EIRGRID & RTE

CELTIC INTERCONNECTOR PROJECT – MARINE CONSULTANCY AND ENGINEERING SERVICES

LAND REPORT

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SUMMARY

Intertek has been commissioned, under its marine consultancy and engineering services contract, to provide a cable landing review for the proposed HVDC Celtic Interconnector cable for EirGrid and RTE. The objective of the study is to establish the least constrained landfall locations from a marine perspective, for further seabed survey.

Intertek conducted Landfall site visits for both the Irish & French sites. In Ireland the ten proposed sites fell into two regions, five near Cork and five near Wexford/Waterford. In France, a total of six potential sites were considered, all in the Brittany region. The site visits were conducted during the period 4th – 7th November 2013 for the Irish landings and 20th – 22nd November 2013 for the French landings.

The objective of the site visits was to assess each proposed site for its suitability as a cable landing site, factoring in all aspects involved in a cable installation. Each site was scored using a weighted system to accurately depict which sites were the most preferred and why. The results of the scoring exercise are presented in Section 5 – Landfall Rankings.

There are a number of recommendations made within this document that should be considered in the final engineering solution for a successful installation. These are set out in Section 6 – Conclusions & Recommendations for Further Work. The recommendations from this Landfall report should be considered, along with the cable Route Investigation Report for the marine route, when scoping the marine survey solution.

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1 INTRODUCTION

1.1 BACKGROUND

EirGrid and RTE are investigating the feasibility of installing a power cable interconnector between Ireland and France. The project will include 2 No. High Voltage Direct Current (HVDC) converter stations, a 700+MW HVDC submarine interconnector between the converter stations and onshore lines/cables as appropriate.

Intertek have been appointed by EirGrid and RTE to provide a range of marine consultancy & engineering services related to the Celtic Interconnector project. These services relate to EirGrid contract Ref ENQEIR369 and Rte contract No. CX513T4010.

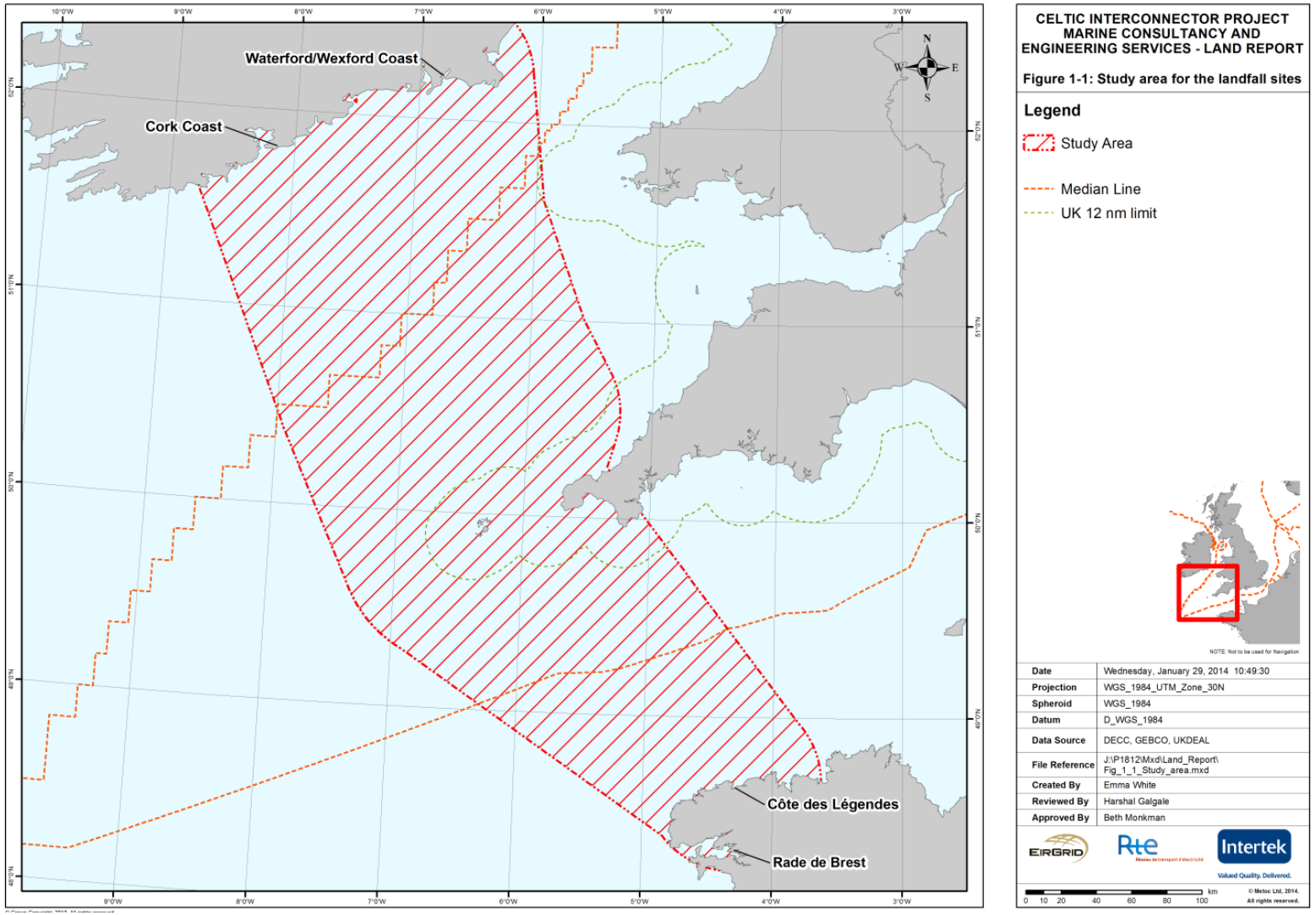
This report focuses primarily on the landfall options for the interconnector cable.

Intertek has carried out site visits to the landfall options in both Ireland and France and this report summarises the findings of the site visits as well as the outcomes of the landfall workshops conducted in Dublin and Paris:

- Landfall workshop with EirGrid and ESBI (Irish land consultant), Dublin, 28th Nov 2013.
- Landfall workshop with RTE, Artelia and C&S Conseils (French land consultant), Paris, 12th Dec 2013.

Figure 1-1 below shows the study area for the landfall sites in Ireland and France.

Figure 1-1 Study area for the landfall sites



1.2 SCOPE OF WORK

The scope of work associated with this report includes the following:

- Conduct in-field & desk-top cable landfall site studies based on project-held information, including SeaZone data, public domain data, Intertek in–house data and previous project expertise.
- Identification and appraisal of nearshore infrastructure, conditions, constraints and considerations (economic, physical, and human environment) that might impact on installation to the cable landfall options.
- Co-ordination with onshore routing constraints.
- Carry out a comparison of the landfall locations for Ireland and France and identify as necessary the least constrained / preferred land location option(s) from a marine perspective (for further marine survey scoping).

1.3 SUPPLIED INFORMATION

The following information was provided by EirGrid and RTE to aid this study:

- ESBI (2013), Extract from Draft Report on Landfall Options.
- C&S Conseils (2013), Project de Liaison Celtic Interconnector – Partie Terrestre Francaise Etude de Contexte (Context Study with Landing Points).

1.4 BACKGROUND INFORMATION

This report assumes the reader has a certain level of knowledge regarding cable landing installation methods. To assist with this, a section describing typical cable installation methods is included in **Appendix A**.

2 METHODOLOGY

Site visits were carried out for the following periods as listed below:

- 4th Nov – 7th Nov 2013, Irish sites.
- 20th Nov – 22nd Nov 2013, French sites.

The above locations were assessed according to the following items below:

Landfall position

The position of the landfall (e.g. near a busy beach or port, etc.) will have an effect on the permits and installation methodology.

Environmental Issues

Environmental sites such as Special Areas of Conservation (SAC), Special Protection Area (SPA), Ramsar, etc. were examined at each landfall to determine their constraints. See 6Appendix B for further details.

Site Access

Each landfall site was examined for available infrastructure (roads, parking, etc.) and space for site office, plant machinery (e.g. excavators, HDD equipment, winches, etc.), amongst others.

Topography

The topography (beach and nearshore profile) was assessed to determine the feasibility of the marine cable approach as well as appropriate landfall methodology.

Geology

The geology was assessed to determine the appropriate landfall methodology.

Nearshore and Beach Description

Assessments of the nearshore and beach were carried out. Details such as erosion, nearshore obstructions (e.g. sea defences, pipes, outfalls, etc.) were noted. This will influence the feasibility of the landfalls.

Third Party Interaction

Third party assets were identified to assess their impacts to the landfalls. This may include oil & gas pipelines, power and telecom cables, sewer outfalls, etc.

Archaeology (including nearshore and littoral)

Desktop review of archaeological resources around the landfall sites was carried out.

Nearshore Approaches

The nearshore approach for each site was assessed with regards to bathymetry, soil types, shipping routes (if any),sensitive fishing grounds (if any), and any other obstructions / constraints.

Metocean Conditions

The action of the local and regional weather and sea conditions on the cable's integrity was assessed with regards to installation (marine and land), operation and maintenance.

Trenchability

The visible geology and beach composition for each site was assessed with regards to the suitability and likelihood of achieving an appropriate level of cable burial for the cable's protection.

Constructability

Based on the above findings, the feasibility and appropriate installation methodology was recommended.

The site visits and assessments carried out were assessed in accordance with the criteria shown in the Table 2-1 below.

Table 2-1 Cable landing criteria

Parameter	Ideal	Acceptable
Beach & Seabed geology & sedimentology	Gently shelving beach & approaches, > 2m sediment cover. Stable beach level.	Gently shelving beach, < 1m sediment cover, pebbles & small boulders if they can be excavated, rock seabed providing profile will not cause cable suspensions. Existing slipway if it offers opportunity as cable way.
Local Weather Patterns & Tides/Currents	Sheltered from prevailing weather, currents < 1knt	Partial shelter from prevailing weather, currents < 2knts
Fishing/anchoring & other risks	No inshore fishing or anchoring	Inshore fixed gear fishing, yacht anchorage, fish farming if clear of cable route.
Proximity & diversity for other cables/pipelines	No cables or pipelines in area	Landing offers sufficient space to achieve adequate separation, to be defined, on a case by case basis.
Access for cable vessel/Barge	10m water depth contour < 500m from MLW mark. Approaches clear of all dangers	10m depth contour < 1000m from MLW mark, off shore dangers with sufficient sea room to allow safe vessel access.
Access for land cable & beach plant	Access via primary roads, no improvements needed, hard standing available for plant.	Access via a regional road or track, with ability to upgrade if required. Space available to build hard standing.
Cable engineering & protection requirements	Cable can be direct buried on beach and off shore	Cable can be protected with split pipe & pinned to seabed if required
Existing power infrastructure	Landing <10km of existing power infrastructure	Landing > 10km from existing power infrastructure, with viable route to build link.

3 STUDY AREA / SITE OVERVIEW

3.1 IRELAND

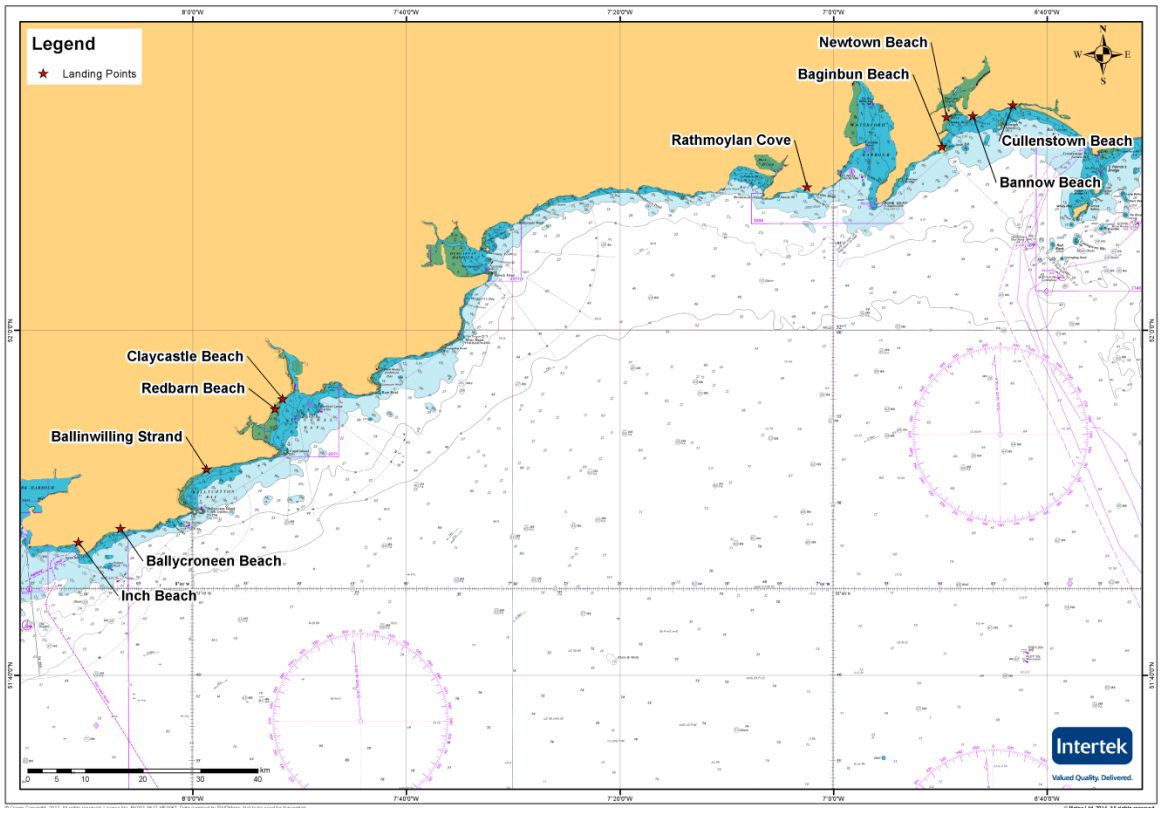
The location of the Irish landfall sites were provided by ESBI (Irish land consultant) following an initial feasibility assessment. There are 10 sites in total and they occur on the southern coast of Ireland spread between County Cork and County Waterford. They have been divided into two study areas as listed below:

Table 3-1 Irish landfall sites

Knockraha Area	Great Island Area
1. Inch Beach	6. Rathmoylan Cove
2. Ballycroneen Beach	7. Baginbun Beach
3. Ballinwilling Strand	8. Newtown Beach
4. Redbarn Beach	9. Bannow Beach
5. Claycastle Beach	10. Cullenstown Beach

Figure 3-1 below shows the location of the landfall sites along the southern coast of Ireland in relation to each other.

Figure 3-1 Overview of Irish landfall sites



3.2 FRANCE

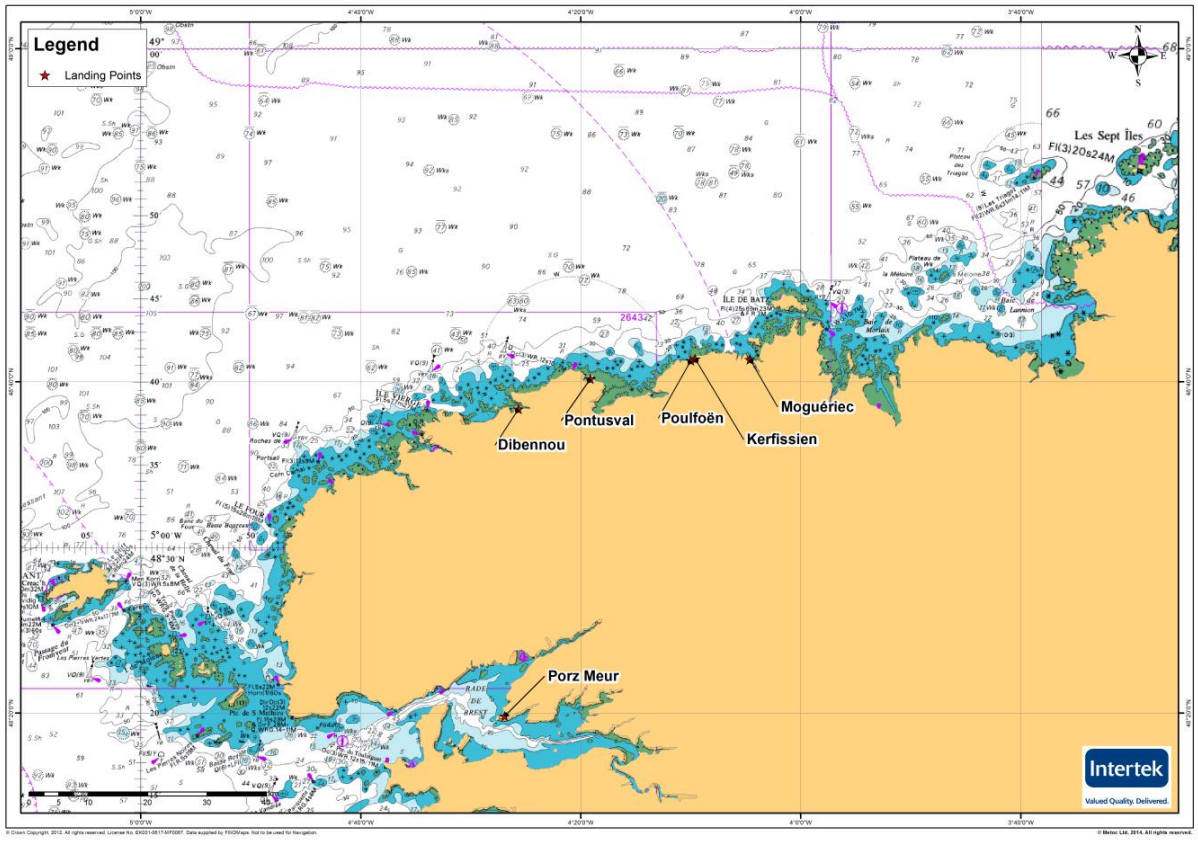
The location of the French landfall sites were provided by C&S Conseils (French land consultant). There are 6 sites in total and they occur on the northern coast of France in the Brittany region. They are listed below:

Table 3-2 French landfall sites

Brittany Region
1. Mogureric
2. Kerfissien
3. Poulfoën
4. Pontusval
5. Dibennou
6. Porz Meur

Figure 3-2 below shows the location of the French landfall sites in relation to each other.

