Celtic Interconnector Offshore Constraints Report

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Abbreviations

Abbreviation	Meaning
BA	Ballycroneen
BAS	Burial Assessment Study
BW1	Ballinwilling 1
BW2	Ballinwilling 2
CL	Claycastle
CPCS	Cable Protection Complementary Study
CPT	Cone Penetration Test
EC	European Commission
EEZ	Exclusive Economic Zone
HVDC	High Voltage Direct Current
IN	Inch Beach
KP	Kilometre Point
MW	Megawatt
RE	Redbarn
SPA	Special Protection Area
SSS	Side Scan Sonar
UK	United Kingdom
UXO	Unexploded Ordnances
WD	Water Depth

1.0 Introduction

1.1 Overview

EirGrid develops, manages and operates the electricity transmission grid. As part of its role EirGrid is mandated to explore and develop opportunities to interconnect the transmission grid with the transmission grids in other countries. EirGrid has been working with its counterpart in France, Réseau de Transport d'Électricité (RTE), to investigate the feasibility of an electrical link between Ireland and France, known as the Celtic Interconnector project.

The project is following EirGrid's six-step Framework for Grid Development as outlined in EirGrid's Have your Say document[1]. This approach facilitates engagement and consultation with stakeholders and the public which helps to explore options fully and make more informed decisions. The project is currently in Step 3 (What's the best option and what area may be affected?) of the Framework for Grid Development.

The project is being supported by the European Union's Connecting Europe Facility (CEF). It is also a European Union Project of Common Interest (PCI) and a designated e-Highway 2050 project.

The interconnector, if developed, would include a High Voltage Direct Current (HVDC) link, with converter stations, subsea and underground circuits. The marine route that has been investigated to date for the Project is shown in Figure 1-1 overleaf.

The marine route runs between the coasts of the Bretagne region in France and the East Cork region in Ireland. The proposed interconnector would have a power capacity of 700 MW and the subsea cable link would consist of one pair of cables which may be laid in a bundled or disjointed configuration depending on the route sections. The foreseen operational life of the interconnector is 40 years.

The approximate length of the marine route is 500 km and is broken down as follows:

- **Nearshore**

  This section encompasses the shallow waters in the final approach to the landfall locations along the coast in both Ireland and France. At the Irish end of the route this section covers the area out to near the 12nm Territorial Waters limit.

- **Offshore**

  This section encompasses the deeper waters away from the shore and covers the majority of the route between Ireland and France. It runs from the Irish Territorial Waters limit and crosses through the Irish Exclusive Economic Zone (EEZ), the UK EEZ, the French EEZ and into French Territorial Waters.

The offshore route, which avoids UK Territorial Waters, has been confirmed as part of the previous studies carried out on the project. The focus of this report is on the constraints associated with the nearshore section of the Irish end of the project.

[1] http://www.eirgridgroup.com/__uuid/7d658280-91a2-4dbb-b438-ef005a857761/EirGrid-Have-Your-Say_May-2017.pdf

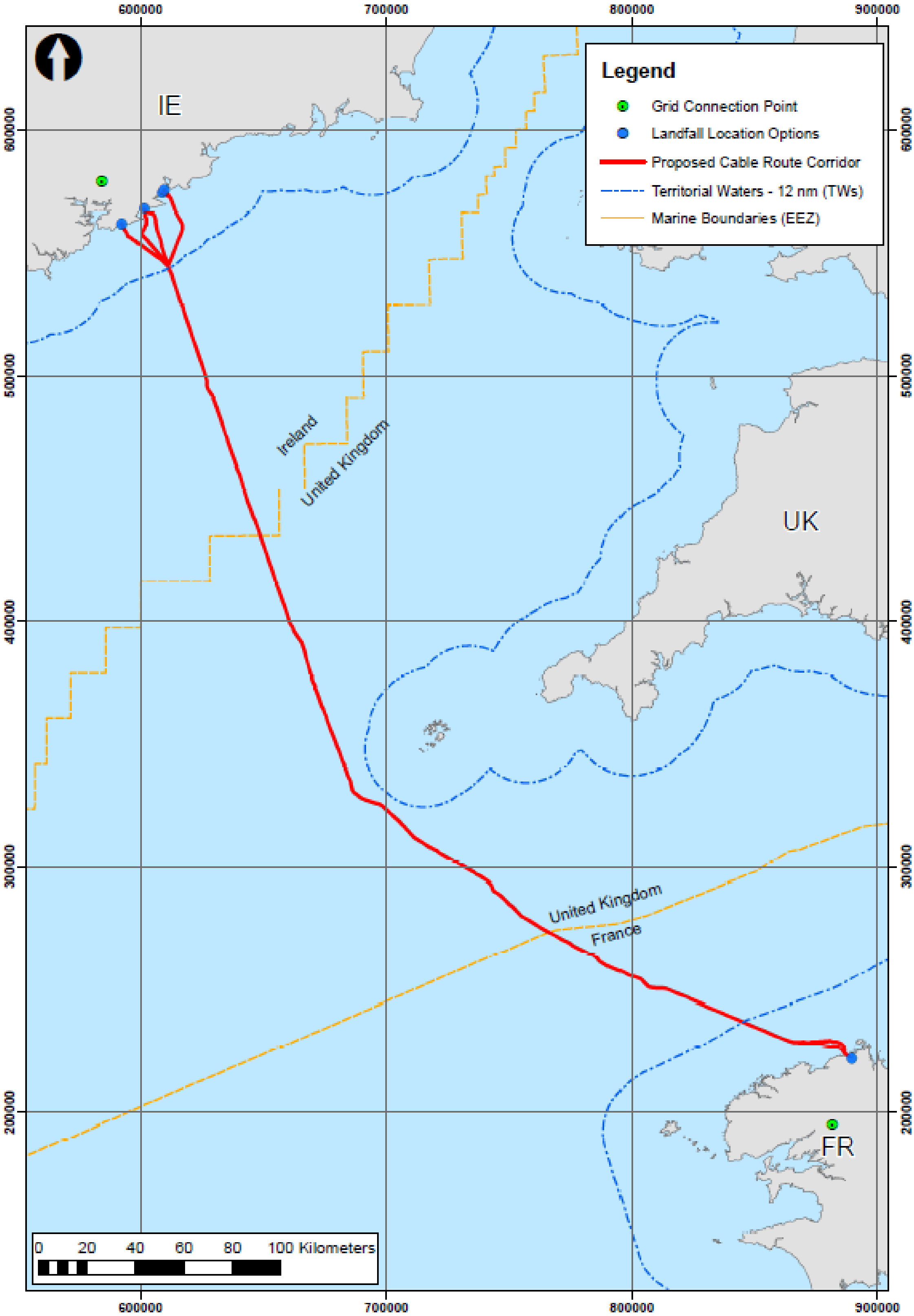

Figure 1-1: Celtic Interconnector Marine Route

1.2 Objectives

The objective of this constraints report is to provide a summary overview of constraints associated with the nearshore route options into each of the landfalls on the Irish side.

1.3 Report Structure

The constraints criteria and sub-criteria to be used in the assessment are outlined in Section 2.0. Each landfall from West to East is then assessed under those criteria from Section 3.0 to Section 7.0.

1.4 Offshore Cable Routes and Landfalls

The five landfall location options under consideration in Ireland are presented in Figure 1-2. The landfalls are spaced along a 27km section of the east Cork coast. From West to East these are Inch Beach (IN), Ballycroneen (BA), Ballinwilling (BW2 to the west, BW1 to the east), Redbarn (RE) and Claycastle (CL).

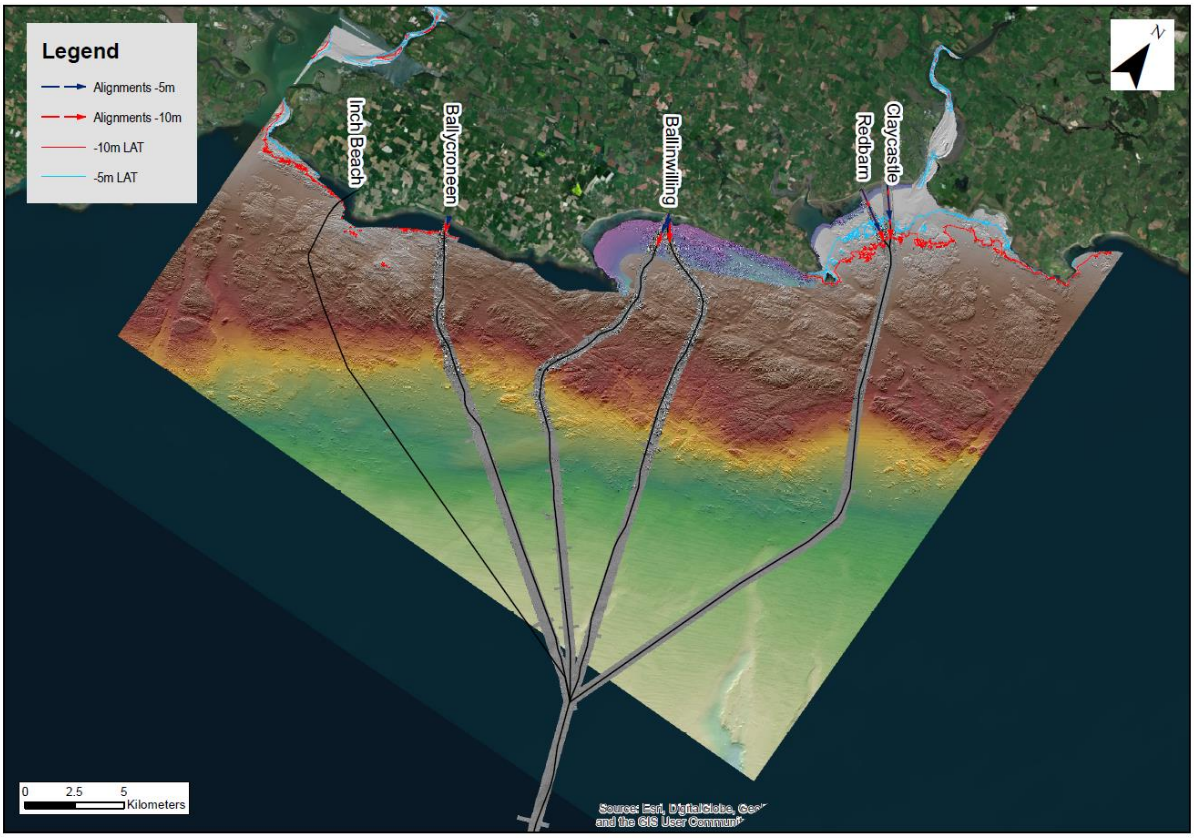

Figure 1-2: Landfall Locations and Nearshore Cable Routes under Consideration

1.5 History of Route Development

The history of the development of the Celtic Interconnector offshore route in terms of information gathered and decisions taken is as follows:

