XLINKS MOROCCO-UK POWER PROJECT

Preliminary Environmental Information Report

Volume 3, Appendix 7.1: Stage 1 Geoarchaeological Review of Marine Geotechnical Investigation

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1.1 Introduction

1.1.1 This document forms Appendix 7.1 - Stage 1 Geoarchaeological Review of Marine Geotechnical Investigation of the Preliminary Environmental Information Report (PEIR) prepared for the UK elements of the Xlinks Morocco-UK Power Project (referred to hereafter as 'the Proposed Development'). The PEIR presents the preliminary findings of the Environmental Impact Assessment (EIA) process for the Proposed Development.

1.1.2 The details of the Proposed Development are included in Volume 1, Chapter 3 of this PEIR: Project Description. The Offshore Cable Corridor extends from landfall at Cornborough Range on the north Devon coast to the limit of the UK Exclusive Economic Zone (EEZ) approximately 370 km offshore (e.g. Volume 1, Figure 1.1 of this PEIR) and encompasses the modern coastline and inshore area in Barnstable Bay, the offshore marine zone and submarine continental shelf further out.

1.1.3 The UK coastal and marine zones contain a legacy of historic assets including a range of fragile and irreplaceable archaeological remains and structures as well as landscapes and sediments that have evidential value for reconstructing local and regional environmental change.

1.1.4 This desk-based geoarchaeological review of geotechnical information forms the first stage (Stage 1 log review; c.f. **Table 1-2**) of investigation and aims to establish the likely presence of and broadly characterise horizons of geoarchaeological interest and evaluate their potential. This document provides the geoarchaeological review of geotechnical logs acquired in 2023-2024, specifically Cone Penetration Tests (CPT) and Vibrocore (VC) geotechnical logs collected along the Offshore Cable Corridor; locations presented on **Figure 1a** and **Figure 1b** (within Annex A of this report).

1.1.5 The report is restricted to the analysis of geotechnical data only and is intended to be read alongside the Desk-Based Assessment (see baseline discussions within Volume 3, Chapter 7 of this PEIR: Marine Archaeology and Cultural Heritage). This report is not intended as mitigation against specific potential archaeological impact and is one of a suite of technical studies that will inform the final ES assessments in respect of Marine Archaeology and Cultural Heritage.

Geology, Topography and Geoarchaeology

1.1.6 This section provides a summary of the time periods and landscape evolution relevant to archaeological periods. It forms the background and context to the Geoarchaeological review of Geotechnical Investigation (GI) and supports the interpretation of formation processes and archaeological potential. A baseline of terrestrial archaeological data has not been collated for the onshore and near offshore areas at this stage.

1.1.7 The Offshore Cable Corridor runs into Barnstable Bay where the rivers Taw and Torridge exit via their estuaries on the coast. These rivers are meandering in form, and infilled and flanked by tidal flats in the inner estuary (clay, silt and sand). Onshore, tidal flats meet marine sands and gravels at the mouth of the estuary (The Crumbles) at Zulu Bank and Saunton Sands and alluvium is mapped inland behind the tidal flats, following the Taw from Instow to Fremington. These river valleys and their deposits would have extended out across the continental shelf, their lower reaches drowned by rising sea levels.

1.1.8 Timeframes and the associated deposits mapped by the BGS are divided into hard or bedrock geology relating to pre-Quaternary timeframes and the superficial geology (Quaternary) associated with archaeological periods.

Bedrock Geology

1.1.9 The bedrock formed before humans evolved and is mapped by the BGS offshore GeoIndex (BGS 2024; **Figure 2, Annex A**). Although of no archaeological potential, bedrock is the parent material of subsequently deposited soils and sediment. Sedimentary mudstones, shales, slates, and sandstones (Devonian and Carboniferous) (Primary formations) are prevalent both onshore and extend offshore, ranging from approximately 50 km to over 100 km from the coastline.

1.1.10 Triassic Mudstones and halite-stone (Secondary formations) are relatively limited on the near-shore, with discrete observations occurring around 20-30 km from Hartland Point.

1.1.11 Chalk (upper Cretaceous), Limestone (Eocene), Mudstone/Siltstone (Miocene) and siliciclastic, argillaceous and sandstones (Palaeogene) (Tertiary formations) border the Primary formations offshore.

1.1.12 The Proposed Development is expected to traverse six main geological sections (c.f. **Figure 1a, Figure 1b, and Figure 2 Annex A**):

1.1.13 From CPT(VC) 32 to CPT(VC) 44 and CPT(VC) 46, CPT(VC) 53 and VC 56, the solid geology is anticipated to be Devonian and Carboniferous, comprising Limestone (Eocene) and Mudstone/Siltstone (Miocene);

- CPT(VC) 45 and CPT(VC) 51, Triassic Mudstones and halite-stone;
- From CPT(VC) 22 and CPT(VC) 31, the solid geology is expected to primarily consist of Palaeogene Rocks comprising Mudstone/Siltstone (Miocene) and siliciclastic, argillaceous and sandstones (Palaeogene);
- CPT(VC) 06 and CPT(VC) 21 the solid geology is expected to primarily consist of Chalk formations;
- CPT(VC) 05 and CPT(VC) 03 the solid geology is expected to primarily consist of Limestone (Eocene); and
- CPT(VC) 02 and CPT(VC) 01 the solid geology is expected to primarily consist of Mudstone/Siltstone (Miocene).

1.1.14 Superficial geology was deposited during the last 2.6 million years (Mya) of the Earth's history, the Quaternary, the period in which humans evolved. The Quaternary is characterised by a series of alternating cold-warm oscillations (glacial-interglacial cycles). These climatic phases are categorised into 'Marine Isotope Stages' (MIS), derived from palaeoclimate proxies (such as foraminifera) from deep sea core samples. Even-numbered MIS stages denote cold (glacial) periods and odd numbers represent warm (interglacial) stages.

1.1.15 The Quaternary is subdivided into the Pleistocene (c. 2.6 million to approximately 12 thousand years ago / ka) and the Holocene (12 ka to the present, MIS1) (**Table 1-1)**.

1.1.16 The Pleistocene is largely characterised by long glacial stages (c. 80-120 thousand years) when sea levels were low due to global water being locked up in polar ice, and modern submerged areas exposed. Glacial stages are punctuated by warm interglacials (c. 10-20 thousand years) when sea levels were high, approximating the present day. Temperate phases when the climate improved, but less significantly, are identified as 'interstadials' and short, cold snaps 'stadials'. For example, a climatic deterioration around 18 ka during the last deglaciation (Devensian deglaciation) is labelled the Dimlington stadial. The BRITICE Glacial map and Geographic Information System (GIS) database shows glacial landforms related to the last British-Irish Ice Sheet and indicates that the Devensian ice margin (23 ka) was 60-170 km north and north-west of the Offshore Cable Corridor. However, within St George's Channel and the Celtic Sea, the Devensian ice mass may have extended to the Isles of Scilly (BRITICE Glacial Mapping Project: UoS 2017; Tyrrell et al. 2004). Sediments within these parts of the Offshore Cable Corridor may lie on subglacial, englacial and supraglacial deposits. The North Devon coast was not glaciated under any Pleistocene glaciation (Buscombe & Scott 2008), and unglaciated shallow shelves such as in Barnstable Bay were exposed by low sea levels, and large tracts of the Celtic Sea were subaerial (Ransley and Sturt 2013). Shelf exposure would have been enhanced by the glacial forebulge of the Devensian ice sheet (**Figure 3**), which further raised the continental crust.