Figure 3-2 Overview of the French landfall sites

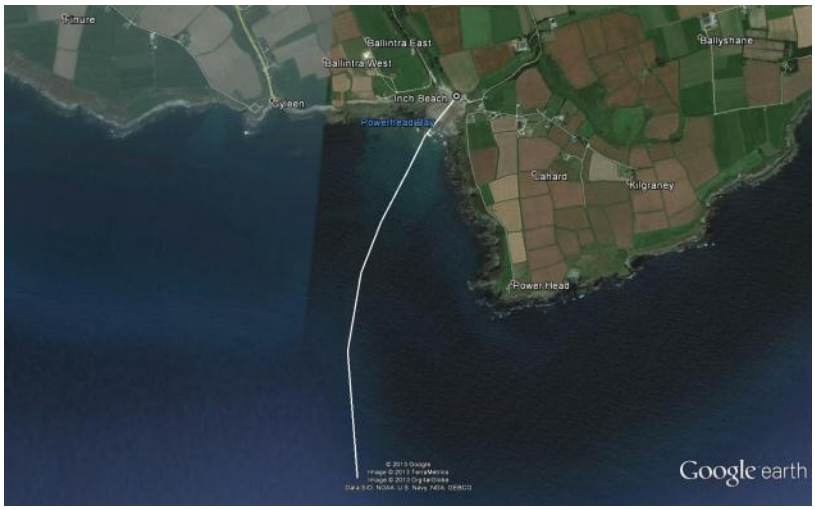


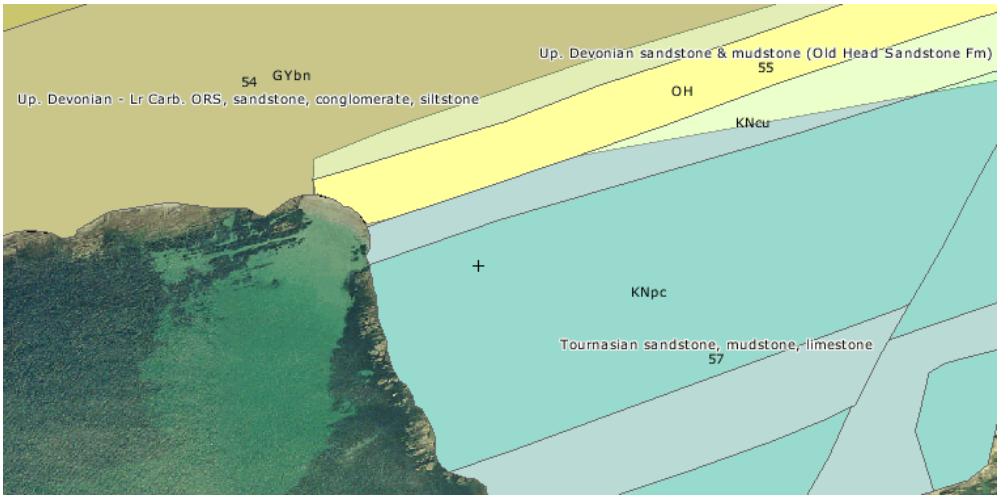
4 LANDING SITE DETAILS

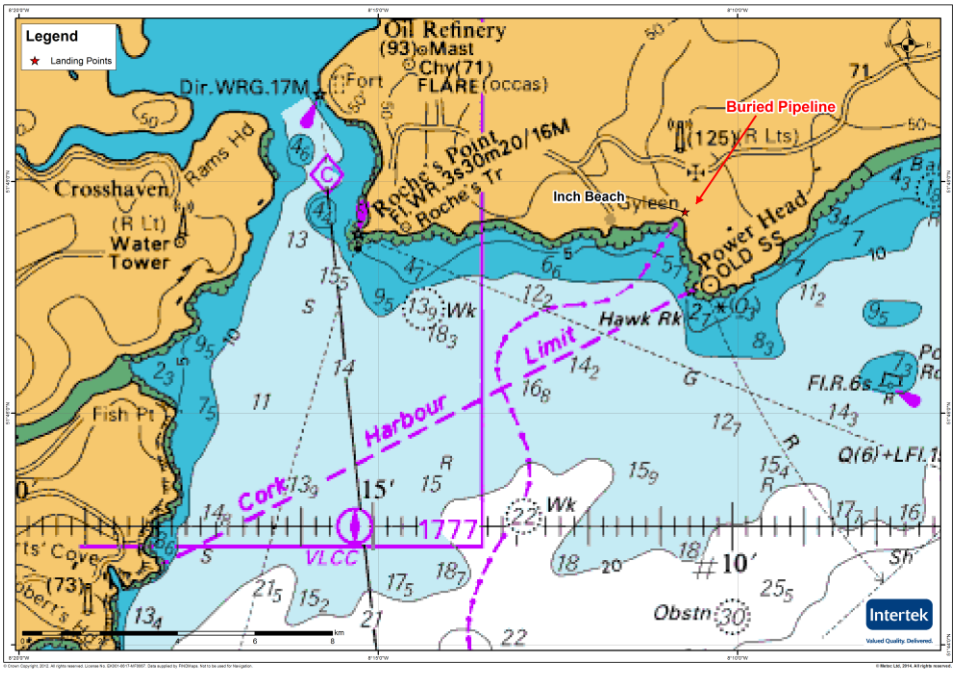
The findings of the site visits and the desktop studies for the Irish and French landfall sites are detailed in the sections below.

4.1 IRELAND LANDFALL OPTIONS

4.1.1 Inch Beach

Landing	Inch Beach
District	Midleton District, County Cork
Position (WGS 84 UTM Zone 30N)	**51°47'44.24"N 8°10'43.92"W**
Time & Tide of visit	04th November 2013 Nearest Port: Cobh Predictions source for Cobh, UK Admiralty Time Height 04 05:23 4.22m 11:54 0.12m Mon 17:44 4.24m
Area Summary topographical description	Inch Beach is situated 5km to the east of the entrance to Cobh Harbour and 1km north of Power Head. The beach faces 210° T (True north) and is therefore exposed to the prevailing south westerly wind and waves. It is sheltered from west north west to south east directions by substantial rock cliffs. See Figure 4-1 below. **Figure 4-1 Inch Beach Approach**  The beach is approximately 160m wide, bordered on both sides by prominent rock outcrops extending both ways along the coastline. Behind the beach is well drained farmland consisting of mainly grazing fields. Two small rivers flowing down independent valleys, discharge fresh water onto the eastern and western sides of the beach. The backshore is largely flat apart from a large outcrop near the centre. Between the foreshore and backshore, a storm berm consisting of stones and cobbles extends up to 1.5m in height above the sandy foreshore. Inch Beach is undeveloped. Two permanent and less than five temporary dwellings are scattered on the hill above the eastern side of the beach, with a Coastguard Station looking out from atop the western cliff. There are no significant buildings behind the beach.

Social Factors	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.
Access to Site	Reasonable. Two winding single track roads provide access to small car parks above the east and west sides of the beach. Both roads could accommodate heavy vehicles.
Access to beach	Good access to the beach is directly available by foot from each car park. Heavy plant could easily access the beach and storage areas from either car park.
Plant storage area	There are two possibilities for plant storage adjacent to the High Water mark. These being: 1. The main car park on the east side of the beach 2. A flat area of grass adjacent to the western car park.
Joint pit area & cable ducts	Subject to seismic survey identifying depth of the bedrock, the Transition Joint Pit (TJP) connecting to the marine cable to the land cable could be located in a field to the north of the eastern Car park. This field may be privately owed.
Composition of beach	This sandy beach is flanked by prominent resilient rock outcrops - to the west by vertically dipping Late Devonian sandstones and slates, and to the east by Early Carboniferous Sandstones, Mudstones and Limestones. See Figure 4-2 below. A fault runs approximately north south along the western Valley separating these rock formations. The foreshore is composed of well graded compacted medium sands which would easily support construction vehicles. The east side of the backshore is composed of very coarse pebbles and cobbles mixed with alluvial discharge from the streams above the sand. This forms a low berm <1m high over which a stream flows. Rock outcrops 3-4m high in the middle of the backshore beach. The west side of the backshore has no berm and is composed mainly of sand all the way to the HWM. Rough grass extends immediately above the HWM. **Figure 4-2 Inch Beach bedrock geology**  * For a full geological key please see http://spatial.dcenr.gov.ie/imf/imf.jsp?site=GSI_Simple
Beach Profile	The foreshore has an even gradient of approximately 5° at the head of the beach reducing to 3° beyond 20m of the HWM.
Erosion & Deposition	There is no evidence of coastal erosion at this landing, the sand being protected from dispersal by the surrounding rock outcrops. However, there are warnings posted to surfers and bathers of strong tidal currents at this location which contribute to the beach's current composition. Deposition of the sand appears to be stable with no evidence of longshore drift. Any movement of the sand has not exposed the existing buried pipeline at this location.
Sea Defences	There are no man made sea defences at this beach.

Obstructions on beach	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. The surface of the sand beach is unobstructed for approximately 100m between rock outcrops to the east and west.					
Offshore obstructions	The seabed approach to this beach appears clear of surface obstructions. See Figure 4-3 however the buried pipeline entering the bay could restrict anchoring. The high rock outcrops on either side of the beach may pose a risk to vessels attempting to land here **Figure 4-3 Buried pipeline** 					
Existing infrastructure	The two access roads and car parks are the only existing infrastructure features of this site. Electricity supply to the Coastguard and farm dwellings is installed.					
Distance LWM to contours	To 5 m	0.4km	To 10 m	0.8km	To 20 m	3km
Distance MHWM to MLWM	90 m					

Cable Installation options	The cable could be installed through the middle of the beach avoiding both the rock outcrops and the existing pipeline. An open cut installation method could be considered through the backshore and foreshore and jetting below LWM. Excavated material being used to backfill the trench. Alternatively HDD to beyond the extent of the rocky cove entrance could be considered. This approach could potentially avoid crossing agreement difficulties with the existing gas pipeline. Whilst land access is reasonable, Inch beach's exposure to the prevailing weather from the south west could result in an increased risk of weather downtime during marine operations. Strong tidal streams near shore may also slow inshore survey and installation operations. Cobh Harbour is 12km from site and could serve as a useful base for both the nearshore survey vessel and the cable support vessels. Alternatively Ballycotton harbour is 18km from site and could be used as a haven for small survey and support vessels. Small vessels may struggle in the large swells that break so careful consideration should be given to the optimal seasonal weather window. Also, launching small vessels from Inch beach would not be advisable in conditions of any swell.
Conclusions	From a provisional cable engineering perspective, Inch beach would be a possible landing point. The primary consideration with siting the cable landing at this beach is any requests which could be made by Kinsale Energy in relation to routeing or protection efforts to lay the cable near to or cross their 24" pipeline. The Kinsale Energy Pipeline is not evident at the surface and is assumed to be buried. This would imply that burial of a cable at Inch Bay is feasible. The cable route (to avoid the pipeline) and its burial depth will depend on the extent of bedrock. To be as identified by a shallow land and marine seismic survey. Contact should be made with the operators of the Gas Pipeline to establish procedures to share this location with the proposed power cable landfall. If agreement is reached survey data from the installation of the pipeline should be analysed to ensure safe routeing of the proposed cable. It is important to determine the depth of sediment above bedrock to establish whether achieving target burial depth could be feasible at this location. Seasonal weather and wave height records should be analysed in order to optimise both survey and construction operations.

November 2013 Site Pictures

Figure 4-4 Inch Beach looking south west

Figure 4-5 Foreshore and backshore berm looking north west to W. Stream Outfall

Figure 4-6 Backshore berm looking north east to eastern Stream Outfall

Figure 4-7 Foreshore and backshore berm looking north east

November 2013 Site Pictures

Figure 4-8 Rock outcrop looking west towards Cobh Harbour entrance

Figure 4-9 HWM looking west to Coastguard's lookout

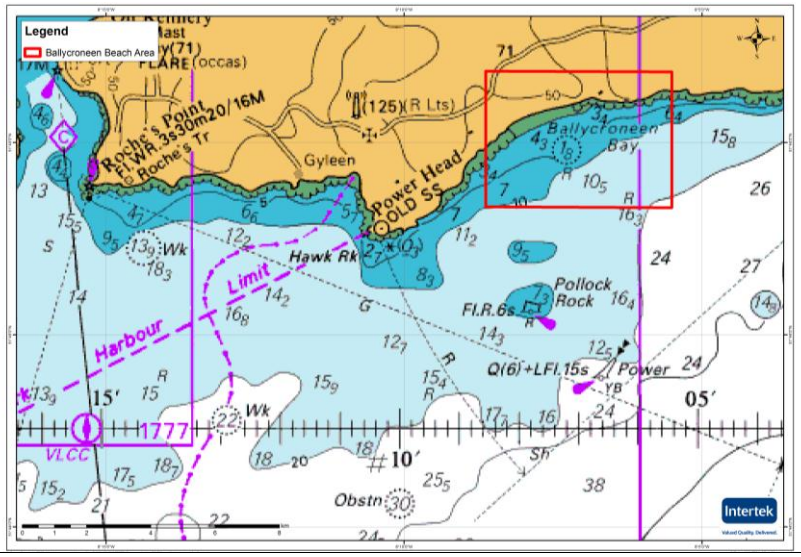
Figure 4-10 HWM looking south east

Figure 4-11 Eastern foreshore

4.1.1.1 Environmental Constraints

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 structures to avoid damage. The location of the gas pipeline has been covered in the previous section. Consultation with the owner of the pipeline is recommended if this option was to be pursued.

4.1.2 Ballycroneen Beach

Landing	Ballycroneen Beach
District	Midleton District, County Cork
Position (WGS 84 UTM Zone 30N)	**51°48'31.77"N 8° 6'46.26"W**
Time & Tide of visit	04th November 2013 07th November 2013 Nearest Port: Ballycotton MHWS 4.1m MLWS 0.4m MHWN 3.2m MLWN 1.3m *Ballycotton predictions source tidetimes.org.uk 4th November* High Tide 05:16 (4.20m) Low Tide 11:43 (0.40m) High Tide 17:35 (4.20m) 7th November* Low Tide 01:38 (0.50m) High Tide 07:33 (4.10m) Low Tide 14:02 (0.60m) High Tide 19:53 (4.00m)
Area Summary topographical description	The proposed landfall is at the eastern end of Ballycroneen Beach which extends westwards for 1.8km towards the entrance to Cobh harbour 12km to the west. It may be reached by road 6.5km south of Croyne. See Figure 4-12 and Figure 4-13. **Figure 4-12 Ballycroneen Beach**  **Figure 4-13 Location of Ballycroneen Beach** 

	The landfall is at the end of a valley that cuts approximately 40m through gently undulating countryside. A small river discharges fresh water onto the beach. See Figure 4-14. **Figure 4-14 River discharging onto Ballycroneen Beach**  The backshore is generally flat with a 4m high storm berm sloping at approximately 6˚ and extending for 50m to an even homogeneous sand beach sloping at 1˚ - 2˚ for 120m to the LW at time of visit. The beach faces 198˚T. The foreshore consists of prominent rock outcrops either side of a flat sand beach. This is approximately 240m wide at the LWM tapering to 165m just below HWM at the foot of the pebble and cobble storm berm. The inter-tidal zone extends for approximately 165m from the HWM to LWM.
Social Factors	The landfall is within 1km of 6 private dwellings, 1 farm and 5 temporary caravans. The latter just behind the backshore. One large dwelling sits in the valley at the mouth of the river, within 30m of the proposed cable route. The beach is popular for surfing & fishing all year round with most visitors attracted to bathing during the summer months. The single track road delivers vehicles to a 50 x 25m tarmac car park right next to the beach. Although this beach has some heritage features it is not protected by Natura 2000 legislation.
Access to Site	Access to the site is good via a single track road suitable for Heavy Goods Vehicles. There is adequate turning for such vehicles in the car park.
Access to beach	Access to the beach is reasonable however in some places there is a steep drop of up to 1.5m over sea defence boulders that must be negotiated. A path through this would need to be engineered to allow plant easy access to the beach.
Plant storage area	With the agreement of the land owners adequate plant storage area could be established either on the beach car park or at the local farmyard 200m from the beach.
Joint pit area & cable ducts	There is adequate space for the proposed TJP either adjacent to the car park or on higher ground further up the valley in the grounds of the residential property. It may be necessary to install cable ducts between the TJP's and a point above the MWM. These could be installed by excavating an "open cut" trench through the cobbles, pebbles and sand.
Composition of beach	Behind the backshore rough grass grows on the recent deposits of topsoil and alluvium. The backshore is composed of a well sorted mix of cobbles & pebbles washed up on a storm berm at the top of the beach. The berm has been fortified in places by large boulders, some over 1m across. See Figure 4-15 and Figure 4-16.

Figure 4-15 Storm berm with sea defence boulders looking east

Figure 4-16 Storm berm looking north

Below the berm, the foreshore is composed of well graded, compacted medium sands which would easily support construction vehicles.

Flanking the sands are prominent outcrops of Upper Devonian and Lower Carboniferous Mudstones, Sandstones Siltstones and Conglomerates. These form the bedrock of the beach at uncertain depths below the sand. See Figure 4-17.

Figure 4-17 Ballycroneen bedrock geology

* For a full geological key please see http://spatial.dcenr.gov.ie/imf/imf.jsp?site=GSI_Simple

	Due both to their hardness and vertically dipping stratigraphy, these rocks are very resistant to erosion by the sea. See Figure 4-18 & Figure 4-19. The position of the outcrops has the effect of trapping and stabilising the sand beach in between them. **Figure 4-18 west side of beach rock outcrop looking east**  **Figure 4-19 east side of beach rock outcrop looking east**  A varying quantity of alluvial material is washed down onto the beach by the river. This does not contribute a significant deposit as it is largely washed away by the sea.					
Beach Profile	The profile of the beach is approximately <10° at the head of the beach reducing to <5°in the lower sections close to the MLWM.					
Erosion & Deposition	There is little evidence of coastal erosion at this location. The pebbles and cobbles of the storm berm protect the softer soils behind. It may be that these pebbles and cobbles have been washed down by the river, however this is unclear. The presence of the man placed boulders suggests that additional strength is required at times during heavy storms to protect the backshore from erosion					
Sea Defences	Minor sea defences in the form of boulders have been placed along the lowest point of the HWM. See Figure 4-15.					
Obstructions on beach	The main obstructions on the beach are the rock outcrops.					
Offshore obstructions	The water on the approaches to the landing is shoal, which will restrict access for installation, no other physical obstructions were observed.					
Existing infrastructure	Although sparsely populated, Ballycroneen has a well maintained access road and car park with associated new dwellings overlooking the beach. Electricity, fresh water and landline communications are readily available.					
Distance LWM to contours	To 5 m	0.4km	To 10 m	0.7km	To 15 m	2.4km

Distance MHWM to MLWM	185 m
Cable Installation options	Subject to seismic interpretation of the depth of sand covering the bedrock, the cable could be laid in an excavated trench. The favoured cable route would avoid the rock outcrops and follow the deepest sand above the bedrock. An open cut installation method would involve excavating through the backshore and foreshore and jetting below LWM. Excavated material being used to backfill the trench. HDD here may be a feasible option (subject to survey) and provide more effective cable protection in the nearshore area from the high energy environment. Landing a cable at this site would be highly weather dependent as the beach is open to the prevailing south westerly weather and swell. Small vessels may struggle in the large swells that break and hence careful consideration should be given to the optimal seasonal weather window. Also, launching small vessels from Ballycroneen beach would not be advisable in swell conditions.
Conclusions	From a provisional cable engineering perspective, Ballycroneen east beach appears to be a viable cable landing for a power cable. The relatively unpopulated location and the gently sloping foreshore and backshore with no significant cliffs are advantageous to cable installation. However, the beaches high exposure to prevailing south westerly weather and waves may make it less suitable for survey and installation operations than more sheltered locations. Seasonal weather and wave height records should be analysed in order to optimise both survey and construction operations.

November 2013 Site Visit Pictures

Figure 4-20 Ballycroneen Beach looking north west

Figure 4-21 West side of beach rock outcrop looking west

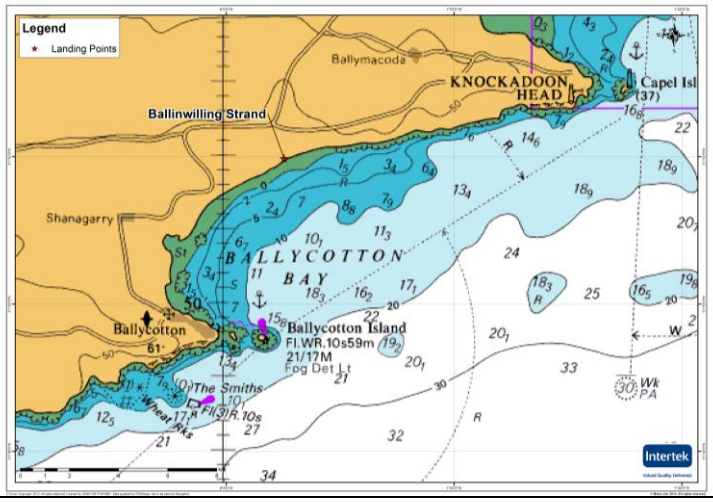
Figure 4-22 Ballycroneen Beach looking north

Figure 4-23 Storm berm looking north

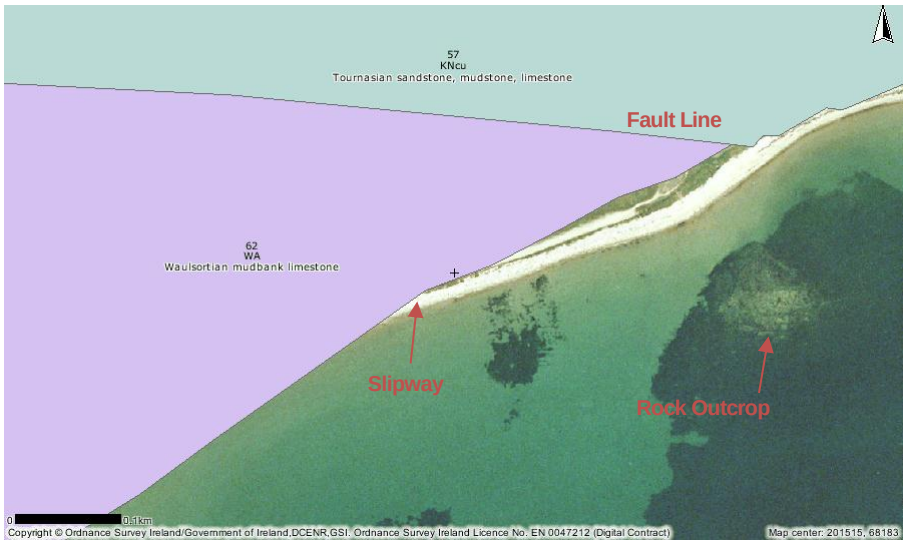
4.1.2.1 Environmental Constraints

Desktop review revealed that there are no protected sites within the vicinity of Ballycroneen Beach. A number of wrecks have been identified in the vicinity however the cable could be routed around these structures to avoid damage.

