionalised if necessary, i.e. to allow access to certain sections ahead of others. GridLink will seek to have all surveys complete within one year of commissioning.
PS21	Up to 50 bottom drift net surveys shall be carried out between KP15 to KP20, KP35.5 to KP36.5, KP38 to KP51.8, KP55 to KP59, KP64.5 to KP69 and KP94 to KP95 to determine any material changes to the seabed as a result of cable installation activities that affects bottom drift net fishing; the objective of the surveys is to determine if bottom drift nets that are able to clear the seabed prior to any intrusive works are able to continue post-cable installation. To prioritise fishing access and minimise disruption, post-installation bottom drift net surveys will be undertaken at the earliest opportunity, with the cable route being sectionalised if necessary, i.e. to allow access to certain sections ahead of others. GridLink will seek to have all surveys complete within one year of commissioning.
PS22	Bottom drift net surveys shall be carried out by the local fishing vessel that has established during the data gathering exercise in 2020 that they bottom drift over the cable route. A Client Representative (observer) will be onboard the vessel for the duration of the bottom drift to record the position of deployment and position of recovery and any locations at which the bottom drift snagged. The objective of the survey is to demonstrate pre- and post-cable burial that the ground can be bottom drift netted; catch details are not required and will not be recorded during the survey.
PS23	Should trawl or bottom drift net surveys identified post-installation that a material change to the seabed has occurred, the snag source will be inspected and the seabed returned to a condition suitable for trawl or bottom drift netting.
PS24	Marine operations shall be avoided or at the least minimised as far as reasonably practicable within route sections KP15 - KP30 and KP45 - KP60 during June to October (exact timing to align with Cockle fishery opening dates as announced by KEIFCA for specific year) to minimise the disruption to commercial cockle fishing activities.
PS25	Mass flow excavation shall be prohibited in route sections KP15 to KP30 and KP45 to KP60 during the period June to October (exact timing to align with Cockle fishery opening dates as announced by KEIFCA for specific year).
PS26	Cable lay operations shall minimise sediment suspension in the water column or smothering of the seabed between KP0 to KP30 and KP45 to KP60 by selection of the cable installation and burial methods, vessels and tools and incorporation of appropriate mitigation measures into marine operations
PS27	Between KP0-30 and KP45-60, sediment plumes generated by cable installation shall be monitored either by a vessel that is independent of the cable-lay spread or using sensors mounted on a frame on the seabed. Water quality (specifically heavy metal concentrations) and suspended sediment

ID	Project Specific Mitigation Measure
	concentrations will be measured. Monitoring will be undertaken prior to installation to provide a baseline against which measured values can be compared; will continue throughout installation and through to a period (to be defined) post-installation to demonstrate a return to pre-installation conditions. The monitoring plan, selection of the vessel and monitoring protocols shall be coordinated with KEIFCA. Should any sediment plumes from cable installation be identified as causing a risk of non-compliance with the marine environmental assessment, the cable-lay vessel shall be informed and marine operations, cable installation and/or burial methods shall be reviewed and additional measures identified to reduce the sediment plume. Details of the cause of the sediment plume and additional mitigation measures shall be notified to KEIFCA.
PS28	The locations of any UXO requiring clearance by deflagration shall be notified with the FLO to determine any fisheries sensitivities and whether consideration should be given to moving the deflagration point to avoid seabed disturbance that could permanently affect fishing activity.
PS29	The clearance of any UXO by deflagration between KP15 to KP30 and KP45 to KP60 shall be notified to the FLO, TEFA and KEIFCA, and consideration shall be given to moving the UXO to a safe location away from cockle beds prior to deflagration.
PS30	Time delay between sequential cable installation operations, e.g. cable-lay and post-lay burial, shall be minimised to a short as reasonably practicable.
PS41	On completion of final planned and remedial external protection designs GridLink shall confirm with the MCA whether any aids of navigation such as marker buoys may be required where external protection has been installed.
PS43	Intrusive seabed works shall be minimised in the Downs Atlantic Spawning Ground (KP87.5 to KP114) between November and December and if feasible intrusive seabed works shall be avoided in January.
PS44	Deflagration will be used on all UXO charge sizes
PS46	GridLink will provide a Technical Note to all fishing vessels in the region (distributed by the FLO) that outlines all the positions and dimensions of the following: ▪ Location of cable cut ends and associated clump weights ▪ Final installed position of cables ▪ Final positions (including dimensions) of crossings ▪ Final position of any remedial external cable protection (including dimensions). The Technical Note will be accompanied by an A3 double sided laminated chart showing the cable route and associated information that can be kept onboard a vessel. The laminated chart will also include contact details for the FLO and GridLink.



GRIDLINK INTERCONNECTOR

FISHING ACTIVITY
Fishing and Environmental Constraints

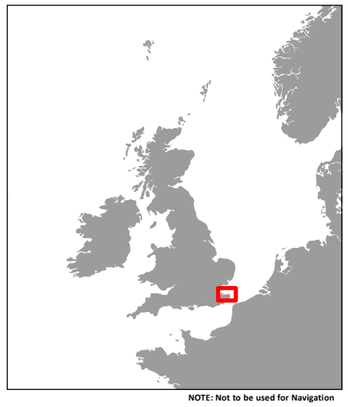
Drawing No: P2172-FISH-009 | **A**

Legend

- KP
- GridLink Preferred Cable Route
- 12nm Territorial Sea Limit
- EEZ Boundary
- London Array Export Cables

Constraint

- Pre and Post-Cable Bottom Drift Net Surveys
- Pre and Post-Cable Trawl Surveys
- Seabed Should be Returned to Original State
- Mass Flow Excavation Prohibited
- Location of UXO Detonation May Require Moving
- Marine Operations to be Avoided or Minimised
- Minimise Sediment Suspension in Water Column
- KEIFCA Monitoring of Sediment Plume
- Fronded Mats at London Array Cable Crossing
- Environmental Habitat Survey Required



NOTE: Not to be used for Navigation

Date	29 May 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	FLO; MarineRegions; UKHO; GEBCO; ESRI;
File Reference	J:\Gridlink\P2172_Mxd\06_FISH\ P2172-FISH-009.mxd
Created By	Chris Dawe
Reviewed By	Emma Langley
Approved By	Anna Farley

0 10 20 30 40 km

12.8 Residual Effect

The assessment presented in Table 12-9 indicated that three pressures have the potential to have a Significant effect on commercial fisheries. Project Specific Mitigation has been proposed and the significance of the following pressure has been re-assessed to determine if a significant residual effect remains

- Physical change (to another seabed type) (Section 12.8.1);
- Snagging resulting from obstruction on the seabed (Section 12.8.2); and
- Change in water depth (Section 12.8.3).

In addition, it has been identified through consultation with the fishing industry that additional Project Specific Mitigation would be welcomed, as best practice, for certain pressures which were assessed as Not Significant. These pressures are discussed collectively in Section 12.8.4.

12.8.1 Physical change (to another seabed type)

The assessment identified two aspects of the Proposed Development which have the potential to cause a significant effect on a small number of fishing vessels operating in the area: a) London Array crossing; b) other locations requiring external cable protection.

The London Array crossing is particularly sensitive due to the proposed berm height and the use of the area general demersal trawls and beam trawling. The objective of project specific mitigation PS1 and PS3 is to encourage sediment to build up on the crossing post-installation with the aim to return the seabed back to its sandy sediment. It is proposed that frond mats will be incorporated into the crossing design. Discussions with the manufacturer have identified that these can either be placed around the perimeter of the cable protection with the added benefit of combating scour risk, and/or placed along the slope of the berm. Frond mats locally interrupt and reduce the velocity of the near bottom currents encouraging sediment deposition. Over time sediment builds up to form an embankment on and around the mats. It is anticipated that once sediment builds up on the mats and crossing it will be a suitable substrate for trawling.

It is possible that external cable protection will be required due to ground conditions precluding the achievement of the target depth of lowering in sediment. The objective of the project specific mitigation for these locations is to reduce the footprint of the cable protection material as far as possible.

Although there may be short- to medium-term effects on the fishery in the long-term it is expected that established trawl lines can be maintained. Project specific mitigation PS20 through to PS23 monitors the success of the reinstatement of the seabed after cable installation by undertaking trawl surveys at key locations along the Preferred Cable Route. These surveys will establish that the Preferred Cable Route was suitable for the fishery prior to installation work starting and confirm at the end that the seabed has been returned to a fit state to allow the fishery to continue in future.

These focused measures in combination will reduce the magnitude of the effect to low and therefore the overall significance of the residual effect for the pressure has been assessed as **Minor** and is **Not Significant**.

12.8.2 Snagging resulting from obstruction on the seabed

Several aspects of the Proposed Development have been identified as having the potential to create snagging hazards on the seabed. Thirteen project specific mitigation measures have been identified that seek to reduce the magnitude of effect on individual vessels by removing the hazard or removing the risk that fishing vessels will be exposed to the hazard. For example, PS16 through to PS18 are concerned with the provision of guard vessels to protect fishing from cable exposed on the seabed.

PS13 through to PS15 and PS46 target the risks associated with cutting out-of-service cables and propose measures to reduce snagging hazards because of this activity.

PS1, PS3 and PS4 are also appropriate as they seek to minimise snagging hazards at the London Array crossing and where external cable protection is used.

These focused measures in combination will reduce the magnitude of the effect to low and therefore the overall significance of the residual effect for the pressure has been assessed as **Minor** and is **Not Significant**.

12.8.3 Change in water depth

Two potential effects have been identified by the assessment under this pressure; an increase in water depth caused by scour around external cable protection; and a decrease in water depth caused by the deposition of external cable protection.

The London array crossing has been identified as a potentially high-risk area where scour may occur. The objective of project specific mitigation PS1, PS2 and PS3 is to reduce the likelihood of scour e.g. by encouraging resedimentation, changing the angle of the crossing and adding anti-scour systems.

Certain locations have been identified where the presence of cable protection will significantly reduce the water depth such that safe navigation may be impeded. The objective of the project specific mitigation for these locations is to reduce the footprint of the cable protection material as far as possible. PS4 seeks to ensure that Contractor is cognisant of this objective and makes reasonable endeavours to respect it. However, if it is essential to use external cable protection at these locations then to reduce the sensitivity of shipping to the effect, additional Project Specific Mitigation has been proposed. This includes, but is not limited to, consultation with the MCA once final designs for rock berms are complete. In addition, based on recommendations from the MCA, aids to navigation such as marker buoys may be required in areas where external protection may impede safe navigation (PS41). Although these additional measures will facilitate the management of the reduction in water depth impeding safe navigation, in effect reducing the sensitivity of commercial fishing, as a precaution the assessment concluded that the sensitivity of the receptor remains as medium. This is because the specific requirements for and designs of external cable protection have not been confirmed. The overall significance of the residual effect therefore remains as **Moderate** and is **Significant.** However, it should be noted that this conclusion applies to very localised areas of seabed and for the wider industry there will no significant residual effects.

12.8.4 Effects which are Not Significant

Extensive consultation with local fishing organisations and vessels has been undertaken by GridLink, Intertek and the GridLink FLO to inform the environmental assessment. Although the assessment concluded that five pressures[1] will not have a significant effect on commercial fisheries, Project Specific Mitigation has been requested by the fishing industry to be considered as best practice for the Thames Estuary region.

The requested mitigation measures and how they are addressed by the Proposed Development are summarised in Table 12-14.

[1] Temporary displacement of fishing activity; temporary habitat disturbance; Changes in suspended solids (water clarity); Underwater noise changes; and transition elements and organo-metal contamination

Table 12-13 Requested Project Specific Mitigation for Effects which are Not Significant

Requested Project Specific Mitigation Measure	Reference to PSM (PS ID)
Ensure lines of communication between GridLink and fishing organisations are clearly outlined and understood by all parties.	PS12
If feasible avoid peak seasons, thereby minimising disruption to the industry.	PS19, PS24, PS43
Minimise suspended sediment concentrations and provide assurance through monitoring that the cockle beds will not be significantly affected.	PS25 – PS27
Provide assurance that key shellfish grounds will not be affected by UXO detonation (if required).	PS28, PS29, PS44

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13. MARINE ARCHAEOLOGY

This Chapter describes the existing baseline environment in terms of marine archaeology, identifies the pressures associated with the Proposed Development on the marine cultural heritage resource, presents the findings of the environmental assessment, and describes how significant effects (if any) will be mitigated.

Where relevant, any limitations relating to the baseline conditions, data sources, scientific understanding or interpretation in the process of assessing significance have been highlighted.

13.1 Data Sources

The assessment focusses on the Asset Placement Corridor. It included a marine desk-based assessment (Coracle Archaeology 2020a) and an archaeological assessment of marine geophysical survey data (Coracle Archaeology 2020b). The purpose of these archaeological assessments was to identify known and potential sites of archaeological interest along the Asset Placement Corridor that might be affected by the Proposed Development. Technical Appendix K provides the results of these assessments.

13.1.1 Desk Based Assessment

The marine archaeology desk-based assessment (DBA) (Coracle Archaeology 2020a) identified known sites and features of cultural heritage significance in UK waters, from mean high water springs (MHWS) to the UK / France EEZ boundary, in proximity to the Proposed Development. The DBA included a documentary and cartographic search utilising a variety of sources to locate all known cultural heritage assets. These included:

- Historic England Archives (HEA);
- UK Historic Environment Records (HER);
- UK Hydrographic Office (UKHO) review of cartography, historic charts and sailing directions;
- Records held by the Archaeology Data Service (ADS);
- Marine Environment Data Information Network (MEDIN);
- British Geological Survey (BGS) regional guide and previous work in the area;
- Rapid coastal zone assessment (RCZA) survey reports;
- Readily accessible published sources and grey literature (e.g. results from previous studies);
- Relevant Strategic Environmental Assessment (SEA) reports (e.g. UK Continental Shelf SEA archaeological baseline) and Coastal Survey Assessment reports.
- European Marine Observation and Data Network (EMODnet); and
- OceanWise Wrecks and Obstructions database.
- Wrecksite.eu website

The DBA included all known and potential marine cultural heritage assets identified during the assessment. All records were assigned a unique Coracle Archaeology (CA) number for ease of identification. The results of the DBA are included in the Marine Archaeology Technical Report (Technical Appendix K).

13.1.2 Geophysical and geotechnical survey data

Between June and October 2019, MMT Sweden AB undertook geophysical and geotechnical surveys along the Asset Placement Corridor. The marine geophysical survey collected multibeam echosounder (MBES), sidescan sonar (SSS), magnetometer and sub-bottom profiler data (SBP); the geotechnical survey collected data from two boreholes in the intertidal zone, and 108 vibrocores.

The survey data was assessed for Coracle Archaeology by the Coastal and Offshore Archaeological Research Services (COARS), University of Southampton. The results of this assessment (Coracle Archaeology 2020b) have been incorporated into the Marine Archaeological Technical Report (Technical Appendix K) and have been used to assess the potential effect of the Proposed Development on the archaeological resource.

13.2 Consultation

Table 13-1 summarises the relevant consultation responses on marine archaeology. All comments have been received from the Marine Management Organisation (MMO).

Table 13-1 Consultation responses and how they have been addressed

Summary of consultation response	How response has been addressed
Additional high resolution pre-construction survey data must support identification and investigation of features of possible archaeological interest	See report on the assessment of marine geophysical survey data (Technical Appendix K)
All subsequent work must be directed by an agreed archaeological Written Scheme of Investigation (WSI) and a Protocol for Archaeological Discoveries (PAD). This must be included with any Environmental Report prepared for the project. The archaeological WSI must contain methodologies for further high-resolution site investigation, analysis and reporting including any specifications for geophysical, geotechnical and diver or other video/camera investigations to be employed post-consent.	A project-specific archaeological WSI including a PAD is provided as Technical Appendix L.
Cable installation through highly mobile seabed areas must be informed by archaeological analysis and interpretation of marine survey data.	See report on the assessment of marine geophysical survey data (Technical Appendix K)
Geotechnical assessment exercises comprising vibrocore, grab sampling and cone penetration testing (CPT) must be planned so that material is obtained to determine the likelihood of encountering sedimentary sequences of archaeological interest.	See report on the assessment of marine geotechnical survey data (Technical Appendix K)
The survey timetable must allow for archaeological assessment of geophysical data, such as Sub Bottom Profiler (SBP) data to inform the geotechnical survey.	See report on the assessment of marine geotechnical survey data (Technical Appendix K)
In consideration of the difficulty associated with identifying aircraft crash sites at sea it is important that survey specifications include archaeological objectives to support assessment of geophysical survey data.	See report on the assessment of marine geophysical survey data Technical Appendix K)
Sections 12.4 and 12.5 do not appear to mention electricity export cables from offshore wind farms. The text only mentions “five active cables within 250m” which is too general and could allude to telecommunications or even other electricity interconnector cables such as NEMO Link.	All export cables from OWFs were accurately detected and reported. See report on the assessment of marine geophysical survey data (Technical Appendix K)
The Environmental Report must explain how the available spatial data regarding historic seascape characterisation has been employed within the proposed project to determine how perception of historic character may accommodate the proposed changes.	HSC data has been assessed to determine how perceptions of the historic seascape may be affected by the Proposed Development. The results are presented within this chapter.

Summary of consultation response	How response has been addressed
A project timetable must be provided to demonstrate an appropriate sequencing of defined work packages that facilitates the corroboration of desk-based sources of information, data acquired from other relevant programmes such as reports generated by the Offshore Renewables Protocol for Archaeological Discoveries (ORPAD) and other (archaeological) technical reports completed for seabed development projects in the vicinity of this proposed project (e.g. London Array Offshore Wind Farm electricity export cable; and NEMO Link).	All available data has been collated and assessed in previous reports (Technical Appendix K)
The Environmental Report must use survey data directly acquired for this proposed project to identify known sites of archaeological interest and any other sites of possible archaeological interest.	See report on the assessment of marine geophysical survey data (Technical Appendix K)
The Environmental Report must spatially identify any exclusion zones to avoid either known sites or other anomalies of archaeological interest which are identified pre-application	See Section 13.7 Project-specific Mitigation below.
The Environmental Report must detail a system for reporting any anomalies identified as of possible historic or archaeological interest, which might be encountered during pre-constructions surveys, during construction and operation and the decommissioning of the authorised scheme.	A project specific archaeological WSI including a PAD is provided as Technical Appendix L.
The Environmental Appraisal Report must determine whether any of the "28 HMS wrecks" identified in the scoping report might be impacted by the proposed development	Addressed in both the DBA and the assessment of marine geophysical survey data (Technical Appendix K)
Any geotechnical works, conducted to inform HDD, should ascertain whether sedimentation sequences of possible archaeological interest exist within the proposed development area. Further, the Archaeological Officer at Kent County Council Heritage Conservation Team should be consulted.	Addressed in the assessment of marine geophysical and geotechnical survey data (Technical Appendix K). Kent County Council have been consulted by the Onshore Environmental Consultants as part of the Planning Application.
Should any high-resolution survey data reveal the presence of previously unknown, anomalies of possible archaeological interest, an avoidance strategy must be a key aspect of mitigation. This must be updated in the Environmental Appraisal.	See Section 13.7 Project Specific Mitigation below.
The DBA should corroborate the archaeological interpretation of the geophysical survey data collected in October 2019 as a direct component of the impact appraisal exercise and not just "append" it to any Environmental Appraisal produced.	The results of the DBA were cross-referenced with the results of the geophysical survey (Technical Appendix K)
The recognition that all military aircraft are subject to the provisions of the Protection of Military Remains Act 1986 must be included in the Environmental Appraisal.	Recognised in DBA and technical report (Technical Appendix K)
Any assessment and interpretation of data must be conducted by an experienced and professionally accredited marine archaeologist to ensure both the quality of the data and whether it is sufficient to support archaeological analysis.	All reports and data were analysed by professionally accredited marine archaeologists including Dr Michael Walsh of Coracle Archaeology and Dr Michael Grant of COARS, University of Southampton.
Table 11.3 is incorrectly titled.	Title has been reviewed and changed
A comment made within Appendix A that archaeological assessment of survey data will be "incorporated into the survey design" is unclear whether this is in reference to any further programme of data gathering or in consideration of the survey campaign already completed. This must be clarified within the final Environmental Appraisal.	See report on the assessment of marine geophysical and geotechnical survey data (Technical Appendix K) and mitigation proposed in this Chapter.

13.3 Existing Baseline

This section provides a summary of the baseline environment as understood from review of all archaeological assessments completed to date. More detailed discussions of the marine historic environment can be found in the Marine Archaeological Technical Report (Technical Appendix K).

13.3.1 Palaeo-environmental deposits – offshore route

The potential to encounter sub-seabed palaeo-environmental data in the Medway Estuary, the Thames Estuary and in the southern North Sea is known to be high. Indeed, a considerable amount of scientific literature has been devoted to the development of a fuller understanding of palaeo-environmental deposits in the region, particularly in the vicinity of the Proposed Development. This literature has been reviewed extensively (Technical Appendix K; Coracle Archaeology 2020b).

Assessment of the sub-bottom profiler and geotechnical survey data collected within the Proposed Development has revealed the presence of a series of palaeo-channels along the Asset Placement Corridor, including deposits formerly associated with (semi-)terrestrial environments. These include organic clays and peats present at depths of up to -32.75m lowest astronomical tide (LAT), with high potential for prehistoric exploitation. Seven of the 108 vibrocores reviewed have been identified for further geo-archaeological investigation.