1.1.17 Holocene marine sediment dominates the area, primarily comprising sand, sandy gravel, and gravelly sand. According to the BGS marine sands and gravels are typically found as extensive sheets with a thickness of less than 5 m, overlying a relatively smooth bedrock surface. Sandbanks and ridges may be identified where deposits thicken. Localised areas of marine muddy sands are mapped by the BGS on the south of Barnstable Bay. While the Taw and Torridge estuaries are likely to extend offshore, organic and fine-grained silts and clays are not mapped by the BGS.

Table 1-1: Late Quaternary Chronology and UK Archaeological Periods

	Marine Isotope Stage (MIS)	Approximate date (thousands of years ago)	Epoch	Stage name				British archaeological period	Climate	
Late Quaternary	1	0.5	Holocene		Late		Historic	post medieval	warm	Interglacial
		1						Medieval		
		2						Roman		
		3					Prehistoric	Iron Age		
		4			Mid			Bronze Age		
		6						Neolithic		
		12			Early			Mesolithic		
	2	13	Late Pleistocene	Devensian	Late	Devensian 'Lateglacial'	Loch Lomond stadial	Upper Palaeolithic	cold	Glacial (last cold stage)
		14					Windemere interstadial		warmer	
		20					Dimlington stadial (late glacial maximum)		cold	
	3	58			Middle		Upton Warren interstadial	Middle Palaeolithic	warmer	
	4	75			Early				cold	
	5a	79					Brimpton interstadial		warmer	
	5b	96							cold	
	5c	103					Chelford interstadial		warmer	
	5d	115							cold	
	5e	125		Ipswichian					warm	Interglacial
	6	190	Late Middle Pleistocene	Wolstonian Complex					cold	glacial
	7	220		Aveley interglacial					warm	interglacial
	8	315		Wolstonian Complex					cold	glacial
	9	325		Purfleet interglacial				Lower Palaeolithic	warm	interglacial
	10	390							cold	glacial
	11	400		Hoxnian					warm	interglacial
	12	475		Anglian					cold	glacial

Sea level and Coastal change

1.1.18 Coastal environments are dynamic, and during the Quaternary sea-level varied significantly with remarkable effect on both the terrestrial landscape and marine zone of the UK's shores. Shorelines dramatically shifted as global sea levels rose and fell and sediment was eroded and transported by waves, currents, rivers, ice, gravity and wind.

1.1.19 During interglacials, such as the present Holocene warm stage, sea levels were high. Calm, low-energy conditions predominated, and organic-rich and fine-grained sediment (silts and clays) were deposited in sheltered coastal locations, estuaries and across floodplains forming marsh environments. With the onset of glacial stages, the climate cooled and ice gradually built up in Polar regions, lowering global sea-level and exposing previously submerged land around the coast. Areas that are now offshore would have been dry land, exposed to the elements and available for human exploitation. Sand was deposited on beaches and gravels in higher-energy coastal zones (by aeolian and littoral processes). Sediment reworking by wave action is typical in shallow and near-shore marine environments, while in more stable and protected coastal locations and in deeper marine environments fine-grained sediments accumulated. At the height of the Devensian (the last glacial stage) sea levels were around 120 m lower than the present day (Peltier et al. 2002), and possibly as low as 135 m below (Bouysse et al. 1976).

1.1.20 There are many reconstructions of sea-level change and offshore palaeogeography at different scales and for different UK regions (e.g. Jelgersma 1979; Lambeck 1995a; Coles 1998; Shennan et al 2000; Milne et al 2002; Peltier et al. 2002). Broadly, the observed pattern from the peak of the Devensian Lateglacial through the Holocene shows rapid sea-level rise to the Neolithic (c. 6ka) followed by stabilisation and then continued rise at a slower rate through later prehistory and the historic periods. The weight of the Devensian ice sheet depressed the underlying land and as the ice melted, the rebound of the landmass countered the effect of sea-level rise. Neolithic sea-level stabilisation may be in part attributed to this effect. As many local factors come into play, sea-level is described in relative terms (Relative Sea Level, RSL).

1.1.21 A sea-level reconstruction for the south Devon coast (Gehrels and Anderson, 2014) indicates that at the beginning of the Holocene (Mesolithic, c. 12 to 6 ka) RSL was approximately -18 m below present, consistent with the onshore river base levels during the same period. By the Neolithic period (c 6 ka to 4.5 ka) RSL had risen to between approximately -8.5 to -5m. Sea level rise continued through the Bronze and Iron Ages (c. -5 to -1 m) and into the Roman period (-0.5m). Over the last 4000 years RSL has been fairly stable with a marginal rate of rise through the medieval and medieval periods (to approximately -0.8 m to -1.5 m) (**Table 1-1**).

1.1.22 Rapid RSL rise in the Mesolithic was a major event, drowning the dryland coastal embayment near-shore and re-establishing a fully marine connection between the North Sea and the English Channel (Tyrrell et al 2004). As RSL rose further through the Neolithic and Bronze Age, soils and fine-grained sediment (clay, silt and organics) accumulated in sheltered coastal settings and estuaries and, as rivers backed up, created marsh environments inland from the coast.

Geoarchaeological Potential

1.1.23 Rivers and coastal zones are resource-rich, and therefore foci for prehistoric human activity. Exposures of habitable shelves were probably at their greatest just before and after glacial maxima, when sea levels were low and shelves ice-free. As described above, this part of the coast was never beneath an ice sheet, and, where shallow, the continental shelf would have formed a large tract of dry land (Paragraph 1.1.16).

1.1.24 Holocene tidal and alluvial deposits (particularly clays and peats) can be good preserving environments for organic archaeological remains, structures (such as wooden trackways, fish traps and jetties) and palaeoenvironmental remains or 'ecofacts' can survive due to waterlogging for long periods. Ecofacts such as pollen and diatoms have evidential value for reconstructing local and regional environmental and landscape change, in combination with geoarchaeological assessment of the sediments. The geoarchaeological potential of alluvial sediment can broadly be considered as follows:

- Minerogenic alluvium – silts, clays and occasionally sands have potential for preservation of snails, diatoms (microscopic algae) and ostracods (bivalve crustacea); and
- Organic alluvium - organic silt, organic clay, peat, and peaty soils can preserve pollen, seeds and plant fragments. Organics (terrestrial plant macrofossils) can also be dated by radiocarbon techniques that can support the establishment of a chronology for the depositional sequence. Peat is a good indicator of a former environment where conditions were wet, but sufficiently well-drained for vegetation to grow, and this can therefore also provide an indication of levels of dry-land human activity.