- Late 2013 to early 2014: Early studies (fishing, shipping and navigational features) were undertaken on the basis of four main offshore route options
- Early to mid-2014: Onshore studies were conducted in both Irish and French territories to identify a range of feasible landfall locations
- Mid to late 2014: Route-specific studies (marine and foreshore archaeology, Unexploded Ordnance (UXO) studies) were commissioned.
- Late 2014 to mid-2015: Route modifications were made during the survey campaigns in order to avoid some challenging areas.
- Late 2015 to mid-2016: Further engineering studies (detailed fishing and shipping, burial studies and geoarchaeological assessment of vibrocore logs) were carried out
- Early 2016: Burial assessment studies (BAS) suggested further analysis of additional landfalls on the Irish side
- Late 2017: Geophysical survey campaign undertaken
- Mid 2018: Geotechnical and benthic survey campaign undertaken
- Mid to late 2018: A metocean and hydrosedimentary study conducted along the route
- Late 2018: developed the burial assessment studies (BAS) for the alternative routes and revised the BAS for the original route.
- Late 2018 to early 2019: Archaeological assessments and reporting was undertaken

1.6 Marine Surveys

Geophysical and geotechnical marine surveys have been undertaken on routes into all the landfalls except Inch beach. Following site visits, workshops and ranking exercises the recommended landfall locations proposed for inclusion in the initial marine survey were Ballinwilling Strand and Ballycroneen Beach. It was therefore decided not to survey a route into Inch Beach as it did not perform as well during the desktop assessment. One of the key constraints is the presence of the 24” Kinsale Energy gas pipeline at this landfall.

The initial marine survey carried out in 2014/15 showed challenging conditions on all approaches. Further evaluation of additional third party data indicated the presence of sediment channels to Redbarn/Claycastle and an alternative route to Ballinwilling which indicated the potential for less challenging conditions for burial of a subsea cable. An additional geophysical and geotechnical marine survey was undertaken in 2017/18 to assess these routes.

The purpose of the geophysical surveys was:

- Map the seabed and sub-surface to optimise cable routing and enable assessment of cable target burial depth along the route(s);

- Inform planning of the geotechnical sampling programme;
- Identification of marine habitat areas for benthic survey;

A marine geophysical survey was undertaken between August and November 2014. The main surveyed route was 488km long and ran from Ballinwilling Strand to Moguériec, France. A further route option into Ballycroneen Beach was also surveyed. The survey corridor was 500m wide in the offshore section, narrowing to 250m near the landing areas in Ireland and France.

After completion of each geophysical survey, locations for geotechnical sampling were identified and an assessment made as to the likelihood of encountering Unexploded Ordnances (UXO) during sampling based on Side Scan Sonar (SSS) and magnetometer data.

In 2015 (June to September), a geotechnical and benthic survey campaign was performed on the eastern Ballinwilling 1 and the Ballycroneen branch route all the way to France. In 2018 (June to July) a geotechnical survey was carried out on the Claycastle, Redbarn and the western Ballinwilling 2 route.

The objective of the geotechnical campaigns was to undertake geotechnical (vibrocore and CPT) sampling and in-situ and laboratory testing in order to evaluate the nature and mechanical properties of the surficial seabed soils.

The benthic surveys aimed to delineate and map potentially environmentally sensitive seabed features within the cable route corridor; in particular, the presence of potential Annex I habitat communities (biogenic reefs, stony reefs or submarine structures made by leaking gases as specified under the European Commission Habitats Directive (EC Habitats Directive 92/43/EEC)). Baseline data was obtained for all habitat types recorded within close proximity to the proposed operations (via benthic sampling and seabed imagery) in line with international requirements. The sampling strategy was based on a seabed sampling using a special tool designed for use in coarse and mixed sediments. On completion of the work scope, environmental samples were recovered and processed in specialised laboratories, where the subsequent results were interpreted. Outputs included particle size distribution, heavy and trace metals, total organic carbon, total organic matter, hydrocarbon concentrations and pH levels.

Archaeological assessments included a desk-based assessment and non-intrusive surveys on each of the landfalls. The assessments included walkover, hand-held metal detection, and geophysical (electrical conductivity) surveys at each of the locations. The marine archaeological assessment also comprised a review of geophysical and geotechnical survey data collected over the proposed route corridors. The purpose of the archaeological assessments is to identify known and potential sites and features of archaeological interest in the cable survey corridor that might be impacted by the project. The impact of the project on those sites will then be limited through the adoption of appropriate mitigation measures.

2.0 Offshore Constraints Analysis

2.1 Assessment Criteria

Each of the proposed landfalls were assessed against the criteria presented in Table 2-1, where applicable.

Table 2-1 Offshore Constraints Assessment Criteria

Constraint	Subcriteria
Technical	Security & Asset Protection
	Technology Operational Risk
Deliverability	Implementation Timelines
	Risk of Untried Technologies
	Cable Installation risk
	Supply Chain Constraints
	Cable installation methods at landfall
	Fishing and shipping Impact during Development
Environmental	Benthic, Marine Habitats
	Seabed impacts
	MetOcean Factors
	Hydrosedimentary Impacts
	Noise
	Archaeology
Socioeconomic	Impact on fisheries
	Recreation & Tourism
	Cultural Heritage
	Defence
Economic	Project Implementation Costs
	Project Life-Cycle Costs
	Contingency Costs
	Pre-Installation Engineering Costs

2.2 Key Considerations

In order to reduce the risk of damage to a submarine cable from fishing or shipping activities burial of the cable beneath the seabed is required. This becomes increasingly challenging when the following seabed constraints are encountered:

1. **Outcropping and subcropping rocks**: areas featuring rock outcrops and subcrops are challenging for cable burial due to the uneven and sometimes difficult terrain restricting performance of burial tools.
2. **Surface boulder fields**: surface boulders present a significant challenge for cable installation: when rerouting is not possible, and trenching must be attempted, surface boulders must be removed pre-lay.
3. **Subsurface boulders**: Cable burial could also be impeded by the presence of sub-surface boulders covered in sediment.
4. **Seabed gradient**: The operation of cable burial equipment is limited by seabed gradient.

The band of bedrock identified at the shore approaches to the Irish landfalls represents a significant technical challenge to the project. Cable routes which follow the sediment channels identified within the bedrock offer a more straightforward installation (Claycastle, Redbarn & Ballinwilling 2).

Cable burial at landfall can be performed either by open cut or Horizontal Directional Drilling (HDD). For an open cut landfall construction the cable installation vessel is positioned offshore in a water depth of 10m or greater. The cable is pulled onshore using a shore-based winch which is connected to the cable on the vessel via a hauling line. The cable is surface laid on the beach and post-lay trenched to minimise costs and disruption to the surrounding environment. This operation could be decoupled from the main cable installation such that it could occur off-peak by burying a conduit into which the cable would later be installed.

Figure 2-1: Cable Plough for Open Cut

Horizontal directional drilling is a trenchless construction method utilizing equipment and techniques from horizontal oil well drilling technology and conventional road boring. HDD installation involves firstly drilling a carefully guided pilot hole from the onshore location to the specified exit point offshore. During the drilling of the pilot hole the location of the drilling head is continually monitored. Following the completion of the pilot hole the tunnel is enlarged through successive reaming runs until the hole is large enough to accommodate the cable duct. The HDD entry point is typically at a dry location above the highest astronomical tide (HAT). The exit point can be optimised to suit ground conditions.

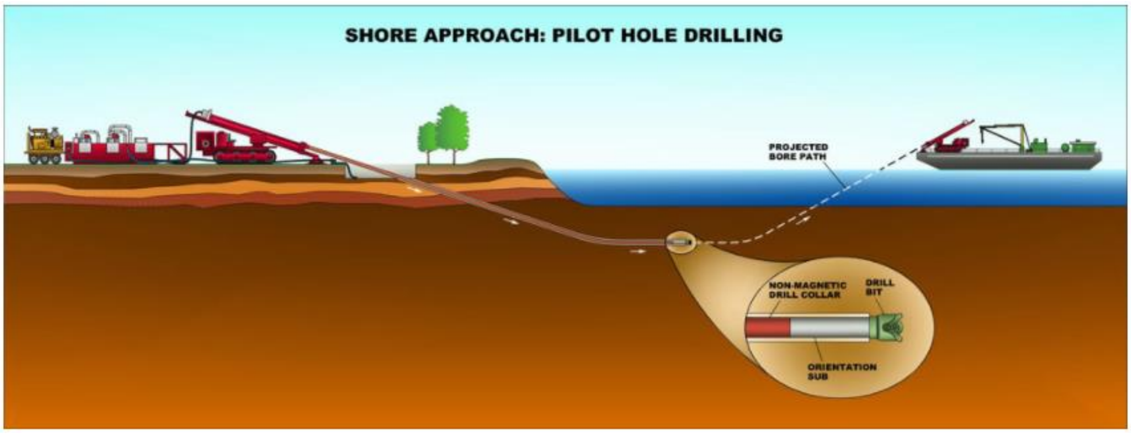

Figure 2-2: Overview of Onshore to Offshore HDD Operation

The results from the surveys for these key considerations are provided in Table 2-2. These inputs will be referenced extensively in this constraints report for each landfall.

Table 2-2 Comparison of Surveyed Nearshore Routes

Criterion	Irish Landfall Offshore Approach Route				
	Ballycroneen (BA)	Ballinwilling 2 (BW2)	Ballinwilling 1 (BW1)	Claycastle (CL)	Redbarn (RE)
Overall length (km)	25.9	27.8	26.8	34	33.6
Rocky Outcrops (km)	11.5	6	15.2	0	2
Dense boulders (km)	0.1	15.4	1.1	9.0	11.7
High Seabed Gradient (km)	6	3	13.5	0	2.5
Distance to 10m WD (km)	1.5	1.5	0.9	2.9	2.7
Exposure (Wind)	moderately sheltered	moderately sheltered	least sheltered	most sheltered	most sheltered
Exposure (Wave)	moderate swell	moderate swell	highest swell	lowest swell	lowest swell
Max Current	0.1m/s	0.125m/s	0.1m/s	0.1m/s	0.1m/s

3.0 Inch

3.1 Overview

Inch Beach is situated 5km to the east of the entrance to Cobh Harbour and 1km north of Power Head.