13.3.2 Palaeo-environmental deposits – landfall

A general model for the main Pleistocene and Holocene sediment-types likely to be encountered in the foreshore area of the Isle of Grain and Kingsnorth has been proposed by Bates (2006; 2008

- Pleistocene fluvial sands and gravels representing buried terraces inundated during Holocene marine transgression;
- Pleistocene solifluction, head and colluvium at the inner margins of the terraces buried by sea level rise;
- Pleistocene silts and clays representing interglacial sequences cut into or resting on the terrace surfaces beneath the Holocene marsh; and
- Clays, silts and peats of Holocene date formed immediately prior to or following marine transgression. The estuarine deposits may contain a shift in the stratigraphy from estuarine mudflats to sand flats/banks and also contain common organic-rich silt layers.

Analysis of the two intertidal boreholes taken near landfall at Kingsnorth did not, however, reveal the presence of any sediments deemed to be of geo-archaeological potential.

13.3.3 Marine cultural heritage

Thirty-one wrecks, 10 aircraft, 25 obstructions, five findspots and 12 monuments are recorded within the Asset Placement Corridor in UK waters (see Table 13-2). Of these, six wrecks (**CA9, CA16, CA23-24, CA94** and **CA216**) and all 10 aircraft (**CA10-14, CA20-22, & CA25-26**) are protected under the 'Protection of Military Remains Act 1986' (PMRA 1986). These are included in the relevant site types in Table 13-2.

Analysis of the geophysical data collected within the Proposed Development identified 283 geophysical anomalies, 37 of which relate to known historical assets. Only designated sites and historical assets that correspond to a geophysical anomaly will be discussed further in this report (see Table 13-9 and 13-10).

Table 13-2 Historical assets within the Asset Placement Corridor in UK waters

Type	Total
Wreck	31
Aircraft	10
Obstruction	25
Findspot	5
Monument	12
Feature	0
Total	**83**

13.3.4 Historic Seascape Characterisation

13.3.4.1 Scope and methodology

This section outlines the scope and methodology used for the Historic Seascape Characterisation (HSC) assessment. This assessment focuses primarily upon the Asset Placement Corridor. It is, however, important to recognise that perceptions of the historic seascape and the values ascribed to it are difficult to assess within such a limited geographical scope. Where necessary, potential impacts upon perceptions of the wider historic seascape are also discussed below.

The Asset Placement Corridor sits exclusively within the Kent Thames HSC area (Study Area E; Land Use Consultants 2017a). This forms one part of the Consolidated National Historic Seascape (NHSC) Database, a resource designed to ensure that strategic management decisions regarding England's seascape and heritage assets are underpinned by consistent and comprehensive baseline evidence for the seascape's historic character (Land Use Consultants 2017b).

The national HSC method applies to the whole of England's coastal zone (land and seas), England's share of UK territorial waters, and adjacent UK controlled waters as defined in the Marine and Coastal Access Act 2009 section 322. A detailed analysis of the HSC method is provided in National Historic Seascape Characterisation: User Guide (Land Use Consultants 2017a).

The consolidated NHSC project undertook a GIS-based characterisation of English waters and coastal zones, using a suite of related techniques to map interpretations of historic character in the past and present. HSC attributes are linked to GIS in three main categories:

- The historic seascape 'character type' hierarchy (i.e. broad type, type and sub-type);
- Present historic seascape character; and
- Previous historic seascape character.

The HSC GIS output is provided in a number of layers, showing the extent of the dominant historic character types within the following contexts:

- The sub-sea floor;
- The sea floor;
- The water column;
- The sea surface;
- Coastal and conflated; and,
- Previous character.

Within each of these layers, the GIS shows the character type considered to be dominant at any particular location. This does not mean that other character types are not present at that location, merely that they are considered subordinate. Dominance should not be equated with significance: a subordinate character type may in reality be more significant than a dominant one.

13.3.4.2 HSC baseline

This baseline assessment focuses only upon the sea floor, sub-sea floor and coastal and conflated GIS contexts (see Table 13-3). These have been assessed with regard to the potential effects of the proposed scheme on the character of the historic seascape. Impacts on all other HSC contexts (water column, sea surface and previous character) are considered to be negligible, temporary and fully reversible and will not be considered further.

Table 13-3 HSC baseline

HSC GIS Context	Broad character type	Character type(s)	Sub character type(s)
Sub-sea floor	Industry	Energy industry	Submarine power cable; Renewable energy installation (wind)
Sub-sea floor	Cultural topography	Cultural topography (marine)	Coarse, fine and mixed sediment plains; Sand banks with waves
Sub-sea floor	Cultural topography	Palaeo-landscape component	Palaeo-channel
Sub-sea floor	Navigation	Navigation hazards	Shoals and flats
Sub-sea floor	Communications	Telecommunications; Transport	Submarine telecommunications cable; Tunnel
Sea floor	Navigation	Navigation hazard; Navigation activity; Maritime safety	Wreck hazard; Maritime debris; Sholas and flats; anchorage; safety area
Sea floor	Industry	Energy industry	Submarine power cable; Renewable energy installation (wind)
Sea floor	Fishing	Fishing	Bottom trawling; fixed netting; shellfish dredging
Sea floor	Cultural topography	Cultural topography (inter-tidal); Cultural topography (marine)	Mudflats; Saltmarsh; Coarse and fine sediment plains; Sandbanks with waves
Sea floor	Cultural topography	Palaeo-landscape component	Palaeo-channel
Sea floor	Communications	Telecommunications	Submarine telecommunications cable
Sea floor	Ports and docks	Ports and docks	Harbour; Working pier
Coastal and conflated	Navigation	Navigation hazard; Navigation activity; Maritime safety	Wreck hazard; shoals and flats; Navigation route; Anchorage; Buoyage; Safety services

HSC GIS Context	Broad character type	Character type(s)	Sub character type(s)
Coastal and conflated	Industry	Energy industry	Renewable energy installation (wind); submarine power cable; Power station (fossil fuel)
Coastal and conflated	Cultural topography	Cultural topography (inter-tidal); Cultural topography (marine)	Mudflats; Saltmarsh; Coarse, fine and mixed sediment plains
Coastal and conflated	Fishing	Fishing	Shellfish dredging; Fixed netting
Coastal and conflated	Communications	Telecommunications	Submarine telecommunications cable
Coastal and conflated	Communications	Transport	Tunnel
Coastal and conflated	Coastal infrastructure	Flood and erosion defence	Sea defence
Coastal and conflated	Ports and docks	Ports and docks	Port; Working pier

The dominant broad character type for the sea floor within the Asset Placement Corridor is Navigation. This is further divided into character types Navigation activity, Navigation hazard and Maritime safety. These character types encompass areas that present significant risks to shipping or smaller crafts, and in this area include the sub-types Anchorage, Safety area, Maritime debris and Wreck hazard. At a national level the values and perceptions attributed to this HSC character type are considerable, and often based upon experience of danger in the form of wrecks or groundings. Navigation hazards are often prominent in the consciousness of coastal communities as a result of the potential risk to life.

The sea floor is also crossed in multiple places by the character type Energy industry, including the sub-character types Renewable energy installation (wind) and Submarine power cable. The effects of the energy industry on the historic environment are many and varied. Scour around the base of wind turbines or external cable protection, for example, can affect physical remains on or within the seabed, though their overall effect is expected to be relatively small, comparable to storm or flood events or dredging and trawling. It is also anticipated that the perception of the energy industry within the historic seascape will alter as the UK moves further from fossil fuels and towards renewable energy sources.

The character type Fishing is also prevalent on the sea floor, incorporating Shellfish dredging, Fixed netting and Bottom trawling. Bottom trawling refers to commercial fishing involving the trawling of the lowest levels of the water column and/ or the surface of the sea floor, the demersal and benthic zones respectively. Bottom trawling often results in the disturbance of the sea floor itself. Shellfish dredging refers to the regular commercial collection of naturally-occurring shellfish stocks (cockle, oysters and scallops in the Thames Estuary region), using a dredge towed behind a fishing vessel. Fixed netting is mostly confined to inshore waters and consists of commercial fishing by fixed nets. It is important to recognise that the locations of actual fishing at any given time may vary and will depend upon several factors, including the behaviour of the commercial fish species, fishery regulation and custom and tradition. The commercial fisheries in the region are described in detail in Chapter 12.

Both Cultural topography (inter-tidal) and Cultural topography (marine) are also present, in the form of Mudflats and Saltmarsh near-shore, with Coarse and Fine sediment plains and Sand banks with waves offshore. The cultural topography of the region is largely a product of natural processes, where the physical imprint of human activity is subtle and overlooked but which can nevertheless be

perceived as cultural to varying extents. The physical expressions of the seabed topography can, for example, influence the nature and extent of human activities (e.g. fishing activities) as well as the potential for the presence of wrecks, debris and palaeo-landscapes. These areas can best be described as 'semi-natural environments', though it is their cultural dimension and perceptions thereof that are the prime concerns of the HSC. The sea floor also contains Palaeo-landscape components (broad character type Cultural typography) in the form of sub-character types Palaeo-channels; the former course or channel of a river preserved as a geological feature. Finally, the sea floor of the Asset Placement Corridor includes the character type Telecommunications, sub-character type Submarine telecommunications cable. This is the most frequent function of submarine cabling.

The sub-sea floor is dominated by the character type Energy industry, including the sub-character types outlined above. Also present is Cultural topography (marine), including Coarse, Mixed and Fine sediment plains and Sand banks with waves. Palaeo-landscape components in the form of Palaeo-channels are present within the NHSC data, as are Navigation Hazards (sub-character type Shoals and flats) and Telecommunications (Submarine telecommunications cable).

The dominant coastal and conflated broad character type is Navigation, encompassing character types Maritime safety (Buoyage) and Navigation activity. The latter is overwhelmingly the most dominant, incorporating the sub-character types Navigation route, Wreck hazard, Shoals and flats and Anchorage. Navigation activity can be defined as human activity directly related to the passage of shipping traffic, including intimately associated areas and features such as anchorages. The physical demarcation of these areas varies from wholly legal, through to custom and usage. Character type Energy industry is also represented in the coastal and conflated dataset, including Submarine power cable, Renewable energy installation (wind) and one Power station (fossil fuel).

Also present within the coastal and conflated context are Cultural topography (inter-tidal), including both Mudflats and Saltmarsh, and Cultural topography (marine) including Coarse, Fine and Mixed sediment plains. Inter-tidal regions are subject to extensive processes of fluctuation and change related to dynamic coastal processes; these areas are classified as much perceptually as by technical definition. Tidal fluctuations are nevertheless the dominating aspect of a saltmarsh, the cyclical inundation defining the plants and animals that can survive in these areas, and thus human usage.

Fishing in the Asset Placement Corridor at the Coastal and conflated level includes the sub-character types Shellfish dredging and Fixed netting, whilst Telecommunications (sub-character type Submarine telecommunications cable) and Transport (sub-character type Tunnel) are also present. Finally, character types Flood and erosion defence and Ports and docks are present within the Asset Placement Corridor, including the sub-character types Sea defence and Port and Working pier.

13.3.4.3 HSC baseline summary

Examination of the baseline information has enabled the identification of sensitivity (to change) for those HSC character types most likely to be affected by the Proposed Development. Ascribed levels of sensitivity relate solely to the Asset Placement Corridor.

13.4 Potential Pressure Identification and Zone of Influence

Table 13-4 identifies the pressures the Proposed Development could have on the marine cultural heritage resource. For each pressure the assessment considered the different aspects of the Proposed Development during installation, operation (including repair) and decommissioning. In order to evaluate the most significant effects, the largest zone of influence from these aspects was selected. The zones of influence are presented in Table 13-4 and will be assessed further.

Table 13-4 Pressure identification and zone of influence – marine archaeology

Potential Pressure	Aspect	Project Phase	Project Activity	Receptor	Zone of Influence
Direct damage to archaeological assets by intrusive seabed works	HDD	Installation	Shore landing	Potential palaeo-environmental deposits. Currently known and unknown / unrecorded / unlocated wrecks and obstructions, and archaeological assets within the Asset Placement Corridor. Marine Character Areas (MCAs, HSC)	Two ducts. ~600m long x 750mm wide
	Pre-sweeping		Seabed preparation		Select locations as identified in Table 3-4. Maximum of 63m wide.
	Pre-lay grapnel run				15m wide along entire length of Preferred Cable Route
	Anchoring		Cable burial		Within Application Area up to KP55
	Trenching (ploughing & jet-trenching)				15m wide along entire length of Preferred Cable Route
	Deposit of external cable protection		Cable protection		Select locations as identified in Tables 3-9 and 3-11. Maximum of 12.5m wide at crossings and 9.1m wide where required for ground conditions. Note 1
	Anchoring. Trenching (ploughing & jet-trenching)	Operation Maintenance and repair	Cable burial		3 locations 15m wide x 500m long
	Should re-burial not be feasible		Deposit of external cable protection		3 locations 7m wide x 500m long
	Anchoring. De-Trenching	Decommissioning	Cable removal		15m wide along entire length of Preferred Cable Route
Indirect damage to archaeological assets	Siltation rate changes from HDD, pre-sweeping, and trenching	Installation	Shore landing. Seabed preparation Cable burial	Potential palaeo-environmental deposits Currently known and unknown / unrecorded / unlocated wrecks and obstructions, and archaeological assets within the CSC Marine Character Areas (MCAs, HSC)	NOTE 2
	Scour associated with external cable protection		Cable protection		Within Application Corridor
	Siltation rate changes from trenching	Operation (Maintenance and repair)	Cable burial		NOTE 2
	Scour associated with external cable protection		Cable protection		Within Application Corridor
	Siltation rate changes from de-trenching	Decommissioning	Cable removal		NOTE 2

Potential Pressure	Aspect	Project Phase	Project Activity	Receptor	Zone of Influence

1. Berm widths at crossings range from 9.8m to 12.5m. The maximum berm width associated with the planned Mercator / Joss crossing has been used for the zone of influence. It is possible that at the London Array crossing fronded mats will be placed around the perimeter of the crossing. This will increase the seabed footprint to a width of 20m.

2. Zone of Influence is determined by sediment suspension calculations as the median settling distance for fines – although it should be noted that the calculated suspended sediment concentrations (SSC) are within the range of natural variability for the Medway and Thames Estuaries and settlement depth is less than 1 mm. Silt will settle out of suspension typically within one tidal cycle within 200m to 1km of the cable route in the Thames Estuary. Zone of Influence for settlement of coarse fractions (sand and gravel) is significantly less than silt, with particles settling within a couple of minutes and <30m of the cable route.

13.5 Embedded Mitigation

The embedded mitigation relevant to marine archaeology is provided in Table 13-5 below. When undertaking the assessment, it is assumed that these measures will be complied with.

Table 13-5 Embedded mitigation – marine archaeology

ID	Embedded mitigation measure	Project Phase		
		I	O	D
EM1	Intertidal zone of the Medway Estuary at the Kingsnorth shore crossing shall be crossed by horizontal directional drilling (HDD) to avoid disturbance to the surface sediments and habitats. HDD must exit beyond the mean low water springs mark to avoid the Medway Estuary and Marshes SPA and Medway Estuary and Marshes SSSI.	■		
EM3	Submarine cables will be bundled together.	■		
EM4	Deployment of anchors/anchor chains on the seabed will be kept to a minimum in order to reduce disturbance to seabed and will be within the Proposed Development.	■	■	■
EM5	Cable burial and protection design as detailed in the Burial Assessment Study, final crossing designs and planned and remedial final external protection designs shall be within the maximum design parameters detailed in the GridLink Marine Licence Application or robust justification for the deviations provided.	■		
EM7	External cable protection (rock and/or mattresses) shall only be deployed where it is demonstrated that adequate burial depth cannot be achieved; the footprint of any external protection shall be the minimum required to ensure adequate cable protection and stability	■	■	
EM9	Cable protection heights and widths shall be minimised, taking into account the requirements to maintain the structural integrity of the berms.	■		
EM13	London Array crossing design shall comprise one continuous cable protection across all four cables (rather than four individual cable crossings) to minimise eddy currents causing scour at end of berms	■		
EM28	The size of the Pre-Lay Grapnel shall be optimised for the expected duty and seabed obstacles to be cleared; over-sized PLG shall not be used	■		
EM47	GridLink Written Scheme of Investigation (WSI) and a Protocol for Archaeological Discoveries (PAD) shall be implemented during all marine operations.	■	■	■

13.6 Significance Assessment

13.6.1 Approach

The approach used for the marine archaeology assessment generally follows the approach outlined in Chapter 4 adapted to apply the industry standard for marine archaeology, with defined values specifically tailored towards the management of the marine cultural heritage resource. It is a methodology that has been used successfully on large-scale developments in UK waters. Importantly, the approach still identifies the sensitivity of the receptor, or in this case the significance of the historic asset, and the magnitude of the change to determine the overall significance of the effect on a receptor.

13.6.1.1 Significance of the historic asset

The significance of each historic asset has been assessed on a scale ranging from very high to very low. Significance can be defined as the sum of cultural heritage values, incorporating evidential, historical, aesthetic, and communal values. The following assessment of significance is based on the professional judgement of the assessor and informed by the criteria presented in Table 13-6.

Table 13-6 Significance of the historic asset

Historic asset significance	Description / reason
Very high	▪ Historic assets of international importance ▪ An HSC character type extremely sensitive to the introduction of a new HSC character type in the proposed location, and which could result in significant effects on the perception of the HSC character type
High	▪ Designated and protected wrecks and scheduled monuments ▪ Historic assets of national importance ▪ Maritime losses where the position is known and has been positively identified ▪ Targets of high archaeological potential identified in the geophysical survey ▪ An HSC character type particularly sensitive to the introduction of a new HSC character type in the proposed location, and which could result in significant effects on the perception of the HSC character type
Medium	▪ Historic assets of regional importance ▪ Targets identified in the geophysical survey of medium archaeological potential ▪ Obstructions that could be indicative of wreckage or submerged features ▪ An HSC character type capable of accepting the introduction of a new HSC character type in the proposed location, but with some effects on the perception of the HSC character type
Low	▪ Targets of low potential identified in the geophysical survey ▪ Stray archaeological find spots ▪ An HSC character type capable of accommodating the introduction of a new HSC character type in the proposed location with limited effects on the perception of the HSC character type
Very low	▪ Targets identified through the assessment of geophysical survey data as likely to represent a natural feature ▪ An HSC character type capable of accommodating the introduction of a new HSC character type in the proposed location with no effect on the perception of the HSC character type

13.6.1.2 Magnitude of change

Unlike terrestrial assessments, the method to determine the magnitude of effect in the context of marine archaeology is limited to the severity of effect. For the purpose of this assessment, severity is considered to be synonymous with magnitude.

The magnitude of change is a measure of the scale or extent of change in baseline conditions, irrespective of the value of the heritage assets affected. The criteria used to inform the assessment of the magnitude of change are set out in Table 13-7.

Table 13-7 Magnitude of change

Magnitude	Definition
Very high	Total loss or major alteration of the historic asset, removing the asset's value The HSC character type is fundamentally changed, such that the perceptual values currently ascribed to it would no longer be apparent or would be greatly altered
High	Loss of one or more key elements of the historic asset, substantially reducing the asset's value The HSC character type is changed such that the perceptual values currently ascribed to it would be significantly altered
Medium	Slight physical alteration of the historic asset not affecting key elements, slightly reducing the asset's value The HSC character type is changed such that the perceptual values currently ascribed to it would be moderately altered
Low	Very slight or negligible alteration of the historic asset The HSC character type is changed such that the perceptual values currently ascribed would be slightly altered
Very Low	Almost no alteration of the historic asset The perceptual values currently ascribed to the HSC character type remain unchanged

13.6.1.3 Significance of effect

The assessment of the significance of an effect was undertaken using professional judgement guided, where necessary, by the matrix shown in Table 13-8. The assessment of significance is influenced by the significance of a receptor and the magnitude of the predicted change from the baseline condition.

Table 13-8 Significance of effect

Receptor significance	Magnitude of effect				
	Very High	High	Medium	Low	Very Low
Very High	Major	Major	Moderate	Minor	Minor
High	Major	Moderate	Minor	Minor	Negligible
Medium	Moderate	Minor	Minor	Negligible	Negligible
Low	Minor	Minor	Negligible	Negligible	Negligible
Very Low	Minor	Negligible	Negligible	Negligible	Negligible

The significance of the results returned in the DBA (Coracle Archaeology 2020a), and the archaeological assessment of marine geophysical survey data (Coracle Archaeology 2020b) and analysis of the HSC are presented below.

13.6.2 Direct damage to archaeological assets by intrusive seabed works

Aspects of the Proposed Development that disturb the seabed could directly affect the marine archaeological resource. These include HDD under the foreshore and intertidal zone, anchoring in shallow water, pre-sweeping, pre-lay grapnel run, cable trenching (e.g. jetting or ploughing) and the deposition of external cable protection.

13.6.2.1 Palaeo-environmental deposits

Analysis of two intertidal boreholes taken near landfall at Kingsnorth as part of the assessment of marine geophysical and geotechnical survey data did not reveal the presence of any sediments deemed to be of geo-archaeological potential. The potential for near-surface submerged palaeo-landscape features to be affected by the Proposed Development at the landfall is therefore considered to be low, so no assessment of significance is required.

Assessment of the sub-bottom profile and geotechnical survey data revealed the presence of a series of palaeo-channels, including deposits formerly associated with (semi-)terrestrial environments. These include organic clays and peats present at depths of up to -32.75m LAT (Coracle Archaeology 2020b, Technical Appendix K). Seven of the 108 vibrocores reviewed have been identified for further geo-archaeological investigation. These have the potential to provide palaeo-environmental evidence which could enhance the understanding of the prehistoric period in the area and may therefore be characterised as of medium significance.