1.1.25 Archaeology can also include Palaeolithic (780ka to 12ka) artefacts such as stone tools and faunal remains including early humans (hominins) contained within the sedimentary record. Such remains are rare, but significant for understanding the early human occupation of Britain.

Aims and Objectives

1.1.26 UK maritime heritage has provided a research focus since the early 20th century and has global relevance. Research questions for maritime archaeology can broadly be divided into the two related categories of the environment (changing coasts, sea level and landscape) and people (maritime settlement, exploitation, seafaring and networks) (Ransley and Sturt 2013).

1.1.27 The primary objectives of this geoarchaeological assessment of geotechnical logs are as follows:

- Assess the geotechnical logs to identify deposits of geoarchaeological potential, assigning high, medium and low-priority status;
- Interpret the depositional environments represented;
- Cross-reference with other data (if available) to aid determining the extents of any identified deposits;
- Identify any deposits suitable for palaeoenvironmental assessment;
- Determine the importance of the deposits, with regard to their archaeological and palaeoenvironmental potential;

- Report the results as part of the ongoing environmental assessment for the proposed scheme; and
- Make recommendations for the next stage of investigation with reference to key research questions and regional/national period-specific and maritime research agendas.

1.1.28 As the project progresses, and with an understanding of geoarchaeological potential, aims can be refined to adapt to research themes and those in the more detailed regional frameworks and generated since the 1990s by the Rapid Coastal Zone Assessments (RCZA) (Historic England 2013) to enhance the knowledge of the coastal historic environment and Historic Landscape and Seascape Characterisations (HLSC).

1.2 Geoarchaeological Review Framework

Introduction

1.2.1 A five-stage approach sets out the levels of investigation appropriate to the data obtained, accompanied by formal reporting of the results at the level achieved. This approach is considered to constitute best practice for characterising geoarchaeological potential, determining the need for further investigation, and describing the receptor of interest. The results of this process will inform an assessment of impacts on the receptor and an appropriate and proportionate mitigation strategy. The stages are summarised below (**Table 1-2**). This report comprises the Stage 1 log review.

Table 1-2: Stages of geoarchaeological assessment and recording (modified from stages developed by Wessex Archaeology)

Stage	Method	Description
1	Review	A desk-based archaeological assessment of any ground investigation (trial pits and boreholes). It aims to establish the likely presence of and broadly characterise deposits of archaeological interest as a basis for deciding whether Stage 2 archaeological recording is required. The Stage 1 report will state the scale of Stage 2 work proposed.
2	Geoarchaeological Recording	Archaeological recording of selected retained or new core samples will be undertaken. This will entail the splitting of the cores, with half of each core being cleaned and recorded. The Stage 2 report will state the results of the archaeological recording and will indicate whether any Stage 3 work is warranted.
3	Sampling and Assessment	Depending upon the results of Stage 2, sub-sampling and palaeoenvironmental assessment (pollen, diatoms and foraminifera) may be required. Subsamples will be taken if required. Assessment will comprise laboratory analysis of the samples to a level sufficient to enable the value of the palaeoenvironmental material surviving within the cores to be identified. Subsamples will also be taken and/or retained at this stage in case scientific dating is required during Stage 4. Some scientific dating (e.g. radiocarbon or Optically Stimulated Luminescence (OSL)) may be undertaken at this stage to provide chronological context. The Stage 3 report will set out the results of each laboratory assessment together with an outline of the archaeological implications of the combined results, and will indicate whether any Stage 4 work is warranted.

4	Analysis and Dating	Full palaeoenvironmental analysis of ecofacts assessed during Stage 3. Typically, Stage 4 will be supported by scientific dating (e.g. radiocarbon or OSL) of suitable subsamples. Stage 4 will result in an account of the successive environments within the coring area, a model of environmental change over time, and an outline of the archaeological implications of the analysis.
5	Final Report	If required Stage 5 will comprise the production of a final report of the results of the previous phases of work for publication in an appropriate journal. This report will be compiled after the final phase of archaeological work, whichever phase that is.

Sources

1.2.2 The data sources consulted for this Stage 1 geoarchaeological review are laid out in Table 1-3.

Table 1-3: Data sources consulted

Source	Data	Comment
British Geological Survey (BGS)	GeoIndex Offshore Drift and solid geology, digital map; online historical geological and geotechnical borehole and trial pit data.	Used to understand the characteristics of the bedrock, soils and substrate of the area of the site, which can provide an indication of suitability for early settlement, and potential depth of remains. These datasets include information on lithostratigraphical units and structural geology of bedrock, seabed sediments, hard substrate distribution, as well as summaries of bedrock lithologies and Quaternary deposits. These datasets offer valuable insights into the offshore geology of the UK, supporting geological studies, resource exploration, and coastal management efforts.
Client	Geotechnical Log data and report	Geotechnical logs acquired during 2023-2024 as part of the UK elements of the Xlinks Morocco-UK Power Project.
BRITICE Glacial Map v2.0	Map and GIS database	Map and GIS database of glacial landforms and features of the last British-Irish Ice Sheet
Internet	Web-published reports and articles	The geomorphological evolution and Quaternary history of South-West England: a rationale for the selection and conservation of sites

Methodology

1.2.3 Cone Penetration Tests (CPT) (44 no.) and Vibrocore (VC) geotechnical logs (44 no.) were obtained from within the Offshore Cable Corridor (GEOxyz 2023); locations presented on **Figure 1a** and **Figure 1b**, Annex A.

Geotechnical drilling/coring and sampling

1.2.4 Geotechnical samples were recovered using CPT and VC techniques, providing a near-continuous record of the deposits within the shallow subsurface. The standard methodology for the Geotechnical drilling/coring strategy for CPT and VC has been outlined below.

1.2.5 Cone Penetration Test (CPT): The standardized CPT involves pushing a 1.41-inch diameter 55^{o} to 60^{o} cone through the underlying ground at a rate of 1 to 2 cm/sec. CPT rigs usually employ 1 m long rods. They can usually penetrate normally consolidated soils and colluvium but have also been employed to characterize weathered Quaternary and Tertiary age strata. Cemented or unweathered horizons, such as sandstone, conglomerate or massive volcanic rock can impede the advancement of the probe.

1.2.6 Vibrocore (VC): This sampling technique is used to collect unconsolidated saturated sediment samples. It involves attaching a core tube to a power head that generates mechanical vibrations, which facilitate penetration into the sediment under the static weight of the vibrocoring apparatus. Unlike other methods like dredging or coring with impact forces, VC relies on vibration-induced particle rearrangement for penetration.