4.1.3 Ballinwilling Strand

Landing	Ballinwilling Strand
District	Youghal District, County Cork
Position (WGS 84 UTM Zone 30N)	**51°51'58.63"N 7°58'43.83"W**
Time & Tide of visit	04th November 2013 (Ballycotton Gauge LW 11:43. HW 17:35) 07th November 2013 (Ballycotton Gauge LW 14:02 HW 19:53) HW Ballycotton is HW Cobh +0005 MHWS 4.1m MHWN 3.2m MLWN 1.3m MLWS 0.4m Ballycotton predictions source tidetimes.org.uk 4th November: High Tide 05:16 (4.20m); Low Tide 11:43 (0.40m); High Tide 17:35 (4.20m) 7th November: Low Tide 01:38 (0.50m); High Tide 07:33 (4.10m); Low Tide 14:02 (0.60m); High Tide 19:53 (4.00m)
Area Summary topographical description	Ballinwilling Strand is a continuation of the northern side of Ballycotton Bay, approximately 7 km south east of Castlemartyr and 4.5km due north of Ballycotton Island lighthouse. Apart from sea defences, a slipway and car park, Ballinwilling strand and its surroundings are largely undeveloped. The beach is bordered by grass fields gently rising 1km away to the north and northwest by 30m. Apart from a single dwelling 30m from the car park, there are no buildings within a 500m radius of the beach. The nearest settlements are Ballycrenane and Ballybutler over 1km away, both consist of <10 buildings. See Figure 4-24 & Figure 4-25. **Figure 4-24 Ballinwilling Strand**  **Figure 4-25 Location of Ballinwilling Strand** 

	The beach faces 155˚T & is orientated 071˚T and extends for just over 1km to the north east and 5km to the south west. The HWM is characterised by a steep storm berm rising 2.5 at 10˚ to the horizontal. Below the berm, the foreshore slopes at 2˚ for 95m to the LWM. The inter-tidal zone extends 150m from the high to the low water mark and is generally flat with some rock outcrops in the lower sections.
Social Factors	The beach is popular for leisure visitors however it has few built facilities to offer. Bathers during the summer months and walkers throughout the year can be amply accommodated in the 300 x 14m public car park Construction and survey operations would have little social impact on the social welfare of users of this beach.
Access to Site	There is good heavy vehicle access to the car park via a fairly straight single track road with some passing places. The car park provides very good turning and storage space.
Access to beach	Primary access to the beach is available direct from the road via a concrete slipway. See Figure 4-26. Although this slipway is both robust and wide enough for heavy plant to easily access the beach, the end of it is obstructed by numerous boulders and 0.75m drop to the sand. This could be modified without too much difficulty to suit smooth entry and exit for wheeled and tracked vehicles. **Figure 4-26 Primary beach access via concrete slipway through sea defences**  Secondary access is available via a minor road 700m to the north east. Although steeper and narrower than the primary access, this point of entry would require no modification. See Figure 4-27. **Figure 4-27 Alternative beach access point** 
Plant storage area	This location facilitates very good plant storage within the large car park adjacent to the beach.

Joint pit area & cable ducts	The proposed transition TJP area would be either behind the backshore within the field or within the car park area. Ducting through the storm berm may be required to connect the TJP to the foreshore section of the cable.
Composition of beach	The storm berm is composed of Quartzite/Dolomitic Limestone/Sandstone cobbles and pebbles overlying coarse, well graded sands. The sea defences have been constructed of hard (possibly quartzite) boulders mostly greater than 1m across. These have been arranged between the storm berm and the soft shore protecting the soft superficial soils beneath the road and car park from being taken away by the sea. Below the storm berm, much of the foreshore down to LW mark is composed of well graded medium to coarse compacted sands. However there is also a significant outcrop of Dolomitic limestone extending 40m above the LWM opposite the sea defended section of the beach. A further outcrop is exposed to the north east at low tide. This alternation of sand and rock outcrop at the lower end of the beach suggests that the bedrock is close to the surface and periodically exposed as the sand moves above it. Heavy track base plant installation machinery would not be expected to have problems working on the sandy sections of this beach. See Figure 4-28 and Figure 4-29. **Figure 4-28 Ballinwilling geology. Note rock outcrop**  * For a full geological key please see http://spatial.dcenr.gov.ie/imf/imf.jsp?site=GSI_Simple **Figure 4-29 Ballinwilling Strand** 
Erosion & Deposition	The beach is a high energy environment with a surf zone extending 200m beyond LWM To prevent erosion, the car park and slipway have been fortified with large boulders creating a 2-3m high cliff above the beach.

	The combination of high tide and strong onshore wind and swell may threaten the existing storm berm. The rock outcrops have been cut to a jagged platform terrace by continued erosion by the sea. See Figure 4-30 **Figure 4-30 Exposed dolomitic limestone outcrop at low tide**  There is no evidence of long shore drift. Other than cobbles and pebbles washed up on the storm berm, there is no evidence of significant deposition
Sea Defences	Sea defences consisting of large boulders often greater than 1m across have been placed to protect the car park and slipway. See Figure 4-27
Obstructions on beach	The beach is clear of man-made obstructions. However significant rock outcrops appear above LWM opposite the sea defences section of the beach. See Figure 4-30. This obstruction is absent in the inter tidal zone south west of the slipway,
Offshore obstructions	The main offshore obstructions to this cable landfall would be subsea rock outcrop on the approaches to the LWM. Historic aerial images of the shallow water approaches indicate dark patches of possibly kelp growing on rock outcrop. Marine geophysical survey would ascertain a suitable burial path between these outcrops.
Existing infrastructure	There is a drainage outfall pipe on the beach mid-way along the length of the car park which serves to drain the fields behind. See Figure 4-31. Aside from the outfall pipe, road, car park and slipway there is no significant infrastructure at this location. **Figure 4-31 Drainage outfall location** 

Distance LWM to contours	To 5 m	0.6km	To 10 m	1.3km	To 15 m	3.9km

Distance MHWM to MLWM	130m
Cable Installation options	Consideration should be given to the extent of rock outcrop below the low water mark on the approach route to this landfall. It may not be possible to find a clear burial route through this rock. The preferred landfall location would be to the west of the slipway beyond the extent of the sea defences. This would avoid the north east section of the beach where installation would disturb the sea defences of the upper foreshore and where burial of the cable over the rock outcrop of the lower foreshore may not be achievable. The favoured cable route would avoid the rock outcrops and be through the sand deep enough above the bedrock to achieve the target burial. Subject to seismic survey identification of the bedrock depth, open cut excavation of the storm berm and foreshore could facilitate adequate burial of the cable. Alternatively an HDD installation here could be feasible and enable avoidance of any thin patches of sediment above the bedrock or rocky outcrops and provide more effective cable protection. Ballycotton Bay is a relatively sheltered location from the prevailing south westerly wind and swell. This should afford a lower risk of weather disruption for installation and survey operations than more exposed locations.
Conclusions	Ballinwilling's isolated location and good beach access for plant make it an attractive landing proposition for the power cable. Selection is primarily dependent on the distribution of near shore rock outcrop on the approach to the beach. Should a clear near shore route be identified, the burial of the cable in the foreshore and over the storm berm should be fairly straightforward for plant operating from the car park.

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Figure 4-32 Existing sea defences looking north east

Figure 4-33 Top of storm berm and potential TJP site Note: no man made sea defences in this section

4-34 Wave cut rock outcrop exposed at low tide

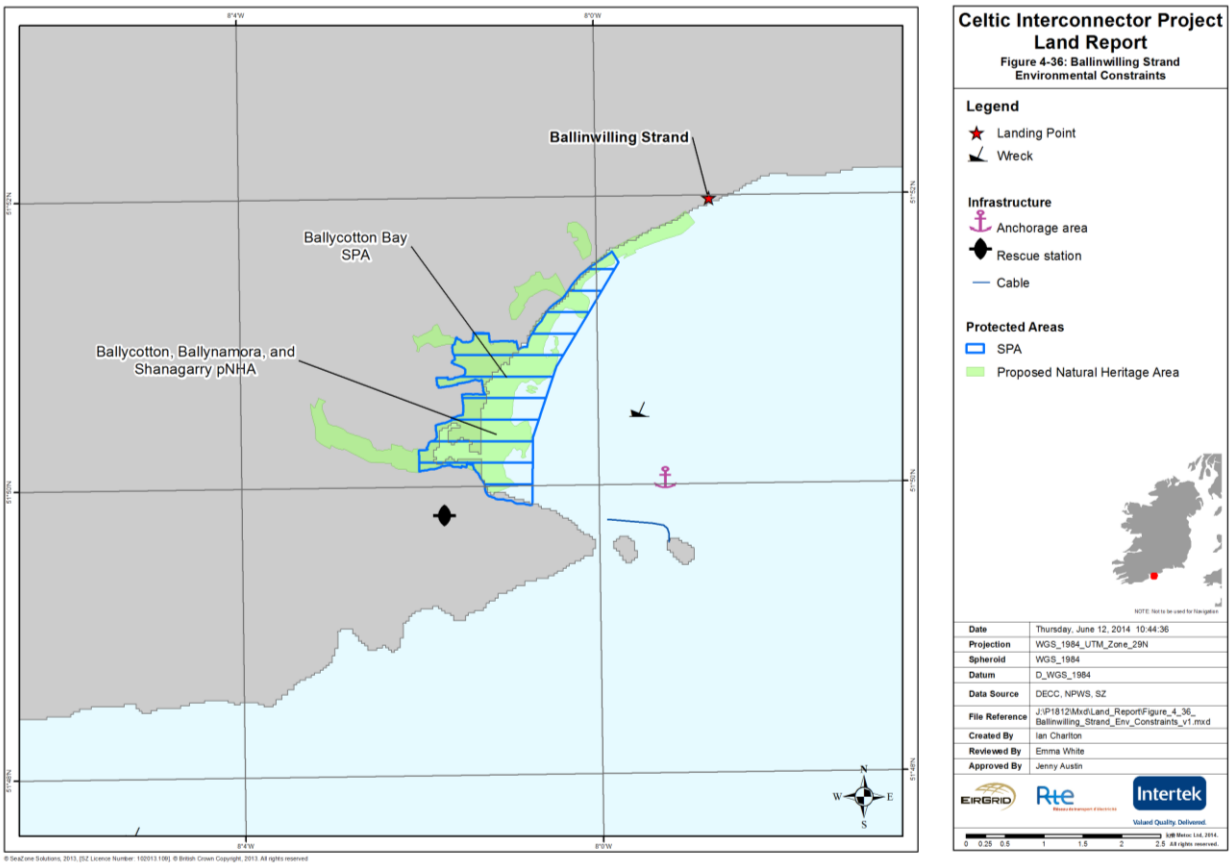
Figure 4-35 Sand beach looking north west towards sea defences

4.1.3.1 Environmental Constraints

The environmental constraints for the Ballinwilling Strand landfall are summarised below and in Figure 4-36.

Site	Feature of Conservation Interest	Proximity to landfall	Constraints	Recommendations
Ballycotton Bay Special Protected Area (SPA) and Ramsar Site	Nationally important bird species and mud flat and sand flat habitat.	1.4km	Potential disturbance to bird species	Consult with National Parks and Wildlife Service (NPWS)
Ballycotton, Ballynamona and Shanagarry proposed Natural Heritage Area (pNHA)	Wetlands and associated coastal vegetation and bird species.	0.3km	Potential disturbance to bird species	Consult with NPWS

Figure 4-36 Ballinwilling Strand Environmental Constraints



4.1.4 Redbarn Beach

Landing	Redbarn Beach
District	Youghal District, County Cork
Position (WGS 84 UTM Zone 30N)	**51°55'28.17"N 7°52'19.54"W**
Time & Tide of visit	05th November 2013 HW Redbarn is HW Cobh +0005 MHWS 3.9m MLWS 0.3m MHWN 3.1m MLWN 1.2m Low Tide 00:16 (0.30m) High Tide 06:10 (4.00m) Low Tide 12:35 (0.30m) High Tide 18:29 (4.00m)
Area Summary topographical description	Redbarn Beach is situated on the north western coast of Youghal Bay, approximately 3.75km south west of Youghal, the coast line lies exposed to the Celtic Sea (Muir Cheilteach) to the south east. The beach faces 115˚T and is afforded some protection from the prevailing wind a waves by Knockadoon head to the south west and Ardmore head to the north east. The sandy beach forms part of Youghal Bay extending 3km south west to Pilmore and 3km north east to Williamstown. Behind the beach is a flat area of grassland that gives way to a low dune <3m high beyond which lie fairly flat grassland fields. See Figure 4-37 and Figure 4-38

Figure 4-37 Redbarn Beach

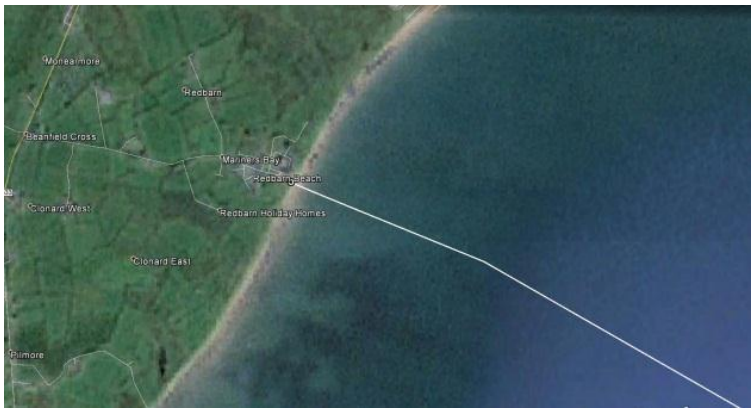
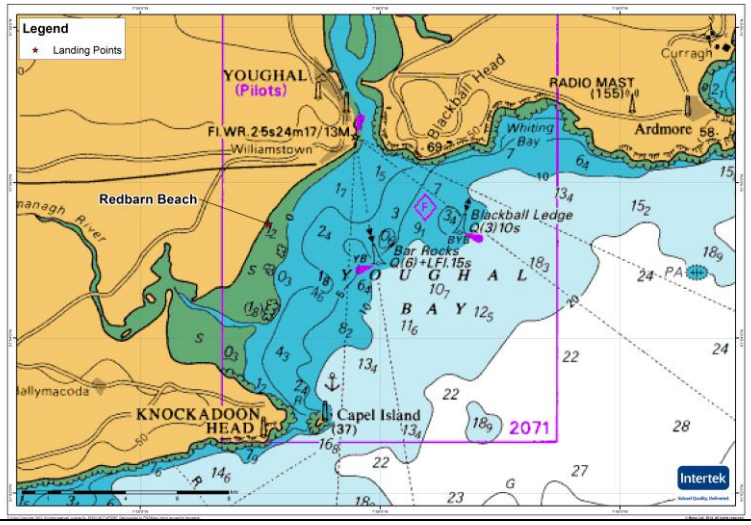
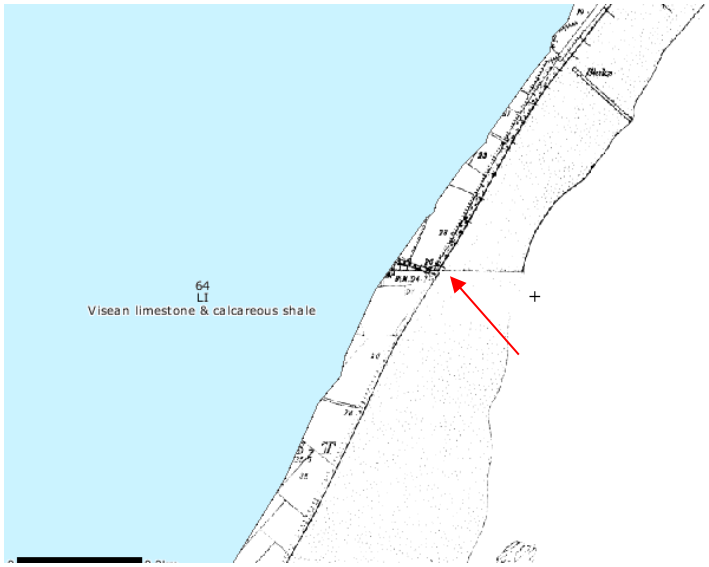


Figure 4-38 Location of Redbarn Beach



Social Factors	Redbarn is dominated by the 125 bedroom 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. Whilst it is popular with holidaymakers during the summer months it is more isolated and quieter than Claycastle beach. There is a designated bathing area in front of the Hotel however the proposed cable would lay outside this zone. Signage indicates temporary car parking for holidaymakers is available on the beach at the HWM. The preferred landings would be at least 200m from the hotel. Cable installation has the potential to impact on hotel trade if performed during the summer months.
Access to Site	There is good access directly to the beach via two single track roads. The primary access road is tarmacked and arrives on the beach adjacent to the hotel. See Figure 4-39. The secondary access road is fortified by hard core and leads onto the beach from a nearby holiday homes site. See Figure 4-40. **Figure 4-39 Primary beach access in field on opposite side of the access road from the hotel**  **Figure 4-40 Secondary access to beach.**  Tractor tyre tracks were observed on the secondary access (see above figure). Both roads could accommodate heavy tracked or wheeled vehicles and there is ample space to turn vehicles on the beach below HWM. Although drying at low tide, Youghal harbour has quay facilities for small survey and support vessels. There is also an anchorage for vessel with <5m draft.
Access to beach	The access roads adjacent to the hotel and farm as described above lead directly onto the beach.
Plant storage area	With the agreement of the land owner, plant storage area could be established on the grassland behind the sand dune. See Figure 4-41. Access here would be via the secondary access road. It may be necessary to construct a temporary

	track way on this soft land to support the weight of heavy plant. **Figure 4-41 Possible plant storage area** 
Joint pit area & cable ducts	Depending on the final choice of landing site, the proposed TJP area would either be within the field opposite the access road from the hotel or the field behind the beach to the north east of the Hotel. See Figure 4-39 and Figure 4-41.
Composition of beach	The foreshore is composed of well graded fine to medium sands with scattered pebbles in the upper foreshore. Fine wind-blown sands make up the low dunes of the backshore, held together by rough grasses. There is no evidence of outcrop of the Carboniferous Limestone Bedrock which suggests that it is well buried. See Figure 4-42 **Figure 4-42 Redbarn Beach geology**  * For a full geological key please see http://spatial.dcenr.gov.ie/imf/imf.jsp?site=GSI_Simple
Beach Profile	The profile of the beach is even throughout its length and less than 5˚
Erosion	There is little evidence of erosion with the grass meeting the slope of the beach and not wave cut features.
Sea Defences	Apart from the wall supporting the front garden of the hotel, there are currently no man made sea defences here. Naturally formed Sand dunes providing protection from the sea. There is some evidence of historic sea defences reinforcing the sand dunes to the north east of Redbarn beach. See Figure 4-43.