It is nevertheless reasonable to assume that such deposits represent little more than a tiny fraction of a much more extensive landscape. Given the linear nature of the Proposed Development, the localised effect would therefore have a direct effect on a very small proportion of the palaeo-landscape itself. This, combined with the embedded mitigation measures such as EM3 ensuring cables are bundled together, and EM47 ensuring a project-specific WSI and PAD are in place for all marine operations, means that it is possible to characterise the magnitude of the effect on palaeo-environmental deposits as low.

In conclusion, the overall significance of effect is **Negligible** and no project specific mitigation is required.

13.6.2.2 Known historic assets and geophysical anomalies

A total of 283 geophysical anomalies with archaeological potential have been identified within the Asset Placement Corridor (Coracle Archaeology 2020b), 37 of which correspond to known historic assets identified by the DBA (Coracle Archaeology 2020a). The significance of each of these has been assessed, ranging from high to low. It is important to recognise that the significance of the asset is usually, though not exclusively, synonymous with archaeological potential described elsewhere (see Technical Appendix K). The significance of the asset, assessment of magnitude and overall significance of effect for each of the 283 geophysical anomalies is presented in Table 13-12 (historic assets) and Table 13-13 (other geophysical anomalies). Where the assessment has concluded that the overall significance of the effect on an anomaly is Minor or Moderate, then Project Specific Mitigation has been proposed in the form of Archaeological Exclusion Zones (AEZs). It should be noted that, where deemed necessary, the precautionary principle has been adopted and AEZs have been proposed even though the assessment concluded a negligible effect on the anomaly being assessed. The conclusions of the assessment are discussed further below:

There are six wrecks (**CA9, CA16, CA23-24, CA94 & CA216**) and the remains of 10 aircraft (**CA10-14, CA20-22, & CA25-26**) within the Asset Placement Corridor that are protected under the 'Protection of Military Remains Act 1986' (PMRA 1986). Of these, four (**CA16, CA24, CA94 & CA216**) are clearly associated with geophysical anomalies, and two (**CA14 & CA23 / CA39**) are possibly associated with geophysical anomalies. The location of the remaining 10 protected sites remains unknown. The significance of the six located, protected assets is therefore deemed to be high. Following the matrix

outlined in Table 13-8 above, the magnitude of effect has been assessed as high. The overall significance of the effect has been assessed as **Moderate**. Project Specific Mitigation in the form of AEZs has therefore been proposed.

Accurate locational informational is not available for the remaining assets protected under the PMRA 1986 (**CA9-13, CA20-23, & CA25-26**). These had very general locational information recorded in the DBA and were not located in the analysis of the geophysical survey data. No project-specific mitigation (such as AEZs) can therefore be proposed. Any unexpected archaeological discoveries encountered in the process of the works will be addressed with strict adherence to the terms of the project-specific PAD (embedded mitigation EM47). Should evidence for any of these protected sites be encountered, work in that location will cease immediately, a temporary exclusion zone will be imposed, and the relevant authorities will be notified and consulted accordingly.

This assessment has identified potential for effects on 30 further assets of high significance within the Asset Placement Corridor. The majority of these are located some distance from Preferred Cable Route. The effect on these assets has been therefore been assessed as low, so the overall significance of the effect has been assessed as **Minor**. Adopting the precautionary principle, however, Project Specific Mitigation in the form of the AEZs is proposed to avoid accidental damage from vessel anchors or from final route variation.

Similarly, potential effects have been identified for 60 assets within the Asset Placement Corridor of medium archaeological significance. The majority of these too are located some distance from the Preferred Cable Route; the magnitude of impact on these assets has been assessed as low, so the overall significance of effects is assessed as **Negligible**. No project-specific mitigation is therefore required. However, to avoid accidental damage from vessel anchors and to mitigate against variance in the final route, minor mitigation measures in the form of small AEZs have been proposed.

The Preferred Cable Route encroaches on the proposed AEZs of four of the medium archaeological significant anomalies (**CA_2058, CA_2250, CA_2257 & CA_2274**). Given the potential for the intrusive seabed works to directly interact with these anomalies, the magnitude of effect has been assessed as high. The overall significance of the effects has been assessed as **Minor** and Project Specific Mitigation has been proposed.

This assessment has further identified potential for impacts on 187 assets with low historic significance within the Asset Placement Corridor. The magnitude of effect on these assets has been assessed as low, and the overall significance of the effects has been assessed as **Negligible**. Adopting the precautionary principle, small AEZs have been assigned to the assets to avoid accidental damage and mitigate against route variance.

The Preferred Cable Route encroaches on the proposed AEZs for 14 of these anomalies (**CA_2009, CA_2011, CA_2049, CA_2097, CA_2112, CA_2137, CA_2211, CA_2222, CA_2226, CA_2235, CA_2248, CA_2260 & CA_2269**). Though analysis of the geophysical survey results classified these anomalies as being of low archaeological potential, the small possibility that these are indicative of wreckage or other submerged features cannot be totally discounted. Using the precautionary principle, and due to the high probability that intrusive seabed works will affect these 14 anomalies, the magnitude of effect has been assessed as high, and the overall significance of the effect has been assessed as **Minor** and Project Specific Mitigation has been proposed.

Fifty-one historical records located within the Asset Placement Corridor were identified by the DBA but were not visible in the geophysical survey. These included 17 wrecks, nine aircraft, 11 obstructions, five findspots and nine monuments. Locational information for these records is vague, and no assessment of significance is required. It is nevertheless anticipated that embedded mitigation and the implementation of the project specific PAD (embedded mitigation EM47) will serve to mitigate potential effects.

13.6.2.3 Currently unknown archaeological assets

The considerable number of historical records and geophysical anomalies identified throughout the course of the assessment suggests that the potential to encounter unexpected archaeology or archaeological remains during the course of these works is moderate. It is anticipated that embedded mitigation and the implementation of the project specific PAD (embedded mitigation EM47) will mitigate risks to unidentified marine archaeology and cultural heritage that may be encountered throughout the works. The PAD will outline:

- what actions will need to be undertaken in the event that anything potentially archaeological should be encountered;
- the likely nature of any potential archaeological discoveries;
- the roles and responsibilities of the installation teams; and
- contact details for the archaeological consultant.

Furthermore, it is highly likely that anchor placement in shallow waters will occur beyond the Asset Placement Corridor, and therefore beyond the study area addressed in the Marine Archaeology Technical Report (Technical Appendix K). The wider study area examined in the DBA (1km radius from the centreline of the proposed cable route (Coracle Archaeology 2020a) suggests that this is an unusually busy area archaeologically. Project Specific Mitigation in the form of survey and review of anchor placement locations is therefore proposed to mitigate potential risks to currently unknown archaeological assets, or assets whose location has not been confirmed by previous surveys.

13.6.2.4 Historic seascape characterisation

The Proposed Development will not result in the introduction of a new HSC character or sub-character type to the region as both Energy industry and Submarine power cable are already well represented within the Asset Placement Corridor. The significance of the HSC character type Energy industry has been assessed as very low, both due to its prevalence within the area and because values and perceptions ascribed to it are generally limited. The magnitude of change can therefore be assessed as very low, with the overall significance of effect assessed as negligible. No project-specific mitigation is required.

There is potential for direct physical impacts upon the wider historic seascape as a result of construction, operation, maintenance and decommissioning phases of the Proposed Development. These effects are, however, likely to be time-limited. Furthermore, the relatively limited footprint of the Proposed Development suggests that direct impacts on the perceptions and values ascribed to the wider historic seascape can be assessed as negligible.

13.6.3 Indirect damage to archaeological assets

Several aspects of the Proposed Development have the potential to have indirect effects on the archaeological resource. These include HDD under the foreshore and intertidal zone, anchoring in shallow water, pre-sweeping, cable trenching (e.g. jetting or ploughing) and the deposition of external cable protection.

13.6.3.1 Palaeo-environmental deposits

Analysis of data for the Asset Placement Corridor has identified a number of deposits and palaeo-channels that have the potential to enhance our understanding of the prehistory of the area. It is nevertheless reasonable to assume that these deposits represent little more than a tiny fraction of a much more extensive landscape. The use of HDD at the foreshore and anchoring of vessels in shallow waters is therefore unlikely to result in any significant effect on the palaeo-environmental landscape and the evidence it contains. Similarly, the potential effects of a minor alteration in sea-bed levels that

may be associated with pre-sweeping, trenching or deposition of external cable protection can be characterised as very low. No Project Specific Mitigation is therefore required.

13.6.3.2 Known historic assets and geophysical anomalies

As outlined above, 283 anomalies have been identified within the Asset Placement Corridor, 37 of which correspond to known archaeological assets. Sixteen sites within the Asset Placement Corridor are protected under the terms of the 'Protection of Military Remains Act 1986'.

Any of these assets may be subject to indirect effects during the installation, operation, and decommissioning of the Proposed Development. These effects may be caused as a result of potential scouring and sediment plume effects as identified in Table 13-4 above, and may result in increased protection to (e.g. partial or total burial), or the deterioration of assets in the vicinity. Table 3-4 (Chapter 3, Project Description) outlines the locations of areas of high mobility sediments and sand waves in which pre-sweeping may be conducted; in a worst-case-scenario, the assets would be significantly altered as an indirect effect of the Proposed Development. It is nevertheless evident that even in a worst-case scenario the spoil volumes and dispersal of material are expected to be minimal. Embedded mitigation measures and the implementation of a project-specific PAD are therefore considered sufficient to mitigate against any indirect impact upon archaeological assets from activities identified in Table 13-4.

The Proposed Development will require seven crossings of existing in-service cables which will require external cable protection. Table 13-9 identifies the closest known asset to each crossing point and the AEZ assigned to that asset. The closest asset (**CA_2251**) to any of the crossings is 82m SE of the proposed Mercator/ Joss crossing point. The significance of this asset has been assessed as **Low** and it has therefore been assigned an AEZ of 10m radius. The magnitude of effect from the installation of crossing point protection on this asset is considered **Low** as it is considerably beyond the proposed AEZ, so the significance of potential effect is **Negligible**. No mitigation is required.

As the closest assets to each of the other crossing points are further away, the magnitude of impact is reduced, as is the significance of potential effect and the requirement for mitigation. Any debris recovered to the cable ship during these operations will be assessed for archaeological potential in accordance with the terms of the project-specific protocol for archaeological discoveries (PAD).

Table 13-9 AEZs in proximity to the crossing points of existing cables

Crossing Description	KP Start	KP End	Maximum berm width (m)	Easting	Northing	Nearest asset (CA no)	Distance from crossing point	Extent of assigned AEZ (m rad)	Encroached by CP protection?
London Array Wind Farm export cables (4 cables as one continuous external protection)	51.85	52.12	9.76	1) 380431 2) 380470 3) 380525 4) 380606	5703496 5703477 5703450 5703411	CA_2212	385m NW at closest point	10m	No
Mercator / JOSS (new)	71.28	71.36	12.46	396513	5696509	CA_2251	82m SE	15m	No
Thanet Wind Farm North & South export cables (2 cables as one continuous external protection)	77.57	77.7	11.86	1) 401269 2) 401234	5692337 5692367	CA_2262	432m SE at closest point	10m	No
PEC telecommunication cable	80.5	80.63	11.86	400309	5690251	CA_2263	182m NE	15m	No
Tangerine telecommunication cable	81.72	81.8	11.86	5692337	5692337	CA_2264	276m E	12m	No
NEMO Interconnector	84.8	84.88	10.96	405933	5686912	CA_2267	940m SE	25m	No
Atlantic Crossing - Seg B1 telecommunication cable	96.85	97.03	11.26	405933	5678926	CA_2270	156m NE	10m	No

Table 3-11 (Chapter 3, Project Description) identifies further areas where external cable protection may be required owing to the presence of challenging geology (high-strength clay and chalk). Table 13-10 highlights the nearest AEZs to areas of external cable protection. The external cable protection encroaches upon proposed AEZs for two assets (**CA_2248**, a geophysical anomaly with low significance, and **CA_2250**, a geophysical anomaly of medium significance). These AEZs are also encroached by the Preferred Cable Route, therefore Project Specific Mitigation has already been proposed and no further action is required. The remaining AEZs are considered to be of sufficient distance from areas of external cable protection to require no mitigation.

Measures to reduce scour at cable crossing points and points of external cable protection are outlined in Chapter 3 (Project description) and Chapter 5 (Physical processes). Any impact from scour at crossing points on known historic assets is expected to be **Negligible**.

Table 13-10 AEZs in proximity to external cable protection

CBRA Zone	KP Start (rev2)	KP End (rev2)	Nearest asset (CA no)	Distance from KP (m) at closest point	Extent of assigned AEZ (m rad)	Encroached by external cable protection?
10	13.304	13.899	CA_2142	35m NW	30m	No
42	68.899	69.999	CA_2244	44m N	10m	No
43	69.999	70.799	CA_2248	0m	10m	**Yes**
44	70.799	72.869	CA_2250	0m	12m	**Yes**
46	73.841	74.499	CA_2255	143m SW	10m	No
50	76.840	83.999	CA_2265	86m NE	140m	No
60	112.478	116.842	CA_2283	4688m NW	10m	No

13.6.3.3 Historic seascape characterisation

HSC character type: Energy industry

Energy industry is mapped as the dominant HSC character type for the sub-sea floor and is also prevalent on the sea floor, including the sub-character type Submarine power cable. The Proposed Development will not therefore introduce any new character or sub-character types to the HSC, and will have no impact on the way this character type is perceived; the significance of this character type can therefore be assessed as very low. The overall significance of effect on this character type is assessed as negligible and no project specific mitigation is required.

HSC character type: Navigation

The broad character type Navigation, including the character types Navigation activity, Navigation hazard and Maritime safety, is dominant within both the sea floor and the coastal and conflated datasets. This HSC character type is considered to be of very low significance as it is capable of accepting the introduction of a sub-character type that is already prevalent within the region with no effect on how it is perceived. The significance of effect can therefore be assessed as negligible. No project specific mitigation is required.

HSC character type: Fishing

Fishing is prevalent within the sea floor and coastal and conflated datasets, including sub-character types Shellfish dredging, Fixed netting and Bottom trawling. Although the installation of the Proposed Development will potentially lead to some displacement of fishing activity, activity will be possible outside of the affected area and the impact will be short and time limited. This character type is therefore capable of receiving the Proposed Development without adversely affecting the way it is perceived; it can therefore be considered to be of very low significance.

Cable protection will be installed at various locations along the route (see Table 13-10), which has the potential to impact upon Fishing and the values and perceptions ascribed to it. However, as such protection will only be required along a fraction of the total route, the magnitude of change can be assessed as low. The significance of effect is deemed to be negligible and no project specific mitigation is required with respect to cultural heritage.

HSC character type: Cultural topography (marine)
Cultural topography (marine) is present in both the sea floor and coastal and conflated datasets, including Coarse, Fine and Mixed sediment plains and Sandbanks with waves. This character type is deemed to be of very low significance, due to its considerable extent within the area and because values and perceptions attributed to it are generally fairly limited. As the installation of the Proposed Development will not introduce a new character type to the region, the overall significance of effect is assessed as negligible and no project-specific mitigation is required.

HSC character type: Cultural topography (inter-tidal)
The cultural topography (inter-tidal) of the region includes Mudflats and Saltmarsh. Any impact upon this widespread character type is expected to occur during the installation phase – e.g. HDD and cable-trenching – and would therefore be limited in extent and duration. Perceptual values presently ascribed to it are unlikely to be altered; the significance of effect is therefore assessed as negligible. No project specific mitigation is required.

HSC character type: Palaeo-landscape components
Palaeo-landscape components are present in the sea floor and sub-sea floor GIS. Physical impacts on known palaeo-environmental deposits have been addressed above; it is the values and perceptions ascribed to the palaeo-landscape that are of concern here. This HSC character type is considered to be of low significance as it is capable of accepting the introduction of a character type already present in the area with limited effects on how it is perceived. Values and perceptions attributed to it are also generally limited, with the archaeological potential for submerged landscapes generally poorly understood within the wider community. The significance of effect is therefore assessed as negligible and no project specific mitigation is required.

HSC character types: Telecommunications, Transport, Flood and erosion defences and Ports and docks
The HSC character types Telecommunications, Transport, Flood and erosion defences and Ports and docks are all present to a limited extent within the Asset Placement Corridor. The proposed development will have no effect on the perception of these HSC character types, so their significance has been assessed as very low. The magnitude of change is also very low, so the overall significance of effect is assessed as negligible. No project-specific mitigation is required.

13.7 Project Specific Mitigation

In addition to the embedded mitigation outlined in Table 13-5, Table 13-11 presents Project Specific Mitigation that will be implemented.

Table 13-11 Project specific mitigation

ID	Project Specific Mitigation
PS7	Position of planned anchor placements shall be surveyed. Data shall by analysed by both a marine ecological specialist and a marine archaeologist for presence of sensitive habitats and archaeological features respectively. Positions of planned anchor placements shall be adjusted if Sabellaria reef or marine heritage assets are identified at the location.
PS39	Marine archaeological exclusion zones (as detailed in GridLink Environmental Report and GridLink WSI), and any subsequent zones demarked following the implementation of the PAD shall be adhered to during all marine operations.
PS40	The GridLink cable route currently encroaches on 18 proposed AEZs. Each anomaly shall be visually inspected (using ROV or diver study) to determine if the anomaly is archaeological sensitive. Following the results of the visual inspection and discussion with the marine archaeologist the AEZ may be refined or removed and a decision on the cable route shall be made.

Table 13-12 and Table 13-13 list the proposed Archaeological Exclusion Zones and the associated historic asset or potential geophysical anomaly.

Table 13-12 Recorded historic assets along the Asset Placement Corridor in UK waters

CA report reference	Site name	Type	Receptor significance	Magnitude of impact	Significance of potential effects	Proposed mitigation	Residual effect
CA9	*Tamarisk*	Protected wreck	N/A	N/A	None	None	None
CA10	*Junkers Ju88a-1 (5100) 3z+Hs*	Protected aircraft	N/A	N/A	None	None	None
CA11	*Hurricane Mk I P2806*	Protected aircraft	N/A	N/A	None	None	None
CA12	*Hurricane Mk I R4121*	Protected aircraft	N/A	N/A	None	None	None
CA13	*Messerschmitt Me109e-4 (5256) 1+*	Protected aircraft	N/A	N/A	None	None	None
CA14	*Crash site of Messerschmitt Bf109E-4*	Protected aircraft	High	High	Moderate	20m AEZ	Negligible
CA15	*Supremity*	Wreck	High	Low	Minor	40m AEZ	Negligible
CA16	*HMS Capricornus*	Protected wreck	High	High	Moderate	100m AEZ	Negligible
CA17	*Houston City*	Wreck	High	Low	Minor	110m AEZ	Negligible
		Wreck	High	Low	Minor	110m AEZ	Negligible
CA18	*Herland*	Wreck	High	Low	Minor	25m AEZ	Negligible
		Wreck	High	Low	Minor	50m AEZ	Negligible
CA20	*Spitfire Mk I N3060*	Protected aircraft	N/A	N/A	None	None	None
CA21	*Hampden*	Protected aircraft	N/A	N/A	None	None	None
CA22	*Heinkel He111h-5 (3840) 5j+Cs*	Protected aircraft	N/A	N/A	None	None	None
CA23	*HMS Lavinia L*	Protected wreck	N/A	N/A	None	None	None
CA24	*HMS Vimiera*	Protected wreck	High	High	Moderate	50m AEZ	Negligible
			High	High	Moderate	55m AEZ	Negligible
			High	High	Moderate	40m AEZ	Negligible
			High	High	Moderate	20m AEZ	Negligible
			High	High	Moderate	25m AEZ	Negligible
CA25	*Junkers Ju88a-5 (6396) 7t+Ml*	Protected aircraft	N/A	N/A	None	None	None

CA report reference	Site name	Type	Receptor significance	Magnitude of impact	Significance of potential effects	Proposed mitigation	Residual effect
CA26	*Hurricane Mk I R4093*	Protected aircraft	N/A	N/A	None	None	None
CA27	*HMS Alert (possibly)*	Wreck	High	Low	Minor	140m AEZ	Negligible
CA28	Surrey	Wreck	High	Low	Minor	40m AEZ	Negligible
CA36	Unknown	Wreck	High	Low	Minor	30m AEZ	Negligible
CA38	Unknown	Wreck	High	Low	Minor	30m AEZ	Negligible
CA39	Unknown (possibly *HMS Lavinia L* (**CA23**))	Wreck	High	High	Moderate	40m AEZ	Negligible
CA41	Unknown	Wreck	High	Low	Minor	70m AEZ	Negligible
CA53	Unknown	Obstruction	Medium	Low	Negligible*	18m AEZ	Negligible
CA56	Unknown	Obstruction	Low	Low	Negligible*	15m AEZ	Negligible
CA57	Unknown	Obstruction	High	Low	Minor	25m AEZ	Negligible
CA58	Unknown	Obstruction	Medium	Low	Negligiable*	15m AEZ	Negligible
CA59	Unknown	Obstruction	High	Low	Minor	25m AEZ	Negligible
CA60	Unknown	Obstruction	Medium	Low	Negligible*	30m AEZ	Negligible
CA61	Unknown	Obstruction	High	Low	Minor	20m AEZ	Negligible
CA62	Unknown	Obstruction	Medium	Low	Negligible*	35m AEZ	Negligible
CA63	Unknown	Obstruction	Medium	Low	Negligible*	15m AEZ	Negligible
CA65	Unknown	Obstruction	Medium	Low	Negligible*	15m AEZ	Negligible
CA66	Unknown	Obstruction	High	Low	Minor	20m AEZ	Negligible
CA67	Unknown	Obstruction	High	Low	Minor	20m AEZ	Negligible
CA68	Unknown	Obstruction	Low	Low	Negligible*	15m AEZ	Negligible
CA70	Unknown	Obstruction	Low	Low	Negligible*	15m AEZ	Negligible
CA80	Battery	Monument	High	Low	Minor	50m AEZ	Negligible
CA87	Anchorage	Monument	Medium	Low	Negligible*	10m AEZ	Negligible

CA report reference	Site name	Type	Receptor significance	Magnitude of impact	Significance of potential effects	Proposed mitigation	Residual effect
CA88	Anchorage	Monument	Medium	Low	Negligible*	40m AEZ	Negligible
CA94	*U-37*	Protected wreck	High	High	Moderate	180m AEZ	Negligible
CA216	*HMT Pyrope*	Protected wreck	High	High	Moderate	70m AEZ	Negligible
CA243	*MV Lisbeth M*	Wreck	High	Low	Minor	60m AEZ	Negligible

*Although the assessment of the significance of potential effects on some assets has been assessed as negligible, in some cases where deemed necessary, the precautionary principle has been adopted and mitigation in the form of appropriately-sized AEZs has been imposed.