Review of Geotechnical Investigation (GI)

1.2.7 The 44 geotechnical VC and CPT logs were reviewed by a qualified geoarchaeologist at Stage 1. Logs variously include the following sedimentary information:

- Depth
- Texture
- Composition
- Colour
- Inclusions
- Structure (massive or bedded), and
- Contacts or boundaries between deposits

1.2.8 CPT and VC logs are recorded relative to Mean Sea Level (MSL) and vary from up to 5.25m in length (CPT) to up to 5.95m (VC). Sediments are described and classified according to Robertson et al. (1986)'s Soil Behaviour Type (SBT), but an interpretation of depositional processes or stratigraphy is not allocated:

- Clay - organic soil
- Clays: clay to silty clay
- Silt mixtures: clayey silt & silty clay
- Sand mixtures: silty sand to sandy silt

- Sands: clean sands to silty sands
- Dense sand to gravelly sand
- Stiff sand to clayey sand
- Stiff fine-grained

1.2.9 An interpretation of depositional environments, formation processes and geoarchaeological potential was made based on the GI. Of greatest geoarchaeological potential are sediments from former terrestrial environments and features or inclusions of possible archaeological and palaeoenvironmental interest. These may include the following:

- Peat layers and deposits containing organic material such as wood fragments, roots, dark staining and charcoals;
- Clay or silt deposits, especially those containing laminations that may represent lake or tidal environment (such as lacustrine varves or tidal rhythmites);
- Inorganic fossils (such as molluscs);
- Any indication of human activity including artefacts such as flint or pottery (although finding these within core samples is rare); and,
- Any other indications of terrestrial depositional environment (such as sand banks or soil horizons).

1.3 Geoarchaeological Review of Geotechnical Investigation

1.3.1 The Stage 1 review of information on GI, geology, topography and sea-level and coastal change is used to develop an understanding of the palaeolandscape on this part of the coastal zone and Celtic Sea. A basic geoarchaeological classification (GC) was then established, outlining likely depositional processes and geoarchaeological potential (Table 1-4).

1.3.2 Elements of the seabed nearer to the present-day coastline would have been exposed to subaerial conditions during cold stages when sea levels were low, and at its greatest extent prior to and following the peak of the Devensian Lateglacial (**Table 1-1**). As terrestrial environments are of greatest geoarchaeological potential, the near-shore continental shelf (above elevations of c. -18m relative to sea-level) comprises the principal zone of geoarchaeological potential where remnants of now offshore terrestrial sediments could harbour archaeological and palaeoenvironmental remains.

1.3.3 Vibrocores were collected every 10 km along the entire Offshore Cable Corridor (e.g. spacing between VC/CPT 53 and 59; c.f. **Figure 4**) with a further, final near-shore vibrocore at the HDD exit location. Thus, three borehole locations (VC/CPT 53, 59 and 60) were located within the near-shore continental shelf area. Only these boreholes displayed the Holocene stratigraphy described in Table 1-4 (GC1 to GC3). The extent, distribution, character and geoarchaeological potential of the offshore Holocene stratigraphy cannot be characterised across the entire near-shore shelf, on account of the large area, however, the spot data collected from these boreholes nevertheless contributes to the geoarchaeological understanding of the area.

1.3.4 Although the shallower off-shore areas were dry land in the Mesolithic, the palaeo-Taw and Torridge river valleys extended out across the continental shelf and would have attracted humans for fishing, hunting and provided a transport route to the palaeocoastline and sea.

1.3.5 The potential for palaeoenvironmental remains is largely governed by the extent of sediment reworking and organic content. The potential for prehistoric archaeological remains within submerged seabed sediment is influenced by two key factors:

- The deposition of archaeological material within these layers due to human activity (such as occupation sites, temporary camps and butchery sites) and subsequent alteration by natural agents (such as rivers, coastal processes or ice sheets).
- The accumulation and preservation of sediments, both pre- and post-Devensian, within which archaeological material is located, or which influenced the location of or protected sites.

Georchaeological Classification

1.3.6 Within the near-shore cable corridor, 3 no. GI locations were undertaken with production of associated logs i.e. VC/CPT 53, 59 and 60 (**Figure 4, Annex A**). Elevations range from c -10m MSL (VC 60 near-shore) to -30m MSL (VC 53 at the edge of the shelf). Deposit elevations vary according to proximity to shore, but generally show seabed sediment comprising massive sand (c. 1m thick) capping the sequence (GC1) (Table 1-4). This is likely to be a marine sand reworked by currents, tidal and wave action throughout the historic and late prehistoric periods. In non-storm conditions, this sort of erosion, reworking and sediment transport is mainly limited to between the high-water mark and 15 m below low water (Tyrrell et al. 2004). GC1 sediments are mainly sandy and minerogenic and of low geoarchaeological potential due to sediment mixing and the low ecofactual preservation potential of sands.

1.3.7 Beneath these reworked GC1 deposits, clays with chunks of organic material are recorded in VC/CPT 60 (GC2). Given the log elevation, these sediments may date to the Mesolithic or early Neolithic (c. 6ka) as RSL rose 10 m (from -18 m) in the early Holocene. Poor sorting, lack of bedding and chunks of organic material (possibly ripped up from surrounding wetlands) suggest that GC2 could be a storm deposit. There is therefore low potential for GC2 to contain *in-situ* archaeological remains.

1.3.8 Mesolithic tidal flats are represented by laminated clays between c. -17 and -15 MSL (GC3). Depending on the extent of organic content, these sediments have moderate potential to preserve ecofacts for past environmental reconstruction. The potential of GC3 to contain archaeological remains is uncertain, but in rare instances, areas of tidal flats can preserve remains of prehistoric trackways, fish traps and boats.

1.3.9 From GI location 51 westward, sands and gravels are located at depth (up to 65 m below MSL) (GC4). In places, these are overlain by seabed sediment (GC1) and probably represent glacial outwash sands and gravels deposited by the melting Devensian ice sheet (**Figure 3, Annex A**). The Devensian ice mass may have extended to the Isles of Scilly within the St George’s Channel and the Celtic Sea. The channel would have been carved out by ice and infilled by glacial outwash. Environmental and archaeological remains are unlikely to survive in outwash sediments due to the coarse-grained nature and the depositional environment.

1.3.10 The gravel of ‘shale’ seen at the base of some cores is likely to be Devonian and Carboniferous mudstone bedrock (GC5) and of no archaeological potential.

Table 1-4: Deposit sequence - descriptions, interpretation (stratigraphy) and potential

Geoarch classification (GC)	Elevation (m relative to MSL)	Description	Interpretation and date	Geoarchaeological potential (archaeological and ecofactual)	GI (CPT/VC) location where sediment represented
GC1	10.5 to 15	Very dark grey fine silty massive sand with shell material (c. 1m thick)	Sea bed sediment reworked from the Bronze Age to the present day	Low	53, 59, 60
GC2	11 to 11.8	Very dark grey / black firm clay with organics (c. 0.80m thick)	Neolithic storm event with rip up clasts of organic material	Low to Moderate depending on organic content	60
GC3	15.4 to 16.6	Mid-grey brown firm thickly laminated clay with sand, shell and occasional organic clay lenses	Mesolithic or Neolithic tidal flats	Low to Moderate depending on organic content	53, 59
GC4	31 to 62	Fine brown and dark grey calcareous shelly sand, with occasional lenses of silt and lenses and clasts of clay	Devensian glacial outwash and fluvial sands and gravels	Low	01 to 51, 53
GC5	12 to 62	Mainly not encountered in near-shore boreholes. Dark brown medium shale gravel (platy, angular)	Bedrock – Devonian and Carboniferous mudstone	None	51, 59, 60

1.4 Conclusion and Recommendations

1.4.1 The UK coastal zone contains a legacy of historic assets including a range of fragile and irreplaceable archaeological remains and structures as well as landscapes and sediments that have evidential value for reconstructing local and regional environmental change.