The beach is approximately 160m wide, bordered on both sides by prominent rock outcrops extending both ways along the coastline, see Figure 3-1. The main obstruction to a cable landing on this beach is the buried 24” export gas pipeline from the Kinsale field.

The rock outcrops either side of the sand beach restrict the width of entry and exit to the beach to approximately 100m.

Figure 3-1: Inch Beach Landfall Approach

3.2 Technical

The significant length of rocky outcrops on this route will necessitate the requirement for specialist rock trenching equipment. Rock trenching carries a higher risk of damage to the cable during installation than burial in sediment. This route has the second longest section of rocky outcrop and therefore a high damage risk to the cable during installation. Once installation to the required depth is achieved the risk of damage to the cable is comparable across all routes.

3.3 Deliverability

The primary consideration with siting the cable landing at this beach is the 24” Kinsale Energy pipeline which could affect cable routeing or require protection efforts to lay the cable near to or cross the pipeline. Kinsale Energy is in the process of decommissioning the pipeline but it is unlikely that the pipeline will be removed post decommissioning.

The length of rocky outcrops on the route will proportionally affect the deliverability of the route. Implementation timelines will be dependent on the progress rate of installation through the rocky sections. There will be increased uncertainty with regard to trenching progress rates through rocky areas.

Rock trenching requires specialist equipment each rated for different rock strengths. The ability of rock-trenching equipment is highly dependent on site specific geology and therefore previous experience may not be a reliable reference. There may not be rock-trenching trials on location prior to construction and therefore the risk remains. In addition, the requirement for rock-trenching may limit the number of contractors able to perform the cable installation at Inch Beach.

The cable is at increased risk of damage during installation due to the presence of rocky outcrops. Should damage occur in-field repairs will be required which will directly affect the implementation timelines.

An open cut landfall is deemed feasible due to sufficient sediment cover on the beach and at very shallow water.

3.4 Environmental

A desktop review revealed that there are no protected sites within the vicinity of Inch Beach. A number of wrecks have been identified in the vicinity however the cable could be routed around these features to avoid damage. Detailed benthic surveys were not conducted at this landfall.

Rock-trenching would result in a permanent deformation of the seabed. Where possible any trenching would be back-filled. If external rock protection were required where burial in the rock was not possible this would result in the introduction of rock, likely from a quarry in Norway.

As most trenching/cutting activity is subsea and there is no requirement for piling, noise levels above the waterline would not be expected to be significant and would not vary greatly between routes. However, noise levels below water which could affect marine mammals and would be greater where rock cutting activity is expected..

Due to the close proximity of all landfalls MetOcean conditions are similar along much of the approach routes. However, Inch Beach faces southwest and is therefore exposed to the prevailing south westerly wind and waves which could result in increased weather downtime during installation.

3.5 Socioeconomic

The key socioeconomic impacts of the marine approaches are fisheries, recreation and tourism. Fishing disruption in this area would not be expected to be significant based on AIS data analysed as part of the Fishing and Shipping study. Feedback from the fishery associations advised that the Inch approach is the least densely fished route.

During construction a temporary exclusion corridor would be required on the beach thus dividing the beach in two for a number of weeks. This operation could be decoupled from the main cable installation such that it could occur off-peak by burying a conduit into which the cable would later be installed. All works would be temporary.

This beach is popular with bathers during the summer months. Powered by prevailing south westerly winds, steep waves break far from the shoreline which attracts surfers throughout the year. A surf school operates from the beach.

3.6 Economic

The Inch Beach route has not been extensively costed. However, due to the level of rock trenching required and potential issues regarding routing with the existing pipeline it is expected that the overall implementation costs could be significant.

3.7 Key Constraints and Considerations

The key offshore constraints associated with Inch are summarised below;

- Potential for extensive rock-cutting and remedial external protection.
- Increased risk of damage during installation due to requirements for rock cutting.
- Existing pipeline limiting approach route.
- Exposed to weather from the southwest which could hamper installation.
- High submarine noise levels during rock cutting operations.
- Challenging landfall requiring rock cutting operations.

4.0 Ballycroneen

4.1 Overview

The landfall at Ballycroneen is formed by a small bay surrounded on both sides by rock outcrops. The intertidal area consists of a wide sandy beach. The cable branch route to Ballycroneen is 26km. It is characterised by 11.5km of rocky outcrops and 6km of high seabed gradient.

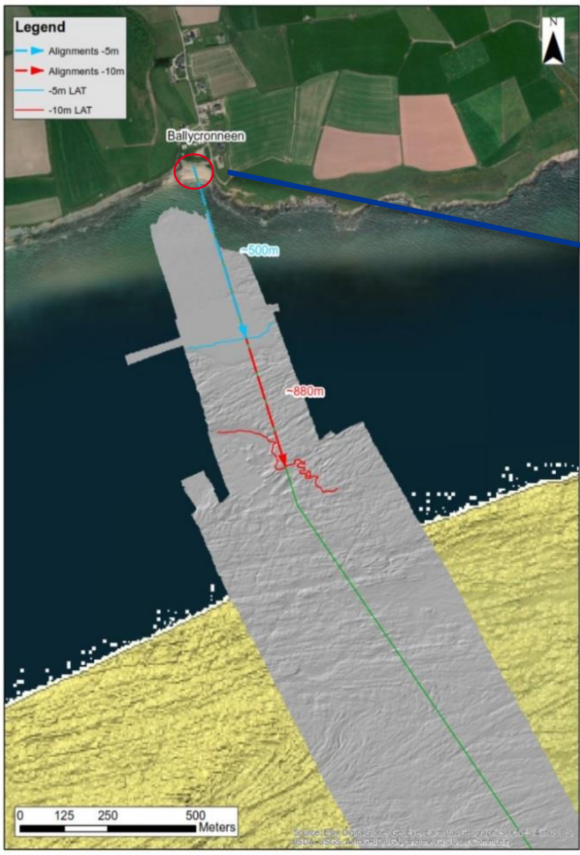

Figure 4-1: Ballycroneen Landfall Approach

The Ballycroneen landfall approach was surveyed in 2014-15 as an alternative to the route to Ballinwilling Strand. Extending as it does further to the west of the area, it is less sheltered than the Ballinwilling Strand routes, but it reaches deeper waters more rapidly, making it a shorter approach for cable pull-in operations. The bathymetric profile is similar to that of the BW1 route and outcropping rocks create areas of variable slope out to Kilometre Point (KP) 8.7 (approximately). Beyond KP 8.7, the underlying rock stratum gives way to pleistocene deposits and the profile becomes smoother.

4.1.1 BA S1: KP 0.0 – KP 8.7

This section is dominated by outcropping rocks with occasional depositions of sediment of limited depth (generally less than 0.5m). Near the shore, the Ballycroneen route features clayey sands (of varying density) around 1.0m deep in a fairly continuous deposit out to KP 0.6. Beyond KP 1.0, coarser sediments prevail as the route heads into deeper water. Below the surficial sediments, the weak mudstone that appears inshore gives way to sandstones, slates and limestones as seen near Ballinwilling Strand. Slopes up to 10° which may pose challenges to installation are crossed occasionally as mounds of outcropping bedrock are crossed.

Boulders are encountered in clusters out to KP 4.5 (approx.), before a large area of medium concentration appears between KPs 4.5 and 7.0 (not a “boulder area”). Magnetic anomalies lie on the route at KPs 1.4, 5.1 and 8.6; others at KP 3.9, 5.4 and 7.0 are avoided by re-routing within the surveyed corridor.

4.1.2 BA S2: KP 8.7 – KP 25.9

Around KP 8.7, the same transition to underlying Pleistocene deposits as was seen on the BW1 route is observed on BA. The subsoil is described as a mixture of gravelly sand and clay of varying densities and strengths. Surficial sediments, mostly clay and gravelly sand, increase in depth compared to the inshore section, generally ranging from 0.5m to 1.0m. Areas where the surficial sediment extends deeper are met intermittently, with one large hill-like accumulation occurring from KP 11.5 to 13.5; temporarily interrupting the steady increase in water depth.

Boulders are sparse throughout this section, with occasional small “boulder areas” falling within the corridor but clear of the route. A small but concentrated “boulder area” is crossed at KP 17.5; then from KP 21.8 to 23.6, small but less dense areas start to coincide with the route more frequently. Beyond KP 23.6 and to the end of the section (where the BA route meets BW1) boulders are again very infrequent. Magnetic anomalies appear 100m or so from the route at KP 8.7, and close to/on the route at KP 13.8; otherwise the corridor is relatively clear in the vicinity of the cable route.

4.2 Technical

The 11.5km of rocky outcrops on this route would necessitate the requirement for specialist rock trenching equipment. Rock trenching carries a higher risk of damage to the cable during installation than burial in sediment. This route has the second longest section of rocky outcrop and therefore a high damage risk to the cable during installation. Once installation to the required depth is achieved the risk of damage to the cable is comparable across all routes.

4.3 Deliverability

The length of rocky outcrops on the route will proportionally affect the deliverability of the route. Implementation timeline will be dependent on the progress rate of installation through the rocky sections. There will be increased uncertainty with regard to trenching progress rates through rocky areas.

Rock trenching requires specialist equipment each rated for different rock strengths. The ability of rock-trenching equipment is highly dependent on site specific geology and therefore previous experience may not be a reliable reference. There may not be rock-trenching trials on location prior to construction and therefore the risk remains. In addition, the requirement for rock-trenching may limit the number of contractors able to perform the cable installation at Ballycroneen.

The cable is at increased risk of damage during installation. Should damage occur in-field repairs would be required which will directly affect the implementation timelines.

The nearshore survey data indicates that for the first 500m of the cable route the seabed is formed by thin layer (0.5-1.5m) of sandy sediments which give way to rock outcrops. An open cut landfall is therefore considered feasible. However, given the depth of seabed sediments and potential for seabed mobility it is expected that significant levels of rock cutting would be required within this section of the landfall to ensure long term cable protection. During landfall construction a section of the small cliff and existing rock armour would need to be removed to allow trenching of the cable.

Local fishing and shipping are centred around two harbours, Ballycotton and Youghal. The Ballycroneen route is expected to result in limited disruption to fishing and shipping during construction.