<table>
<tr><td></td><td colspan="6">Figure 4-43 Redbarn Beach looking south west from Claycastle
 

Note: Drainage outfall and old sea defences</td></tr>
<tr><td>Obstructions on beach</td><td colspan="6">There are some wooden posts, which are most likely in place to prevent the public from driving vehicles along the beach. There are a few boulders near to the primary access road. A 55m drainage outfall pipe is also present from the dunes to the nearshore. Apart from the already mentioned obstacles, there no other surface obstructions on this beach. See Figure 4-43 and Figure 4-44.

Figure 4-44 Unobstructed sandy beach – facing south east
  </td></tr>
<tr><td>Offshore obstructions</td><td colspan="6">The water on the approaches to the landing is shallow with the 10m contour extending up to 3km offshore at its widest. The Admiralty chart indicates Rocks and Ledges on the approach to Youghal Harbour</td></tr>
<tr><td>Existing infrastructure</td><td colspan="6">The roads leading to the beach are adequate for construction vehicles. The hotel is ideally located for construction personnel. Public toilets, drinking water and telephone are available close to the beach.</td></tr>
<tr><td>Distance LWM to contours</td><td>To 5 m</td><td>1.9km</td><td>To 10 m</td><td>2.36km</td><td>To 15 m</td><td>5km</td></tr>
<tr><td>Distance MHWM to MLWM</td><td colspan="6">140 m</td></tr>
<tr><td>Cable Installation options</td><td colspan="6">There is potential to land the cable using an open cut installation method through the fields either to the south west or north east of the Hotel. The open cut method would be possible due to the low gradient and relative ease of working excavators on the beach. Natural backfill of the trench would quickly take place.
HDD, although a potential option here, would not avoid the requirement of a shallow water vessel to perform the shore-end due to the length of shallow water. As HDD for a power cable is not recommended in the majority of cases for lengths over 1.5km (due to the tensile strength of the cable being able to withstand the pull up the duct) the 10m WD contour here is 2.36km from the HWM.</td></tr>
</table>

	For either installation technique the use of a separate installation vessel (i.e. a barge) would result in a cable joint being required to be built into the cable design at the point of transfer between the barge and the main installation vessel. There is adequate room for plant and equipment storage and workspace at this site.
Conclusions	Redbarn beach has good potential for landing the HVDC cable. It is relatively sheltered affording low risk of weather downtime. The unobstructed sandy beach with good access for heavy plant facilitates ease of installation. The lack of bedrock outcrop suggests that target cable burial should be achievable. The shallow near shore approach to the beach may require a long section of inshore jetting, it is also unlikely that a cable lay vessel would be able to get within 2km of low water mark therefore a cable barge is likely to be required. The isolated nature of the beach and quiet off season period also make for an attractive option for installation out of the holiday season. The views of the residents of the dwellings next to the beach need to be taken in to account. Seasonal weather and wave height records should be analysed in order to optimise both survey and construction operations.

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Figure 4-45 Flat grassland behind Redbarn Beach. Looking south west towards Ballyskibbole

Figure 4-46 Low dunes looking north east towards Youghal

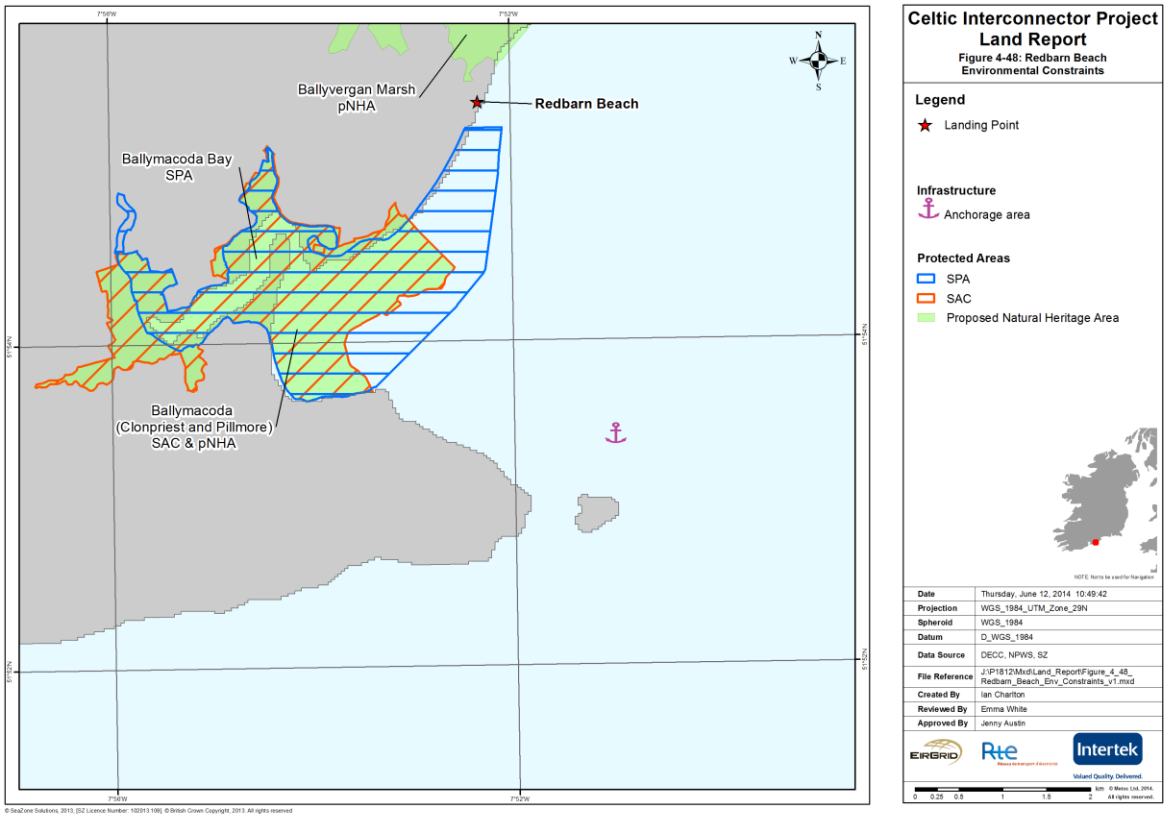
Figure 4-47 Redbarn Beach looking south west from lawn in front of Quality Hotel and Leisure Centre

4.1.4.1 Environmental Constraints

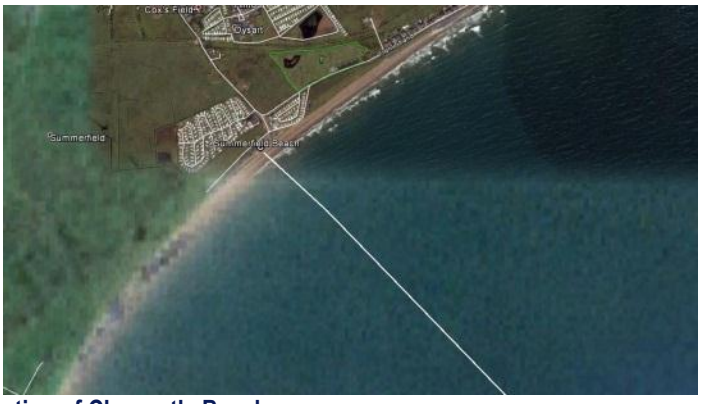
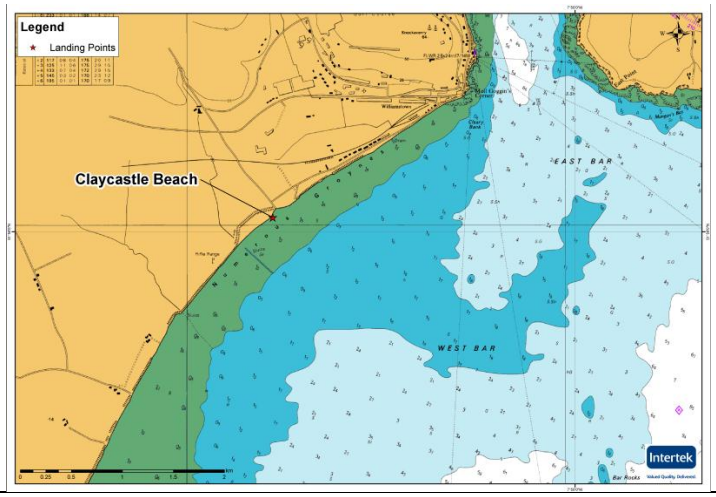
The environmental constraints for the Redbarn Beach landfall are summarised below and in Figure 4-48.

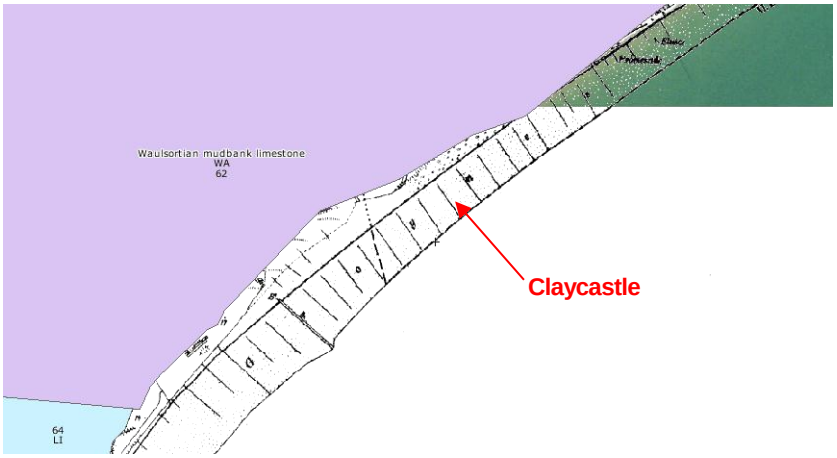
Site	Feature of Conservation Interest	Proximity to landfall	Constraints	Recommendations
Ballyvergan Marsh pNHA	Coastal sand & clay cliffs and fresh water marsh and associated bird species.	0.3km	Potential disturbance to bird species	Consult with NPWS
Ballymacoda Bay SPA and Ramsar site.	Overwintering waterfowl species and the site supports internationally important black tailed godwit (*Limosa limosa*). This site is also designated for its internationally important wetland habitat.	0.3km	Potential disturbance to bird species	Consult with NPWS
Ballymacoda (Clonpriest and Pillmore) Special Area of Conservation (SAC)	Mudflats and sandflats, saltmarsh (*Salicornia* sp.) and Atlantic sea meadows.	1.5km	The interest features of this site are not expected to impacted by the project	Consult with NPWS

Figure 4-48 Redbarn Beach Environmental Constraints



4.1.5 Claycastle Beach

Landing	Claycastle Beach
District	Youghal District, County Cork
Position (WGS 84 UTM Zone 30N)	**51°56'2.77"N 7°51'35.78"W**
Time & Tide of visit	05th November 2013 HW Claycastle Beach is HW Cobh +0005 MHWS 3.9m MLWS 0.3m MHWN 3.1m MLWN 1.2m Nearest Port is Youghal. Tides for site vis Low Tide 00:16 (0.30m) High Tide 06:10 (4.00m) Low Tide 12:35 (0.30m) High Tide 18:29 (4.00m)
Area Summary topographical description	Claycastle Beach is situated on the north western coast of Youghal Bay, approximately 2.5km south west of Youghal, the coast line lies exposed to the Celtic Sea (Muir Cheilteach) to the south east. It faces 135˚ T and is somewhat protected from the prevailing south westerly wind and swell by Knockadoon head to the south west and Ardmore head to the north east. The beach is low lying with an extensive area of marshland behind it protected from the sea by low sand dunes no higher than 4m above HWM. Within 2km of Youghal, the marshland has been drained to make dry land for the Seafield caravan site containing over 100 static caravans. To seaward of the caravan site is a well maintained tarmac car park approximately 280 x 20m. The beach has a constant gradient of 3˚or less for most of the 140m between HWM and LWM. There is no significantly steep storm berm as the beach slopes gently into the dunes. See Figure 4-49 and Figure 4-50. **Figure 4-49 Claycastle Beach**  **Figure 4-50 Location of Claycastle Beach** 

Social Factors	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 significantly higher than at Redbarn 1km to the south west.
Access to Site	Access to the site is very good via the approach road to the car park and would pose no significant problem for heavy plant. Although drying at low tide, Youghal harbour has quay facilities for small survey and support vessels. There is also an anchorage for vessel with <5m draft.
Access to beach	Reasonable access to beach is available from the car park which sits on a sand and boulder sea defence no more than 2m above the beach. At present there are concrete footpaths from the car park to the beach which could be widened to create a path for heavy plant access. See Figure 4-51. **Figure 4-51 Walkway from carpark to beach** 
Plant storage area	Good plant storage area is available in the car park subject to the owner's permission.
Joint pit area & cable ducts	The proposed TJP area would be either under the car park or behind the dunes. The dune area may prove problematic due to the shallow depth to the groundwater table.
Composition of beach	The lower foreshore is largely composed of coarse to medium well compacted sands becoming coarser and with assorted pebbles sand and stones in the higher foreshore. There is no outcropping of the Carboniferous limestone bedrock on this beach. The backshore sand dunes are composed of well sorted fine to medium sands bound together with rough grasses. See Figure 4-52. **Figure 4-52 Claycastle Beach geology**  * For a full geological key please see http://spatial.dcenr.gov.ie/imf/imf.jsp?site=GSI_Simple
Beach Profile	The profile of the beach is <10°.

Erosion & Deposition

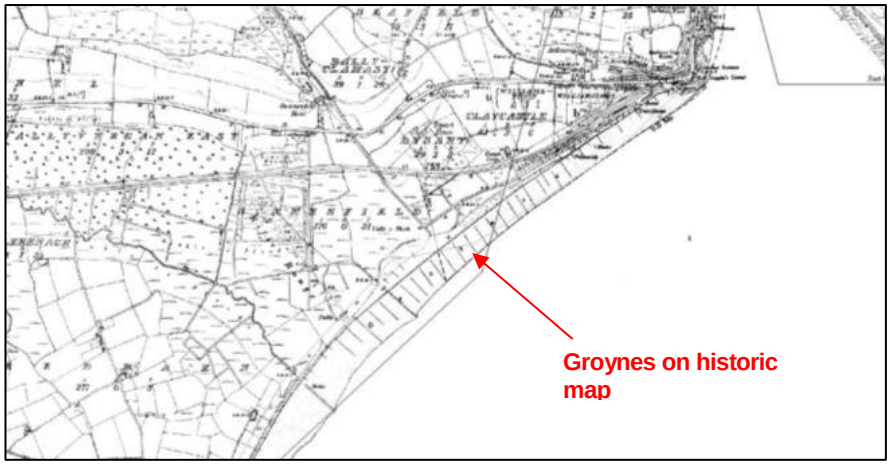
Erosion and deposition does occur on this beach. Evidence for this lies with attempts in the past to control longshore drift by building groynes and dumping rock. Some of these are still visible above the current sand deposit. See Figure 4-53 & Figure 4-54.

Figure 4-53 Former rock dumped sea defences between Claycastle and Redbarn Beaches

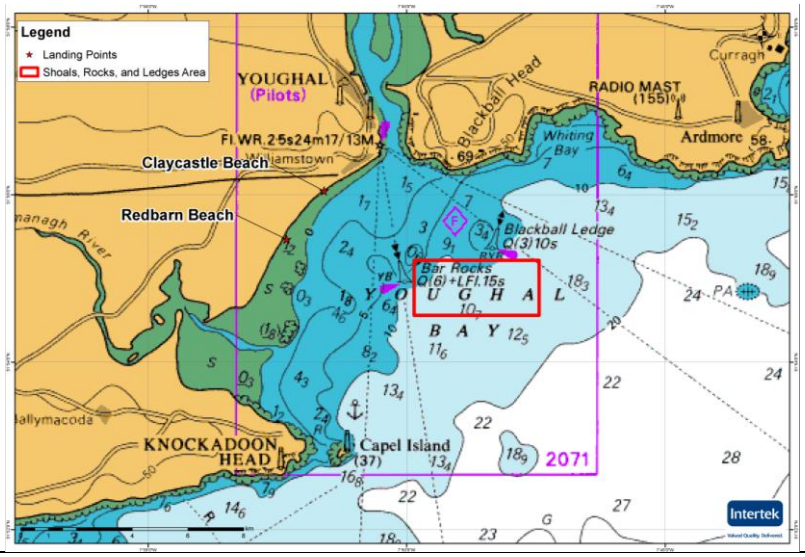
Figure 4-54 Buried groynes

Historical 6" Irish Ordnance Survey maps reveal groynes that have since been buried. The depth of burial of these groynes suggests that the beach is more of depositional rather than an erosional environment.

Figure 4-55 Historic Irish Ordnance Survey map of Claycastle Beach



Although there is clearly movement of sand on the beach, the lack of a high storm berm or gradient suggests that the beach experiences relatively low energy marine conditions and is naturally stabilised to its present day form.

Sea Defences	Sea defences have been put in place to protect the car park and caravan site to the north east. However south west of the car park low sand dunes stabilise the backshore.
Obstructions on beach	Two drainage outfall pipes/sluices up to 70m long discharge fresh water from the marshland under the dunes onto the foreshore. These are located at: 1. The southern end of the car park: Geographic coordinate 51° 55.942' N 007° 51.730'W (Figure 4-56). 2. In between Claycastle and Redbarn beaches: Geographic coordinate 51° 55.932' N, 007° 51.717'W **Figure 4-56 Drainage outfall at southern end of car park looking towards Redbarn**  Throughout the beach there are numerous remnants of wooden Groynes sticking out through the sand. Some historic rock boulder sea defences protrude midway down the foreshore beach approximately 500m from the Redbarn location.
Offshore obstructions	The Admiralty chart Approaches to Youghal bay indicate shoals rocks and ledges with WD <10m extending up to 3km at its widest from Claycastle and Redbarn beaches. See Figure 4-57. **Figure 4-57 Admiralty chart of Youghal Bay.** 
Existing infrastructure	The proposed site for the TJP is well serviced by road and close to the civic amenities of Youghal.

Distance LWM to contours	To 5 m	1.54km	To 10 m	2.6km	To 15 m	5.5km
Distance MHWM to MLWM	140 m					
Cable Installation options	There are two options to site for the cable at Claycastle beach 1. Landing the cable through the car park 2. Landing the cable to the south of the car park through the dunes. For both options, as with Redbarn, HDD or an open cut installation would effectively deliver the cable to the TJP in the car park. However, either option would entail a long beach pull from the cable ship which is unlikely to navigate closer than the 10m contour. Therefore it is likely that a shallow draft landing barge would need to be considered for this location & would result in a cable joint being required to be built into the cable design at the point of transfer between the barge and the main installation vessel. There is ample hard standing room for plant and equipment storage and workspace at this site.					
Conclusions	From a provisional cable engineering perspective, Claycastle beach is a favourable cable landing location close to amenities and composed of material suitable for cable burial to >3m. The lack of bedrock outcrop would suggest that there is a significant thickness of overburden at this location which favours 3m cable burial specification. Social and environmental impact would be higher than at some of the other landfall options. The feasibility of routing the cable through the marshland behind Claycastle beach should be discussed with the land consultant. Whilst landing the cable on this beach is feasible the long shallow approach out to the 15m contour would involve significant trench-jetting. A historic and current coastal dynamics study is recommended to be undertaken to ascertain the beach stability. Investigate impact of cable landing on ownership of car park and potential disruption to local leisure industry.					