1.4.2 The Stage 1 geoarchaeological review of Geotechnical Investigation (GI) develops an initial understanding of the palaeolandscape for Barnstable Bay and the Celtic Sea based on GI sediment descriptions, geology, topography and literature on sea-level and coastal change. A basic geoarchaeological classification (GC) was derived, outlining depositional processes and geoarchaeological potential.

1.4.3 Only nearshore boreholes (VC/CPT 53, 59 and 60) contain Holocene stratigraphy (GC1 to GC3) and it is concluded that the near-shore shelf above elevations of approximately 18 m below sea level is the principal zone of geoarchaeological potential where remnants of now offshore terrestrial sediment could survive. GI locations further from the coast record glacial outwash sands within a likely deeply incised St George's Channel within the Celtic Sea bed.

1.4.4 The potential for archaeological remains is uncertain but probably low, with the possibility of evidence of estuary exploitation (e.g. trackways, fishtraps and boats) within early Holocene tidal flats (GC3). There is uncertain potential for early prehistoric (Palaeolithic or Mesolithic) occupation or utilisation remains under the early Holocene tidal flats (GC3). Information on the bathymetry of the palaeo-Taw and Torridge river valleys would support an understanding of palaeotopography and potential locations of past human activity, as river valleys were attractive for fishing, hunting and providing transport routes.

1.4.5 The potential for ecofacts is low in all boreholes undertaken with the exception of VC53 and 59. Depending on the extent of organic content, these sediments have low or moderate potential to preserve ecofacts for past environmental reconstruction. Stage 2 archaeological recording should be considered to sample for the presence/absence of palaeoenvironmental remains (pollen, diatoms, ostracods and dating). The Stage 1 investigations completed to date, and the results of future targeted stage 2 recording, do and will provide additional data to inform the geoarchaeological understanding of the area, acknowledging that assessment of the extent, distribution, character and geoarchaeological potential of the offshore Holocene stratigraphy is limited by the spot nature of the vibrocore data.

1.4.6 To support future reporting stages, baseline terrestrial archaeological data for the onshore and near-shore areas could be collated, and palaeocoastline and sea-level reconstructions researched through a more extensive literature review.

1.4.7 It is also recommended that a review of marine archaeology research aims (Ransley *et al*., 2013) against sediment type, interpretation and potential should be undertaken to guide the objectives of any further geoarchaeological investigations.

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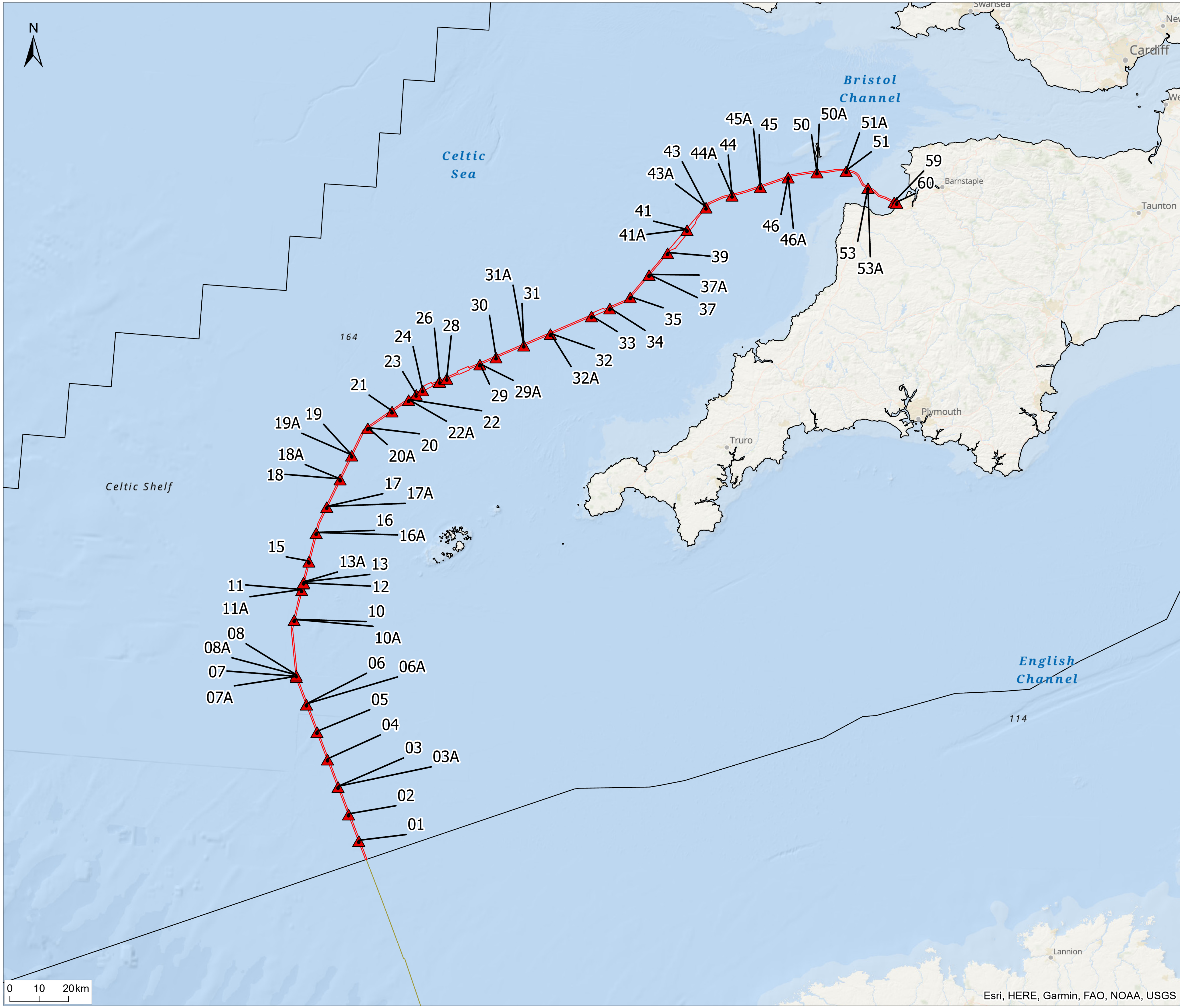
Annex A: Annex Figures

\\Corp\uk\Cloud\UK-GIS01\data\70107275 - XLinks\13_GSS\132_GIS\ArcGIS\ProProjects\PEIR Projects\Cultural Heritage and Marine Archaeology\794-PLN-ESH-00109 - CHMA - Appendix - Site Location Map with Borehole Locations (Cone Penetration Tests).aprx



Notes
1. This plan is scaled at paper size A3. If received electronically it is the recipients responsibility to print to the correct scale. Only written dimensions should be used.