4.4 Environmental

The Benthic surveys of the Ballycroneen approach route indicates that no environmentally sensitive habitats or benthic communities were recorded that would prohibit operations over the proposed cable route. This included, notably, an absence of potential Annex I habitats currently protected under the EC Habitats Directive (e.g. pockmark feature, biogenic or geological reefs). While not significant, the Ballycroneen route recorded the highest number of species and individuals of all 5 routes surveyed. Along all surveyed routes, in areas of cobbles and boulders hydrozoa, bryozoans, cup corals (possibly Caryphyllia smithii), sea urchins (Echinus esculatus), squat lobsters (Possibly Munida rugosa) and some teleost fish were present. At stations with a higher proportion of sand, observed fauna included starfish (Asteroidea), brittle stars (Ophiuroids), decapod spp. and numerous polychaete casts.

There are no protected sites in the marine approach to Ballycroneen.

Rock-trenching would result in a permanent deformation of the seabed. Where possible the trenching would be back-filled. If external rock protection were to be required where burial in the rock was not possible this would result in the introduction of rock, likely from a quarry in Norway.

As most trenching/cutting activity is subsea and there is no requirement for piling, noise levels above the waterline would not be expected to be significant and would not vary greatly between routes. However, noise levels below water which may affect marine mammals would be greater where rock cutting activity could be expected at Ballycroneen.

Due to the close proximity of all landfalls MetOcean conditions are similar along much of the approach routes. However, Ballycroneen has the largest swells and wind speed of all the routes which may affect weather downtime during installation and increase the installation campaign window.

Nothing of particular archaeological significance was found during the surveys.

4.5 Socioeconomic

The key socioeconomic impacts of the marine approaches are fisheries and recreation and tourism. Fishing disruption in this area is not expected to be significant based on AIS data analysed as part of the Fishing and Shipping study.

During construction a temporary exclusion corridor would be required on the beach thus dividing the beach in two for a number of weeks. This operation could be decoupled from the main cable installation such that it could occur off-peak by burying a conduit into which the cable would later be installed.

The beach is popular for surfing and fishing all year round with most visitors attracted to bathing during the summer months. Although this beach has some heritage features it is not a protected site.

4.6 Economic

The Ballycroneen route is the shortest of all routes and therefore has the lowest cable supply costs. However, rock trenching is time consuming and requires specialist equipment, therefore this route would represent a very high installation cost with significant levels of uncertainty with regard to progress rates during burial. In addition, rock cutting would be required at the landfall requiring additional equipment.

4.7 Key Constraints and Considerations

The key offshore constraints associated with Ballycroneen are summarised below;

- Potential for rock-cutting and remedial external protection along 11.5km of the route.
- Increased risk of damage during installation due to requirements for rock cutting.
- High submarine noise levels during rock cutting operations.
- Challenging landfall requiring rock cutting operations.

5.0 Ballinwilling

5.1 Overview

The proposed Ballinwilling landfall is located 34km to the east of Cork and 4.5km to the north-east of Ballycotton.

Two potential approaches to the Ballinwilling landfall have been identified as shown in Figure 5-1. The original approach (BW1) was surveyed in 2015. This cable branch route to Ballinwilling is 27km and is the eastern approach to Ballinwilling as shown below. It is characterised by 15.2km of rocky outcrops and 13.5km of high seabed gradient.

The alternative approach to Ballinwilling (BW2) follows sediment filled channels within the band of bedrock and is the western approach to Ballinwilling as shown below. The alternative cable branch route to Ballinwilling is slightly longer at 28km. However, it is characterised by only 6km of rocky outcrops and 3km of high seabed gradient.

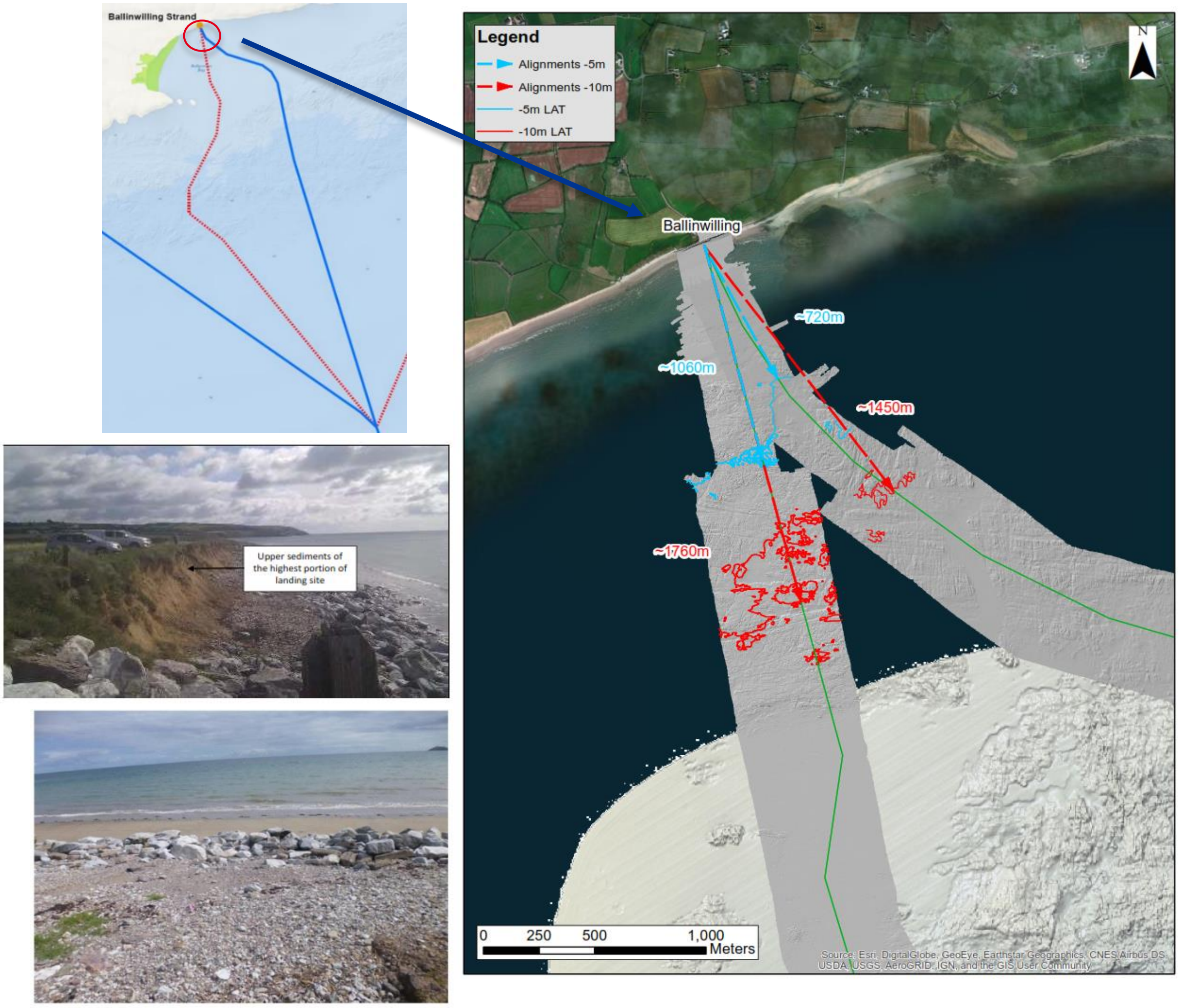

Figure 5-1: Ballinwilling Landfall Approach

5.2 BW1 - Ballinwilling 1

The original route out of Ballinwilling Strand (as surveyed in the 2014 campaign) veers to the east as it heads away from the beach, following a path into deeper waters in as short a distance as possible. The bathymetric profile shows a fairly even increase from 0 to 80m water depth across the area. The first 15km shows a jagged pattern associated with the outcropping rock in that area, and the latter half is relatively smooth, reflecting more consistent sedimentary coverage.

The seabed characteristics in this area are divided into two areas of broad commonality; the rocky section from the shoreline to KP 15.2, and the sand/gravelly section from KP 15.2 to the point at which all the route options meet (KP 26.8).

5.2.1 BW1 S1: KP 0.0 – KP 15.2

Sedimentary deposits over the first 15.2km of the route are sparse and insubstantial where they are present. The patches of sand and gravel range in thickness from 0 to 1.4m in the 400m closest to the shore and occur in pockets of up to 0.5-1.0m thereafter. Granule sizes increase as the water depth increases; from sands near the shore to dense sandy gravel towards the end of the section. The underlying stratum is identified as Devonian/Carboniferous, consisting of sandstone, slates and limestone. The resistance measurements provided by Cone Penetration Tests (CPTs) in the area suggest that the top layer is relatively weak. Areas of seabed slope in the region of 5-10° which may pose a challenge to installation are encountered intermittently.

Short (up to 500m) patches of clustered boulders are recorded infrequently up to KP 7.0, after which the coverage becomes consistently denser, although not sufficiently so to be identified as a “boulder area” (Boulder areas are defined as those where boulders are found to be located closer than 11m apart). There are several magnetic anomalies recorded in the vicinity of KPs 1.0 and 2.0 and again around KPs 6.5 and 9.0, but they appear entirely avoidable.

5.2.2 BW1 S2: KP 15.2 – KP 26.6

From KP 15.2, the sub-cropping rock gives way to Pleistocene deposits described as low to high strength clay. This variation in strength is supported by the cone resistance plots, some of which are comparable to the earlier sandstone/limestone readings; others showing weaker material. The surficial sands and gravels form a more consistent layer of 0.5m to 1m depth on average, with occasional deeper troughs appearing between KPs 18.5 and 20.0.

Boulder concentration continues to vary, with areas of increase broadly correlating with areas of larger-grained sediment rather than boulders. “Boulder areas” are small and few; the most problematic area in this regard falling between KPs 20.0 and 22.0. Occasional magnetic anomalies continue to fall clear of the route, with one falling within the installation corridor at KP 22.8 that will require avoidance.

5.3 BW2 – Ballinwilling 2

The second Ballinwilling Strand route was developed as an attempt to take advantage of what appeared to be large, sediment-infilled channels crossing the offshore area from the landfall vicinity. This route follows a long channel out to the west before turning southeast and following a path roughly centred between the BA and BW1 routes.

The bathymetric profile is very similar in gradient to the BW1 route, except that there are fewer areas of variable slope caused by rocky outcrop.

5.3.1 BW2 S1: KP 0.0 – KP 15.9

The terrain around the first 15.9km of the BW2 route appears to be as encountered along the BW1 route. The substratum is broadly similar to the BA route to the west and BW1 route to the east; to sandstones, slates and limestones. Whilst the seabed still features areas of rock outcropping, BW2 follows a path that (as intended) avoids a good proportion of these. The bedrock remains close to the surface however, and the depth of sediment is less than required to meet burial targets over a cumulative 4.7km.