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Figure 4-58 Claycastle car park and static caravan site

Figure 4-59 Marshland looking west from car park

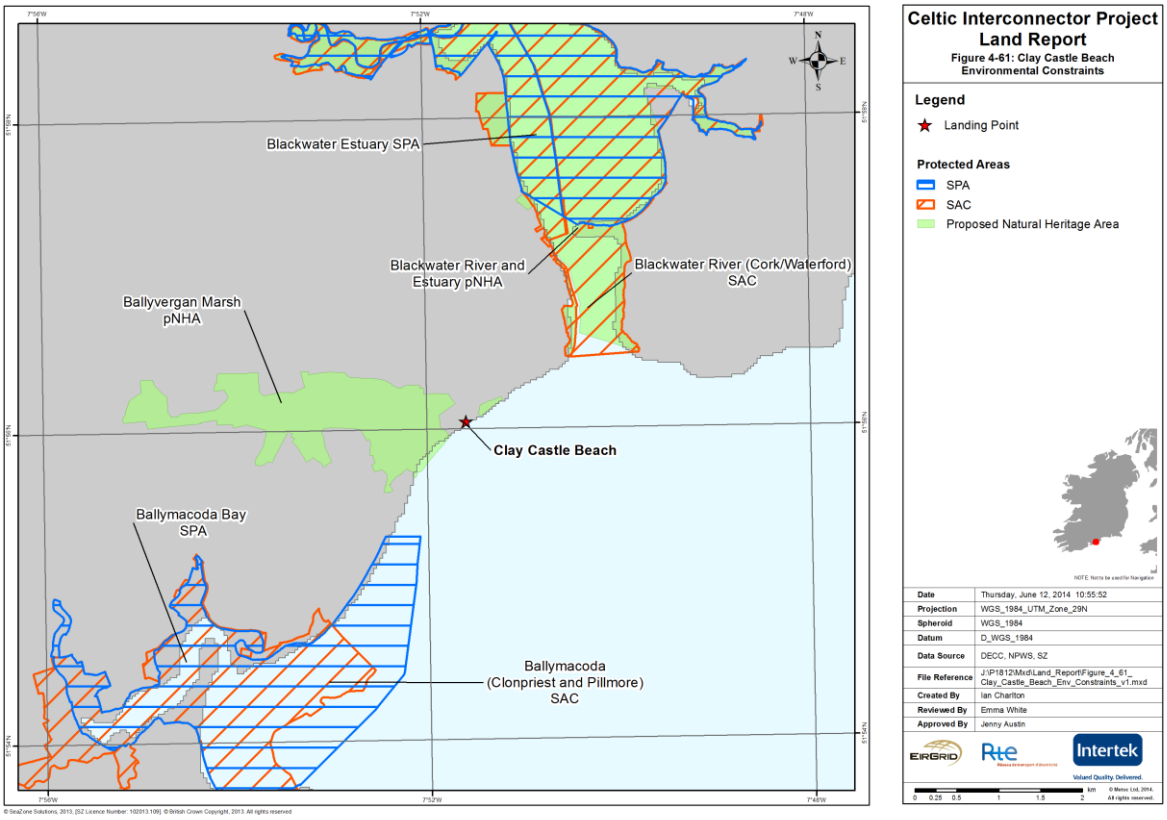
Figure 4-60 Claycastle Beach looking north east towards to Youghal

4.1.5.1 Environmental Constraints

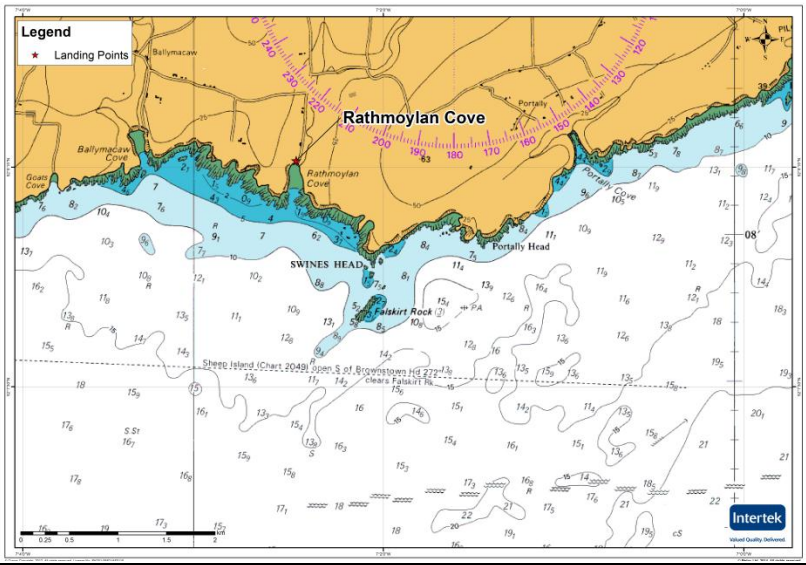
The environmental constraints for the Claycastle Beach landfall are summarised below and in Figure 4-61.

Site	Feature of Conservation Interest	Proximity to landfall	Constraints	Recommendations
Ballyvergan Marsh pNHA	Coastal sand & clay cliffs and fresh water marsh and associated bird species.	0.2km	Potential disturbance to bird species	Consult with NPWS
Blackwater Estuary SPA and Ramsar	Overwintering waterfowl species and the site supports internationally important black tailed godwit (*Limosa limosa*).	2.7km	Potential disturbance to bird species	Consult with NPWS
Backwater River (Cork/Waterford) candidate (cSAC)	Primarily designated for alluvial wet woodlands and Yew wood along with a number of Annex I listed habitats and Annex II listed species.	1.4km	Potential impact upon mobile Annex II listed species associated with this site	Consult with NPWS
Blackwater River and Estuary pNHA	Riparian vegetation, marshes and reedbeds and dry woodlands and nationally important wintering bird species.	1.4km	Potential disturbance to bird species	Consult with NPWS
Ballymacoda Bay SPA and Ramsar site.	Overwintering waterfowl species and the site supports internationally important black tailed godwit (*Limosa limosa*). This site is also designated for its internationally important wetland habitat.	1.2km	Potential disturbance to bird species	Consult with NPWS
Ballymacoda (Clonpriest and Pillmore) cSAC	Mudflats and sandflats, saltmarsh (*Salicornia* sp.) and Atlantic sea meadows.	2.9km	The features of this site are not expected to be impacted by the project	Consult with NPWS

Figure 4-61 Claycastle Beach Environmental Constraints



4.1.6 Rathmoylan Cove

Landing	Rathmoylan Cove
District	County Waterford
Position (WGS 84 UTM Zone 30N)	**52° 8'16.33"N 7° 2'28.91"W**
Time & Tide of visit	05th November 2013 Nearest Port Dunmore east: HW Cobh + 0010; MHWS 4.2m MLWS 0.6m MHWN 3.2m MLWN 1.4m 05 Tue Time Height 00:14 0.24m 06:16 4.33m 12:37 0.22m 18:37 4.26m
Area Summary topographical description	Rathmoylan Cove is situated on the western side of Waterford Estuary, approximately 14 km south east of Waterford, and 5km west of Dunmore east. Facing 180°T, the largely flat sand beach slopes for 150m to LW and is exposed to the Celtic Sea (Muir Cheilteach). It is characterised by extensive rock outcrops and up to 20m high cliffs either side of the 50m wide sandy beach. A small river meanders down a steep sided valley discharging fresh water onto the beach. It is a Geological Heritage Site. See Figure 4-62 and Figure 4-63. **Figure 4-62 Rathmoylan Cove overview**  **Figure 4-63 Location of Rathmoylan Cove** 

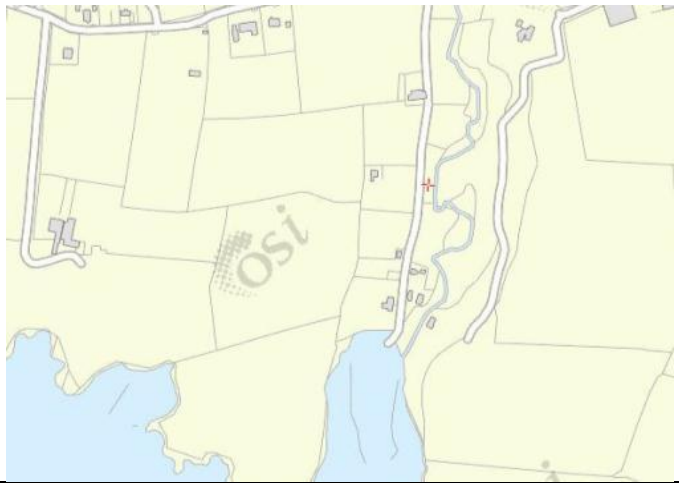
Social Factors	The cove's rocks attract Geologists and fishermen and walkers. It is a relatively undeveloped isolated location. There are 7 buildings clustered around the end of the access road. Some of these appear to be holiday homes although at least 2 appear occupied. The proposed landing is also close to a dwelling at the end of the access road. The social impact of the cable construction would be minimal for this sparsely populated area. See Figure 4-64. **Figure 4-64 Distribution of dwellings at Rathmoylan Cove** 
Access to Site	Access to the site is via the coast road, "south east Coastal Drive - Tramore" from the L4068, this road is suitable for use by heavy vehicles however the road down to Rathmoylan cove is single track and turning at the end would be difficult for large vehicles. Dunmore east harbour is 6km by sea from the site and could be used as a base for survey and support vessels.
Access to beach	Access to the beach is available directly from the road via the concrete slipway which currently has a line of bollards preventing vehicles from entering the beach. See Figure 4-65. **Figure 4-65 Road access looking north** 
Plant storage area	There is no site area available adjacent to the beach. There may be some suitable private land further up the river valley subject to owner's permission.
Joint pit area & cable ducts	A TJP could be located in the field behind the back garden of the house at the end of the access road. See Figure 4-66. Cable ducts would need to be installed to bring the cable up from the beach. There could be problems with encountering bedrock at the joint pit.

Figure 4-66 Backshore looking north

Composition of beach

The majority of the beach is composed of Upper Devonian Red sandstones and the earliest Carboniferous conglomerates of the Harrylock Formation. The rocks display bright red siltstone and sandstone beds, inter-bedded with thick conglomerate units. The rocks are rugged & hard outcropping complex strata dipping in many directions. See Figure 4-67 and Figure 4-68.

Figure 4-67 Entrance to Rathmoylan Cover at LW

Figure 4-68 Rathmoylan Cove looking north

	Between the rock outcrops the foreshore is composed of compacted coarse well sorted sands with some well-rounded pebbles and small cobbles in the upper foreshore washed down by the river. See Figure 4-69. **Figure 4-69 River entering Rathmoylan Cove** 
Beach Profile	The upper foreshore slopes at >10 ˚for the first 50m decreasing to >5˚for the remaining 130 m to the LWM.
Erosion & Deposition	There is no evidence of coastal erosion at this landing. The rocks are highly resistant to wave action and protect the sand from being relocated.
Sea Defences	There are manmade sea defences here consisting of roughly laid boulders supporting the backshore of the beach See Figure 4-65 and Figure 4-66. Elsewhere, the hard rock outcrop provides a natural defence against incursion by the sea.
Obstructions on beach	Apart from the rock outcrops the beach is unobstructed down to LWM. Beyond LWM there may be submerged rocks on the seabed which could obstruct trench jetting operations.
Offshore obstructions	Beside the water on the approaches to the landing shoal, which will restrict access for installation, no other physical obstructions were observed. However the north Channel is a busy secondary shipping channel and co-ordination with the harbour authorities will be required during marine operations.
Existing infrastructure	The main infrastructure is the road and slipway. Water, Telephone and Electricity are in limited supply to the few houses here.
Distance LWM to contours	To 5 m: 0.2km; To 10 m: 0.4km; To 15 m: 2.9km
Distance MHWM to MLWM	180 m
Cable Installation options	HDD through the bedrock may be difficult to achieve here due to the sandstone and conglomerate being exceptionally hard. However this would need to be assessed by an HDD specialist. If achievable HDD to beyond where the cove narrows may result in safer shore-end installation options. It is unlikely that the depth of sand over the bedrock is more than 3m so burial options here may be limited. It may be possible to pin the cable to the rock and dump additional protective rock on top of it. However due to the high energy of the sea hitting the cove, this method may require on-going maintenance. At high tide the cove is completely filled with water. All Installation plant and equipment would need to be stored some distance away from the beach. The seaward approach to the cove would be treacherous in all but flat calm conditions. The entrance is narrow and uncharted. Any vessel over 10m could not land here and it would be risky for any vessel to land here pulling the cable ashore.
Conclusions	Whilst Rathmoylan cove is an interesting Geological feature of this coast, the operational and logistical constraints of installing a HVDC cable here make it a poor landfall location. The cove is small therefore space for heavy plant would be limited. Given the extent of the rock outcrop, the depth of the sand is unlikely to be more than 3m, making effective

	burial of the cable difficult without having to drill through the rock. Gathering survey data from the surf zone into the beach may be problematic due to the unknown rocks beneath the vessel. Exposure to weather and swell from the south makes the seaward entry difficult, although once inside the cove the rocks give some protection from the prevailing weather.

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Figure 4-70 Rathmoylan Cove looking south

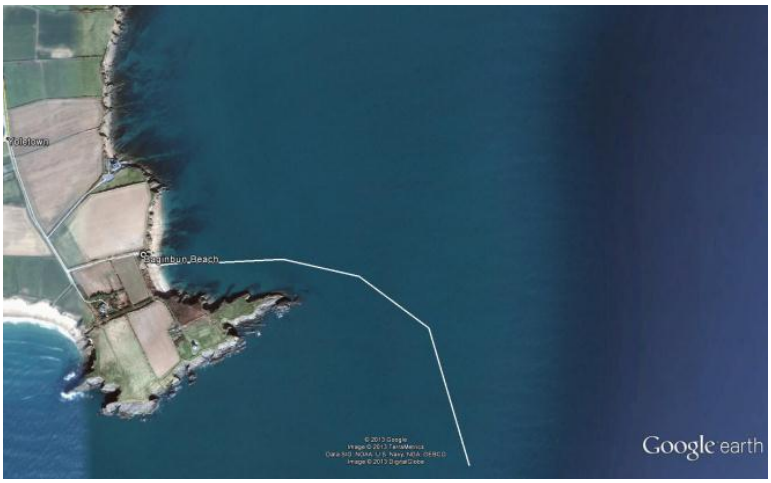
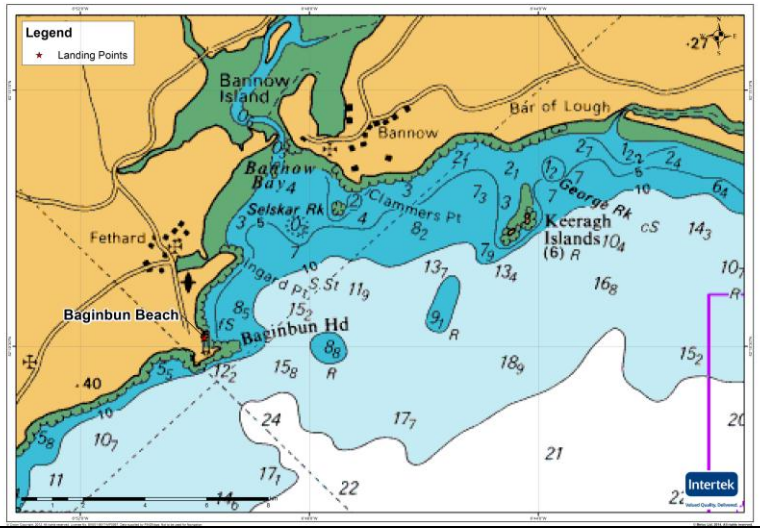
Figure 4-71 Top of the beach looking west

Figure 4-72 River discharge into Rathmoylan Cove

4.1.6.1 Environmental Constraints

Desktop review revealed that there are no protected sites within the vicinity of Rathmoylen Cove. A number of wrecks have been identified in the vicinity however the cable could be routed around these structures to avoid damage.

4.1.7 Baginbun Beach

Landing	Baginbun Beach
District	New Ross District County Wexford
Position (WGS 84 UTM Zone 30N)	**52°10'35.69"N 6°49'49.84"W**
Time & Tide of visit	06th November 2013 There are no MHW or MLW range data available for Spring and Neap cycles at this location. However at Killmore Quay, 16km east of Baginbun beach, MHWS is 3.8m & MHWN is 2.8m Predictions source for Baginbun Head, UK Admiralty Time Height 06 Wed 01:02 0.20m 07:08 4.16m 13:26 0.28m 19:28 4.01m
Area Summary topographical description	Baginbun Beach is situated on the outer western entrance to Bannow Bay, approximately 2 km south of village of Fethard, the coast line lies exposed to the Celtic Sea (Muir Cheilteach) to the east and the bay is sheltered by a large headland which lies to the south. The beach faces 070˚T and is well protected from the prevailing south westerly weather and swell by Baginbun point. The beach is ~30m from HW to LW with seawater filling the cove at high tide. The beach is surrounded by steep cliffs. At the car park the cliff height is ~10m above the beach. See Figure 4-73 and Figure 4-74. **Figure 4-73 Baginbun Beach**  **Figure 4-74 Location of Baginbun Beach** 

Social Factors	This is a very sparsely populated area. Including the Martello tower there are only 3 buildings on Baginbun point, the nearest settlements being Carnivan and Yoletown ~1km away from the beach. The beach is used by summer visitors for bathing and other recreational activities such as diving and canoeing throughout the year. The social impact of landing a cable here may be greater than at some of the alternative landfalls. **Figure 4-75 Baginbun beach with OSI historic images**  Note sparseness of buildings
Access to Site	Access to the site is via the coast road, from the R734, this road is suitable for use by heavy vehicles which could make their way to the car park at the top of the cliff.
Access to beach	Access to the beach is very poor down a 16 ˚rough narrow track. The track is not wide enough for normal road vehicles and would have to be significantly modified to allow heavy plant access to the beach. See Figure 4-76. **Figure 4-76 Access to beach** 

	Figure 4-77 Base of Access road  **Figure 4-78 Base of access road on beach** 
Plant storage area	Plant storage on the beach is not available. Some plant could be stored in the small car park. Further storage could be facilitated in nearby fields subject to permission from the landowner. See Figure 4-79. **Figure 4-79 Car park at top of 10m cliff** 
Joint pit area & cable ducts	The proposed transition joint pit (TJP) would have to be at the top of the ~10m high cliff perhaps in an adjacent field to the car park. Special ducting would have to be constructed to bring the marine cable up from the beach to the TJP. A safe route for this is not obvious and may involve drilling through the rock.

Composition of beach	The beach is composed of soft well washed coarse sand. In places the bedrock appears through the sand. The cliffs are composed of Palaeozoic Cambrian Slates, Quartzites and Greywackes. The rocks are highly resilient to erosion by the sea thus forming the significant promontory of Baginbun point.					
Beach Profile	Baginbun beach slopes at a fairly constant angle of 6˚					
Erosion	There is no evidence of coastal erosion at this landing. The steep beach profile suggest that surplus sand is quickly transported away to maintain this shape.					
Sea Defences	There are no sea defences on this beach. The rocks naturally protect the shoreline from the sea.					
Obstructions on beach	The main obstructions on the beach are the rock outcrops.					
Offshore obstructions	There is high chance of rock outcrop in the approach to Baginbun bay. Bathymetric survey data would be needed to confirm this.					
Existing infrastructure	Other than the single track road and car park, there is little existing infrastructure at this location.					
Distance LWM to contours	To 5 m	0.13km	To 10 m	0.95km	To 15 m	4.1km
Distance MHWM to MLWM	30 m					
Cable Installation options	Given the aforementioned geology, HDD operations here may be challenging and require specialise cutting tools. The feasibility of this operation would need to be assessed through an HDD survey. If achievable HDD may resolve the cable routeing difficulties posed by the high cliff between the landing point and the potential TJP location. The short inter-tidal zone and nearby deep water would facilitate a close approach by the cable lay vessel and a relatively short beach pull. Providing access to the beach could be modified an open cut installation could be possible. However, should the access road modification not be possible, an alternative could be to transfer the shore-end equipment on a shallow draft barge, before transferring to the beach, as needed, by landing craft.					
Conclusions	Whilst Baginbun offers good shelter for the cable landfall and the soft sand is good for burial, finding a route where the cable can be buried to the target burial depth without hitting the bedrock could prove difficult. The 30m distance between HW and LW limits the working area marginally. Furthermore, as the HWM is directly adjacent to the base of the cliff, the time during which installation equipment could access the beach would be limited and dictated by the tide cycle at the time of installation. Getting the cable from the beach to the TJP may mean constructing special ducting to route up or through the cliff face. The soft sand may slow works or require temporary tracks to be installed for heavy plant working on the beach. The steep narrow road leading down the beach prohibits large plant access without significant engineering to widen the road.					