Legend
- XLinks UK Offshore Cable Corridor
- Indicative Cable Centreline
- UK Exclusive Economic Zone (EEZ)
- Core Penetration Test - CPT

Rev	Description	By	CB	Date
P01	First Draft	CE	TM	10/04/24

Client: Xlinks 1 Limited

Project: Xlinks Morocco-UK Power Project

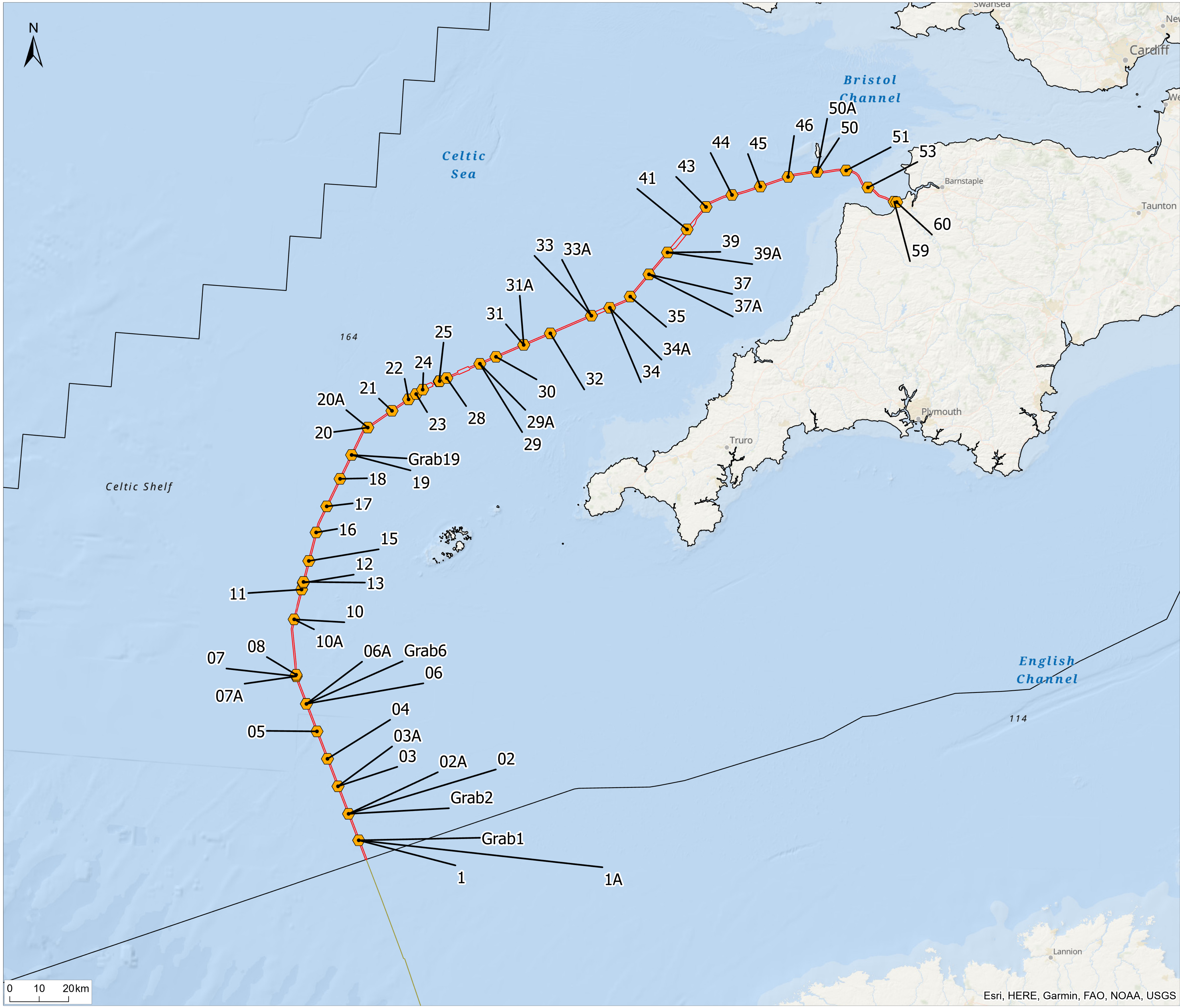
Title: Site Location Map with Borehole Locations (Cone Penetration Tests)

Status	Drawn By	PM/Checked By
DRAFT	CE	TM

Project Number	Scale @ A3	Date Created
794-PLN-ESH-00109	1:1,200,000	Apr 2024

Figure Number: **1a**

Rev: **P01**



Notes

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Legend

- XLinks UK Offshore Cable Corridor
- Indicative Cable Centreline
- UK Exclusive Economic Zone (EEZ)
- Vibrocore - VC

Rev	Description	By	CB	Date
P01	First Draft	CE	TM	10/04/24

Client Xlinks 1 Limited

Project Xlinks Morocco-UK Power Project

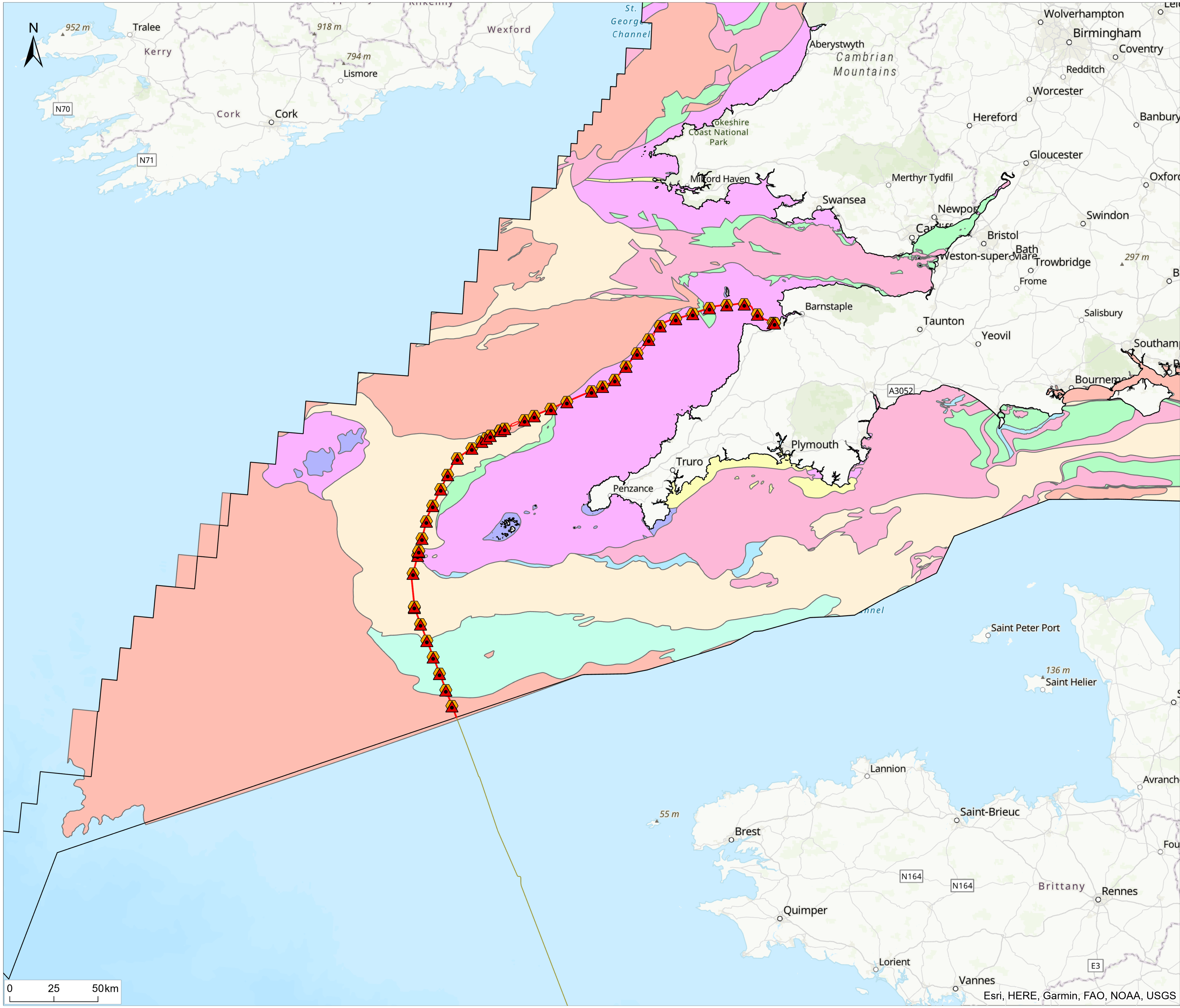
Title Site Location Map with Borehole Locations (Vibrocore)