Table 13-13 Marine geophysical anomalies along the Asset Placement corridor in UK territorial waters

CA report reference	Site description	Receptor significance	Magnitude of effect	Significance of potential effects	Proposed mitigation	Residual effect
CA_2001	Geophysical anomaly - MAG - *Messerschmitt Bf109E-4*	High	High	Moderate	20m AEZ	Negligible
CA_2002	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2003	Geophysical anomalies - MBES, SSS & MAG	Medium	Low	Negligible*	15m AEZ	Negligible
CA_2004	Geophysical anomalies - MBES & SSS	Medium	Low	Negligible*	10m AEZ	Negligible
CA_2005	Geophysical anomalies - MBES & SSS	Medium	Low	Negligible*	10m AEZ	Negligible
CA_2006	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2007	Geophysical anomalies - SSS & MAG	Medium	Low	Negligible*	15m AEZ	Negligible
CA_2008	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2009	Geophysical anomaly - MAG – **encroached by Preferred Cable Route**	Low	High	Minor	10m AEZ & ground-truth	Negligible
CA_2010	Geophysical anomaly - MAG	Medium	Low	Negligible*	10m AEZ	Negligible
CA_2011	Geophysical anomaly - MAG - **encroached by Preferred Cable Route**	Low	High	Minor	10m AEZ & ground-truth	Negligible
CA_2012	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2013	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2014	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2015	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2016	Geophysical anomalies - MBES & MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2017	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2018	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2019	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2020	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2021	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible

CA report reference	Site description	Receptor significance	Magnitude of effect	Significance of potential effects	Proposed mitigation	Residual effect
CA_2022	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2023	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2024	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2025	Geophysical anomalies - SSS & MAG	Medium	Low	Negligible*	15m AEZ	Negligible
CA_2026	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2027	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2028	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2029	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2030	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2031	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2032	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2033	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2034	Geophysical anomalies - MBES, SSS & MAG	Medium	Low	Negligible*	25m AEZ	Negligible
CA_2035	Geophysical anomalies - MBES & SSS	Medium	Low	Negligible*	15m AEZ	Negligible
CA_2036	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2037	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2038	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2039	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2040	Geophysical anomalies - MAG	Medium	Low	Negligible*	65m AEZ	Negligible
CA_2041	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2042	Geophysical anomalies - SSS & MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2043	Geophysical anomalies - MBES & SSS	Medium	Low	Negligible*	90m AEZ	Negligible
CA_2044	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible

CA report reference	Site description	Receptor significance	Magnitude of effect	Significance of potential effects	Proposed mitigation	Residual effect
CA_2045	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2046	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2047	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2048	Geophysical anomalies - MBES & MAG	Medium	Low	Negligible*	15m AEZ	Negligible
CA_2049	Geophysical anomaly - MAG - **encroached by Preferred Cable Route**	Low	High	Minor	10m AEZ & ground-truth	Negligible
CA_2050	Geophysical anomalies - SSS & MAG	Low	Low	Negligible*	40m AEZ	Negligible
CA_2051	Geophysical anomalies - SSS & MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2052	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2053	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2054	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2055	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2056	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2057	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2058	Geophysical anomalies - SSS & MAG - **encroached by Preferred Cable Route**	Medium	High	Minor	15m AEZ & ground-truth	Negligible
CA_2059	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2060	Geophysical anomalies - SSS & MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2061	Geophysical anomalies - SSS & MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2062	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2063	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2064	Geophysical anomalies - MBES & SSS	High	Low	Minor	25m AEZ	Negligible
CA_2065	Geophysical anomalies - MBES & SSS - CA59	High	Low	Minor	25m AEZ	Negligible
CA_2066	Geophysical anomalies - SSS & MAG	Medium	Low	Negligible*	15m AEZ	Negligible

CA report reference	Site description	Receptor significance	Magnitude of effect	Significance of potential effects	Proposed mitigation	Residual effect
CA_2067	Geophysical anomalies - MBES, SSS & MAG	Medium	Low	Negligible*	50m AEZ	Negligible
CA_2068	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2069	Geophysical anomalies - SSS & MAG - CA60	Medium	Low	Negligible*	30m AEZ	Negligible
CA_2070	Geophysical anomalies - MBES & SSS - CA61	High	Low	Minor	20m AEZ	Negligible
CA_2071	Geophysical anomalies - SSS & MAG - CA62	Medium	Low	Negligible*	35m AEZ	Negligible
CA_2072	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2073	Geophysical anomalies - MBES & SSS - CA58	Medium	Low	Negligible*	15m AEZ	Negligible
CA_2074	Geophysical anomalies - MBES & MAG	Medium	Low	Negligible*	15m AEZ	Negligible
CA_2075	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2076	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2077	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2078	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2079	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2080	Geophysical anomalies - MBES, SSS & MAG - CA57	High	Low	Minor	25m AEZ	Negligible
CA_2081	Geophysical anomalies - SSS & MAG	Medium	Low	Negligible*	15m AEZ	Negligible
CA_2082	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2083	Geophysical anomalies - MBES, SSS & MAG	Medium	Low	Negligible*	15m AEZ	Negligible
CA_2084	Geophysical anomalies - MBES, SSS & MAG	High	Low	Minor	50m AEZ	Negligible
CA_2085	Geophysical anomalies - MBES & MAG	Medium	Low	Negligible*	15m AEZ	Negligible
CA_2086	Geophysical anomalies - MBES & MAG	Medium	Low	Negligible*	15m AEZ	Negligible
CA_2087	Geophysical anomalies - MBES & MAG	Medium	Low	Negligible*	15m AEZ	Negligible
CA_2088	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2089	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible

CA report reference	Site description	Receptor significance	Magnitude of effect	Significance of potential effects	Proposed mitigation	Residual effect
CA_2090	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2091	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2092	Geophysical anomalies - MBES, SSS & MAG	Medium	Low	Negligible*	15m AEZ	Negligible
CA_2093	Geophysical anomalies - MAG - CA87	Medium	Low	Negligible*	10m AEZ	Negligible
CA_2094	Geophysical anomalies - SSS & MAG - CA63	Medium	Low	Negligible*	15m AEZ	Negligible
CA_2095	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2096	Geophysical anomalies - MBES & MAG	Medium	Low	Negligible*	10m AEZ	Negligible
CA_2097	Geophysical anomaly - MAG - **encroached by Preferred Cable Route**	Low	High	Minor	10m AEZ & ground-truth	Negligible
CA_2098	Geophysical anomalies - SSS & MAG	Medium	Low	Negligible*	10m AEZ	Negligible
CA_2099	Geophysical anomalies - MBES, SSS & MAG	High	Low	Minor	40m AEZ	Negligible
CA_2100	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2101	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2102	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2103	Geophysical anomalies - MBES, SSS & MAG - CA53	Medium	Low	Negligible*	18m AEZ	Negligible
CA_2104	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2105	Geophysical anomalies - MAG - CA88	Medium	Low	Negligible*	40m AEZ	Negligible
CA_2106	Geophysical anomalies - MBES, SSS & MAG	Medium	Low	Negligible*	20m AEZ	Negligible
CA_2107	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2108	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2109	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2110	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2111	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible

CA report reference	Site description	Receptor significance	Magnitude of effect	Significance of potential effects	Proposed mitigation	Residual effect
CA_2112	Geophysical anomaly - MAG - **encroached by Preferred Cable Route**	Low	High	Minor	10m AEZ & ground-truth	Negligible
CA_2113	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2114	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2115	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2116	Geophysical anomalies - MBES & SSS	Low	Low	Negligible*	12m AEZ	Negligible
CA_2117	Geophysical anomaly - MAG	Medium	Low	Negligible*	15m AEZ	Negligible
CA_2118	Geophysical anomalies - SSS & MAG - unknown wreck (CA39) – possibly *HMS Lavinia L* (CA23)	High	High	Moderate	40m AEZ	Negligible
CA_2119	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2120	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2121	Geophysical anomalies - MBES & SSS - CA80	High	Low	Minor	50m AEZ	Negligible
CA_2122	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2123	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2124	Geophysical anomalies - MBES, SSS & MAG - unknown wreck (CA38)	High	Low	Minor	30m AEZ	Negligible
CA_2125	Geophysical anomalies - MBES, SSS & MAG	High	Low	Minor	20m AEZ	Negligible
CA_2126	Geophysical anomalies - MBES, SSS & MAG - CA67	High	Low	Minor	20m AEZ	Negligible
CA_2127	Geophysical anomalies - MBES, SSS & MAG - CA66	High	Low	Minor	20m AEZ	Negligible
CA_2128	Geophysical anomalies - MBES & MAG	Medium	Low	Negligible*	20m AEZ	Negligible
CA_2129	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2130	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2131	Geophysical anomalies - MBES, SSS & MAG	Medium	Low	Negligible*	20m AEZ	Negligible
CA_2132	Geophysical anomalies - SSS & MAG	High	Low	Minor	50m AEZ	Negligible
CA_2133	Geophysical anomalies - MBES, SSS & MAG	High	Low	Minor	25m AEZ	Negligible

CA report reference	Site description	Receptor significance	Magnitude of effect	Significance of potential effects	Proposed mitigation	Residual effect
CA_2134	Geophysical anomalies - MBES & MAG	Medium	Low	Negligible*	20m AEZ	Negligible
CA_2135	Geophysical anomalies - MBES & SSS	Medium	Low	Negligible*	25m AEZ	Negligible
CA_2136	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2137	Geophysical anomaly - MAG - **encroached by Preferred Cable Route**	Low	High	Minor	10m AEZ & ground-truth	Negligible
CA_2138	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2139	Geophysical anomalies - SSS & MAG	Medium	Low	Negligible*	15m AEZ	Negligible
CA_2140	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2141	Geophysical anomalies - SSS & MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2142	Geophysical anomalies - SSS & MAG	Low	Low	Negligible*	30m AEZ	Negligible
CA_2143	Geophysical anomalies - MBES & MAG	Low	Low	Negligible*	20m AEZ	Negligible
CA_2144	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2145	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2146	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2147	Geophysical anomalies - MAG	Low	Low	Negligible*	15m AEZ	Negligible
CA_2148	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2149	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2150	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2151	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2152	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2153	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2154	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2155	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2156	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible

CA report reference	Site description	Receptor significance	Magnitude of effect	Significance of potential effects	Proposed mitigation	Residual effect
CA_2157	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2158	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2159	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2160	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2161	Geophysical anomalies - SSS & MAG	Medium	Low	Negligible*	10m AEZ	Negligible
CA_2162	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2163	Geophysical anomalies - MBES & MAG	Medium	Low	Negligible*	10m AEZ	Negligible
CA_2164	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2165	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2166	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2167	Geophysical anomalies - SSS & MAG	Medium	Low	Negligible*	15m AEZ	Negligible
CA_2168	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2169	Geophysical anomalies - MBES, SSS & MAG - *Herland*	High	Low	Minor	25m AEZ	Negligible
CA_2170	Geophysical anomalies - MBES, SSS & MAG - *Herland*	High	Low	Minor	50m AEZ	Negligible
CA_2171	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2172	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2173	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2174	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2175	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2176	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2177	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2178	Geophysical anomalies - MBES & SSS	Low	Low	Negligible*	10m AEZ	Negligible
CA_2179	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible

CA report reference	Site description	Receptor significance	Magnitude of effect	Significance of potential effects	Proposed mitigation	Residual effect
CA_2180	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2181	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2182	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2183	Geophysical anomalies - MBES & MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2184	Geophysical anomalies - MBES, SSS & MAG - *HMS Vimiera*	High	High	Moderate	50m AEZ	Negligible
CA_2185	Geophysical anomalies - MBES, SSS & MAG - *HMS Vimiera*	High	High	Moderate	55m AEZ	Negligible
CA_2186	Geophysical anomalies - MBES, SSS & MAG - *HMS Vimiera*	High	High	Moderate	40m AEZ	Negligible
CA_2187	Geophysical anomaly - MAG - *HMS Vimiera*	High	High	Moderate	20m AEZ	Negligible
CA_2188	Geophysical anomalies - SSS & MAG - *HMS Vimiera*	High	High	Moderate	25m AEZ	Negligible
CA_2189	Geophysical anomalies - SSS & MAG	Low	Low	Negligible*	25m AEZ	Negligible
CA_2190	Geophysical anomalies - SSS & MAG - *HMS Capricornus*	High	High	Moderate	100m AEZ	Negligible
CA_2191	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2192	Geophysical anomalies - SSS	High	Low	Minor	25m AEZ	Negligible
CA_2193	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2194	Geophysical anomalies - SSS & MAG	Medium	Low	Negligible*	40m AEZ	Negligible
CA_2195	Geophysical anomalies - SSS	High	Low	Minor	100m AEZ	Negligible
CA_2196	Geophysical anomalies - MAG	Low	Low	Negligible*	15m AEZ	Negligible
CA_2197	Geophysical anomalies - *Supremity*	High	Low	Minor	40m AEZ	Negligible
CA_2198	Geophysical anomalies - MBES, SSS & MAG - *Houston City*	High	Low	Minor	110m AEZ	Negligible
CA_2199	Geophysical anomalies - MAG	Low	Low	Negligible*	20m AEZ	Negligible
CA_2200	Geophysical anomalies - SSS & MAG - *Houston City*	High	Low	Minor	110m AEZ	Negligible
CA_2201	Geophysical anomalies - SSS & MAG	Medium	Low	Negligible*	35m AEZ	Negligible
CA_2202	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible

CA report reference	Site description	Receptor significance	Magnitude of effect	Significance of potential effects	Proposed mitigation	Residual effect
CA_2203	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2204	Geophysical anomalies - SSS & MAG	Medium	Low	Negligible*	10m AEZ	Negligible
CA_2205	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2206	Geophysical anomalies - MAG	Low	Low	Negligible*	25m AEZ	Negligible
CA_2207	Geophysical anomalies - SSS & MAG	Medium	Low	Negligible*	10m AEZ	Negligible
CA_2208	Geophysical anomalies - SSS & MAG - CA65	Medium	Low	Negligible*	15m AEZ	Negligible
CA_2209	Geophysical anomalies - MBES, SSS & MAG - unknown wreck (CA41)	High	Low	Minor	70m AEZ	Negligible
CA_2210	Geophysical anomalies - MBES, SSS & MAG	High	Low	Minor	60m AEZ	Negligible
CA_2211	Geophysical anomaly - MAG - **encroached by Preferred Cable Route**	Low	High	Minor	10m AEZ & ground-truth	Negligible
CA_2212	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2213	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2214	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2215	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2216	Geophysical anomalies - MAG	Low	Low	Negligible*	60m AEZ	Negligible
CA_2217	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2218	Geophysical anomaly - SSS	Low	Low	Negligible*	10m AEZ	Negligible
CA_2219	Geophysical anomalies - SSS & MAG	Medium	Low	Negligible*	10m AEZ	Negligible
CA_2220	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2221	Geophysical anomalies - MBES, SSS & MAG - *HMS Pyrope*	High	High	Moderate	70m AEZ	Negligible
CA_2222	Geophysical anomaly - MAG - **encroached by Preferred Cable Route**	Low	High	Minor	10m AEZ & ground-truth	Negligible
CA_2223	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2224	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible

CA report reference	Site description	Receptor significance	Magnitude of effect	Significance of potential effects	Proposed mitigation	Residual effect
CA_2225	Geophysical anomaly - MAG - **encroached by Preferred Cable Route**	Low	High	Minor	10m AEZ & ground-truth	Negligible
CA_2226	Geophysical anomaly - MAG - **encroached by Preferred Cable Route**	Medium	High	Minor	10m AEZ & ground-truth	Negligible
CA_2227	Geophysical anomalies - SSS & MAG	Medium	Low	Negligible*	10m AEZ	Negligible
CA_2228	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2229	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2230	Geophysical anomalies - MBES & MAG - *MV Lisbeth M*	High	Low	Minor	60m AEZ	Negligible
CA_2231	Geophysical anomaly - MAG - CA68	Low	Low	Negligible*	15m AEZ	Negligible
CA_2232	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2233	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2234	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2235	Geophysical anomaly - MAG - **encroached by Preferred Cable Route**	Low	High	Minor	10m AEZ & ground-truth	Negligible
CA_2236	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2237	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2238	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2239	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2240	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2241	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2242	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2243	Geophysical anomalies - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2244	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2245	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2246	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible

CA report reference	Site description	Receptor significance	Magnitude of effect	Significance of potential effects	Proposed mitigation	Residual effect
CA_2247	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2248	Geophysical anomaly - MAG - **encroached by Preferred Cable Route**	Low	High	Minor	10m AEZ & ground-truth	Negligible
CA_2249	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2250	Geophysical anomalies - MBES, SSS & MAG - **encroached by Preferred Cable Route**	Medium	High	Minor	12m AEZ & ground-truth	Negligible
CA_2251	Geophysical anomalies - SSS & MAG	Medium	Low	Negligible*	15m AEZ	Negligible
CA_2252	Geophysical anomalies - SSS & MAG	Medium	Low	Negligible*	10m AEZ	Negligible
CA_2253	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2254	Geophysical anomalies - MBES, SSS & MAG - *Surrey*	High	Low	Minor	40m AEZ	Negligible
CA_2255	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2256	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2257	Geophysical anomaly - SSS - **encroached by Preferred Cable Route**	Medium	High	Minor	25m AEZ & ground-truth	Negligible
CA_2258	Geophysical anomalies - MBES & SSS	Low	Low	Negligible*	10m AEZ	Negligible
CA_2259	Geophysical anomalies - MBES & SSS	Low	Low	Negligible*	10m AEZ	Negligible
CA_2260	Geophysical anomaly - MAG - **encroached by Preferred Cable Route**	Low	High	Minor	10m AEZ & ground-truth	Negligible
CA_2261	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2262	Geophysical anomalies - MBES, SSS & MAG	Medium	Low	Negligible*	10m AEZ	Negligible
CA_2263	Geophysical anomalies - MBES & MAG	Medium	Low	Negligible*	15m AEZ	Negligible
CA_2264	Geophysical anomalies - MBES, SSS & MAG	Medium	Low	Negligible*	12m AEZ	Negligible
CA_2265	Geophysical anomalies - MBES, SSS & MAG - *HMS Alert*	High	Low	Minor	140m AEZ	Negligible
CA_2266	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2267	Geophysical anomalies - SSS	Medium	Low	Negligible*	25m AEZ	Negligible

CA report reference	Site description	Receptor significance	Magnitude of effect	Significance of potential effects	Proposed mitigation	Residual effect
CA_2268	Geophysical anomalies - MBES & SSS	Medium	Low	Negligible*	20m AEZ	Negligible
CA_2269	Geophysical anomaly - MAG - **encroached by Preferred Cable Route**	Low	High	Minor	10m AEZ & ground-truth	Negligible
CA_2270	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2271	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2272	Geophysical anomalies - MBES, SSS & MAG	Medium	Low	Negligible*	12m AEZ	Negligible
CA_2273	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2274	Geophysical anomalies - MBES, SSS & MAG - **encroached by Preferred Cable Route**	Medium	High	Minor	15m AEZ & ground-truth	Negligible
CA_2275	Geophysical anomalies - SSS & MAG	Medium	Low	Negligible*	10m AEZ	Negligible
CA_2276	Geophysical anomalies - MBES & MAG	Medium	Low	Negligible*	10m AEZ	Negligible
CA_2277	Geophysical anomaly - MAG - CA56 & CA70	Low	Low	Negligible*	15m AEZ	Negligible
CA_2278	Geophysical anomalies – MBES & SSS - *U-37*	High	High	Moderate	180m AEZ	Negligible
CA_2279	Geophysical anomalies - MBES & SSS - unknown wreck (CA36)	High	Low	Minor	30m AEZ	Negligible
CA_2280	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2281	Geophysical anomaly - MAG	Low	Low	Negligible*	15m AEZ	Negligible
CA_2282	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible
CA_2283	Geophysical anomaly - MAG	Low	Low	Negligible*	10m AEZ	Negligible

13.8 Residual Effect

This assessment has highlighted the potential for effects on 283 archaeological assets identified in the desk based assessment (Coracle Archaeology 2020a) and the archaeological assessment of geophysical survey data (Coracle Archaeology 2020b).