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Figure 4-80 Baginbun Beach looking South West

Figure 4-81 Baginbun Beach looking north east

Figure 4-82 Low water looking north. Note rock outcrop in sand

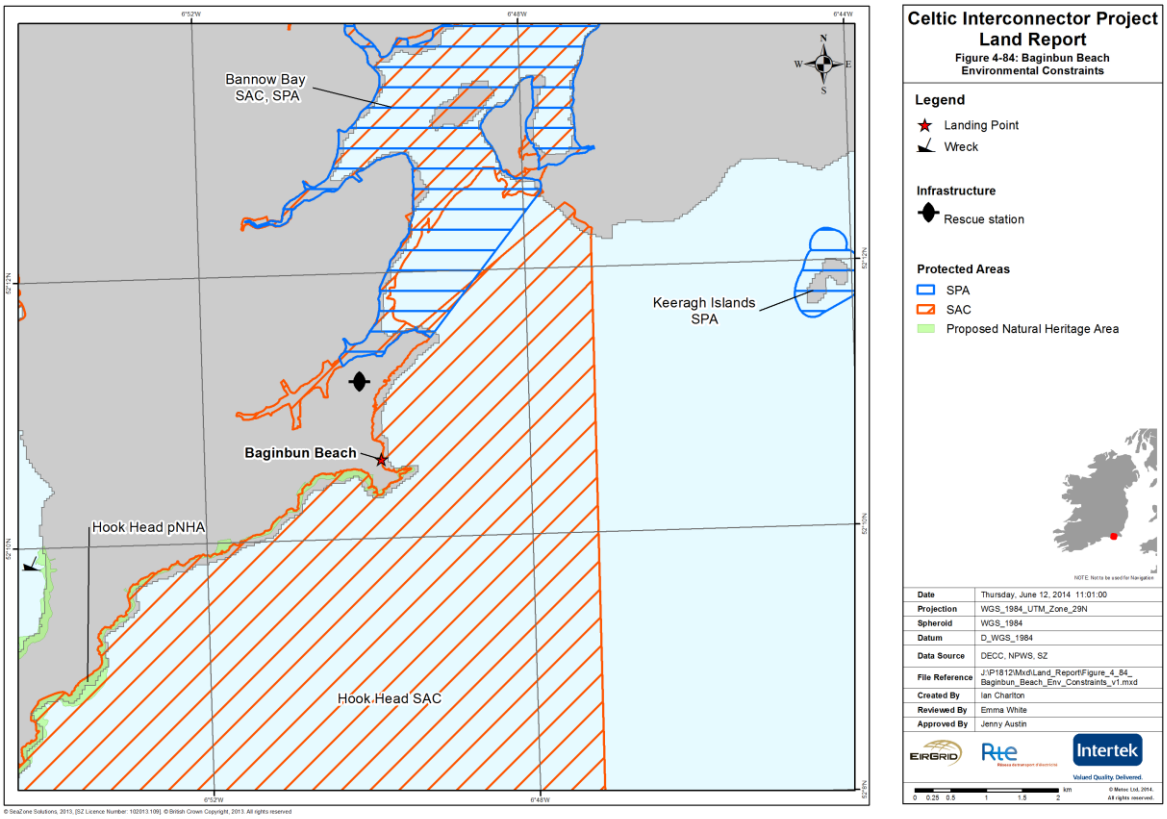
Figure 4-83 Low water looking south. Note rock outcrop in sand

4.1.7.1 Environmental Constraints

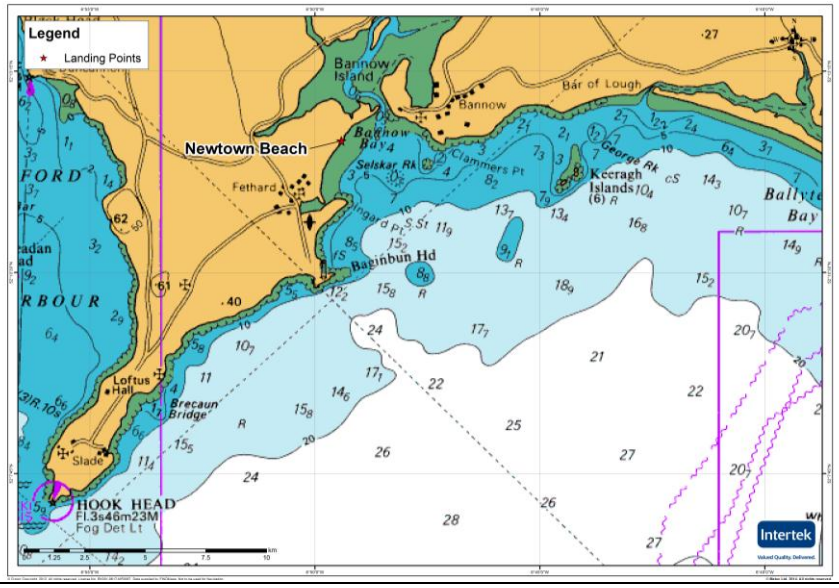
The environmental constraints for the Baginbun Beach landfall are summarised below and in Figure 4-84.

Site	Feature of Conservation Interest	Proximity to landfall	Constraints	Recommendations
Hook Head cSAC	Annex I reef, large shallow inlets and bays and vegetated sea cliffs of the Atlantic and Baltic coasts	10m	The features of the site are not expected to be impacted by the project.	Consult with NPWS
Hook Head pNHA	Sea cliff vegetation and bird species	0.3km	Potential disturbance to bird species	Consult with NPWS
Bannow Bay cSAC	11 listed Annex I coastal habitats	1.1km	The features of the site are not expected to be impacted by the project.	Consult with NPWS
Bannow Bay SPA and Ramsar Site	Wintering wildfowl and the site supports internationally important brent goose (*Branta bernicla*) along with a number of other nationally important species. Important wetland habitat.	1.4km	Potential disturbance to bird species	Consult with NPWS

Figure 4-84 Baginbun Beach Environmental Constraints



4.1.8 Newtown Beach

Landing	Newtown Beach by Fethard
District	New Ross District, County Wexford
Position (WGS 84 UTM Zone 30N)	**52°12'17.94"N 6°49'24.67"W**
Time & Tide of visit	06th November 2013 HW Newtown on sea is HW Cobh +0014. 16km east of Newtown beach the MHWS at Kilmore Quay is 3.8m & MHWN 2.8m Predictions source tidetimes.org.uk Low Tide 00:53 (0.60m) High Tide 06:56 (4.20m) Low Tide 13:14 (0.70m) High Tide 19:16 (4.10m)
Area Summary topographical description	Newtown Beach is located 2.3km drive north east of Fethard-on-sea. The beach is situated at the western entrance to Bannow Bay, approximately 2.5 km south east of village of Newtown. The beach faces 120˚T into the Celtic Sea and is generally sheltered from the south westerly wind and swell. It is generally flat with 4m cliffs tapering to 0m above HWM 150m northwards along the beach. See Figure 4-85. The proposed landing coordinate is at the end of an access road atop of the 4m cliff. The preferred landing would be further north as indicated in Figure 4-85 and Figure 4-86. **Figure 4-85 Newtown Beach proposed landing**  **Figure 4-86 Location of Newtown Beach** 

Social Factors	Newtown beach shows no indications of leisure activities other than walkers. There were no warning signs for bathers indicating that this is not a popular bathing area. The surrounding area has numerous dwellings to which the cable installation may disrupt.
Access to Site	Access to the site access road is via the coast road (L81151), which is suitable for use by heavy vehicles. However, the road to the beach car park is narrow, steep and not suitable for heavy plant vehicles. There is no turning space at the base of this road. See Figure 4-87. **Figure 4-87 Car parking at end of access road** 
Access to beach	Access to the beach is available only by foot, following a path northwards along the top of the cliff for 130m. Access could possibly be constructed through the farmland behind the cliff.
Plant storage area	With the agreement of the land owner a plant storage area could be established in the field on the north side of the access road. Entry to this field for heavy plant may have to be constructed.
Joint pit area & cable ducts	A TJP could be built in the field behind the cliff front. Consideration should be given to the amount of erosion likely to occur in the next 50 years, accordingly siting the TJP a safe distance back from the present HWM.
Composition of beach	The beach is composed mainly of rock outcrop overlaid by thin layers of coarse sand with pebbles and cobbles scattered by the tide and waves. The rock outcrop consists of Palaeozoic Cambrian Greywakes, Slates and Quartzite dipping in many directions forming a gently sloping wave cut platform throughout the foreshore. See Figure 4-88. **Figure 4-88 Wave cut platform. Cambrian slates and Greywakes overlain by recent topsoil** 
Beach Profile	The profile of the beach is <5˚
Erosion	The base of the low soft mudstone/slate cliff is exposed to erosion during high tides and storm swells. This creates a jagged profile to the cliffs as the topsoil is taken away by the sea. See Figure 4-89.

<table>
<tr><td></td><td colspan="6">Figure 4-89 Erosion at base of cliff
  </td></tr>
<tr><td>Sea Defences</td><td colspan="6">There are no man made sea defences at this location. The wave cut platform of rock outcrop provides some protection to the erosion of the sand and cliffs by causing waves to break further offshore.</td></tr>
<tr><td>Obstructions on beach</td><td colspan="6">The beach is littered with outcropping Cambrian Greywacke Siltstone, mudstone and conglomerate of varying degrees of hardness. These would present a significant challenge to cable burial. See Figure 4-90.

Figure 4-90 Newtown Beach looking north towards Bannow Bay
  </td></tr>
<tr><td>Offshore obstructions</td><td colspan="6">Whilst the approaches to the beach and Bannow bay are shallow and likely to be shifting depths, there are no major offshore obstructions other than the wave cut platform.</td></tr>
<tr><td>Existing infrastructure</td><td colspan="6">There is good infrastructure supporting this location with numerous roads and services connecting Fethard to the surrounding county.</td></tr>
<tr><td>Distance LWM to contours</td><td>To 5 m</td><td>0.45km</td><td>To 10 m</td><td>1.6km</td><td>To 15 m</td><td>5.25km</td></tr>
<tr><td>Distance MHWM to MLWM</td><td colspan="6">~130m</td></tr>
<tr><td>Cable Installation options</td><td colspan="6">Burying the cable to the target burial depth using open cut excavation at this location is unlikely to be a feasible option due to the ubiquitous rock outcrop. Rock blasting could be considered but given the environmental classifications of this site this could prove difficult to obtain permission for this activity.
HDD through the rock could be an option however there is the possibility that a shallow draft vessel or barge would still be required as a result of the extent of the shallow water depths.</td></tr>
</table>

Conclusions	Although a sheltered location, Newtown Beach would not be a preferred location to land the cable mainly due to the likelihood of difficulties associated with burial beneath the ubiquitous rock outcrop. Permission to cut or blast a trench through the rock outcrop may prove difficult given that this landfall is in very close proximity to environmentally protected areas. The limited plant storage and lack of access to the beach also make this a less preferred landfall site.

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Figure 4-91 Newtown Beach looking south west. Note car park at end of access road

Figure 4-92 Continuation of tapering cliff line. Note rock outcrop through sand

Figure 4-93 Looking north west along preferred landing profile

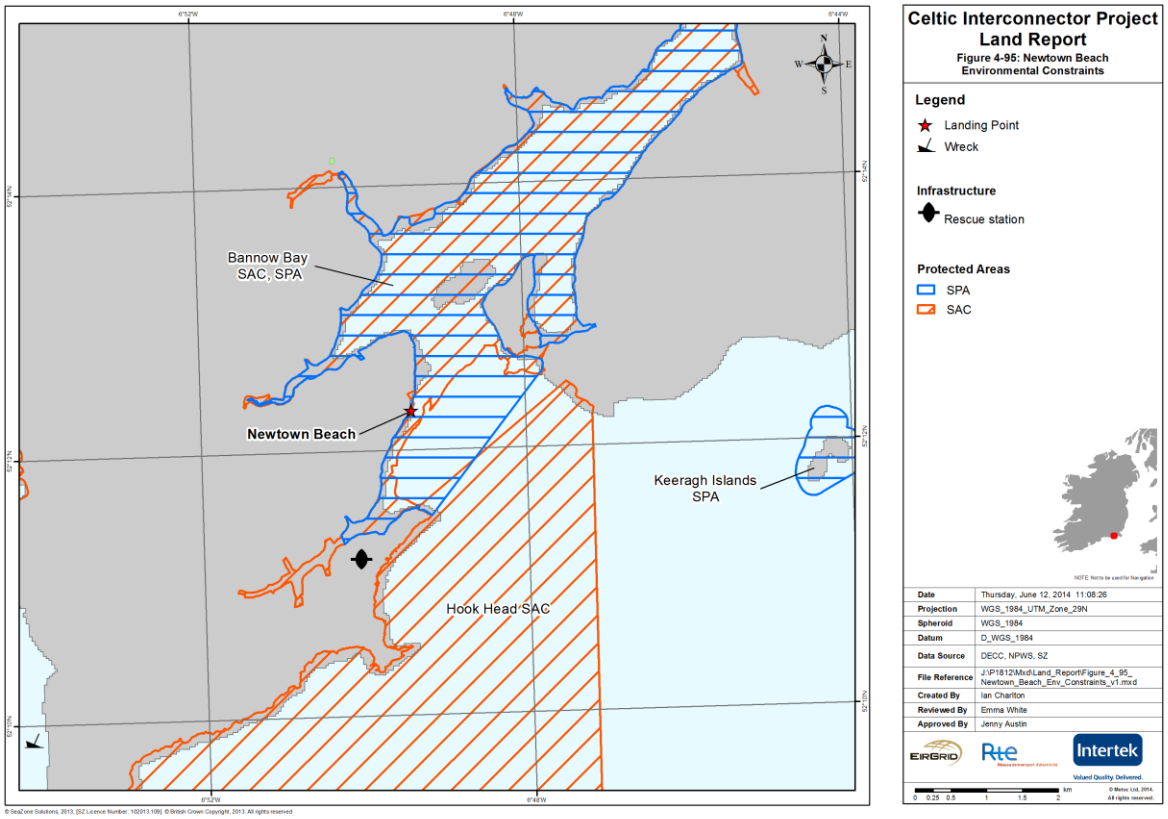
Figure 4-94 Wave cut platform Mid foreshore

4.1.8.1 Environmental Constraints

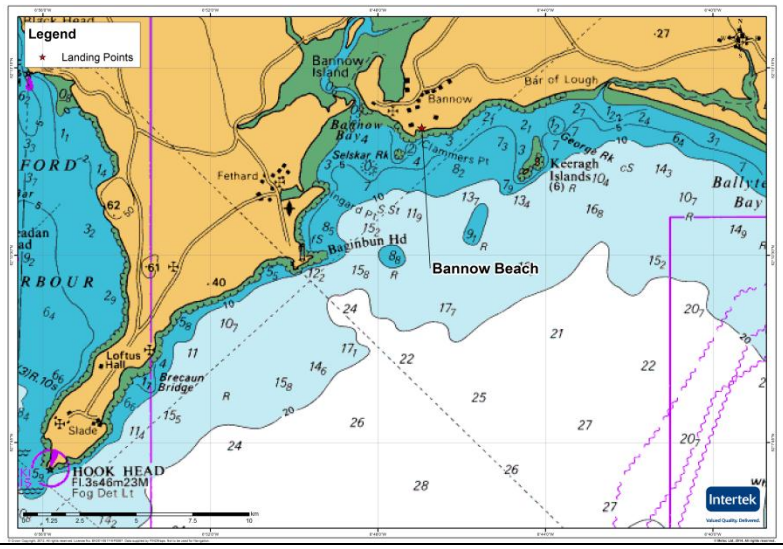
The environmental constraints for the Newtown Beach landfall are summarised below and in Figure 4-95.

Site	Feature of Conservation Interest	Proximity to landfall	Constraints	Recommendations
Bannow Bay SPA and Ramsar Site	Wintering wildfowl and the site supports internationally important brent goose (*Branta bernicla*) along with a number of other nationally important species. Important wetland habitat.	5m	Potential disturbance to bird species	Consult with NPWS
Bannow bay cSAC	11 listed Annex I coastal habitats.	30m	The features of the site are not expected to be impacted by the project	Consult with NPWS
Hook Head cSAC	Annex I Reef, large shallow inlets and bays and vegetated sea cliffs of the Atlantic and Baltic coasts.	1.1km	The features of the site could potentially be impacted by the project.	Consult with NPWS

Figure 4-95 Newtown Beach Environmental Constraints



4.1.9 Bannow Beach

Landing	Bannow Beach
District	New Ross District, County Wexford
Position (WGS 84 UTM Zone 30N)	**52°12'22.04"N 6°46'57.05"W**
Time & Tide of visit	06th November 2013 HW at Bannow beach is Cobh +0014. Nearest predictions are for Baginbun head. At Killmore Quay, 14km east of Bannow beach, the MHWS is 3.8m & MHWN is 2.8m Predictions source for Baginbun Head, UK Admiralty Time Height 06 Wed 01:02 0.20m 07:08 4.16m 13:26 0.28m 19:28 4.01m
Area Summary topographical description	Bannow Beach is situated at the eastern entrance to Bannow Bay, approximately 0.5 km south of village of Bannow. The beach faces 140˚T and its lower foreshore forms a narrow inlet no more than 70m wide. It is through this inlet that a potential cable route may be found to this landfall. The beach is sheltered from prevailing south westerly wind and swell by the significant wave cut rock outcrop and the cliffs associated with Clammers point on the south west side. The lower foreshore is characterised by significant outcrops of Paleozoic Cambrian Rocks that form wave cut platforms extending to unknown depths below the MLWM. See Figure 4-96 and Figure 4-97. **Figure 4-96 Bannow Beach**  **Figure 4-97 Location of Bannow Beach** 

Social Factors	Bannow is a sparsely populated village with a few farms and less than 30 houses within 1km of the beach. There are farm buildings 200m from the beach along the access road which could possibly be used for plant storage. The social impact of landing a cable at this location may be less than some of the other proposed landfall sites. There is some evidence of the beach once being used to land small lobster fishing boats, however only the single boathouse at the top of the access road remains.
Access to Site	Access to the site is via the coast road, off the R736, this road is suitable for use by heavy vehicles. The tarmac road ends at a small car park.
Access to beach	From the car park a hard core covered road sloping at 6˚, provides access to the beach. This road would be suitable for heavy plant use. See Figure 4-98 and Figure 4-99. **Figure 4-98 Beach access road and boat house**  **Figure 4-99 Kiln Bay from base of beach access looking south east** 
Plant storage area	There are 2 options for plant storage. 1. In the rough grass area on top of the cliff adjacent to the car park (see Figure 4-100). 2. 200m from the beach along the site access road there is farm with concrete yards that could be rented for storing heavy plant and landing equipment.

	Figure 4-100 Car parking at end of site access road 
Joint pit area & cable ducts	The marine cable could potentially leave the beach alongside beach access road and then under the site access road. There are potential sites for the TJP in fields adjacent to the access road.
Composition of beach	The beach is composed of very coarse sands, gravel and pebbles with assorted Greywacke and quartzite cobbles in the upper foreshore. The lower foreshore either side of kiln bay is characterised by significant outcrops of Palaeozoic Cambrian Slates and Greywackes of the Kiln Bay formation. These are hard largely impenetrable rocks interleaved with resilient quartzite and mudstones. See Figure 4-101. **Figure 4-101 Wave cut rock looking south west towards to Clammers Point** 
Beach Profile	The foreshore slopes at ~5˚ from the HWM for ~30m increasing to ~8° 20m from the MLWM.
Erosion	There is no evidence of coastal erosion at this landing however the steep slope and large size of pebbles and cobbles washed up on the beach suggests a high energy environment capable of moving sediment.
Sea Defences	There are no man made sea defences at this location, the beach being naturally defended by the harness of the rock outcrops and cliffs.
Obstructions on beach	The significant wave cut rock platforms visible at low tide around Kiln Bay are the main obstructions on the beach. The beach itself presents no other significant obstructions.
Offshore obstructions	Google Earth aerial images of the seaward approaches to Bannow beach show significant black patches beneath the sea surface. These are likely to be kelp growing on rock outcropping on the seabed.