Status	Drawn By	PM/Checked By
DRAFT	CE	TM

Project Number	Scale @ A3	Date Created
794-PLN-ESH-00110	1:1,200,000	Apr 2024

Figure Number **1b**

Rev **P01**



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Notes
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Legend
- XLinks UK Offshore Cable Corridor
- Indicative Cable Centreline
- UK Exclusive Economic Zone (EEZ)
- Core Penetration Test - CPT
- Vibrocore - VC

British Geological Survey - GeoIndex 2014

Category
- Chalk
- Igneous
- Mesozoic interbedded
- Mesozoic mudstones
- Mesozoic sandstones and limestones
- Metamorphic
- Palaeozoic sedimentary
- Tertiary interbedded
- Tertiary sandstones and limestones

Note: "Geological data extracted from the BGS GeoIndex Offshore 2014, provided solely for reference purposes."

Rev	Description	By	CB	Date
P01	First Draft	CE	TM	10/04/24

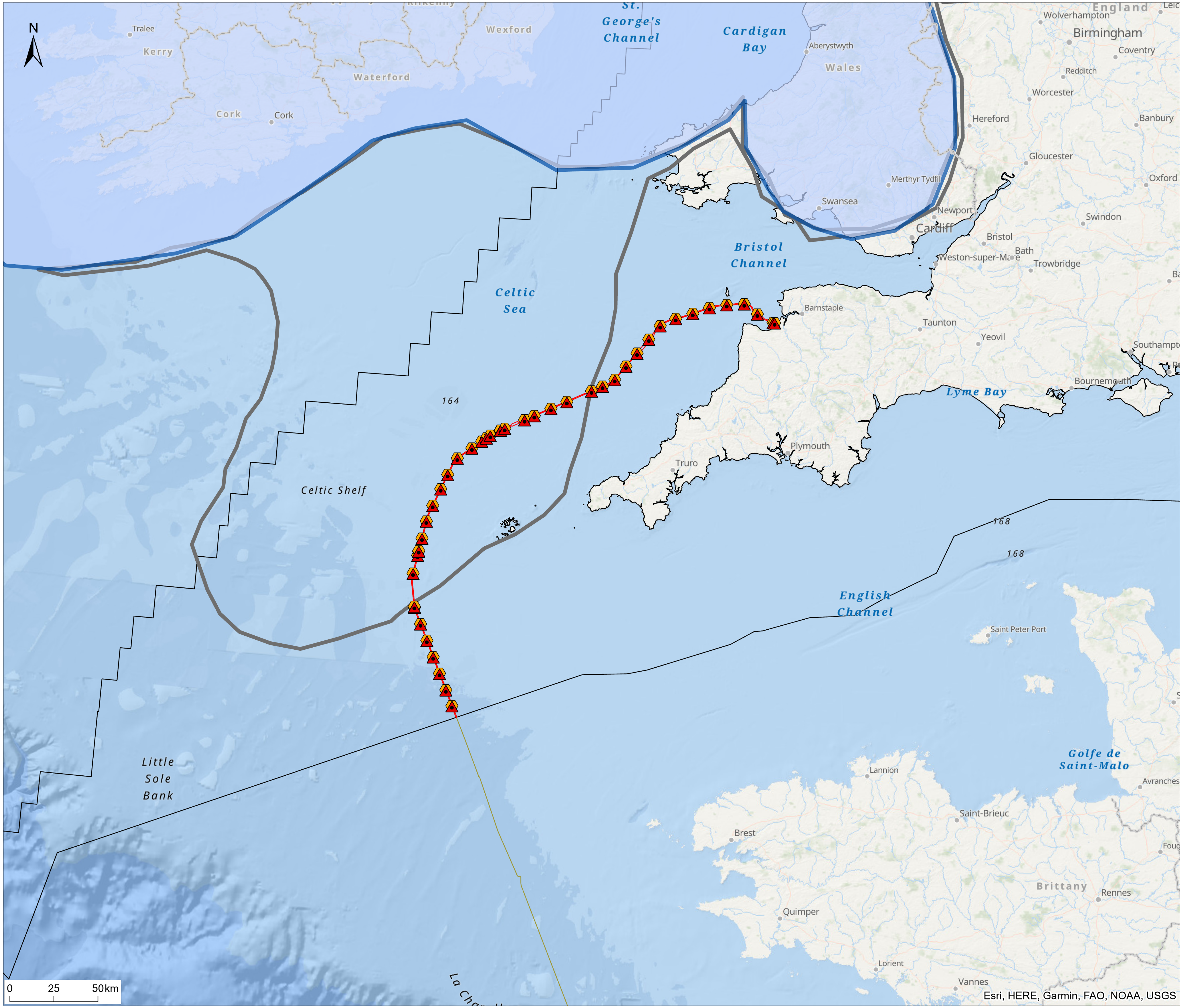
Xlinks

Client: Xlinks 1 Limited

Project: Xlinks Morocco-UK Power Project

Title: Geology with Borehole Locations (BGS GeoIndex offshore 2014)

Status	Drawn By	PM/Checked By
DRAFT	CE	TM
Project Number	**Scale @ A3**	**Date Created**
794-PLN-ESH-00111	1:2,000,000	Apr 2024
Figure Number		**Rev**
2		P01



Notes
1. This plan is scaled at paper size A3. If received electronically it is the recipients responsibility to print to the correct scale. Only written dimensions should be used.