The potential effects on these assets are primarily from pre-sweeping and pre-lay grapnel run, cable burial and from the anchors of project vessels. To mitigate these potential effects, Project Specific Mitigation (PS39) in the form of AEZs of between 10m and 180m radius, centred on the recorded location of each asset or anomaly, have been assigned (see Tables 13-12 and 13-13). Adherence to the AEZs will reduce the overall significance of effects on historic assets and anomalies to **Negligible**.

The preferred cable route encroaches directly on 18 proposed AEZs. Four of these are deemed to be of medium, and 14 of low, archaeological potential (or receptor significance). The possibility that these anomalies are indicative of wreckage or submerged features cannot be discounted. As the AEZs will be encroached by the preferred cable route, either the cable will be re-routed around the AEZs or ground-truthing, by remotely-operated vehicle (ROV) or diver surveys, will be undertaken to determine the extent of the anomaly so the cable can be micro-routed around any potential archaeological asset (PS40). This Project Specific Mitigation reduces the significance of potential effect to **Negligible**.

REFERENCES

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14. CUMULATIVE EFFECTS ASSESSMENT

14.1 Introduction

This Chapter describes the assessment of cumulative effects from the Proposed Development with other past, present, and reasonably foreseeable plans, projects, or licensed activities. The Proposed Development includes all works associated with the installation, commissioning, testing, operation, maintenance, repair and eventual decommissioning of the cable system. All phases are assessed in this Chapter.

Approximately 106km of the Proposed Development lies within territorial waters (i.e. within 12 nautical miles of the coastline) and falls within the South East Inshore Marine Plan area. The remaining 2km, which crosses the UK Exclusive Economic Zone, falls within the East Offshore Marine Plan area.

The East Offshore Marine Plan requires that:

"cumulative impacts affecting the ecosystem of the East marine plans and adjacent areas (marine, terrestrial) should be addressed in decision-making and plan implementation." (MMO 2014b).

A requirement of the draft South East Inshore Marine Plan is that:

"proposals which may have adverse cumulative effects with other existing, authorised or reasonably foreseeable proposals must demonstrate that they will, in order of preference:

a. *avoid*
b. *minimise*
c. *mitigate significant adverse cumulative and/or in-combination effects."* (MMO 2020).

In compliance with the marine plans, any adverse cumulative effects of the Proposed Development and nearby projects, plans or licenced activities are summarised and assessed in this chapter.

Potential cumulative effects (PCE) are assessed using the methodology described in the sections below. The methodology uses the following definitions from the Marine Management Organisation (MMO) Strategic Framework for Scoping Cumulative Effects (MMO 2014):

- **Cumulative effects** are "effects that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project".

  While a single activity may result in an effect that is Not Significant, when combined with other Not Significant Effects, collectively it can result in a cumulative effect that is Significant.

- **Plans, projects and activities** are human activities taking place in the marine environment. A plan typically covers a large area and lays out the foundation for future projects (e.g. The Crown Estate Round 3 offshore wind plan). Projects are individual developments that may have arisen out of the plan (e.g. an individual wind farm). Activities are typically wide ranging and occur outside of a defined project or plan and include for example commercial fishing.

The assessment is based on the best data available on other plans and projects and their timelines which is currently in the public domain or has been made available by the project promoter. It assumes that information made publicly available is accurate and relies on collaborative interactions with statutory consultees, authorities and other developers to identify any changes in information pertinent to the assessment.

The Chapter is split into three parts:

- Part 1 - Intra-project Effects
- Part 2 - Cumulative Effects

- Part 3 - Transboundary Effects.

The approach taken to assess the sensitivity of the receptor and the magnitude of the effect follows the methodology outlined in Chapter 4.

14.2 Consultation

Table 14-1 summarises the relevant consultation responses regarding potential cumulative effects that have been considered by this Chapter.

Table 14-1 Consultation responses

Consultee	Summary of Consultation Response	How / Where Addressed
MMO	The cumulative and inter-related effects to marine/estuarine and migratory fish as well as commercial fishing must be scoped into the assessment.	The potential for cumulative effects on fish receptors that are a Primary or Qualifying Feature of protected areas have been assessed in the GridLink HRA (Technical Appendix E) and GridLink Marine Conservation Zone Assessment (Technical Appendix F). Commercial fisheries have been included in the assessment in Section 14.4.2 below.
MMO	The MMO note that the projects to be considered in the cumulative effects assessment and in-combination will be agreed with the MMO prior to the commencement of the assessment. The proposed Thanet Offshore Extension must be considered in the cumulative effects assessment given the proposed reduction in sea room and potential for crossings which may need to be marked.	Rather than a limited number of specific projects, a comprehensive approach has been taken and all publicly known projects that could potentially cause in-combination effects in the area have been included in the assessment. As all projects were included in the map based assessment (see Section 14.4.2), no projects have been scoped out of the assessment and therefore no list of specific projects has been agreed with the MMO. The recommended data sources were used to download all publicly available data and relevant stakeholders were engaged to confirm the extent of the study area. Although development consent for the proposed Thanet Offshore Extension was refused on 01 June 2020, the developer could appeal this decision. Therefore, the worst case of in-combination effects still includes the proposed Thanet Offshore Extension, which is considered in the map based assessment. See Section 14.4.2.
MMO	The MMO notes that transboundary impacts are not explicitly mentioned in the SR. Hydrodynamic and sedimentary impacts are likely to be localised and it is therefore unlikely that there will be transboundary effects. However, the MMO require the impacts for both nations' waters and their relevant fish receptors to be assessed in the Environmental Report.	Transboundary effects are assessed in Section 14.5.
MMO	It was recommended using Marine Information System to support Cumulative effects assessment. Interactive map showing all determined marine licenses.	The MMO Marine Licenses and Applications Layers (MMO downloaded 2020) were used for GIS analysis. See Section 14.4.2.
MMO	It was noted that a fishermen concern is that there is an increased number of dredging licenses being issued, which will contribute to cumulative effects.	Dredging licenses have been included as restricted areas in the map-based assessment. See Section 14.4.2.
Natural England (NE)	NE advised that there is lots of development in the Margate and Long Sands SAC and these should be captured in the CEA.	This is covered in the GridLink Marine HRA (Technical Appendix E), a summary of the results is presented in Section 14.4.1.

14.3 Part 1 – Intra-project Effects

Typically, intra-project effects can occur between different components of the same project from activities which are geographically close to each other and have the potential for pressures they exert on receptors to overlap spatially or temporally. For a linear interconnector cable such as GridLink, the scope of intra-project effects is limited to the interfaces between onshore and offshore project components i.e. between the Proposed Development and UK Onshore Works.

At the marine interfaces, e.g. between the Proposed Development and the French Marine Works, the effects from the cable installation will move with the installation spread and therefore there is no spatial or temporal overlap; it is a continuation of the effects along the linear project. The significance of effects is therefore considered by the individual environmental assessments for each jurisdiction. No effects have been identified within the Proposed Development, UK Onshore Works and the French Marine Works that could accumulate to have a significant effect.

Two potential pressure-receptor pathway at the interfaces have been considered by the Environmental Appraisal process as follows:

- A pressure-receptor pathway exists relating to potential cumulative effects (PCE) on birds in the Medway Estuary and Marshes SPA and Ramsar at the interface between the Proposed Development and UK Onshore Works; and
- A pressure-receptor pathway exists relating to PCE on marine mammals and specifically harbour porpoise in the Southern North Sea SAC and Banc des Flandres SAC at the interface between the Proposed Development and the French Marine Works.

The significance of effects has been assessed in the GridLink Marine Habitats Regulations Assessment (HRA) – Technical Appendix E, with a summary of the conclusions provided below. No other potential intra-project effects have been identified.

Visual disturbance and above water noise

There is potential for intra-project effects on bird species that are feeding, loafing and breeding within 2-4km of the Proposed Development and could be affected by both the onshore and offshore works during the installation phase of the Proposed Development.

In relation to visual disturbance, the GridLink onshore installation works will mostly take place behind a sea wall, which will control the potential overlap of visual disturbance. Even where the onshore works will be exposed to the foreshore, birds are unlikely to be sensitive to visual disturbance because the area around the Proposed Development is highly industrialised. Shipping density in the Medway Estuary is high, largely attributed to ports at Rochester and Sheerness. The Proposed Development will require several project vessels for installation which will remain within the Medway Estuary and in close proximity to the SPA/Ramsar for durations ranging from several days (cable lay barge) to 1-2 months (jack up barge used for horizontal directional drilling). Given the short-term nature of the visual disturbance, the stationary to slow moving nature of the vessels and the pre-existing high shipping density, the addition of several project vessels in-combination with others will be within the natural variation experienced in the Medway Estuary. Therefore, visual disturbance effects will not combine to any level of significance.

For above water noise, activities are of concern if they emit noise above and beyond day to day levels of existing vessel traffic or the background levels recorded on shore. Such activities mainly include construction of the GridLink converter station.

Kingsnorth is a heavily industrialised area where construction works have been taking place for several years. Above water noise modelling undertaken for the GridLink Converter site construction shows that noise levels drop below the 70dB threshold for significant effects to birds at 50m from the site boundary. As the jack-up barge will be stationed approximately 600m from the site boundary there

will be no spatial overlap of noise levels. Birds using the intertidal area for foraging will not be significantly affected by either project.

Without prejudice to the conclusion of no significant effects, as best practice and through consultation with Natural England, GridLink is proposing to avoid horizontal directional drilling works in the Medway Estuary between 01 October and 31 April (see Project Specific Mitigation PS9) to reduce potential disturbance effects on overwintering birds.

In conclusion, there will be no residual effect on marine birds from the Proposed Development and **No Significant intra-project effects** are expected.

UXO Detonation

The Proposed Development extends through the Southern North Sea SAC and the Bancs des Flandres SAC which are both designated for the conservation of harbour porpoise. If UXO detonation for the Proposed Development is required in the respective UK and French EEZs on the same day there is the potential for intra-project cumulative effects from underwater noise changes on harbour porpoise including disturbance and injurious effects.

An assessment of these effects has been undertaken in Technical Appendix E – GridLink Marine HRA, which concluded at Stage 2 Information to Inform Appropriate Assessment that with implementation of the proposed Project Specific Mitigation, including the commitment to not undertake detonations within UK and French waters on the same day, then **No Significant intra-project effects** are expected.

14.4 Part 2 – Cumulative Effects with other Plans, Projects and Activities

The assessment of in-combination effects for biological receptors has been completed separately following the HRA and Marine Conservation Zone (MCZ) Assessment processes. The assessment is presented in full in Technical Appendix E – GridLink Marine HRA and Technical Appendix F – GridLink MCZ Assessment. The conclusions of these assessments are summarised in Section 14.4.1.

This section primarily focusses on potential cumulative effects (PCE) between the Proposed Development and other plans, project and activities on socio-economic receptors.

14.4.1 Assessment of PCE on Biological Receptors

The pressures on biological receptors were considered separately in the GridLink HRA (Technical Appendix E) and the GridLink MCZ assessment (Technical Appendix F).

14.4.1.1 HRA conclusions

To identify relevant projects to consider for potential cumulative effects, common pressure-receptor pathways were established between the Proposed Development and other projects in the region. Where there was a common pressure-receptor pathway it was determined if the effects spatially overlapped with the Proposed Development within or near a European Site. A cumulative effects assessment was undertaken to determine which projects could potentially have a cumulative effect with the Proposed Development, and these were considered in the Stage 1 Screening.

Stage 1 Screening concluded that Appropriate Assessment is required for two European sites on the basis that there is the potential for significant effects. For the other European sites screened, where it was concluded that alone there was no potential for significant effects, consideration was given as to whether there was the potential for significant cumulative effects with other plans or projects that spatially overlapped with the Proposed Development within the relevant European site. In these cases, **no significant in-combination effects** were identified.

Information to Inform Appropriate Assessment has been provided for Margate and Long Sands SAC and the Southern North Sea SAC. The assessment concluded the following:

Margate and Long Sands SAC

- With respect to the pressures physical change to another seabed type and water flow (tidal current) changes as a result of the requirement for external cable protection within the Margate and Long Sands SAC, three projects have the potential for in-combination effects with the Proposed Development:
  - London Array Offshore Wind Farm and Export Cable; and
  - North Edinburgh Channel (site used for disposal of dredged material from maintenance activities associated with shipping channels)).
  - NeuConnect interconnector
- The Project Specific Mitigation proposed is considered sufficient to reduce likely significant effects on the SAC from the Proposed Development alone.
- Based on the spatially and temporally limited extent of operations and maintenance activities at London Array and the provision of mitigation to reduce scouring effects and habitat loss, there will be no significant in-combination effects as a result.
- With respect to the North Edinburgh Channel, there may be an in-combination effect in relation to habitat disturbance. However, habitat disturbance will be temporary in nature and the high recoverability of the habitats means there would be no significant in-combination effects on the Margate and Longsands SAC.
- It is uncertain if NeuConnect Interconnector will require external cable protection within the European site. However, there appears to be no major infrastructure crossings that may require external protection. It is therefore likely that any effects from NeuConnect will be spatially limited and temporary related to cable lay operations and will not lead to in-combination effects with the Proposed Development.

The assessment of in-combination effects concluded that there will be **no significant in-combination effects** between the London Array Wind Farm, the North Edinburgh Channel, the NeuConnect Interconnector and the Proposed Development.

Southern North Sea SAC

With respect to the pressure underwater noise changes as a result of UXO detonation (if required) a review of projects identified two potential projects for further consideration of PCE: Thanet Extension Offshore Windfarm and NeuConnect Interconnector. It has been identified that both projects could require piling and/or UXO detonation. If a piling event or UXO detonation from a separate project and a UXO detonation from the Proposed Development occurred on the same day during winter, the threshold for significant effects on the Primary Feature harbour porpoise would be exceeded.

When considering the potential for in-combination effects with the above two projects there are some important points to consider. The construction schedules of the two projects are unknown and it is likely that they will not overlap with the Proposed Development. In addition, it is also highly likely that the specific noisy activities from each project will not be scheduled on the same days. However, taking a precautionary approach, it must be assumed that there is the potential for a cumulative effect with one or both projects.

Given the uncertainty around the other construction activities occurring within the SNS SAC, and the fact that it is unknown where, when and if UXO detonation would be required for the Proposed Development **it cannot be ruled out that in-combination effects will not occur** and mitigation measures have been proposed to manage the risk. Project specific mitigation (PS4) ensures that there will be no-intra project significant cumulative effects through liaison with the MMO to ensure potentially noisy activities within the European site are managed collaboratively with other relevant developers who may intend to carry out similar works at the same time.

The assessment of in-combination effects concluded that with the implementation of the proposed mitigation there will be **no significant in-combination effects on the Southern North Sea SAC**.

14.4.1.2 MCZ Assessment conclusions

Screening identified that there was a pathway for effect on five MCZs and that Stage 1 Assessment is required. The MCZs are Medway Estuary MCZ, Swale Estuary MCZ, Thanet Coast MCZ, Goodwin Sands MCZ and Foreland MCZ.

The five MCZs were assessed to determine if the identified pressure-receptor pathways could result in effects on the Protected Features that would hind the achievement of the Conservation Objectives stated for the MCZs. Other plans and projects the effects of which could spatially overlap with the predicted effects from the Proposed Development within an MCZ were also assessed to determine it there was a potential in-combination effect. **No in-combination effects** were identified.

14.4.2 Assessment of PCE on Socio-Economic Receptors

14.4.2.1 Assessment Methodology

The methodology used to assess PCE on socio-economic receptors is based on the MMO Strategic Framework for Scoping Effects (MMO 2014a).

However, due to the number of plans, projects and activities within the study area (195) it was not feasible to follow this process exactly and to provide an individual assessment for all plans, projects and activities. Instead, a map-based approach was used for the assessment of PCE on commercial fisheries, shipping and navigation. Marine archaeology as a receptor was excluded from the assessment because the potential residual effects were deemed negligible and the zone of influence too small to give rise to cumulative effects (see Chapter 13). The steps taken in this assessment process are noted below and described in the following sections.

- **Step 1**: Identify the activities and pressures during each phase of the Proposed Development for which there is a residual effect on a receptor and identify the spatial and temporal extents of pressures (e.g. the maximum zone of influence for each pressure and the temporal extent of each Proposed Development phase).
- **Step 2**: Define a study area around the Proposed Development and identify projects, plans and licensed activities within that area.
- **Step 3**: Map based assessment of cumulative effects.

14.4.2.2 Data Sources

Projects, plans and licensed activities considered in the assessment include, but are not limited to, marine renewable energy sites, offshore wind farms, marine aggregate sites, disposal sites, cable and pipelines, port and harbour activities, oil and gas activities and military areas.

Data on such projects, plans or licensed activities have been established through a desktop review of published information and through consultation with stakeholders e.g. MMO and Natural England (NE). The data sources used to inform the assessment include, but are not limited to, the following:

- The Crown Estate website: Offshore wind farm and marine aggregate digital data;
- The MMO Marine Licenses and Applications GIS data (MMO downloaded 2020);
- The Oil and Gas Authority (OGA) data: wells, pipelines, platforms, FPSOs, terminals, safety zones and hydrocarbon fields (OGA downloaded 2020);
- Scoping consultation responses from the MMO and Natural England; and

14.4.2.3 Limitations and Assumptions

The information used to inform the assessment is subject to the following limitations or assumptions:

- The assessment is based on the best data available on other plans and projects and their timelines which is currently in the public domain or provided by the project promoters. It assumes that third party and publicly available data is correct at the time of publication of the Marine Environmental Report and relies on collaborative interactions with statutory consultees, authorities and other developers to identify any changes in information pertinent to the assessment.
- Given that the Proposed Development is scheduled to commence marine operations in 2022 (dependant on receiving the required permits and consents), information on some other projects (e.g. extent, schedules) and future plans may change. The assessment has been based on the latest available information at the time of publication of the Marine Environmental Report.
- Where information was not available, but spatial extent of an effect could be inferred based on expert knowledge, these projects have been taken forward for assessment. Where there was limited information or there was not enough certainty to carry out the assessment, these projects have been scoped out of the assessment.
- Best efforts have been made to either source publicly available information or contact appropriate developers to request information on plans and projects. This process is in line with the MMO (2014a) guidance and ensures that only cumulative effects for which there is a high degree of confidence are assessed. Where there was limited information or there was not enough certainty to carry out the assessment, these projects have been scoped out of the assessment.

14.4.2.4 Step 1: Identify the Activities and Pressures

The objective of this step is to identify the spatial and temporal extent of minor residual effects the Proposed Development will have on commercial fisheries and shipping. This is done by first establishing the spatial extent of the effects and then establishing the temporal extent.

Define the spatial extent of minor residual effects

To define the spatial extent of minor residual effects the assessment identified all activities (during each phase of the Proposed Development) and their resultant pressures on individual environmental receptors. This was done by creating an activity, pressure and receptor matrix that can be used to identify where a pressure-receptor pathway is present. In this matrix, only the pressures that were included in the Marine Environmental Report and for which there is a residual effect on commercial fishing and shipping have been considered. The Environmental Appraisal process established for each pressure the worst-case zone of influence (or the spatial extent over which a pressure effects a receptor) which has been used in the assessment. Table 14-2 details this process below.

Table 14-2 Activity, pressure, and receptor matrix for the Proposed Development

Project Phase			Activity	Pressure	Receptor	Zone of Influence
I	O	D				
			Presence of project vessels and equipment	Temporary displacement of activity (including required fisheries static gear clearance) / Restricted access to fishing grounds / Disruption to right of passage	Shipping and navigation Commercial fisheries	Spatially defined as width of Application Area. Temporally defined individually for each activity using Table 6-2 and Table 6-3 in the NRA. Takes into consideration a 500m exclusion zone that must be applied to Project Vessels due to their restricted manoeuvrability.
			Presence of cable	Snagging resulting from obstruction on the seabed	Shipping and navigation Commercial fisheries	15m wide x length of Preferred Cable Route
			Deposit of external cable protection	Reduction in water depth impeding safe navigation	Shipping and navigation Commercial fisheries	Specific locations as defined in Tables 3-9 and 3-11. Maximum width of 12.5m wide for external cable protection used at crossings [3] Maximum width of 9.1m wide for external cable protection used due to ground conditions.
			Deposit of external cable protection	Physical change (to another seabed type)	Commercial fisheries	
			Pre-sweeping	Temporary habitat disturbance	Commercial fisheries	Select locations as identified in Table 3-4. Maximum of 63m wide.
			Pre-lay grapnel run, plough & jet trenching			15m wide x length of Preferred Cable Route Potentially up to 20m wide at London Array crossing if frond mats are placed around perimeter of crossing
			Pre-sweeping, cable burial, cable removal	Changes in suspended sediments (water clarity)	Commercial fisheries	1.4km
			UXO detonation (if required) - Impulsive noise	Underwater noise changes	Commercial fisheries	1.0km radius

Development Phases I = Installation; O = Operation; D = Decommissioning.

Define the development phases

The temporal extent is the period covered by each phase of the project. The Proposed Development will have three phases: installation, operation, during which maintenance and repair operations may take place, and decommissioning.

The installation phase for the Proposed Development is planned over 36 months between early 2022 and early 2025.