Sediment content is a combination of sand and mud in the area closest to shore, progressing to sandy gravels/gravelly sands from KP 4.5 onwards. Deeper pockets of sediment are also crossed, generally spanning up to 500m. Between KPs 14.3 and 15.6, a large convex sand feature is crossed, perhaps a continuation of the feature noted at KP 11.5 on BA.

Areas identified as “boulder areas” are crossed frequently along this section, generally correlating to areas of outcropping and sub-cropping rock. Magnetic anomalies appear in a continuous distribution through the survey corridor from KP 7.0 until KP 11.7. The number of targets and lack of correlation with sidescan sonar data (sonar system used to provide an understanding of the differences in material and texture type of the seabed) suggests that these may be caused by a geological feature.

A wreck of 15m apparent length is identified at KP 11.4 (approx.) which is likely to require wider circumnavigation to the east of the corridor.

5.3.2 BW2 S2: KP 15.9 – KP 27.8

Beyond KP 15.9, the sediment becomes consistently deeper, as observed on the neighbouring routes. The surficial sediment is recorded as sand and gravelly sand, alternating with sandy mud as the route progresses. Megaripples of sand of limited amplitude are observed throughout. The character of the underlying sediment is not known at this point but is likely to feature mixtures of gravelly sands and clay.

Areas of dispersed magnetic anomalies are met sporadically along the whole section. The route is largely free from boulders in this area and the seabed is relatively smooth.

5.4 Technical

5.4.1 BW1

The 15.2km of rocky outcrops on the Ballinwilling 1 route will necessitate the requirement for specialist rock trenching equipment. Rock trenching carries a higher risk of damage to the cable during installation than burial in sediment. Ballinwilling 1 route has the longest section of rocky outcrop of all potential landfall approaches and therefore the highest risk of damage to the cable during installation. Once installation to the required depth is achieved the risk of damage to the cable is comparable across all routes.

5.4.2 BW2

The 6km of rocky outcrops on the Ballinwilling 2 route will necessitate the requirement for specialist rock trenching equipment.

5.5 Deliverability

5.5.1 BW1

The length of rocky outcrops on the route will proportionally affect the deliverability of the route. Implementation timeline will be dependent on the progress rate of installation through the rocky sections. There will be increased uncertainty with regard to trenching progress rates through rocky areas. As Ballinwilling 1 route has the longest section of rocky outcrops it represents a high risk for deliverability.

Rock trenching requires specialist equipment each rated for different rock strengths. The ability of rock-trenching equipment is highly dependent on site specific geology and therefore previous experience may not be a reliable reference. There may not be rock-trenching trials on location prior to construction and therefore the risk remains. In addition, the requirement for rock-trenching may limit the number of contractors able to perform the cable installation at Ballinwilling 1.

The cable is at increased risk of damage during installation. Should damage occur in-field repairs would be required which would directly affect the implementation timelines.

The nearshore survey data indicates that for the first 500m of the cable route the seabed is formed by sandy sediments which give way to rock outcrops which extend for several kilometres offshore. Trenching of the cable within the sandy section could be achieved using a plough. Trenching of the cable within the rocky section would require a rock cutter.

Local fishing and shipping is centred around Ballycotton harbour. Ballinwilling (BW1) route provides a good clearance for fishing and shipping activity in the area.

5.5.2 BW2

The length of rocky outcrops on the route will proportionally affect the deliverability of the route. Implementation timeline will be dependent on the progress rate of installation through the rocky sections. There will be increased uncertainty with regard to trenching progress rates through rocky areas. Ballinwilling 2 (6km of rocky outcrops) offers a more favourable route than Ballinwilling 1 in this respect.

Rock trenching requires specialist equipment each rated for different rock strengths. The ability of rock-trenching equipment is highly dependent on site specific geology and therefore previous experience may not be a reliable reference. There may not be rock-trenching trials on location prior to construction and therefore the risk remains.

The cable is at increased risk of damage during installation. Should damage occur in-field repairs would be required which would directly affect the implementation timelines.

The nearshore survey data indicates that along the cable route the seabed is formed by sandy sediments through a narrow channel between rock outcrops which extend for several kilometres offshore. Trenching of the cable within the sandy section could be achieved using a plough.

Local fishing and shipping is centred around Ballycotton harbour. Ballinwilling (BW2) route runs close to Ballycotton harbour with limited open sea for diversion during construction due to the proximity to Ballycotton headland and could therefore expect a disruption to fishing and shipping in the area. In addition, the route traverses a known static fishing zone and therefore fishing activity could be directly affected during construction.

5.6 Environmental

The Benthic surveys of both Ballinwilling approach routes indicate that no environmentally sensitive habitats or benthic communities were recorded that would prohibit operations over the proposed cable route. This included, notably, an absence of potential Annex I habitats currently protected under the EC Habitats Directive (e.g. pockmark feature, biogenic or geological reefs).

Both potential cable routes avoid the Ballycotton Bay Special Protection Area (SPA) and Ramsar Site which is a nationally important bird species and mud flat and sand flat habitat and avoid the Ballycotton, Ballynamona and Shanagarry proposed Natural Heritage Area (pNHA) which contains wetlands and associated coastal vegetation and supports various bird species.

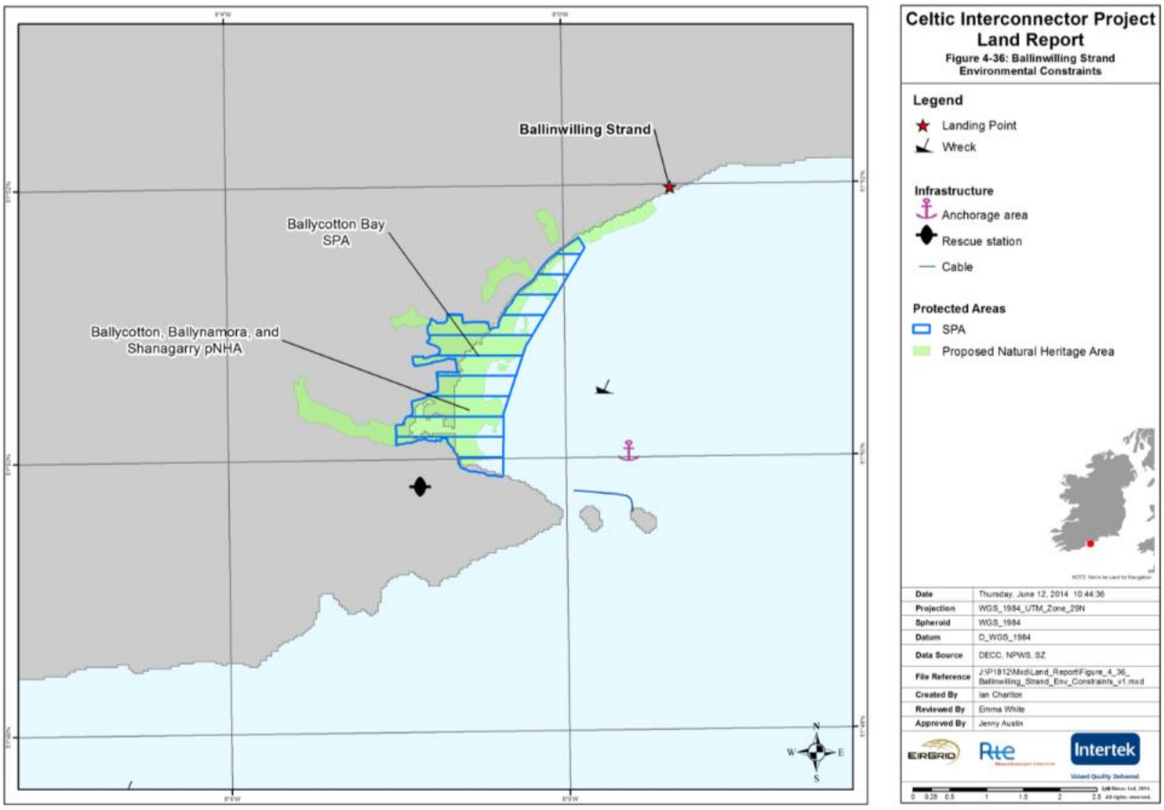

Figure 5-2: Sites Designated for Nature Conservation in the vicinity of Ballinwilling

No features or artefacts of archaeological significance were identified at Ballinwilling Strand. Very few heritage assets were observed within the survey areas from the walkover survey on Ballinwilling Strand. The remains of sea defences, concrete breakwaters and groynes along the edge of Ballinwilling Strand comprise low value heritage assets.

5.6.1 BW1

While not significant, the Ballinwilling 1 route recorded the highest density of marine species of all 5 routes surveyed.

Rock-trenching would result in a permanent deformation of the seabed. Where possible any trenching would be back-filled. If external rock protection were to be required where burial in the rock was not possible this would result in the introduction of rock, likely from a quarry in Norway.

As most trenching/cutting activity is subsea and there is no requirement for piling, noise levels above the waterline would not be expected to be significant and would not vary greatly between routes. However, noise levels below water which could affect marine mammals would be greater where rock cutting activity is expected at Ballinwilling 1.

There is evidence of significant erosion occurring at the Ballinwilling beach due to storm conditions. Numerous boulders of up to 1.0m diameter are present at the base of the cliff at the foreshore. Rock armour has been placed at the base of the cliff, with the assumption to limit costal erosion. Hydrosedimentary study has indicated that this has the highest seabed mobility of any landfall with up to 2m of erosion during a 50 year storm event.

5.6.2 BW2

The Ballinwilling 2 route recorded the lowest density of marine species of all 5 routes surveyed.

Rock-trenching would result in a permanent deformation of the seabed. Where possible any trenching would be back-filled. If external rock protection were to be required where burial in the rock was not possible this would result in the introduction of rock, likely from a quarry in Norway.

As most trenching/cutting activity is subsea and there is no requirement for piling, noise levels above the waterline would not be expected to be significant and would not vary greatly between routes. However, noise levels below water which could affect marine mammals would be greater where rock cutting activity is expected.

There is evidence of significant erosion occurring at the Ballinwilling beach due to storm conditions. Numerous boulders of up to 1.0m diameter are present at the base of the cliff at the foreshore. Rock armour has been placed at the base of the cliff with the assumption to limit costal erosion. Hydrosedimentary study has indicated that this has a high level of seabed mobility with up to 2m of erosion during a 50 year storm event.