Legend

- XLinks UK Offshore Cable Corridor
- Indicative Cable Centreline
- UK Exclusive Economic Zone (EEZ)
- Core Penetration Test - CPT
- Vibrocore - VC
- Devensian Ice Margin - 27kya
- Devensian Celtic Sea Ice - 23kya

Note: Ice margin data extracted from the BRITICE Glacial Map, version 2, 2024, provided solely for reference purposes.

Rev	Description	By	CB	Date
P01	First Draft	CE	TM	10/04/24

Client: Xlinks 1 Limited

Project: Xlinks Morocco-UK Power Project

Title: XLinks Cable Route Boreholes with Devensian ice margins (BRITICE Glacial Map, v2)

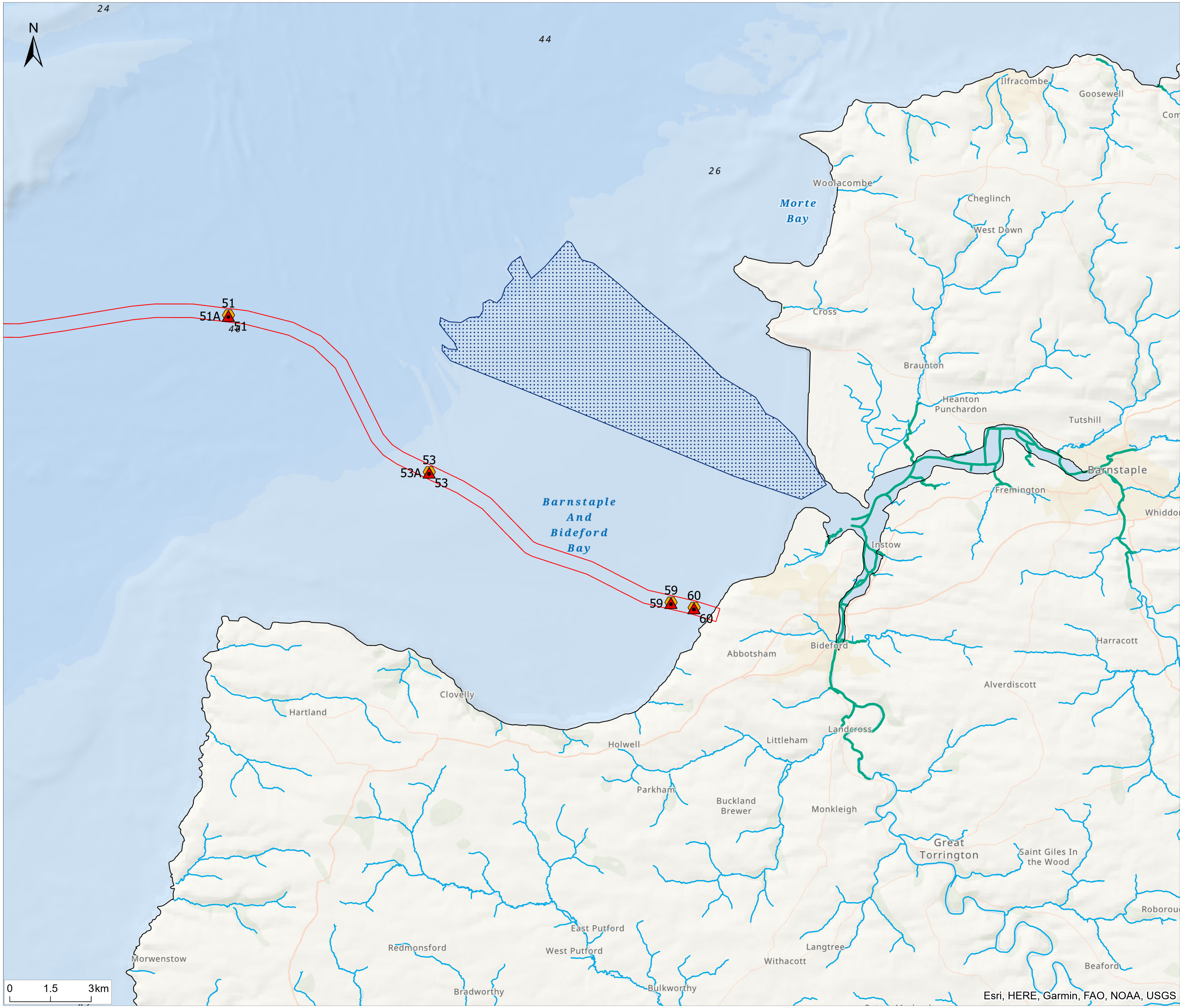
Status	Drawn By	PM/Checked By
DRAFT	CE	TM

Project Number	Scale @ A3	Date Created
794-PLN-ESH-00112	1:2,000,000	Apr 2024

Figure Number: 3

Rev: P01

\\Corp\ukCloud\UK-GIS01\data\70107275 - XLinks\13_GSS\132_GIS\ArcGIS\ProProjects\PEIR Projects\Cultural Heritage and Marine Archaeology\794-PLN-ESH-00112 - CHMA - Appendix - XLinks Cable Route Boreholes with Devensian ice margins.aprx



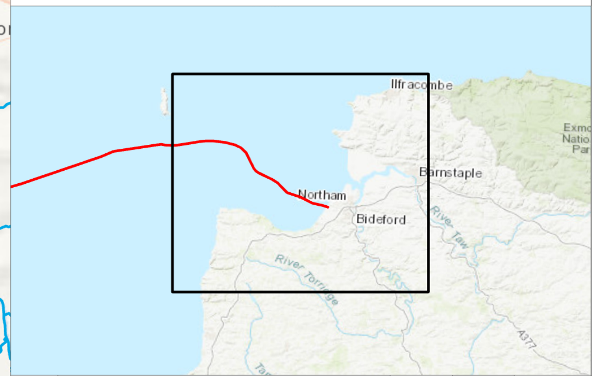
Notes
1. This plan is scaled at paper size A3. If received electronically it is the recipients responsibility to print to the correct scale. Only written dimensions should be used.

Legend

- XLinks UK Offshore Cable Corridor
- UK Exclusive Economic Zone (EEZ)
- Conjectural line - Taw Torridge Estuary
- Nearshore sea bed
- Cone Penetration Test - CPT
- Vibrocore - VC

OS Open Rivers

- Tidal River
- River
- Canal



Rev	Description	By	CB	Date
P01	First Draft	CE	TM	10/04/24

Client: Xlinks 1 Limited

Project: Xlinks Morocco-UK Power Project

Title: Near-shore XLinks VC/CPT borehole locations with Holocene sediment (53, 59 and 60) and nearshore sea bed

Status	Drawn By	PM/Checked By
DRAFT	CE	TM

Project Number	Scale @ A3	Date Created
794-PLN-ESH-00113	1:130,000	Apr 2024

Figure Number: 4

Rev: P01

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