The operational phase considered by the assessment is 25 years (although the expected design life is up to 45 years), nominally between 2025 and 2050. Pressures during the typical operation of submarine cables are restricted to the emission of electromagnetic fields (EMF) and presence of the cable protection materials.

Once installed, the cables are not expected to require routine maintenance. Should a cable fault be detected, maintenance and repair activities will be on a smaller and more localised scale than the installation operations and as such are not expected to have any significant effects. Pressures from maintenance and repair operations are considered by the assessment; however, as any future requirements for repair and maintenance are unknown, timings cannot be included in the assessment.

How and when decommissioning of the Proposed Development takes place is not known. It has been assumed for the purposes of this assessment to take place after 25 years, nominally between 2025 and 2050 (depending on when commissioning occurs). The two options for decommissioning are leave the cables in situ or remove the cables. The latter is likely to represent the worst-case scenario in terms of environmental effects and has therefore been considered in this assessment. Given the lack of certainty over other plans and projects 25 years into the future, only a high-level assessment has been conducted.

Unplanned events are incidents or non-routine events that have the potential to trigger effects that would otherwise not be anticipated during the normal course of installation or operation. By their nature, unplanned events have no temporal scope, as they could occur at any phase and any location of the Proposed Development. As the probability of an unplanned event occurring is very low, unplanned events have been scoped out of the assessment as it is not possible to assign a spatial and temporal scope to the event.

14.4.2.5 Step 2: Define study area and identify projects

The nature of a linear interconnector cable project means that most potential pressures result in temporary or short-term and localised effects. Most effects of the Proposed Development will be restricted to an immediate zone of influence within the Asset Placement Corridor.

When assessing PCE on biological receptors the zone of influence can be used to define the study area for PCE. However, for commercial fisheries and shipping, although these zones of influence are useful in determining the potential for spatial overlap between PCEs they cannot be used to define a study area. This is because fishing grounds span a much wider area than the typical zones of influence. Minor residual effects in more than one area of the grounds could lead to significant effects on the fishery; similarly, for shipping the study area needs to be wider. Based on advice from fisheries stakeholders and the Fisheries Liaison Officer (FLO), it was decided to extend the study area to include the entire area from the coastal baseline out to the 6nm Fishing Limit between Harwich and Felixstowe. This is believed to be the extent of the grounds used by the local fishermen who also fish within the Asset Placement Corridor, and therefore represents the area that they could move into if disrupted by the Proposed Development.

This area was considered reasonable to also assess effects on shipping.

All known projects, plans, and licensed activities within the study area have been identified and mapped using a geographical information system (GIS). Types of projects and plans considered include:

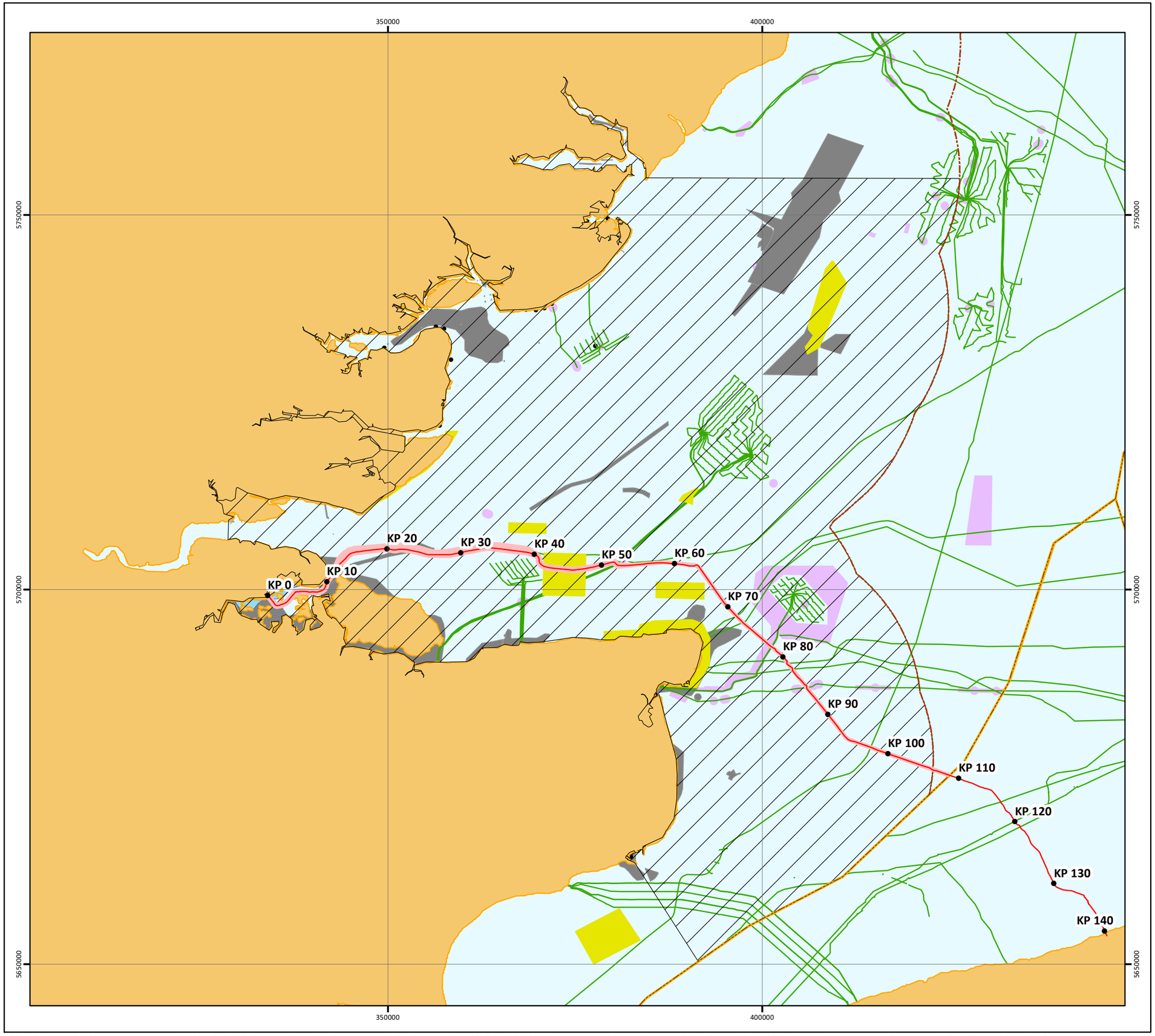
- Renewable energy projects i.e. offshore wind farms;
- Sites for marine aggregate dredging and disposal;
- Cables and pipelines;
- Oil and gas exploration and development;
- Carbon Capture and Storage; and
- Military Practice Areas.

Once an initial map of other projects and plans was created, a secondary screening was undertaken which screened out the following projects and plans:

- Closed disposal sites;
- Duplicate entries; and
- Marine licenses with an end date prior to 2018.

Due to the high level of activity in the study area, this process identified a list of nearly 200 projects.

Figure 14-1 (Drawing P2172-CUMU-001) shows the study area and the spatial extent of existing and future projects. It should be noted that the area extent of future projects is not definitive. Two new projects are known to be missing from the overview: NeuConnect interconnector and the BT Joss telecom cable. However, based on information provided by the project promoters, these projects have been considered in the assessment.



GRIDLINK INTERCONNECTOR

CUMULATIVE EFFECTS
Additional Projects Cumulative Effects Assessment

Drawing No: P2172-CUMU-001 | **A**

Legend

- KP
- GridLink Preferred Cable Route
- Application Corridor
- 12nm Territorial Sea Limit
- EEZ Boundary
- Fishing Study Area

Restricted/Prohibited Areas

- Temporary Disruption
- Prohibited for Bottom Trawling
- Restricted Access
- Future/Continous Applications

N W E S

NOTE: Not to be used for Navigation

Date	14 October 2020
Coordinate System	WGS 1984 UTM Zone 31N
Projection	Transverse Mercator
Datum	WGS 1984
Data Source	OGA; TCE; MMO; KEIFCA; MCA; KIS-ORCA; UKHO; MarineRegions; ESRI; GEBCO; GridLink
File Reference	J:\Gridlink\P2172_Mxd\16_CUMU\ P2172-CUMU-001.mxd
Created By	Chris Dawe
Reviewed By	Emma Storey
Approved By	Anna Farley

GRIDLINK INTERCONNECTOR

intertek

0 5 10 15 20 km

14.4.2.6 Step 3: Map based assessment of the cumulative effects in the study area

Using the information provided in Figure 14-1 (Drawing P2172-CUMU-001) an assessment has been made as to whether the Proposed Development could have a PCE with other projects and plans in the study area. A discussion for each pressure identified in Step 1 is presented below.

Displacement of commercial fisheries and shipping

During the installation, operation and decommissioning phases of the Proposed Development, fishing and other vessels will be requested to stay at least 500m radius away from project vessels and equipment. This will temporarily displace fishing activity from traditional grounds, displace shipping vessels from the area surrounding the project vessel spread and disrupt right of passage. The zone of influence will move as activity progresses along the Preferred Cable Route. Ahead of the installation, fishermen will be asked to move their static fishing gear out of the Application Area; this could take place up to three days ahead of the project vessels arriving in a specific section to ensure the Preferred Cable Route is clear for installation to progress unheeded. The zone of influence is spatially defined as the width of the Application Corridor.

In addition to these restrictions around the Proposed Development, it is likely that there will be other projects, plans and licensed activities in the study area with similar restrictions around their activities. As it was unfeasible to provide an individual assessment for all the projects identified during step 2, it was decided to adopt a map-based approach to the assessment of the cumulative effects in the study area. Hereby, the cumulative effect of temporary displacement and disruption was quantified in terms of area reduction and compared to the total area available for fishing in the study area.

Figure 14-1 (Drawing P2172-CUMU-001) shows the study area, with on the left panel existing projects including dredging and disposal sites, oil and gas infrastructure, cables, renewable energy, and on the right panel future licensed activities. The main data sources for the information included in Figure 14-1 (Drawing P2172-CUMU-001) are the oil and gas data access centre (OGA downloaded 2020) and the MMO Marine Licenses and Applications Layer (MMO download 2020). The limitation of this data set is that many projects such as cables, oil and gas infrastructure and rock protection are represented as point or line features, rather than polygons for which an area can be calculated. Hence, the area calculated underestimates the potential area reduction. On the other hand, due to the relatively short duration of the installation phase of the Proposed Development, it is unlikely that there will be temporal overlap with all the projects that were mapped in the study area. Therefore, it is assumed that this will still give a good indication of the extent of area reduction in the study area.

The total study area spans over 5,318.8 km^2 and includes 415.0 km^2 (7.8%) of areas defined by Intertek as 'Restricted Access' areas where fishing and/or free movement of vessels may be restricted e.g. due to the presence of a windfarm or marine aggregate extraction. Additionally, there are areas where the use of certain gear types are restricted e.g. Prohibited for Bottom Trawling and the Medway Bass Nursery Area. This leaves an area of 4,777.1 km^2 (89.8% of the Total Study Area) where fishing is not usually restricted. Table 14-3 provides the calculations of the areas subject to restrictions on fishing.

Table 14-3 Restricted Fishing Areas

Classification	Area km^2
Total Study Area	5,318.8
Restricted Access	415.0
Prohibited for Bottom Trawling	113.6
Medway Bass Nursery Area	13.1
MMO Marine Licenses and Applications Layer*	429.7

*Only polygons could be included in the area. As a lot of the features such as cables, oil and gas infrastructure and rock protection are represented as points or lines; these could not be included in the analysis.

The cumulative reduction of access from all future projects, plans and licensed activities in the study area for which an area could be calculated amounts to 429.7km^2 which equates to an additional 8.1% of the total study area. The restricted area includes an area around the proposed Thanet Extension Offshore Wind project. Although the decision was taken on the 01 June 2020 to refuse development consent (BEIS 2020), the project promoter may re-apply in future. Therefore, this project has been included within the assessment

The Proposed Development will result in a temporary effect over a maximum area of 40km^2 which equates to 0.8% of the Total Study Area. Considering this access reduction cumulative to the reduction from other activities and the restricted fishing areas, 81.0% of the study area remains available for fishing and navigation. It is recognised that not all of this area will be suitable for fishing due to grounds conditions or navigation due to shallow water depths, but the potential for significant cumulative effects is still very small given the temporary nature of the displacement associated with the Proposed Development and the total sea area available.

The above map-based assessment could not include the NeuConnect Interconnector as charted information on the proposed route is not currently publicly available. However, the NeuConnect Interconnector will originate from the Isle of Grain and follow a route to the north of the existing BritNed Interconnector, whilst the Proposed Development emerges from the Medway Estuary and then lies to the south of the BritNed Interconnector at a typical separation distance of 300 m. Therefore, the Proposed Development is expected to always be located a minimum of 500 m away from Neuconnect, and most likely in excess of 1 km, with BritNed in between. The parallel alignment is expected between approximately KP11 and KP30. Construction of NeuConnect is anticipated to start in 2021 with 2023 as the target completion date. It is therefore feasible that the Proposed Development and NeuConnect installation works will overlap temporally which could result in cumulative effects on the displacement of shipping, particularly with cable installation vessels requiring other vessels to remain at least 500m away due to limited mobility while undertaking operations. Any overlap of the Proposed Development and the NeuConnect marine works will be for a short period of time (maximum a few weeks) and spatially separated, therefore the cumulative effect on displacement of shipping has been assessed as **Minor** and **Not Significant**.

The overall potential cumulative effect of the Proposed Development with all the other plans and projects in the study area on commercial fisheries and shipping has been assessed as **Not significant**.

Snagging resulting from obstruction on the seabed / physical change (to another seabed type)
These two pressures have been grouped together for the assessment as the effects are similar i.e. they prevent commercial fisheries from using established areas to fish.

With respect to the pressures, although the residual effects from the Proposed Development were assessed as Not Significant it is recognised that other projects in the region such as offshore windfarms, marine aggregate extraction and other cable projects (power and telecoms) can also disturbed the seabed causing snagging hazards or deposit protection material on the seabed changing the seabed type and creating snagging hazards. If it is assumed that the seabed has been or will be disturbed within the areas defined as 'Restricted Access' in Table 14-3 or where future projects are planned, approximately 844.7km^2 of the seabed within the study area may have snagging hazards within it. This is equivalent to 16% of the study area. This will be an over-estimate as typically licensed activity areas cover a wider footprint than required for intrusive seabed works e.g. to allow manoeuvring of project vessels, and the area of seabed disturbed is likely to be significantly less. In addition, not all these areas will have been suitable for fishing gear that is sensitive to changes to the seabed terrain. For example, large areas of the study area are used for the deployment of static gear which will not be affected by a change in seabed, whereas bottom drift netting will be affected.

There are a number of cable projects planned in the region, namely; NeuConnect interconnector, BT Joss telecoms cable and Thanet Offshore Windfarm Extension export cables (Thanet Extension).

Except for Thanet Extension, there is limited publicly available information on the other projects. NeuConnect will run parallel to the Proposed Development but north of the existing BritNed Interconnector between approximately KP11 and KP30. This section of the Proposed Development is targeted by pots, general demersal, beam and shrimp trawlers, and bottom drift netting. Where the BT Joss telecoms cable and Thanet Extension cables cross the Proposed Development, the area is currently used for pots and general demersal and beam trawling. Of these fisheries the most sensitive will be bottom drift netting.

Although there is the potential for cumulative effects on bottom drift netting with other projects in the region, particularly the NeuConnect interconnector, the Project Specific Mitigation for the Proposed Development will reduce the magnitude of effects. The risk that fishing vessels will be exposed to snagging hazards will be mitigated by, for example, PS17 through to PS19 which are concerned with the provision of guard vessels to protect fishing from any cable exposed on the seabed. PS14 through to PS16 target the risks associated with cutting out-of-service cables and propose measures to reduce snagging hazards because of this activity, whilst PS21 through to PS24 monitors the success of the project in achieving the commitment to reduce snagging hazards through bottom drift net surveys and trawl surveys at key locations across the cable route. These will establish that the cable route was suitable for the identified fishery prior to installation work starting and confirm at the end of cable installation that the seabed has been returned to a fit state to allow the fishery to continue in future.

Therefore, the potential cumulative effect on commercial fisheries has been assessed as **Not significant**.

Reduction in water depth (impeding safe navigation)

Several other projects have reduced the water depth through the deposit of external cable protection in the study area. Of note is the London Array windfarm export cables/BritNed Interconnector crossing where navigational markings have been deployed due to the shallow water depths now present at the side of a shipping channel. The Proposed Development includes two locations where external cable protection will or may be required which may result in limits or restrictions to shipping (including commercial fishing vessels). These locations are outside of the main shipping channels in areas of lower shipping density relative to other areas in the region and therefore should not lead to cumulative effects on shipping and commercial fisheries. The potential cumulative effect has been assessed as **Not significant**.

Temporary habitat disturbance

The HRA process and MCZ assessment has not identified any in-combination effects between the Proposed Development and other projects relevant to this pressure. In addition, effects on habitats outside of protected sites from the Proposed Development will be not significant (Chapter 7) and effects on fisheries as a result of temporary habitat disturbance will also be not significant (Chapter 12).

If it is assumed that the seabed has been or will be disturbed within the areas defined as 'Restricted Access' in Table 14-3 or where future projects are planned, such that approximately 844.7km^2 of the seabed within the study area may have been disturbed. This is equivalent to 15.88% of the study area. This will be an over-estimate as typically licensed activity areas cover a wider footprint than required for intrusive seabed works e.g. to allow manoeuvring of project vessels, and the area of seabed disturbed is likely to be significantly less. In comparison, the installation footprint of the Proposed Development will be 2.11km^2. Cumulatively this will increase the area disturbed by projects in the study area to 846.81km^2; equivalent to 15.92% of the study area (an increase of 0.04%). This is a negligible change that is unlikely to result in large-scale changes in distribution, type of target species or stock recruitment either in the short-term or longer-term. The potential cumulative effect has been assessed as **Not significant**.

Changes in suspended sediment (water clarity)

Other projects alongside the Proposed Development have the potential to cause cumulative changes in suspended sediment that could affect commercial shellfish beds. Of particular concern are the Maplin Sands cockle beds. The NeuConnect Interconnector will pass closer to the cockle beds than the Proposed Development and, in the event that the installation of the Proposed Development and NeuConnect interconnector coincide, there is the potential for increases in suspended sediment concentrations (SSC's) or, if the respective cable installations are staged, there is the potential that cockle beds will be recovering from an earlier disturbance and the second activity may affect the recovery process.

The effects from the Proposed Development alone will be Not Significant. It is unlikely that cable installation for the Proposed Development along this route section will be at the same time as NeuConnect, and any simultaneous marine operations that may be required can be coordinated to ensure that there is adequate temporal separation to avoid cumulative effects. Therefore, it has been concluded that the sediment plumes from the two installation campaigns will not be simultaneous and it is not a pathway for the two projects to combine to result in a significant effect.

Considering the temporary nature of any increased SSC's, the potential cumulative effect on commercial fisheries is **Not Significant**.

Underwater noise changes

When considering the pressures that have the potential to cause likely significant effects due to underwater noise, in-combination effects will be restricted to those plans and projects which include undertaking activities that produce significant noise (such as piling and UXO detonation).

Projects already constructed, e.g. Nemo Link, or that are unlikely to be undertaking activities that generate significant underwater noise have been discounted. Operational wind farms have been discounted on the basis that activities within operations and maintenance licences do not include piling. Two potential projects have been identified that require further consideration: Thanet Extension Offshore Windfarm and NeuConnect Interconnector.

While the Secretary of State refused development consent for Thanet Extension Offshore Windfarm on 01 June 2020, the project promoter may re-apply again in future. Therefore, this project has been included within the assessment. Annex 6-3: Underwater Noise Assessment of the Thanet Extension Environmental Statement (Vattenfall Ltd 2018) concluded that effects from monopile installation could have temporary effects to fish at worst case of 9.9km away depending on the fish species affected. Therefore, the effect ranges of the Proposed Development and Thanet Extension Offshore Windfarm will overlap in the event UXO detonation and piling coincide.

The NeuConnect Interconnector the installation schedule is assumed to be 2021 through to 2023. The requirement for UXO detonation is currently unknown, however based on the location and requirements for UXO detonation for other projects in the area, this activity may be required in the route section where NeuConnect is parallel to the Proposed Development (KP11 to KP30).

When considering the potential for in-combination effects, it is likely that the construction schedules of Thanet Extension Offshore Windfarm and NeuConnect will not overlap with cable installation in the relevant section of the Proposed Development. In addition, it is unlikely that, in the event of an overlap, the noisy activities from each project will be scheduled at the same time. However, taking a precautionary approach, it is assumed that there is the potential for a cumulative effect with one other project. If UXO detonation or piling from either project were to fall on the same day as UXO detonation occurs associated with the Proposed Development, then it cannot be ruled out that cumulative effects will not occur. Project Specific Mitigation (PS46) mitigates this risk through liaison with the MMO to inform of any UXO clearance, confirm if any projects in the region will be undertaking piling or UXO detonation at the same time and confirm if UXO detonation needs to be coordinated with other developers to reduce potential cumulative effects. Considering this mitigation, it is highly

unlikely that cumulative underwater noise changes will affect the viability of commercial fisheries. The potential cumulative effect has been assessed as **Not significant**.

14.5 Part 3 – Transboundary Effects

The Convention on Environmental Impact Assessment in a Transboundary Context 1991 sets out the obligations of parties to assess the transboundary environmental effect of certain activities at an early stage of planning. It also lays down the general obligations of States to notify and consult each other on all major projects under consideration that are likely to have a significant adverse environmental effect across boundaries.