Due to the close proximity of all landfalls MetOcean conditions are similar along much of the approach routes. Ballinwilling is more sheltered than Ballycroneen but not as sheltered as Claycastle and Redbarn.

5.7 Socioeconomic

5.7.1 BW1

The key socioeconomic impacts of the marine approaches are fisheries, recreation and tourism. The primary fishing activity in the immediate area is static fishing for shrimp which occurs from 1st August to the 15th March when shrimp migrate from the rocky sections to the sandy sections. From a line 51º 47' North and 08º 06' West, North to the shoreline represents the westward line of the shrimp fishing. The eastward line is 51º 47' North and 07º 57' West, North to the shoreline. Feedback from the local fishing association advised that moving fishing gear during the winter months can be challenging due to weather constraints and fishing being restricted to specific locations.

A temporary exclusion corridor would be required on the beach during construction thus dividing the beach in two for a number of weeks. This operation could be decoupled from the main cable installation such that it could occur off-peak by burying a conduit into which the cable would later be installed.

The beach is popular for leisure visitor with bathers during the summer months and walkers throughout the year. Nearshore water sports including surfing, wind surfing and kite-surfing are popular at Garryvoe (near Ballinwilling).

5.7.2 BW2

The key socioeconomic impacts of the marine approaches are fisheries, recreation and tourism. The primary fishing activity in the immediate area is static fishing for shrimp which occurs from 1st August to the 15th March when shrimp migrate from the rocky sections to the sandy sections. From a line 51º 47' North and 08º 06' West, North to the shoreline represents the westward line of the shrimp fishing. The eastward line is 51º 47' North and 07º 57' West, North to the shoreline. Feedback from the local fishing association advised that moving fishing gear during the winter months can be challenging due to weather constraints and fishing being restricted to specific locations.

The narrow vein of sand in Ballinwilling 2 route is heavily fished and disruption could be significant during construction. There is a potential long-term impact to the shrimp migrations if excessive rock protection were to be used. The shrimp fishing in this vein could be affected as a result.

A temporary exclusion corridor would be required on the beach during construction thus dividing the beach in two for a number of weeks. This operation could be decoupled from the main cable installation such that it could occur off-peak by burying a conduit into which the cable would later be installed.

The beach is popular for leisure visitor with bathers during the summer months and walkers throughout the year. Nearshore water sports including surfing, wind surfing and kite-surfing are popular at Garryvoe (near Ballinwilling).

5.8 Economic

5.8.1 BW1

The Ballinwilling 1 route has the longest section of rock trenching required. Rock trenching is time consuming and requires specialist equipment, therefore this route would represent a high installation cost with significant levels of uncertainty with regard to progress rates during burial. In addition, rock cutting would be required at the landfall requiring additional equipment. Overall implementation costs would be at least 40% greater than the best performing route.

5.8.2 BW2

The Ballinwilling 2 route is 1km longer and thus cable supply costs are increased, however it requires significantly less rock trenching. Overall implementation costs could be at least 10% greater than the best performing route and significantly less than Ballinwilling 1.

5.9 Key Constraints and Considerations

5.9.1 BW1

The key offshore constraints associated with BW1 are summarised below;

- Potential for rock-cutting and remedial external protection along 15.2km of the route.
- Increased risk of damage during installation due to requirements for rock cutting.
- Challenging seabed gradients for installation equipment.
- High submarine noise levels during rock cutting operations.
- Challenging landfall requiring rock cutting operations.

5.9.2 BW2

The key offshore constraints associated with BW2 are summarised below;

- Potential for impact on fishing during construction.
- Potential for rock-cutting and remedial external protection along 6km of the route.
- Increased risk of damage during installation due to requirements for rock cutting.
- High concentration of dense boulders.
- High submarine noise levels during rock cutting operations.
- Challenging landfall requiring rock cutting operations.

6.0 Redbarn

6.1 Overview

The Redbarn landfall is located approximately 3km south west of the town of Youghal. The landfall is formed by a gently sloping sandy beach, see Figure 6-1. The offshore route differs from the Claycastle route only for the 3.6km closest to landfall. This 3.6km section is characterised by 2km of rocky outcrops, 2.7km of boulder fields and 2.5 km of high seabed gradient. By contrast the branch into the landfall at Claycastle has none of the above within the final approach.

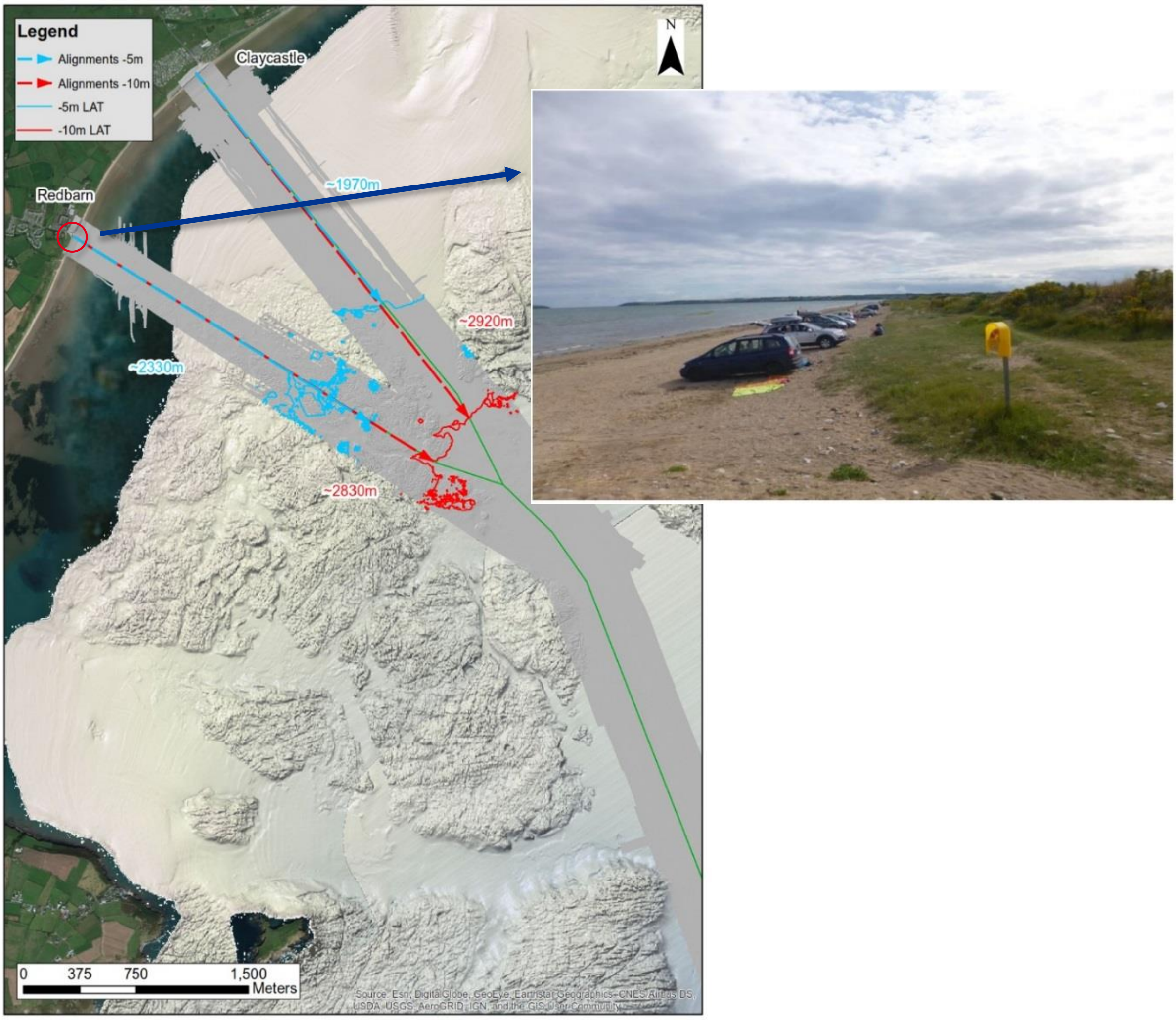

Figure 6-1: Redbarn Landfall Approach

The Claycastle (CL) and Redbarn Beach (RE) routes are entirely common from the offshore node until the point at which they converge approximately 4km from the coast. The routes are longer than those serving the landfalls to the west and follow a line near perpendicular to the coastline until KP 17, before turning south-southwest towards the point at which all of the nearshore routes meet. As with BW2, the routes were conceived to take advantage of apparently in-filled channels of sediment and thereby ameliorate burial conditions in the nearshore area.

The bathymetric profile shows a gentler transition to deeper water than the routes to the west, and a far shorter area of varying slope close to the shore. The band of outcropping rock common to the other routes appears to be present in this area until KP 18.1 (approx.), but the routes stay clear of the outcrops in all but the very nearshore areas. The RE route is affected for a short distance; CL is almost entirely clear.

6.1.1 RE S1: KP 0.2 – KP 3.6

The route section between Redbarn Beach and the point where it meets Claycastle is dominated by rock outcrops and a boulder field. The strip of sand and gravelly sand near the shore gives way to rock at KP 0.9 and continues all but uninterrupted for 2km (approx.). The bathymetric profile is smooth except where disturbed by the rock outcrops; the 10m water depth contour is met around KP 2.7.

Beyond KP 2.0, sands and (predominantly) sandy muds reappear and the bedrock drops away quickly. With the exception of the first 0.9km, the whole RE route to this point is classified as a "boulder field". However, the route appears clear of magnetic anomalies.

6.2 Technical

Redbarn benefits from the sediment channel common to the Claycastle route with sufficient sediment depth to bury the cable to the required depth for protection with the exception of the 3.6km closest to shore where rock trenching would be required. The 2km of rocky outcrops on the Redbarn route would necessitate the requirement for specialist rock trenching equipment. Rock trenching carries a higher risk of damage to the cable during installation than burial in sediment. While this route has more rock outcrops than Claycastle, it has significantly less than the other offshore routes. Once installation to the required depth is achieved the risk of damage to the cable is comparable across all routes.

6.3 Deliverability

While it is one of the longest offshore cable routes, it offers a more straightforward installation with the greatest certainty on deliverability with the exception of the last 3.6km.

The length of rocky outcrops on the route proportionally affects the deliverability of the route. Implementation timeline will be dependent on the progress rate of installation through the rocky sections. There will be increased uncertainty with regard to trenching progress rates through rocky areas.

Rock trenching requires specialist equipment each rated for different rock strengths. The ability of rock-trenching equipment is highly dependent on site specific geology and therefore previous experience may not be a reliable reference. There may not be rock-trenching trials on location prior to construction and therefore the risk remains. In addition, the requirement for rock-trenching may limit the number of contractors able to perform the cable installation at Redbarn.