Existing infrastructure	Other than the access road and the car park there is no significant infrastructure at the isolated location. Electricity is available to the farm and coastguard cottages. There are also 2 x 2" pipes adjacent to the beach access road draining water from the surrounding fields.					
Distance LWM to contours	To 5 m	0.75km	To 10 m	1.5km	To 15 m	5.3km
Distance MHWM to MLWM	~60m					
Cable Installation options	Open cut route options into this beach are likely to be limited to the aforementioned narrow inlet. This would need to be surveyed to establish the distribution of surface bedrock and the depth of sand available for burial. Subject to geotechnical survey of the sediment, open cut or rock blasting may be an option to achieve effective cable burial. HDD is may be an option here but will be subject to a HDD survey and could enable an installation from beyond the narrows of the inlet.					
Conclusions	Given that a feasible route in from the sea is available, the beach composition and profile could support a viable shore pull and burial of the cable at this location. The cable could exit the beach beneath the access road. This landfall provides good access for plant to the beach and medium weather downtime risk. Subject to bathymetric survey, the closest distance to the coast operable by the cable lay ship may leave it exposed to prevailing south westerly wind and swell.					

November 2013 Site Pictures

Figure 4-102 Profile route looking north west. Note beach access road

Figure 4-103 Clammers Point looking south west

Figure 4-104 Bannow Beach looking east

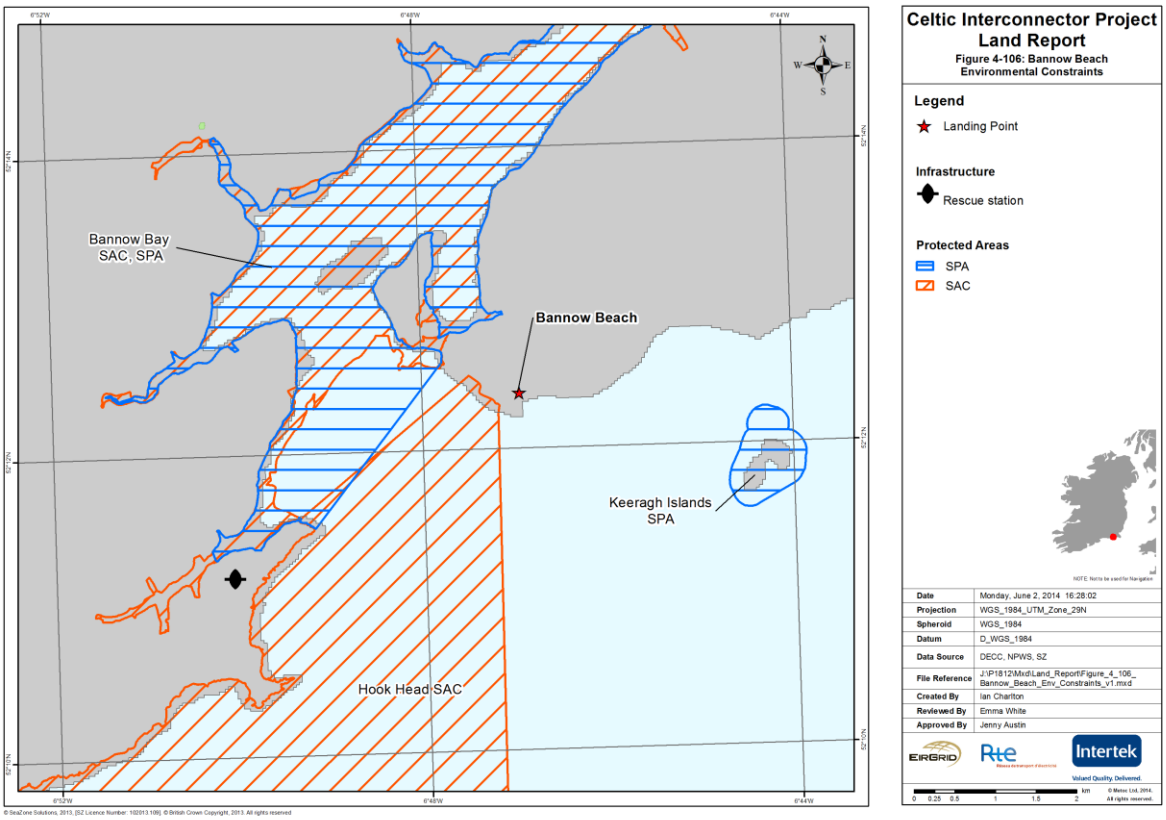
Figure 4-105 Bannow Beach looking north east from Clammers Point

4.1.9.1 Environmental Constraints

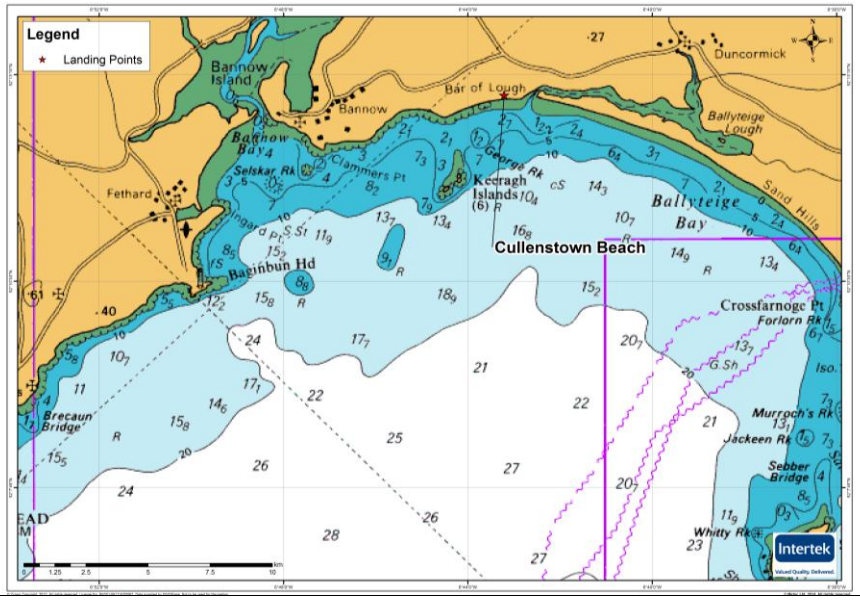
The environmental constraints for the Bannow Beach landfall are summarised below and in Figure 4-106.

Site	Feature of Conservation Interest	Proximity to landfall	Constraints	Recommendations
Bannow Bay SPA	Wintering wildfowl and the site supports internationally important brent goose (*Branta bernicla*) along with a number of other nationally important species. Important wetland habitat.	1km	Potential disturbance to bird species	Consult with NPWS
Bannow Bay SAC	11 listed Annex I coastal habitats	1km	The features of the site are not expected to be impacted by the project.	Consult with NPWS
Hook Head SAC	Annex I Reef, Large shallow inlets and bays and vegetated sea cliffs of the Atlantic and Baltic coasts	0.3km	The features of the site are not expected to be impacted by the project.	Consult with NPWS
Keeragh Islands SPA	Breeding colony of the Annex II species the Cormorant (*Phalacrocorax carbo*)	2.5km	Potential disturbance to breeding *Phalacrocorax carbo*	Consult with NPWS

Figure 4-106 Bannow Beach Environmental Constraints



4.1.10 Cullenstown Beach

Landing	Cullenstown Beach
District	New Ross District, County Wexford
Position (WGS 84 UTM Zone 30N)	**52°12'58.75"N 6°43'12.77"W**
Time & Tide of visit	06th November 2013 HW Cobh +0015; There is no accurate information as to tide heights here. Nearest predictions are for Baginbun head. At Kilmore Quay, 10km south east of Cullenstown beach, the MHWS is 3.8m & MHWN is 2.8m Predictions source for Baginbun Head, UK Admiralty. Time Height 06 Wed 01:02 0.20m 07:08 4.16m 13:26 0.28m 19:28 4.01m
Area Summary topographical description	Cullenstown Beach is situated on the western edge of Ballyteige Bay, approximately 6 km south east of Wellingtonbridge, the coast line lies exposed to the Celtic Sea (Muir Cheilteach) to the south. The beach faces 180˚T and extends eastwards for 10km as the Ballyteige Burrow to Kilmore Quay. At the eastern end of the car park the beach is interrupted by the mouth of an estuary formed by the Ballyteige sand-spit beyond. See Figure 4-107 & Figure 4-108. This feature causes the creation of an offshore bar of sediment washed out from the fast flowing estuary. The beach extends westwards becoming progressively rockier and the cliffs higher towards Bannow, 4.3km away. **Figure 4-107 Cullenstown Beach**  **Figure 4-108 Location of Cullenstown Beach** 

Social Factors	Cullenstown beach is a popular beach for visitors and there are numerous housing developments along the access road to the beach. Leisure activities on the beach include walking, beach fishing and handball however due to strong currents associated with the entrance to the estuary the beach has warning signs that "Bathing is Dangerous". The proposed landing is close to residential properties which look down over the beach from the cliffs, therefore there could be moderate social disruption in siting the cable landing here.
Access to Site	Good access to the site is via the coast road, off the R736, this road is suitable for use by heavy vehicles.
Access to beach	Very good access to the beach is available via a newly tarmac road directly onto an extensive flat hard standing area just above the HWM. See Figure 4-109. **Figure 4-109 Beach access to hard standing** 
Plant storage area	There is ample space to accommodate Heavy plant equipment on the hard standing area currently designated for car parking above the HWM.
Joint pit area & cable ducts	The TJP could be sited either at a convenient location on the top of the cliff clear of residential buildings or beneath the hard standing/car park. Both options would require achievable routing through the dunes and cliff.
Composition of beach	The inter-tidal beach is composed of coarse well sorted sands and gravels. The backshore is finer sand held together by tough grasses forming dunes. The cliff behind the backshore is composed of soft alluvium and topsoil. The Cambrian bedrock consists of Grey green Greywackes and slates which disappear from surface outcrop just west of Cullenstown beach. Moving eastwards, the bedrock becomes more buried beneath the beach sands of the Ballyteige Burrow sand-spit formation.
Beach Profile	The backshore of the beach is marked by a 4m cliff behind a long flat raised beach sloping at <5˚ to the MHWM. The intertidal zone of the foreshore slopes at <5˚ close to the MLWM.
Erosion & Deposition	Significant erosion and deposition is present along entire stretch of beach due to strong currents associated with the mouth of the estuary and long-shore drift forming the Ballytiege Burrow sand-spit formation. Historical maps clearly indicate significant changes to this coastline's morphology. See Figure 4-107 & Figure 4-110.

Figure 4-110 Cullenstown Beach in 2004

Sea Defences

The eastern end of the beach has been heavily defended by large boulders against the encroachment of the mouth of the estuary behind the Ballytiege Burrow sand-spit.

The hard standing car parking area has also been defended against erosion. Large boulders protecting the seaward side against high tide and storm conditions. See Figure 4-111 and Figure 4-112.

Figure 4-111 Sea defences at eastern end of Cullenstown Beach looking east

Figure 4-112 Sea defences at edge of car park looking west

<table>
<tr><td>Obstructions on beach</td><td colspan="6">There are no significant obstructions apart from some rock outcrop appearing at LW to the west of the beach. See Figure 4-113.

Figure 4-113 Cullenstown foreshore looking west
 
</td></tr>
<tr><td>Offshore obstructions</td><td colspan="6">The approach to the landing is shoal and there is a shifting sand bar close to the mouth of the estuary, which will restrict close access to the beach by the installation vessel.
There are 2 small rocky islands 2.3km south west of the beach.
Subject to bathymetric survey, there appear to be no other significant offshore obstructions.</td></tr>
<tr><td>Existing infrastructure</td><td colspan="6">The site has good infrastructure supporting access to the beach including electricity and water supply onto the beach itself. There is a toilet block and accommodation nearby in the village.</td></tr>
<tr><td>Distance LWM to contours</td><td>To 5 m</td><td>0.55km</td><td>To 10 m</td><td>1.44km</td><td>To 15 m</td><td>4.5km</td></tr>
<tr><td>Distance MHWM to MLWM</td><td colspan="6">~ 60m</td></tr>
<tr><td>Cable Installation options</td><td colspan="6">Bringing the cable ashore here could entail excavating an open cut trench up the beach with an option to HDD through the 4m cliff to the TJP location behind.
The preferable options would be to route the cable at a convenient point through the flat hard standing area at the base of the cliffs. This would avoid both the sea defence area to the east, where the beach is more susceptible to erosion, and the significant rock outcrop area to the west.
A more extended HDD option could also be explored to minimise the disruption to this popular beach, this could also minimise the risk of cable exposure from sediment transfer in the nearshore area.</td></tr>
<tr><td>Conclusions</td><td colspan="6">Cullenstown beach is moderately sheltered from the south west however its aspect in relation to Ballyteige Burrow sand-spit causes it to be an active high energy environment for erosional and depositional processes.
Cullenstown beach appears to be a viable cable landing for an HVDC cable system as there is ample space to bring a cable ashore here and access to the beach is good.
Further investigation is required to establish if the ground conditions are suitable for HDD and trenching operations.
Further study of the dynamic processes effecting the movement of sediment at this beach should be researched.</td></tr>
</table>

November 2013 Site Pictures

Figure 4-114 Coarse sands of inter tidal zone looking east

Figure 4-115 HWM looking east

Figure 4-116 HWM looking east

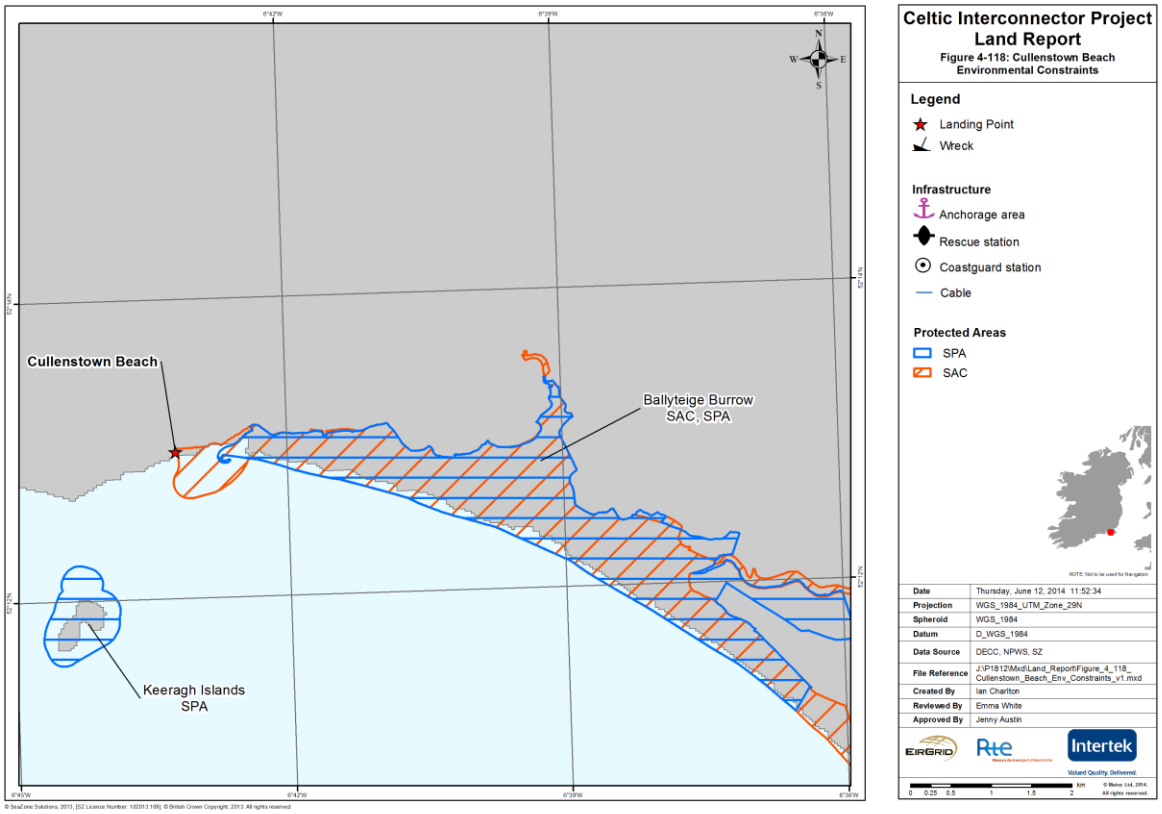
Figure 4-117 Beach gradient looking west

4.1.10.1 Environmental Constraints

The environmental constraints for the Cullenstown Beach landfall are summarised below and in Figure 4-118.

Site	Feature of Conservation Interest	Proximity to landfall	Constraints	Recommendations
Ballyteige Burrow SAC	14 listed Annex I coastal habitats	30m	The features of the site are not expected to be impacted by cable installation.	Consult with NPWS
Ballyteige Burrow SPA	Wintering wildfowl and the site supports internationally important brent goose (*Branta bernicla*) along with a number of other nationally important species. Important wetland habitat.	0.6km	Potential disturbance to bird species	Consult with NPWS
Keeragh Islands SPA	Breeding colony of the Annex II species the Cormorant (*Phalacrocorax carbo*)	1.8km	Potential disturbance to breeding *Phalacrocorax carbo*	Consult with NPWS

Figure 4-118 Cullenstown Beach Environmental Constraints



4.2 FRANCE LANDFALL OPTIONS

4.2.1 Moguériec

Landing	Moguériec
District	Sibiril
Position (WGS 84 UTM Zone 30N)	**Landing Option 1, Moguériec Harbour: 48°41'22.62"N, 4° 4'33.70"W** **Landing Option 2, Moguériec Harbour: 48°41'16.22"N, 4° 4'34.90"W** **Landing Option 3, Moguériec Harbour: 48°41'11.86"N, 4° 4'28.64"W** **Landing Option 4, Tévenn beach: 48°41'27.87"N, 4° 5'4.97"W**
Time & Tide	Date of Visit: 20-11- 2013 Nearest Port: Roscoff 2014 Tidal Ranges Highest Spring Range: 9.2m Lowest Neap Range: 2.3m Time / Height (m) LW: 01:25 / 1.95 HW 07:15 / 8.65 LW: 13:44 / 1.95 HW: 19:36 / 8.35
Area Summary topographical description	Moguériec harbour is situated at the mouth of the Anse du Guillec ~4 km north west of Sibiril. The harbour is sheltered from prevailing westerly winds and from the north by a high sea wall and faces a sandy beach 1.4km in length and the town of Dossen to the north east. There are 4 landing options for the cable at this location. 3 within Moguériec harbour and 1 at Tévenn beach nearby. See Figure 4-119. **Figure 4-119 Moguériec Landing Option Locations** 

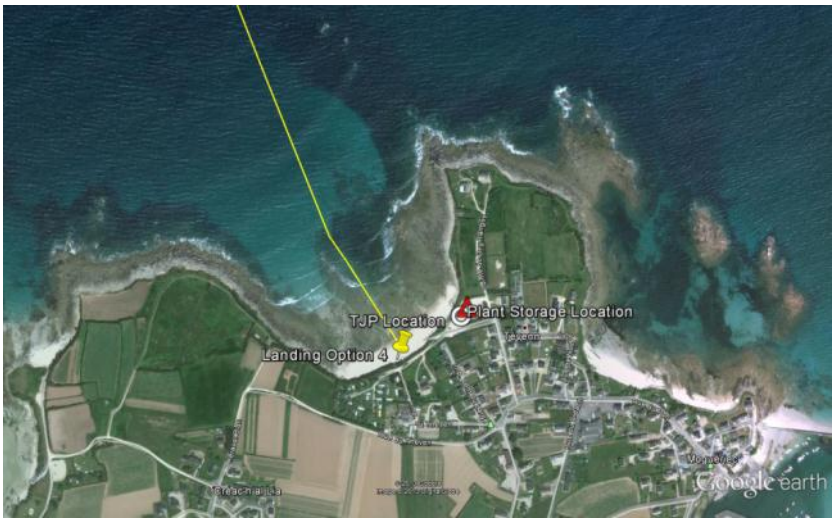
Area Summary topographical description Continued…

Landing Option 1. Faces 020°T and is ~60m wide

Figure 4-120 Moguériec Landing Option 1

Landing Option 2. Faces 060°T and is ~25m wide

Figure 4-121 Moguériec Landing Option 2

Area Summary topographical description Continued…	Landing Option 3. Faces 015˚T and is ~50m wide **Figure 4-122 Moguériec Landing Option 3**  Landing Option 4, Tévenn beach. Faces 335˚T and is ~240m wide **Figure 4-123 Moguériec Landing Option 4** 
Social Factors	Moguériec is a popular for holiday & retirement homes. Buildings are most densely located around the north quay area. The harbour is used throughout the year by fishing boats less than 25m in length. Seafood is landed and stored on both the north and south quays. Between June and September a ferry to the Isle de Batz embarks and disembarks passengers from Moguériec quay. Tévenn beach is used by tourists during the summer months and is a surfing location all year round.