GridLink crosses two maritime jurisdictions (UK and France). An environmental assessment has been conducted for each jurisdiction, as well as for the UK and French onshore components. The subsea cable within French territorial waters and the associated onshore infrastructure is subject to the separate consenting regime of France.

Transboundary effects will be limited to suspended sediment dispersion from cable installation and underwater noise related to the detonation of UXO.

The only country potentially affected by transboundary effects is France. With respect to suspended sediment dispersion, the scale and consequences of transboundary environmental impacts due to the Proposed Development will be less than those in UK waters and are considered to be not significant.

The Marine HRA assessed the potential for transboundary effects from UXO detonation on the Bancs des Flandres SAC. It concluded that with implementation of the proposed Project Specific Mitigation, including the restriction to not undertake UXO detonation in French and UK waters on the same day, means that there will be no significant effects on marine mammals and specifically harbour porpoise, a Primary Feature of the SAC.

In conclusion, there will be **No Significant transboundary effects** from the Proposed Development on French waters.

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15. SCHEDULE OF MITIGATION

This Chapter presents the Embedded Mitigation and Project Specific Mitigation to be incorporated into the design, installation, operation (including repair and maintenance) and decommissioning of the Proposed Development. These measures have been transposed from Chapter 3 and Chapters 5 to 14.

The Schedule of Mitigation will form the basis of an Environmental Management Plan (EMP) to be prepared and implemented for construction and operations. The EMP will be supported by additional documents and plans to elaborate on specific mitigation measures and/or define the means of implementing such measures.

Table 15-1 Embedded Mitigation

ID	Embedded mitigation measure	Project Phase			Subject	Phase
		I	O	D		
EM1	Intertidal zone of the Medway Estuary at the Kingsnorth shore crossing shall be crossed by horizontal directional drilling (HDD) to avoid disturbance to the surface sediments and habitats. HDD must exit beyond the mean low water springs mark to avoid the Medway Estuary and Marshes SPA and Medway Estuary and Marshes SSSI.	■			Protected ecological features	Cable installation
EM2	HDD drilling activities shall be conducted in a manner to minimise risk of bentonite breakout from the HDD entry or exit pits	■			Protected ecological features	Cable installation
EM3	Submarine cables will be bundled together.	■			Protected ecological features / Fisheries	Cable installation
EM4	Deployment of anchors/anchor chains on the seabed will be kept to a minimum in order to reduce disturbance to seabed and will be within the Proposed Development.	■	■	■	Protected ecological features / Fisheries / Navigation	Pre-lay survey / Pre-lay route preparation / Cable installation
EM5	Cable burial and protection design as detailed in the Burial Assessment Study, final crossing designs and planned and remedial final external protection designs shall be within the maximum design parameters detailed in the GridLink Marine Licence Application or robust justification for the deviations provided.	■			Protected ecological features / Fisheries / Navigation	Cable installation
EM6	Cables shall be installed in sand wave troughs wherever practicable, or after pre-sweeping if required, to minimise the risk or exposure by seabed mobility	■			Protected ecological features / Fisheries	Cable installation
EM7	External cable protection (rock and/or mattresses) shall only be deployed where it is demonstrated that adequate burial depth cannot be achieved; the footprint of any external protection shall be the minimum required to ensure adequate cable protection and stability	■			Protected ecological features / Fisheries / Navigation	Cable installation
EM8	External cable protection (excluding crossing locations) shall not reduce chart datum by more than 5%, unless agreed with the MCA and appropriate navigation authorities. If external cable protection at any location including crossings does impact on navigable depth, such locations shall be marked in accordance with Trinity House requirements and suitably marked on navigation charts	■	■		Fisheries / Navigation	Cable installation
EM9	Cable protection heights and widths shall be minimised, taking into account the requirements to maintain the structural integrity of the berms.	■			Protected ecological features	Design

ID	Embedded mitigation measure	Project Phase			Subject	Phase
		I	O	D		
					/ Fisheries / Navigation	
EM10	Cable protection shall be designed to minimise snagging hazards, for example by minimising height above seabed, smooth and shallower profiles, grade used for rock placement, type of rock (e.g. smoother edges).				Fisheries	Cable installation
EM11	In-service third party asset crossings shall not be carried out in buoyed navigable areas with water depths <10m				Navigation	Cable installation
EM12	London Array crossing design shall not exceed 1.76m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).				Fisheries / Navigation	Design
EM13	London Array crossing design shall comprise one continuous cable protection across all four cables (rather than four individual cable crossings) to minimise eddy currents causing scour at end of berms				Fisheries / Navigation	Design
EM14	London Array crossing design shall ensure vertical separation between the cables is preserved against long term settlement whilst minimising total berm height.				Fisheries / Navigation	Design
EM15	Thanet Windfarm North crossing design shall not exceed 2.11m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).				Fisheries / Navigation	Design
EM16	Thanet Windfarm South crossing design shall not exceed 2.11m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).				Fisheries / Navigation	Design
EM17	NEMO Interconnector crossing design shall not exceed 1.96m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).				Fisheries / Navigation	Design
EM18	Cable protection used in NEMO Link crossing design shall minimise footprint on seabed due to presence of Goodwin Sand MCZ Sabellaria reef in area				Protected ecological features	Design
EM19	PEC crossing design shall not exceed 2.11m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).				Fisheries / Navigation	Design
EM20	Atlantic Crossing - Seg B1 crossing design shall not exceed 2.01m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).				Fisheries / Navigation	Design
EM21	Tangerine crossing design shall not exceed 2.11m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).				Fisheries / Navigation	Design
EM22	BT North Sea JOSS crossing design shall not exceed 2.21m high (to comply with maximum design criteria assessed by Navigation Risk Assessment in GridLink Marine Licence Application).				Fisheries / Navigation	Design
EM23	Cutting of out-of-service cables shall be carried out in accordance with ICPC recommendation 1				Fisheries	Cable installation

ID	Embedded mitigation measure	Project Phase			Subject	Phase
		I	O	D		
EM24	Out-of-service cables shall be cut in a manner to avoid spragging/fraying of cable ends or other snagging hazards to fishing nets				Fisheries	Cable installation
EM25	Cut cable end locations and clump weights shall be accurately recorded and charted and positions passed to the FLO at the earliest opportunity.				Fisheries	Cable installation
EM26	Cable installation works shall not encroach on any recognised anchorage that is charted or noted in nautical publications unless agreed with the appropriate Port Authority.				Navigation	Cable installation
EM27	All material disturbed by the Pre-Lay Grapnel Run (PLGR) shall be recovered (unless there is a valid reason why an item cannot be safely recovered)				Fisheries	Pre-lay route preparation
EM28	The size of the Pre-Lay Grapnel shall be optimised for the expected duty and seabed obstacles to be cleared; over-sized PLG shall not be used				Fisheries	Pre-lay route preparation
EM29	Effective channels of communication shall be established and maintained between GridLink and commercial fishing interests. This will include the continued appointment of an onshore Fisheries Liaison Officer (FLO) and if necessary, offshore FLOs. Offshore FLOs should have experience of the Thames Estuary, east Dover Straits and Falls Bank area.				Fisheries	Pre-lay survey / Pre-lay route preparation / Cable installation
EM30	Notices shall be given to other sea users in the area of operations via Notice to Mariners, Kingfisher Bulletins, NAVTEX, and NAVAREA warnings; particular attention shall be paid to ensuring the following organisations receive the notifications: Peel Ports, Port of London Authority (PLA), Thamesport, MCA, Royal Yachting Association (RYA), Vattenfall, London Array, Estuary Services Ltd (Pilots), Trinity House, ROFF, Thanet Fishermen's Association, Whitstable Fishermen's Association, Swale Fishermen Ltd, Harwich Harbour Fishermen's Association, Thames Estuary Fishermen's Association and Leigh Trawlermen Cooperative and individual local fishermen as identified by the FLO.				Fisheries / Navigation	Pre-lay survey / Pre-lay route preparation / Cable installation
EM31	FLO shall be included on distribution list for all daily reports from Project vessels.				Fisheries	Pre-lay survey / Pre-lay route preparation / Cable installation
EM32	Vessels shall take all reasonable efforts to ensure they do not anchor where there is significant navigational traffic or in shipping lanes when waiting on weather. If it is required, the vessels will notify and coordinate with relevant authority.				Navigation	Pre-lay survey / Pre-lay route preparation / Cable installation
EM33	All vessels shall have passage planning procedures, holding positions (e.g. if waiting on weather), traffic monitoring (e.g. radar, AIS and visual), means of communication with third party vessels and emergency response plans in the event a third party vessel approaches on a collision course				Navigation	Pre-lay survey / Pre-lay route preparation / Cable installation
EM34	All vessels (exceeding 20m) shall not exceed 14 knots during operations within the Proposed Development to protect marine mammals from ship strikes.				Marine mammals	Pre-lay survey / Pre-lay route preparation / Cable installation

ID	Embedded mitigation measure	Project Phase			Subject	Phase
		I	O	D		
EM35	Project vessels will comply with the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs) (as amended) Marking and UK Standard Marking Schedule for Offshore Installations Marking, particularly with respect to the display of lights, shapes and signals.				Navigation	Pre-lay survey / Pre-lay route preparation / Cable installation
EM36	Project vessels will be equipped with waste disposal facilities (sewage treatment or waste storage) to IMO MARPOL Annex IV Prevention of Pollution from Ships standards.				Protected ecological features / Fisheries	Pre-lay survey / Pre-lay route preparation / Cable installation
EM37	Ship Oil Pollution Emergency Plans (SOPEPs) shall be provided by Contractor and implemented covering all vessels in accordance with MARPOL Annex I requirements				Protected ecological features / Fisheries	Pre-lay survey / Pre-lay route preparation / Cable installation
EM38	Ballast water discharges from all vessels shall be managed under the International Convention for the Control and Management of Ships' Ballast Water and Sediments standard				Protected ecological features / Fisheries	Pre-lay survey / Pre-lay route preparation / Cable installation
EM39	Hazardous chemicals and materials shall be managed in accordance with applicable standards and guidelines, including maintenance of an inventory of such substances that are used and/or stored, provision of Material Safety Data Sheets (MSDSs), preparation of Chemical Risk Assessments and storage in designated, secure facilities with suitable spill protection and control				Protected ecological features / Fisheries	Pre-lay survey / Pre-lay route preparation / Cable installation
EM40	Biosecurity Plan (BSP) shall be prepared and implemented covering all marine operations, taking into account applicable guidance from the GB non-native species secretariat (2015)				Protected ecological features / Fisheries	Pre-lay survey / Pre-lay route preparation / Cable installation
EM41	Environmental Management Plan (EMP) shall be prepared and implemented covering all marine operations				Protected ecological features	Pre-lay survey / Pre-lay route preparation / Cable installation
EM42	Emergency Spill Response Plan (ESRP) shall be prepared and implemented covering all marine operations				Protected ecological features / Fisheries	Pre-lay survey / Pre-lay route preparation / Cable installation
EM43	Sub-bottom profiling and multi-beam and echo-sounder surveys shall comply with the JNCC guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys (JNCC 2017) (or subsequent amendments)				Marine mammals	Pre-lay survey
EM44	A UXO survey will be undertaken within the UXO Survey Corridor to identify anomalies. If any significant UXO is identified, the decision-making hierarchy taking into account environmental sensitivities, safety and technical considerations shall be: 1. Avoid by micro-routeing 2. If the UXO cannot be avoided, undertake clearance to surface or move UXO outside the cable installation corridor 3. If the UXO cannot be safely moved, clearance by on-site deflagration.				Marine mammals / Fisheries	Pre-lay survey

ID	Embedded mitigation measure	Project Phase			Subject	Phase
		I	O	D		
EM45	UXO clearance shall comply with the JNCC guidelines for minimising the risk of injury to marine mammals from using explosives (JNCC 2010, or as updated), including: a) Establishment of a default 1km mitigation zone for marine mammal observation, measured from the explosive source and with a circular coverage of 360 degrees b) Provision of two trained marine mammal observers (MMO) to implement the JNCC guidelines c) Provision of a Passive Acoustic Monitoring (PAM) to be operated by a suitably trained and experienced MMO to support visual observations. d) Commencement of explosive detonations only during daylight hours and good visibility e) Accurate determination of the amount of explosive required for the operation, so that the amount is proportionate to the activity and not excessive. f) If necessary, planning of a sequence of multiple explosive discharges so that, wherever possible, the smaller charges are detonated first to maximise the 'soft-start' effect. g) if the UXO identified is greater than 10kg then a soft-start procedure shall be used whereby charges of 50g, 100g, 150g, and 200g will be deployed at 5 minute intervals with a further 5 minute interval before the detonation of the UXO.	■	■		Marine mammals	Pre-lay survey
EM46	The GridLink Marine Mammal Mitigation Plan will be implemented for all marine operations and UXO deflagrations.	■	■	■	Marine mammals	Pre-lay survey / Pre-lay route preparation / Cable installation
EM47	GridLink Written Scheme of Investigation (WSI) and a Protocol for Archaeological Discoveries (PAD) shall be implemented during all marine operations.	■	■	■	Marine archaeology	Pre-lay survey / Pre-lay route preparation / Cable installation
EM48	Information related to the as built cable will be provided to navigation and fishing stakeholders as required.		■		Navigation / Fisheries	Post-lay survey
EM49	As-built co-ordinates of the cable route shall be recorded and submitted to the UK Hydrographic Office (UKHO) via a H102 hydrographic note and KIS-ORCA Service; 'as-built' cables shall be marked on Admiralty Charts and fisherman's awareness charts (paper and electronic format)		■		Navigation / Fisheries	Post-lay survey
EM50	Electro-magnetic fields generated by the cable system shall not cause greater than a three degrees deviation on ships' compasses for 95% of the cable route; for the remaining 5% of the cable route, a maximum of five degrees deviation must be attained unless approved by the MCA		■		Navigation / Fisheries	Design
EM51	Post-installation compass deviation surveys shall be carried out where the cables are not bundled together due to the shore crossing (KP0.0 and KP1.0) or other reason and water depths are <10m; the results of any compass deviation shall be provided to UKHO and MCA		■		Navigation / Fisheries	Post-lay survey
EM52	Post-installation inspection surveys shall be carried out every two years (the survey frequency may be reduced only when the depth of burial and seabed restoration has been sufficiently validated).		■		Navigation / Fisheries	Post-lay survey

ID	Embedded mitigation measure	Project Phase			Subject	Phase
		I	O	D		
EM53	Any post-lay cable exposure for whatsoever reason shall be published in the Kingfisher Information System, Notified to Fishermen and guarded until remedial works are completed		■		Fisheries	Post-lay survey
EM54	Vessels are advised in the Mariners Handbook not to anchor within 0.25nm (500m) of cables	■	■		Navigation	Cable installation
EM55	Coordination of timings will be sought from the ports during marine operations to reduce disruption on existing shipping	■	■	■	Navigation	Pre-lay survey / Pre-lay route preparation / Cable installation

I = Installation; O = Operation (including repair and maintenance); D = Decommissioning

Table 15-2 Project Specific Mitigation

ID	Project Specific mitigation	Project Phase			Subject	Phase (detailed)
		I	O	D		
PS1	London Array crossing design shall incorporate fronded mats either as individual gravity secured mats or as attached to tapered concrete mattresses in conjunction with cable protection to facilitate sediment capture and reduce scour. The objective shall be to cover the external cable protection with sand to minimise fishing disruption to bottom drift netting and trawling and return the seabed to a sand habitat within the Margate and Longsands SAC.	■			Ecological protected features / Scour / Fisheries	Design
PS2	Subject to agreement with asset owner and thermal calculations consideration shall be given to reducing the crossing angle (from 90 degrees) for the London Array crossing to orientate the crossing with the tidal flow and direction to minimise risk of scour.	■			Ecological protected features / Scour	Design
PS3	The London Array crossing design shall encourage natural resedimentation of the crossing.	■			Ecological protected features / Scour	Cable installation
PS4	The cable burial and protection strategy shall adhere to the following two principles, in order of priority: 1. Achieving Target DOL along the route so External Protection is not required and in particular no use of External Protection in MCZs and SACs 2. Minimise any displacement of seabed which may not recover naturally within 2-3 years of installation (or else include methods to restore or aid the restoration of the seabed where viable).	■			Protected ecological features	Cable installation
PS5	The GridLink Submarine Cable Bundle shall be installed along the Marine Installation Route Position. Contractor shall avoid deviation from this Route. If deviation is required, the GridLink Submarine Cable Bundle shall remain inside the Asset Placement Corridor and robust justification for the deviation provided to Gridlink for approval. The Route shall not enter areas within the Asset Placement Corridor identified as "Areas of constraint for Asset Placement" unless robust justification is provided to GridLink as to why there is no alternative.	■			Protected ecological features / navigation	Cable installation
PS6	All planned anchor placements must be in the Consent Corridor. Contract shall avoid planned anchor placement in 'Areas of Constraint for Anchor Placement'. If planned anchor placement is required in any one of these areas robust justification shall be provided to GridLink as to why there is no alternative.	■	■	■	Protected ecological features / Navigation	Cable installation
PS7	Position of planned anchor placements shall be surveyed. Data shall by analysed by both a marine ecological specialist and a marine archaeologist for presence of sensitive habitats and archaeological features respectively. Positions of planned anchor placements shall be adjusted if Sabellaria reef or marine heritage assets are identified at the location.	■	■	■	Protected ecological features	Cable installation
PS8	A review of the Environmental Habitat Assessment shall be undertaken by acquiring detailed seabed imagery using side scan sonar and multi-beam echo sounder back scatter analysis combined with drop down camera video acquisition along ten 250m transects located between KP82 to KP92. Along the transects photographs shall be taken every 5 to 10m and / or at areas of interest, with accompanying video recorded.	■			Protected ecological features	Pre-lay survey

ID	Project Specific mitigation	Project Phase			Subject	Phase (detailed)
		I	O	D		
	The Environmental Habitat Survey shall be undertaken no greater than 2 years prior to scheduled installation date to ensure baseline data collected remains valid in any future assessment of impact of the cable installation on Annex 1 biogenic reef. The results of the survey shall be used to micro-route the cable to: a) Avoid Sabellaria reef structures wherever practicable b) If avoidance is not possible (e.g. due to extent of reef), minimise the crossing distance across the reef structure c) If different grades of reef are present, select a cable route through the lowest grade reef.					
PS9	No HDD works to be undertaken in the Medway Estuary between 01 October and 31 April (to avoid effects on overwintering birds).				Birds	Cable installation
PS10	If required, UXO deflagration will be undertaken between 01 April and 31 September (to avoid effects on harbour porpoise).				Marine mammals	Pre-lay route preparation
PS11	Lofitech AS seal scarer acoustic deterrent device (ADD) or similar will be used prior to UXO deflagration in accordance with the GridLink Marine Mammal Mitigation Plan for all UXO deflagrations.				Marine mammals	Pre-lay route preparation
PS12	The GridLink Fisheries Coexistence Plan (FCP) shall be implemented throughout all marine operations.				Fisheries	Pre-lay survey / Pre-lay route preparation / Cable installation
PS13	Cable cut and recovery shall comprise a minimum cut section of 100m (50m either side of centreline). Where cable cuts are within drift netting areas (defined as KP15 to KP20, KP35.5 to KP36.5, KP38 to KP51.8, KP55 to KP59, KP64.5 to KP69, and KP94 to KP95) the following principle shall be respected: Proven drift lines across the cable route shall not be impeded by seabed disturbance caused by the cable cut and recovery e.g. seabed should be returned to original state. If necessary, and in consultation with the FLO, the cutting location shall be extended as far as reasonably practicable within the Application Corridor, and cut ends located to minimise snagging hazards to the drift nets.				Fisheries	Pre-lay route preparation
PS14	'Flat' clump weights shall be used with cut cables - chain weights are not permitted.				Fisheries	Cable installation
PS15	Where cable cuts are within bottom drift net areas (defined as KP15 to KP20, KP35.5 to KP36.5, KP38 to KP51.8, KP55 to KP59, KP64.5 to KP69, and KP94 to KP95) clump weights used for cut cable ends shall be buried.				Fisheries	Cable installation
PS16	Guard vessels shall be deployed where the cable installation vessel is using anchors (indicatively between KP0 and KP55), and in any areas where there is significant navigational traffic to warn shipping, recreational and fishing vessels of the presence of the cable installation spread				Fisheries / Navigation	Cable installation
PS17	Guard vessels shall be deployed wherever the cable is insufficiently protected (e.g. between cable lay and burial, where required DOL has not been achieved) to warn shipping and fishing vessels of the potential temporary snagging hazard				Fisheries / Navigation	Cable installation