The cable is at increased risk of damage during installation. Should damage occur in-field repairs will be required which will directly affect the implementation timelines.

Local fishing and shipping are centred around two harbours, Ballycotton and Youghal. The Redbarn and Claycastle routes approach Youghal, however, there should be sufficient open sea available to minimise disruption to fishing and shipping traffic to Youghal harbour during construction.

6.4 Environmental

The Benthic surveys of Redbarn approach route indicate that no environmentally sensitive habitats or benthic communities were recorded that would prohibit operations over the proposed cable route. This included, notably, an absence of potential Annex I habitats currently protected under the EC Habitats Directive (e.g. pockmark feature, biogenic or geological reefs). The Redbarn route recorded a marginally higher number of marine species and individuals compared to Claycastle.

The potential cable route to Redbarn avoids offshore sites designated for Nature Conservation in the vicinity of Redbarn as shown in Figure 6-2.

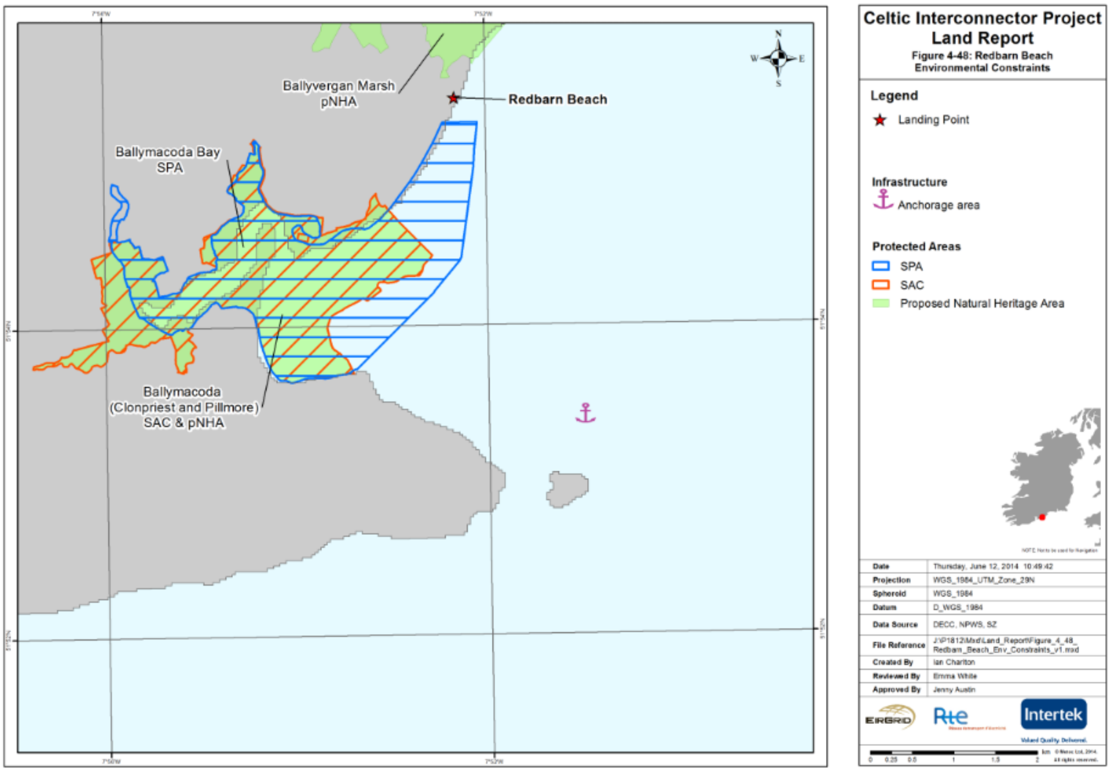

Figure 6-2: Sites Designated for Nature Conservation in the vicinity of Redbarn

Cable burial in sediment would result in temporary disruption of the seabed during trenching operations, however, it is envisaged that the trench would be back-filled with the spoil either during the installation process if specified or by means of natural backfill from surrounding sediment over time.

Rock-trenching (2km) would result in a permanent deformation of the seabed. Where possible any trenching would be back-filled. If external rock protection were to be required where burial in the rock was not possible this would result in the introduction of rock, likely from a quarry in Norway.

As most trenching/cutting activity is subsea and there is no requirement for piling, noise levels above the waterline would not be expected to be significant. However, noise levels below water which could affect marine mammals would be greater where rock cutting activity is expected at Redbarn.

Due to the close proximity of all landfalls MetOcean conditions are similar along much of the approach routes. However, Redbarn (and Claycastle) are the most sheltered of all routes thus represent less risk of weather downtime during construction.

There is no evidence of erosion occurring on Redbarn beach. The hydrosedimentary study shows that this beach (along with Claycastle) has the lowest erosion of any of the possible route landfalls.

Nothing of particular archaeological significance was found during the surveys.

6.5 Socioeconomic

The key socioeconomic impacts of the marine approaches are fisheries, recreation and tourism. The Redbarn route traverses a known static fishing zone and there is a presence of static gear all year round. The primary fishing activity in the immediate area is static fishing for shrimp which occurs from late summer into winter when shrimp migrate from rocky sections into sandy sections.

During the months from March to August fishermen also fish for crab and lobster. As the fishing area is larger than some of the alternative landfalls there would be a higher degree of flexibility as to where the fishing gear can be deployed.

Activities on the beach are seasonal, however, Redbarn is close to an urban centre and therefore likely to see more activity year-round.

Redbarn is dominated by the Quality Hotel and Leisure Centre which overlooks the beach. It is also the location of a small static caravan site and supports a number of permanent holiday homes. There is a designated bathing area in front of the Hotel however the proposed cable route would lay outside this zone. Signage indicates temporary car parking for holidaymakers is available on the beach at the HWM. The preferred landing point would be at least 200m from the hotel.

Landfall construction would require an exclusion corridor on the beach during construction thus dividing the beach in two for a number of weeks. This operation could be decoupled from the main cable installation such that it could occur off-peak by burying a conduit into which the cable would later be installed.

Nearshore water sports including surfing, wind surfing and kite-surfing are popular at Youghal (Redbarn and Claycastle).

6.6 Economic

The Redbarn route is the second longest route (approx. 400m shorter than the Claycastle route) and thus would require the second longest length of cables. The route benefits from the sediment channel with the exception of the 3.6km closest to shore. However, the presence of 2km of rock on the nearshore area would require rock trenching. Rock trenching is time consuming and requires specialist equipment, therefore this route would represent a higher installation cost with greater levels of uncertainty with regard to progress rates during burial when compared with Claycastle. In addition, rock cutting would be required at the landfall requiring additional equipment.

6.7 Key Constraints and Considerations

The key offshore constraints associated with Redbarn are summarised below;

- Up to 2km of rock cutting in shallow water close to the landfall.
- Short length of rock cutting and therefore reduced risk of damage to cable during installation.
- Sheltered from weather during installation.
- High submarine noise levels during rock cutting operations.
- Challenging landfall requiring rock cutting operations.

7.0 Claycastle

7.1 Overview

The proposed Claycastle landfall is located approximately 2km south west of the town of Youghal. The landfall is formed by a gently sloping sandy beach which was extensively surveyed in 2017/18. The offshore cable branch route is 34km and follows a sediment channel identified within the band of bedrock present along this coast. Rocky outcrops are not recorded on the route and there are no issues with seabed gradients.

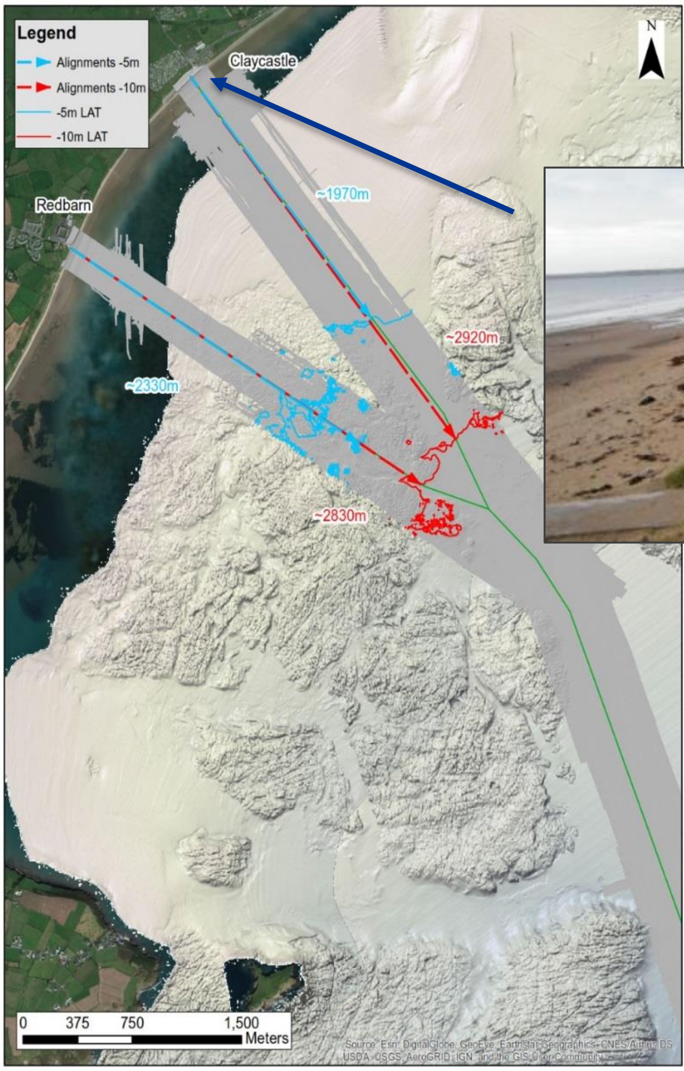

Figure 7-1: Claycastle Landfall Approach

7.1.1 CL S1: KP 0.0 – KP 4.0

The route from Claycastle Beach follows a channel that avoids outcropping rocks between KPs 2.5 and 3.0. The seabed profile is consequently an uninterrupted smooth progression to 10m water depth at KP 2.9, with none of the section qualifying as "challenging" on the grounds of seabed slope.

The sediment in this area is predominantly sandy mud, with patches of sand appearing from KP 3.2. Boulders (classified as "boulder area") are numerous throughout but no other features are noted, magnetic or otherwise.