ID	Project Specific mitigation	Project Phase			Subject	Phase (detailed)
		I	O	D		
	(subject to safe weather conditions). Guard vessels will be required until the cable is sufficiently protected as agreed by GridLink.					
PS18	Guard vessels shall be designed to an appropriate specification for the specified duty, expected weather conditions and other operating requirements, and the captain(s) and crew(s) shall have suitable and sufficient local knowledge and experience of the cable route. Preference should be given to securing guard vessels from the NFFO and the local fishing fleet.				Fisheries / Navigation	Cable installation
PS19	Marine operations shall be planned and organised so as to minimise disruption to commercial fishing during the peak fishing season between April and October as far as reasonably practicable.				Fisheries	Pre-lay survey / Pre-lay route preparation / Cable installation
PS20	A trawl survey shall be carried out between KP10 to KP70 to determine any material changes to the seabed as a result of cable installation activities that affects trawl fishing; the objective of the surveys is to determine if trawl fishing that is able to clear the seabed prior to any intrusive works is able to continue post-cable installation. To prioritise fishing access and minimise disruption, post-installation trawl surveys will be undertaken at the earliest opportunity, with the cable route being sectionalised if necessary, i.e. to allow access to certain sections ahead of others. GridLink will seek to have all surveys complete within one year of commissioning.				Fisheries	Pre-lay survey
PS21	Up to 50 bottom drift net surveys shall be carried out between KP15 to KP20, KP35.5 to KP36.5, KP38 to KP51.8, KP55 to KP59, KP64.5 to KP69 and KP94 to KP95 to determine any material changes to the seabed as a result of cable installation activities that affects bottom drift net fishing; the objective of the surveys is to determine if bottom drift nets that are able to clear the seabed prior to any intrusive works are able to continue post-cable installation. To prioritise fishing access and minimise disruption, post-installation bottom drift net surveys will be undertaken at the earliest opportunity, with the cable route being sectionalised if necessary, i.e. to allow access to certain sections ahead of others. GridLink will seek to have all surveys complete within one year of commissioning.				Fisheries	Pre-lay survey
PS22	Bottom drift net surveys shall be carried out by the local fishing vessel that has established during the data gathering exercise in 2020 that they bottom drift over the cable route. A Client Representative (observer) will be onboard the vessel for the duration of the bottom drift to record the position of deployment and position of recovery and any locations at which the bottom drift snagged. The objective of the survey is to demonstrate pre- and post-cable burial that the ground can be bottom drift netted; catch details are not required and will not be recorded during the survey.				Fisheries	Pre-lay survey
PS23	Should trawl or bottom drift net surveys identified post-installation that a material change to the seabed has occurred, the snag source will be inspected and in consultation with the FLO the seabed will be returned to a condition suitable for trawl or bottom drift netting.				Fisheries	Cable installation
PS24	Marine operations shall be avoided or at the least minimised as far as reasonably practicable within route sections KP15 - KP30 and KP45 - KP60 during June to October (exact timing to align with Cockle fishery opening dates as announced by KEIFCA for specific year) to minimise the disruption to commercial cockle fishing activities.				Fisheries	Pre-lay survey / Pre-lay route

ID	Project Specific mitigation	Project Phase			Subject	Phase (detailed)
		I	O	D		
						preparation / Cable installation
PS25	Mass flow excavation shall be prohibited in route sections KP15 to KP30 and KP45 to KP60 during the period June to October (exact timing to align with Cockle fishery opening dates as announced by KEIFCA for specific year).				Fisheries	Cable installation
PS26	Cable lay operations shall minimise sediment suspension in the water column or smothering of the seabed between KP0 to KP30 and KP45 to KP60 by selection of the cable installation and burial methods, vessels and tools and incorporation of appropriate mitigation measures into marine operations				Fisheries	Cable installation
PS27	Between KP0-30 and KP45-60, sediment plumes generated by cable installation shall be monitored either by a vessel that is independent of the cable-lay spread or using sensors mounted on a frame on the seabed. Water quality (specifically heavy metal concentrations) and suspended sediment concentrations will be measured. Monitoring will be undertaken prior to installation to provide a baseline against which measured values can be compared; will continue throughout installation and through to a period (to be defined) post-installation to demonstrate a return to pre-installation conditions. The monitoring plan, selection of the vessel and monitoring protocols shall be coordinated with KEIFCA. Should any sediment plumes from cable installation be identified as causing a risk of non-compliance with the marine environmental assessment, the cable-lay vessel shall be informed and marine operations, cable installation and/or burial methods shall be reviewed and additional measures identified to reduce the sediment plume. Details of the cause of the sediment plume and additional mitigation measures shall be notified to KEIFCA.				Fisheries	Cable installation
PS28	The locations of any UXO requiring clearance by deflagration shall be notified with the FLO to determine any fisheries sensitivities and whether consideration should be given to moving the deflagration point to avoid seabed disturbance that could permanently affect fishing activity.				Fisheries	Pre-lay route preparation
PS29	The clearance of any UXO by deflagration between KP15 to KP30 and KP45 to KP60 shall be notified to the FLO, TEFA and KEIFCA, and consideration shall be given to moving the UXO to a safe location away from cockle beds prior to deflagration.				Fisheries	Pre-lay route preparation
PS30	Time delay between sequential cable installation operations, e.g. cable-lay and post-lay burial, shall be minimised to a short as reasonably practicable.				Fisheries / Navigation	Cable installation
PS31	Preferred location of any cable joint shall be between KP50 to KP51 or KP53 to KP55.5 (rev3 - GridLink preferred cable route), and/or be located so as to minimise adverse effects on navigation during cable jointing works				Navigation	Design
PS32	If temporary removal of a Trinity House buoy is required, this shall be communicated and arrange between GridLink and Trinity House in plenty of time.				Navigation	Pre-lay survey / Pre-lay route preparation / Cable installation

ID	Project Specific mitigation	Project Phase			Subject	Phase (detailed)
		I	O	D		
PS33	Prior to works commencing GridLink shall arrange a meeting with Peel Ports and PLA to provide anchor patterns and a briefing of the works to be undertake in Harbour Authority Waters; confirm timescales; confirm lines of communication; and understand what activity will be undertaken during the period.				Navigation	Pre-lay survey / Pre-lay route preparation / Cable installation
PS34	GridLink will apply for a Peel Ports River Works Licence, and a Port of London Authority River Works Licence for all installation / construction, repair and maintenance activities undertaken within the relevant Harbour Authority Waters.				Navigation	Pre-lay survey / Pre-lay route preparation / Cable installation
PS35	Written notice of commencement of any works to be carried out in Harbour Authority Waters will be provided to Peel Ports and Port of London Authority (PLA) a minimum of two weeks prior to works (e.g. survey, installation, repair or maintenance).				Navigation	Pre-lay survey / Pre-lay route preparation / Cable installation
PS36	During activity within the Harbour Authority Waters, or within close proximity, daily briefings shall be provided to Peel Ports and PLA that will cover: name of vessel(s) involved and exact location of works for the day.				Navigation	Pre-lay survey / Pre-lay route preparation / Cable installation
PS37	Daily communication with the PLA and relevant working pilot vessel captains shall be established during all marine operations for the duration of the works.				Navigation	Pre-lay survey / Pre-lay route preparation / Cable installation
PS38	An up to date route position list of the survey corridor and route centre line shall be provided to PLA during the relevant marine operations.				Navigation	Pre-lay survey / Pre-lay route preparation / Cable installation
PS39	Marine archaeological exclusion zones (as detailed in GridLink Environmental Report and GridLink WSI), and any subsequent zones demarked following the implementation of the PAD shall be adhered to during all marine operations.				Marine archaeology	Pre-lay survey / Pre-lay route preparation / Cable installation
PS40	The GridLink cable route currently encroaches on 18 proposed AEZs. Each anomaly shall be visually inspected (using ROV or diver study) to determine if the anomaly is archaeological sensitive. Following the results of the visual inspection and discussion with the marine archaeologist the AEZ may be refined or removed and a decision on the cable route shall be made.				Marine archaeology	Pre-lay survey / Pre-lay route preparation / Cable installation

ID	Project Specific mitigation	Project Phase			Subject	Phase (detailed)
		I	O	D		
PS41	On completion of final planned and remedial external protection designs GridLink shall confirm with the MCA (in agreement with Trinity House) whether any aids of navigation such as marker buoys may be required where external protection has been installed.				Navigation	Cable installation
PS42	Prior to works commencing GridLink shall arrange a meeting with yacht clubs in the area including Lower Halstow Yacht Club and the Medway and Swale Estuary Boating Association to provide anchor patterns and a briefing of the works to be undertake in Harbour Authority Waters; confirm timescales; confirm lines of communication; and understand what activity will be undertaken during the period.				Navigation	Pre-lay survey / Pre-lay route preparation / Cable installation
PS43	Intrusive seabed works shall be minimised in the Downs Atlantic Spawning Ground (KP87.5 to KP114) between November and December and if feasible intrusive seabed works shall be avoided in January				Fish	Pre-lay route preparation / Cable installation
PS44	Deflagration will be used on all UXO charge sizes				Marine mammals	Pre-lay route preparation
PS45	With respect to UXO deflagration, GridLink will ensure that UXO deflagration for the project in UK and French sectors will not occur on the same day and will liaise with the MMO to: 1. Inform the MMO of potential UXO clearance requirements and proposed schedule. 2. Confirm with the MMO if any projects in the region will be undertaking piling or UXO detonation/deflagration that overlaps with the proposed schedule. 3. Confirm if UXO deflagration should be coordinated with other developers in the region to reduce potential cumulative effects within the SAC				Marine mammals	Pre-lay route preparation
PS46	GridLink will provide a Technical Note to all fishing vessels in the region (distributed by the FLO) that outlines all the positions and dimensions of the following: ▪ Location of cable cut ends and associated clump weights ▪ Final installed position of cables ▪ Final positions (including dimensions) of crossings ▪ Final position of any remedial external cable protection (including dimensions). The Technical Note will be accompanied by an A3 double sided laminated chart showing the cable route and associated information that can be kept onboard a vessel. The laminated chart will also include contact details for the FLO and GridLink.				Fisheries	Cable installation
PS47	Coordination with the Channel Navigation Service and Dover Coastguard Operations centre to provide 24-hour radio and radar coastal vessel traffic information which helps vessels navigate safely to help prevent collisions at sea.				Navigation	Cable installation
PS48	Within Goodwin Sands MCZ an environmental monitoring plan will be established to monitor colonisation of the external cable protection. Video transects will be run along the external cable protection to record species present, abundance and extent. The objectives of the monitoring will be to establish an evidence base to inform future development within the Goodwin Sands MCZ. Monitoring will be aligned with the condition surveys scheduled for every two years. The monitoring will be undertaken for the first two condition surveys (to cover four-year period in total).				Ecological protected features	Cable installation

ID	Project Specific mitigation	Project Phase			Subject	Phase (detailed)
		I	O	D		
PS49	Environmental monitoring at London Array crossing - The condition surveys will establish (if possible) the depth of sediment cover over the crossing. If the depth of cover is enough to allow sampling, sediment samples will be taken and analysed for particle size. If sufficient sample sizes can be obtained to allow infauna characterisation this will also be undertaken. Data will be reviewed by a benthic specialist and a report compiled and issued to the Marine Management Organisation and Natural England. The environmental monitoring will be undertaken with the first two condition surveys; anticipated for years 2 and 4 post-commissioning.				Ecological protected features	Operation
PS50	Prior to commencement of licensable activities, the Applicant will submit a Technical Note to Marine Management Organisation confirming exact locations for pre-sweeping using a dredger and defining a spoil disposal site. The disposal site shall meet the following conditions: a. Be located within the European site b. Be located on a similar sediment composition as the excavated sediment c. Be within the Application Corridor d. Be outside of the KEIFCA Pan Sands Hole Byelaw Area If a suitable disposal site cannot be identified within the Application Corridor, an external disposal site such as North Edinburgh Channel will be secured. Preference will be given to disposal sites within the Margate and Long Sands SAC. The technical note will confirm that the proposed method and disposal will not have a significant effect on the European site.				Ecological protected features	Design

16. CONCLUSIONS

This Marine Environmental Report presents a comprehensive assessment of the potential effects of the installation, operation (including maintenance and repair) and decommissioning of the Proposed Development and sets out embedded mitigation and proposes project specific mitigation to avoid or reduce significant effects to an acceptable level.

The embedded mitigation and project specific mitigation, as set out in a Schedule of Mitigation in Chapter 15, will form the basis of an Environmental Management Plan to be implemented during the installation and operation of the interconnector.

Following the environmental assessment of the residual effects on the physical, biological and human environments, the following can be concluded:

- Intrusive works on the intertidal mudflats at Kingsnorth have the potential to cause significant effects on estuarine processes and protected bird species. The Applicant is proposing to employ a trenchless technique (horizontal directional drilling) whereby the sensitive intertidal area, part of the Medway Estuary and Marshes Special Protection Area (SPA), Ramsar and Site of Special Scientific Interest (SSSI) and Medway Estuary Marine Conservation Zone (MCZ) is avoided. This will ensure that there are **no significant effects** on estuarine processes or bird species.
- The main effects associated with the Proposed Development are anticipated to be localised, temporary disturbance to the seabed during installation. The cables will be buried in the seabed between 1.7m and 3.5m in depth; depth of lowering depends on the sediment conditions and external risks at specific locations. For all subtidal habitats (benthic communities) and fish species, this will result in effects which are **Not Significant**. In addition, there will be **no significant effects** on the Kent and Essex inshore Fisheries and Conservation Authority (KEIFCA) Pan Sand Hole Byelaw Area. Without prejudice to this conclusion, Project Specific Mitigation has been proposed as best practice to minimise displacement of the seabed and intrusive works in sensitive areas; avoid deviation from the GridLink Preferred Cable Route; avoid anchor placement is sensitive habitats; and minimise the use of external cable protection.
- The deposit of external cable protection for the crossing of the London Array Offshore Windfarm Export cables has the potential to result in significant effects on the seabed sediments of the Margate and Long Sands Special Area of Conservation (SAC) and commercial fisheries. As the sandy sediments present are a sub-feature of the Primary Feature of the SAC they are highly sensitive to a change in sediment type. In addition, the deposit of cable protection could lead to scour and snagging of fishing gear. The presence of cable protection has the potential to hinder certain fishing gear types e.g. trawling, requiring vessels to make permanent changes to established fishing areas. Project Specific Mitigation has been proposed, the objective of which is to reduce scour and encourage sediment to build up on the crossing post-installation, with the aim to return the seabed back to its sandy sediment. It has been proposed to incorporate frond mats into the crossing design to provide a long-term sustainable solution to encourage re-sedimentation. It is anticipated that once sediment builds up on the mats and crossing it will return the sediment feature of the SAC and still be a suitable substrate for bottom drift netting. Although there may be short-term effects on the SAC and commercial fishery, implementation of the project specific mitigation will ensure there will be **no significant residual effects.** Post installation monitoring will also be undertaken to validate the effectiveness of the mitigation proposed.
- The Proposed Development crosses seven European Sites and three MCZs; it has therefore been subject to the Habitats Regulations Assessment process and MCZ Assessment process which concluded:
    - With respect to the deposit of external cable protection in the Margate and Long Sands SAC there is the potential for an adverse effect on the conservation objectives for the Primary

Feature ''Sandbanks which are slightly covered by sea water all the time' and Appropriate Assessment is required. Therefore, Project Specific Mitigation has been proposed with the objective of encouraging sediment build up over the external cable protection to return the seabed to a sand habitat. Evidence has been provided to demonstrate that the project specific mitigation proposed will be an effective long-term solution in mitigating adverse effects. Post installation monitoring will also be undertaken to validate the effectiveness of the mitigation. With implementation of the proposed mitigation, the Proposed Development **will not have an adverse effect on the integrity of the Margate and Long Sands SAC** either alone or in combination with other plans or projects.

- For pre-sweeping in the Margate and Long Sands SAC there is the potential for an adverse effect on the conservation objectives for the Primary Feature ''Sandbanks which are slightly covered by sea water all the time' and Appropriate Assessment is required. The Information to Inform AA concluded that pre-sweeping **will not have an adverse effect on the integrity of the Margate and Long Sands SAC** either alone or in combination with other plans or projects.
- With respect to the high order detonation of unexploded ordnance (UXO) in the Southern North Sea SAC, there is the potential for an adverse effect on the conservation objectives for the Primary Feature harbour porpoise and Appropriate Assessment is required. A similar conclusion was reached for the potential for transboundary effects of the Primary Features harbour porpoise, grey seal and common seal of the Bancs des Flandres SAC (France). This assessment also applies more widely to all marine mammals within the Proposed Development which are European Protected Species. It cannot be ruled out that the Proposed Development will not have significant in-combination effects or significant transboundary effects with other projects in the Southern North Sea SAC and Bancs des Flandres SAC given the potential for other noisy activities (piling for new windfarms and UXO detonation for windfarms and new subsea cables). Project Specific Mitigation has been proposed to reduce the significance of effects by avoiding the requirement for detonation; reducing the size of the charge used by using low order detonation (deflagration); and ensuring animals are not near to any detonation. This includes a seasonal restriction when harbour porpoise are expected to be most abundant in the area. In addition, UXO detonation will not be carried out in UK and French waters on the same day and liaison will be implemented with the MMO and other developers to manage any conflicting schedules for windfarm piling or UXO detonation at any other simultaneous projects. With implementation of the proposed mitigation, the Proposed Development **will not have an adverse effect on the integrity of the Southern North Sea SAC or Bancs des Flandres SAC** either alone or in combination with other plans or projects.
- The Habitats Regulation Assessment (HRA) process concluded that for all other European sites that the Proposed Development crosses or is in proximity to there will be **no likely significant effects** and Appropriate Assessment is not required.
- The Stage 1 MCZ Assessment has concluded that for the MCZs that the Proposed Development crosses (Medway Estuary MCZ, Goodwin Sands MCZ, and Foreland MCZ) and two adjacent sites (Swale Estuary MCZ and Thanet Coast MCZ) the conditions of Section 126 of the Marine and Coastal Access Act 2009 can be met. There is **no significant risk that the Proposed Development either alone or in combination with other plans or projects will hinder the achievement of the conservation objectives** stated for the MCZs; and the MMO can exercise its functions to further the conservation objectives for the MCZs.

- Where burial in the seabed is prevented e.g. at third-party asset crossings or where ground conditions may prevent burial to the required target depth, external cable protection will be required. The Navigation Risk Assessment (NRA) concluded that there is the potential for localised significant effects on navigation from the deposit of external cable protection. For all crossings with existing in-service cables the under-keel clearance indicates safe navigation. However, two

locations have been identified where a reduction in water depth could limit or restrict navigation; the planned BT North Sea Joss crossing and an area in shallow water where ground conditions may prevent cable burial. To minimise the risk to shipping due to the water depth changes, the Maritime and Coastguard Agency will be consulted regarding the final designs for rock berms to determine requirements for aids to navigation i.e. marker buoys. Although there may be minor localised residual effects, overall there will be **no significant residual effects** on shipping and navigation.

- The presence of the cable installation vessels will cause temporary disturbance to fishing, recreation and shipping in the vicinity of the Proposed Development. Disruption will be limited to discrete sections of the Proposed Development, progressing along the Proposed Development during installation (and decommissioning) or confined to the location of the maintenance or repair activity. A communications protocol will be established with Peel Ports and Port of London Authorities, Trinity House and sailing clubs in the area to ensure disruption is minimised. Guard vessels will be used where the installation spread has restricted manoeuvrability and is near shipping channels e.g. between KP0 and KP55, and if the cable is exposed on the seabed between lay and burial / protection operations. As a result, **no significant residual or cumulative effects** are expected.
- The potential effects on commercial fisheries will be **Not Significant,** including effects on the cockle fishery from suspended sediments. However, a change in water depth at selected locations associated with the deposit of cable protection which could result in a localised significant residual effect. Without prejudice to the conclusion of no significant effects, an extensive series of Project Specific Mitigation has been developed in consultation with the local fishing industry. The objectives are to remove snagging hazards and provide assurance that fishing activities can be safely continued after cable installation; reduce the footprint of the cable protection material as far as possible; ensure lines of communication with fishing organisations are clearly outlined and understood by all parties; if feasible, avoid marine operations during peak fishing seasons, thereby minimising disruption to the fishing industry; minimise suspended sediment concentrations and provide assurance through monitoring that the cockle beds will not be significantly affected; and provide assurance that key shellfish grounds will not be affected by high order UXO detonation (if required). The Project Specific Mitigation includes monitoring the success of the mitigation by undertaking bottom drift net surveys and trawl surveys at key locations along the cable route. These will establish that the cable route was suitable for the identified fishery prior to installation work starting and confirm at the end of cable installation that the seabed has been returned to a fit state to allow the fishery to continue in the future.
- Archaeological exclusion zones will be established around potentially significant archaeological assets. A Written Scheme of Investigation (WSI) and Protocol for Archaeological Discoveries (PAD) will be implemented throughout all phases of the Proposed Development. Therefore, there will be **no significant residual effects** on marine archaeology.
- During operation, the cables will generate low electromagnetic fields that will emanate up to a maximum of 10m from the cables (depending on burial depth) before diminishing to natural background levels. There will be **no significant effects** on biological receptors (e.g. benthic communities, fish, marine mammals) and the fields will not interfere with navigation systems for commercial shipping or recreational boating.
- The Cumulative Effects Assessment concluded that with respect to high order UXO detonation there is the potential for significant intra-project, cumulative and transboundary effects on marine mammals from the sudden, brief and significant underwater noise changes. However, with the implementation of Project Specific Mitigation, including the commitment to use low order detonation (deflagration) on all charge sizes, in relation to the Southern North Sea SAC and Bancs des Flandres SAC, the effects can be managed and **no significant residual intra-project, cumulative**

and transboundary effects are expected. All other potential intra-project, cumulative and transboundary effects have been assessed as **Not Significant**.

- Any effects from decommissioning activities (cable removal) will be broadly similar to those during cable installation. The appropriate method of cable decommissioning will be determined prior to the end of the interconnector's design life. This will consider hazards presented by leaving cables in-situ and potential constraints if removed entirely. The effects of removal are predicted to be minor and temporary in nature, and not greater than the effects associated with installation which are considered to be not significant.