7.1.2 CL S2: KP 4.0 – KP 18.1

In this section the route follows a wider, deeper channel through the shoreline area of outcropping rock. Depths to bedrock of tens of metres are common; the objective of finding a more favourable route for burial having been achieved. The seabed continues to comprise sands and sandy muds throughout this section. The survey data identifies a number of intermediate reflectors in some areas, suggesting that some harder soils may be present between the surficial sediment and the bedrock 20-50m below.

The route remains free of dense boulders for this whole section, although magnetic anomalies are scattered across the corridor throughout. Rocky outcrops appear again to either side of the route between KPs 9.5 and 13.0, but the depth of the sediment along the route centreline remains over 4m. Between KPs 15.5 and 18.5, areas of sub-cropping rock skirt the route but again the bedrock never comes within 5m of the seabed surface. This is because of some route engineering undertaken in this area by the survey contractor; the route is guided towards the east of the corridor between KPs 11.2 and 17.2.

7.1.3 CL S3: KP 18.1 – KP 34.0

Beyond KP 18.1, the sediment remains tens of metres deep; typically 20-50m and more in some areas. On the surface, sand and sandy mud alternate, and the subsurface continues to show intermediate strata above the bedrock. The water depth gradually increases from 70m (approx.) to 80m (approx.) at a fairly steady gradient. Megaripples of sand become pronounced from KP 29.1 to the end of the route section.

Boulders within this section are sufficiently infrequent to be classified individually. An avoidable cluster is met at KP 22.5, and another at KP 23.5. Areas of (dispersed) magnetic anomalies become more intermittent; falling mostly in the sections between KPs 18.1 and 21.7 and between KPs 30.5 and 34.0. In all instances these appear avoidable, but potential Unexploded Ordnance (pUXOs) must be further identified as an exclusion zone will be applicable.

From KP 29.0 to KP 33.6, items of debris are identified scattered across the corridor. Conceivably, these may be associated with the wreck identified in the far west of the corridor at KP 33.1. The wreck is recorded at 7.9m in length but 14.3m in height, perhaps suggesting partial burial of the item or that other sections may be present outside the corridor. As the feature surveyed is over 200m from the route it does not present an issue for routing.

7.2 Technical

In order to reduce the risk of damage to the cable due to fishing and shipping activity it is required to bury the cable to a suitable depth or protect the cable by placing a rock berm over the cable. Claycastle offers a good technical route as it follows a sediment channel with sufficient sediment depth to bury the cable to the required depth for protection.

7.3 Deliverability

While it is the longest offshore cable route, it offers a more straightforward installation with the greatest certainty on deliverability. Sediment coverage is good and installation is most straightforward with standard tools employed. There should be no requirement for rock trenching tools and associated timeline implications and cable installation damage risks. There are 9km of boulder fields which would require pre-sweeping before cable installation.

Claycastle offers good conditions for open-cut trench at landfall as there are no outcropping rocks identified. All other routes show some rock outcrops in shallow water which would require trenching through rock at landfall.

Local fishing and shipping are centred around two harbours, Ballycotton and Youghal. The Redbarn and Claycastle routes approach Youghal, however, there should be sufficient open sea available to minimise disruption to fishing and shipping traffic to Youghal harbour during construction.

7.4 Environmental

The Benthic surveys of Claycastle approach route indicate that no environmentally sensitive habitats or benthic communities were recorded that would prohibit operations over the proposed cable route. This included, notably, an absence of potential Annex I habitats currently protected under the EC Habitats Directive (e.g. pockmark feature, biogenic or geological reefs). The Claycastle route recorded the lowest number of marine species and individuals of all 5 routes surveyed.

The potential cable route to Claycastle avoids offshore sites designated for Nature conservation in the vicinity of Claycastle as shown in Figure 7-2.

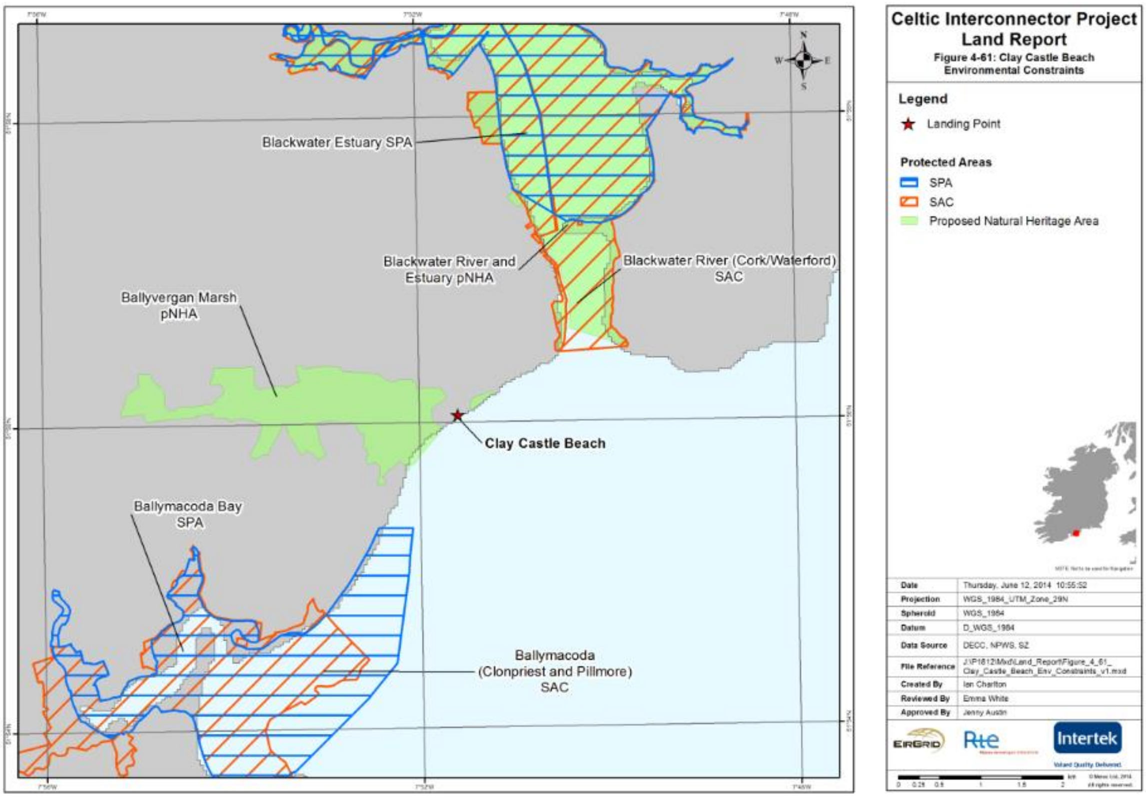

Figure 7-2: Sites Designated for Nature Conservation in the vicinity of Claycastle

Cable burial in sediment would result in temporary disruption of the seabed during trenching operations, however, it is envisaged that the trench would be back-filled with the spoil either during the installation process if specified or by means of natural backfill from surrounding sediment over time. It is not expected that there would be a permanent deformation of the seabed or introduction of materials from a remote source unlike all other routes where rock trenching and rock placement are expected.

As trenching/cutting activity would not be required noise levels above and below water, which could affect marine mammals, would be much less than all other routes.

Due to the close proximity of all landfalls MetOcean conditions are similar along much of the approach routes. However, Claycastle (and Redbarn) are the most sheltered of all routes and thus represent less risk of weather downtime during construction.

Erosion and deposition do occur on this beach. Evidence for this lies with attempts in the past to control longshore drift by building groynes and dumping rock. The depth of burial of existing groynes suggests that the beach is more of depositional rather than an erosional environment. The hydrosedimentary study shows that this beach (along with Redbarn) has the lowest erosion of any of the possible route landfalls.

A series of features were observed during the archaeological surveys. These were related predominantly to peat deposits observed within the potential route corridor. The peat deposits included evidence of plant remains (tree roots). The geophysical survey detected these remains as extending under the beach both landward and seaward. Several metal anomalies were also located during the metal detector survey. These were located predominantly at the high water mark and were largely low detector value anomalies, indicating probable ferrous material.

While nothing of particular archaeological significance was found the presence of peat has the ability to store items of archaeological interest. EirGrid intends to conduct further investigations in 2019 to determine the extent of the peat across the route corridor. Based on the output of these further investigations it may be possible to avoid the peat deposits, otherwise appropriate mitigation measures could be adopted if this option was ultimately brought forward.

7.5 Socioeconomic

The key socioeconomic impacts of the marine approaches are fisheries, recreation and tourism. The Claycastle route traverses a known static fishing zone and there is a presence of static gear all year round. The primary fishing activity in the immediate area is static fishing for shrimp which occurs from late summer into winter when shrimp migrate from rocky sections into sandy sections.

During the months from March to August fishermen also fish for crab and lobster. As the fishing area is larger than some of the alternative landfalls there would be a higher degree of flexibility as to where the fishing gear can be deployed.

Activities on the beach are seasonal, however, Claycastle is closer to an urban centre and therefore likely to see more activity year-round. Being less than 3 km from the amenities of Youghal and offering temporary accommodation less than 100m from the beach, Claycastle is a popular seaside holiday resort especially during the summer months.

The large car park facilitates day trippers, walkers and runners to the beach. The social impact of constructing a cable landing here would be higher than at Redbarn 1km to the south west.

Landfall construction would require an exclusion corridor on the beach during construction thus dividing the beach in two for a number of weeks. However, this operation could be decoupled from the main cable installation such that it could occur off-peak by burying a conduit into which the cable would later be installed.

Nearshore water sports including surfing, wind surfing and kite-surfing are popular at Youghal (Redbarn and Claycastle).

7.6 Economic

While the Claycastle route is the longest route and thus requires the longest length of cables, the lack of rock trenching results in the lowest installation cost and offers greater certainty with regard to progress rates during burial.

7.7 Key Constraints and Considerations

The key offshore constraints associated with Claycastle are summarised below;

- Very good sediment coverage with no rock cutting required.
- An area of peat deposits have been recorded at Claycastle Beach.
- No rock cutting and therefore reduced risk of damage to cable during installation.
- Sheltered from weather during installation.
- Lower level of submarine noise during construction as no rock cutting required.
- Straightforward landfall as no rock cutting operations required.

8.0 Summary

8.1 Objectives

As set out in the objectives in Section 1.2 this document provides a summary overview of constraints associated with the nearshore route options into each of the landfalls on the Irish side.

The constraints have been assessed for each landfall under a number of headings defined by the Project. The constraints are based on engineering and survey documents and data produced as part of the Celtic Interconnector project in addition to publicly available information.

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