Access to Site	Landing Option 1: Overall access to Moguériec is good with roads suitable for heavy vehicles. Turning off the coast road at Kérivoas there is parking space in Moguériec on both fishing quays. Landing Option 2 & 3: Access to these sites is via the Quay Moguériec and is good for heavy vehicles. However beyond the Quay there is only a footpath to the backshore of both beaches. Landing Option 4: Tévenn has good access for heavy vehicles from Moguériec via Rue de Pors Misclic to a 40 x 30m car park adjacent to the beach See Figure 4-124. **Figure 4-124 Landing Option 4 Tévenn – Upper Access to beach & Car park** 
Access to beach	Landing Option 1: To access this beach plant would need to drive through the Rue de Begar Rest which is both narrow and winding. The slipway accessing the beach is narrow and would need to be widened and strengthened to allow heavy plant onto the beach. See Figure 4-125 **Figure 4-125 Beach Access Landing Option 1**  

Access to beach Continued…	Landing Option 2 & 3 Access to both these beaches is restricted to a footpath. This could be widened and perhaps temporarily reinforced to allow beach access to heavy plant. Alternatively a temporary access road across fields could be built connecting the beaches to the Kersaurzon road. Landing Option 4: Beach access is good via ~2m drop slipway from the car park. See Figure 4-126. **Figure 4-126 Landing Option 4 Tévenn – Access to beach** 
Plant storage area	Landing Option 1: Plant storage is very limited at this location. It may be possible to use the car park on the north quay. Landing Option 2 & 3: Depending upon the access road options, plant could either be stored at the end of the south Quay or in fields behind the beaches Landing Option 4: Ample plant storage is readily available in the car park adjacent to the beach.
Joint pit area & cable ducts	Landing Option 1: There is little room for the TJP behind this beach as the Rue de Begar Rest and nearby buildings preclude a clear site. Landing Option 2: The TJP could be located in the waste ground at the end of the south Quay. This may involve installing a short HDD duct beneath the granite boulder and out onto the sandy beach. Landing Option 3. There is ample clear space in the fields behind this landing option for a TJP. Landing Option 4: The TJP could be sited within or adjacent to the car park. Alternatively the TJP could be located on the waste ground at the end of the Imp Vent du Large Road.

Composition of beach

Landing Option 1: The lower foreshore is composed largely of well compacted coarse white sands. However the upper foreshore almost all the way to the HWM is composed of hard migmatitic granite outcrops through the sand. See Figure 4-127, Figure 4-128 & Figure 4-129.

Figure 4-127 Landing Option 1 looking south

Figure 4-128 Landing Option 1 looking east

Figure 4-129 Landing Option 1 & Harbour approach looking east

Landing Option 2 & 3 consist of a flat well compacted coarse white sands in the lower foreshore and hard migmatitic granite outcrops and loose boulders up to 2m across in the upper foreshore. Although these boulders may be virtually impenetrable to the HWM at landing option 2, the distance from the Quay to the sand just below the HWM is < 25m.

Figure 4-130 Landing Option 2 looking south

Figure 4-131 Landing Option 2 & 3 looking south

At landing option 3 there is more sand between the boulders than at landing option 2 however the distance to the clear sandy beach is some 60m.

Landing Option 4: The west side of Tévenn beach is bounded by cliffs ~3m high composed of mixed recent sediments of sand, mud and topsoil. See Figure 4-132. These cliffs taper in height towards the east becoming <2m above HWM at the car park. See Figure 4-133.

Composition of beach Continued…

Figure 4-132 Tévenn Beach Cliffs on backshore

Composition of beach Continued…

Figure 4-133 Landing Option 4 Tévenn – Looking east

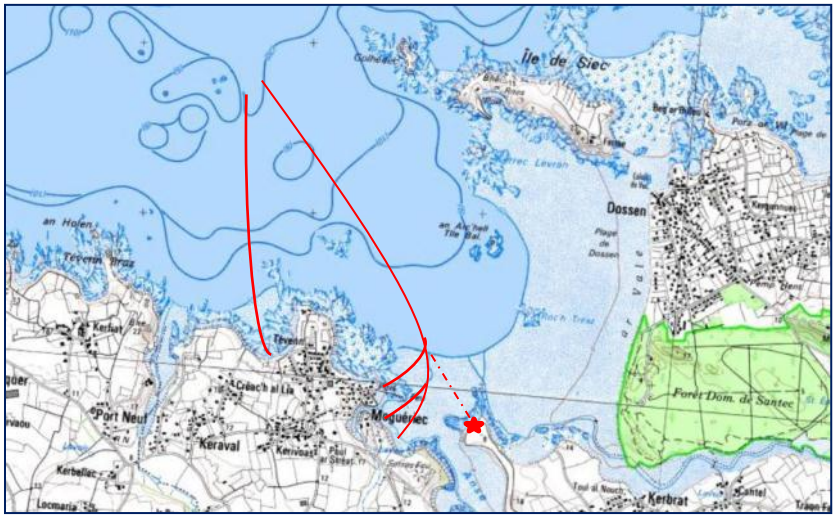
The upper section of Tévenn beach foreshore is composed of well sorted soft wind/storm blown white sand with a few small pebbles. See Figure 4-134

Figure 4-134 Tévenn Beach looking north west

Below this, hard migmatitic granite outcrops through the sand See Figure 4-134 & Figure 4-135.

Note: there is a clear path of sand all the way to the LWM however the depth of sand is uncertain.

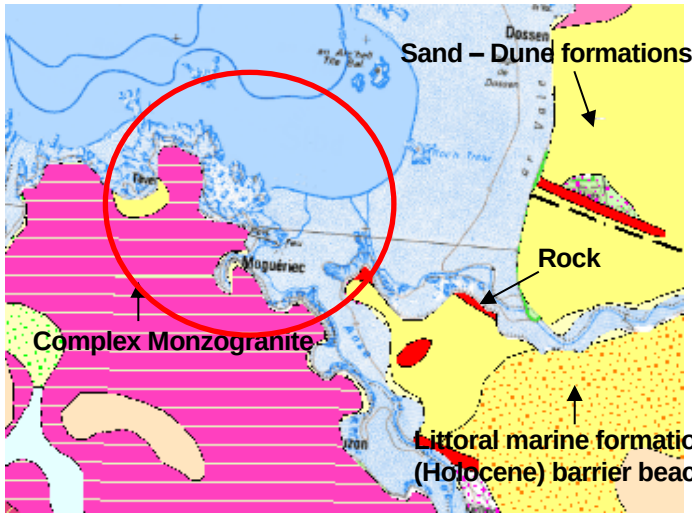
	Figure 4-135 Tévenn Beach looking south. Note Cliffs & Granite outcrops 
Beach Profile	Landing Option 1: The foreshore to the LWM slopes at <5˚ Landing Options 2 & 3: The lower foreshore to the LWM slopes at <5˚ whereas the upper foreshore to the HWM over the granite boulders slopes between 5˚ and 10˚. Landing Option 4: The foreshore slopes at <5˚
Erosion	Landing Option 1: There is little evidence of erosion at this location, any longshore drift or storm based erosion being prevented by the granite outcrop Landing Option 2 & 3: There is little evidence of erosion at this location, any longshore drift or storm based erosion being prevented by the granite outcrop Landing Option 4: There is some evidence of erosion in the cliff at the back of this beach. This being the result of high tides and strong onshore winds at this exposed location. Otherwise the beach is naturally protected from erosion by the granite outcrops.
Sea Defences	Landing Option 1: The Sea wall protecting Moguériec harbour provides sea defence to the back of this beach. See Figure 4-120 & Figure 4-125. Otherwise, the granite provides a natural protection for the area immediately above the HWM. Landing Option 2 & 3: There are no man made sea defences here, the granite boulders providing protection against the sea. Landing Option 4: There are some sea defences in the form of granite boulders protecting the seaward edge of the car park. See Figure 4-133. Otherwise the beach is defended naturally by the granite outcrops.
Obstructions on beach	Landing Option 1: Outcrops of granite boulders and tors of various heights above the sand are the main obstructions of the upper foreshore. Landing Option 2 & 3. Apart from the granite boulders of the upper foreshore, there are few obstructions on these beaches. There are small vessel (<10m) moorings at the harbour entrance which may conflict with the routing of the cable at Landing option 2. **Note:** To land at locations 1, 2 or 3, the cable route may need to cross the harbour entrance channel. Landing Option 4: The main obstructions on this beach are the numerous granite outcrops which extend from just below the storm berm to the LWM and beyond.
Offshore obstructions	Landing Option 1, 2 & 3: As well mobile shallow sand bars, there a numerous unmarked submerged rocks at the entrance approach to Moguériec harbour. Leading marks are in place to guide vessels to the harbour entrance. The harbour is dries out at low water. Landing Option 4: Tévenn is exposed to wind and waves between north west and northerly directions. There are some unmarked charted rocks 4km offshore however these should not greatly hinder a cable lay ship.

<table>
<tr><td>Existing infrastructure</td><td colspan="6">Good infrastructure is available in and around Moguériec. Road via Sibiril (4km) connect the port to regional centres of Saint Pol De Leon (10km), Morlaix (30km), Lesneven, (30km) & Landivisiau (24)km.</td></tr>
<tr><td>Distance LWM to contours</td><td>To 5 m</td><td>1.0km</td><td>To 10 m</td><td>1.75km</td><td>To 20 m</td><td>2.6km (1.4km bc)</td></tr>
<tr><td>Distance MHWM to MLWM</td><td colspan="6">Landing Option 1: ~ 200m
Landing Option 2: ~ 375m
Landing Option 3: ~ 450m
Landing Option 4: ~ 275m</td></tr>
<tr><td>Cable Installation options</td><td colspan="6">Landing Options 1, 2 & 3: Cable installation at each of these locations would involve an initial beach pulls from a separate location. See Figure 4-136.
Figure 4-136 Moguériec Harbour Approaches. Source InfoTerra
 

With potential separate beach pull location - ✱
The main pull into Dossen Bay Beach would entail either a cable ship or shallow water barge stationed as near to the beach as the draft of the installation vessel would allow.</td></tr>
<tr><td></td><td colspan="6">The second pull to the preferred landfall option would require the cable to change heading and be pulled into the beach over the granite outcrops at each location.
Subject to bedrock conditions, there is an option to HDD a short duct to bring the cable up to the quay level at landing option 2.
The feasibility of completing beach pull operations during one tide for each of the landing options should be explored.
Once in place the option to bury the cable in the lower foreshore is good however alternative methods of burying the cable over the exposed granite should be explored.
Landing Option 4: Cable installation here would involve a single straight beach pull from The north west. See Figure 4-123. Options to bury the cable in the inter-tidal zone are limited to finding a clear route through the sand or rock blasting could be considered. In the event of insufficient sand coverage being available, the alternative option to consider could be to rock dump over the cable within the inter-tidal zone.
Depending upon preferred land connection location, HDD through the cliffs at the west end of the bay may be necessary. Another consideration would be to HDD to the 10m WD contour to facilitate a potentially more straight forward marine shore-end operation.</td></tr>
</table>

Conclusions	For the three options at Moguériec Port involve a pulling the cable ashore in two directions which may involve the cable lay vessel being brought inshore to <10m WD. Landing options 1 and 2 would involve crossing the port entry channel which may require deeper cable burial than an outside channel route. Landing option 2 has the least amount of visible granite to traverse before the cable could be buried in the sand. For landing option 4 at Tévenn a straight, single, relatively short pull from offshore offers a simpler installation option. There is also good potential for burial in the upper foreshore and backshore with several locations available for the TJP. However, although vehicles could negotiate the lower foreshore to LWM, finding an effective burial depth in the sand between the granite outcrops may not be possible. For all four landing options laying the cable over granite outcrop will mean little possibility of burial. Rock dumping or pining options would need to be explored. The other feasible option which could avoid these additional protection efforts would be to HDD to the 10m WD contour. A geophysical and geotechnical survey over all these landing options would reveal the extent of sand covering the bedrock. This survey would be crucial to optimising the preferred landing option route.

Historical Images



* For a full geological key please see http://infoterre.brgm.fr/viewer/MainTileForward.do

Figure 4-137 Moguériec Geology

Figure 4-138 View from harbour looking south east into Anse du Guillec

Figure 4-139 Landing Option 3 looking south

Figure 4-140 Landing Option 2 looking E

November 2013 Site Visit Images

Figure 4-141 Landing Option 4 Tévenn – Looking west

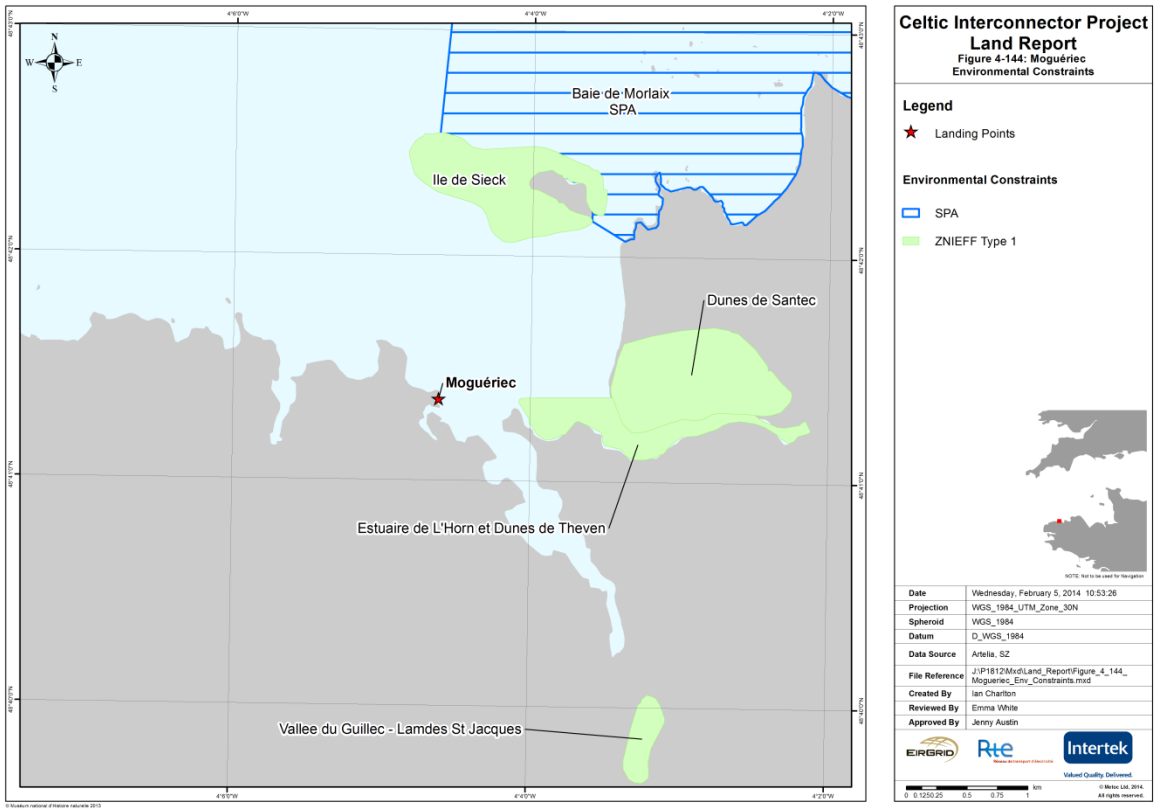
Figure 4-142 Tévenn Beach foreshore

4.2.1.1 Environmental Constraints

A summary of the environmental constraints for the Moguériec landfall are presented below. Also see Figure 4-143.

Landfall	Site	Feature of Conservation Interest	Proximity to landfall	Constraints	Recommendations
Moguériec	ZNIEFF type 1 n ° 530006306 l'Horn et dunes de TEVEN, n°530008378 Dunes de SANTEC et n°53015123 Ile de SIECK).Natura 2000 area in sea Directive FR5300015 and Habitat Directive birds FR5310073 Bay de MORLAIX.		Located in close proximity.	The landing area is not located in a protected area, however it is in close proximity.	Discussion with the environmental authority.

Figure 4-143 Moguériec Environmental Constraints



4.2.2 Kerfissien

Landing	Kerfissien
District	Cléder
Position (WGS 84 UTM Zone 30N)	**48°41'21.53"N 4° 9'32.82"W**
Time & Tide	Date of Visit: 20-11- 2013 Nearest Port: Brignogan-Plage Time / Height (m) LW: 01:09 1.80 HW 06:58 8.05 LW: 13:29 1.80 HW: 19:17 7.80 2014 Tidal Ranges Highest Spring Range: 8.65m
Area Summary topographical description	Kerfissien is a small seaside resort ~5 km north of Plouescat. The surrounding area is generally flat with low gradient undulating hills. The coast adjacent to the resort consists of 4 rocky bays the largest of which forms a small harbour with moorings for vessels less than 10m. The harbour is protected from the north by a 110m long harbour wall and dries out at low water. The shore side part of the harbour comprises 160m wide curved beach facing ~038°T. The south eastern side of the beach is characterised by rock outcrops ~ 5m high and associated cliffs see Figure 4-144 **Figure 4-144 Backshore Cliff looking south east**  The north west side of the beach formed by a granite headland with sand dune & rough grass gently sloping to the beach. A storm berm <2m forms the backshore. See Figure 4-145

Area Summary topographical description Continued…	**Figure 4-145 Kerfissien Beach Access Slipway and Storm Berm** 
Social Factors	Kerfissien is a popular seaside resort attracting many tourists during the summer months. The beach and those nearby are popular for bathing, sailing surfing, boating and recreational fishing. There are a number of moorings for vessels <10m in the harbour. Holiday accommodation and camping are available nearby. There is a 50 x 60m car park next to the main beach with shops and cafes, most of which were closed for winter on the day of the site visit. Bringing the cable ashore during the summer months will have a significant social impact on the tourism of the area.
Access to Site	Access to the site is via the coast road, the D330. This road is suitable for use by heavy vehicles.
Access to beach	Access to the beach is via a concrete slipway wide and strong enough for heavy vehicles. See Figure 4-145. The beach is firm and will support wheeled vehicles. During the site visit, tractors and trailers were working on the beach collecting kelp.

Plant storage area	There is an adequate plant storage hard standing space at the end of the access road to the beach. See Figure 4-146 & Figure 4-147. **Figure 4-146 Kerfissien Harbour looking east**  **Figure 4-147 Potential Plant Storage** 

Joint pit area & cable ducts	The proposed transition joint pit (TJP) area would be at the top of the slipway or in the waste ground between the access road and the HWM. See Figure 4-148 **Figure 4-148 Beach Access from Main Car Park looking south east** 
Composition of beach	This beach is mainly composed of granite bedrock outcrop and boulders with a thin covering of well sorted coarse white sand. The granite was formed 250 – 400 million years ago during the Hercynian Orogeny and forms part of Brignogan phase of intrusive rocks. The granite is monzonitic in composition and very hard. Prolonged weathering of weaknesses in the granite, potentially over hundreds of years, has produced large rounded boulders and Tors characteristic of this coast. See Figure 4-149.
	Figure 4-149 Monsonitic Granite Tors on Kerfissien beach  Note: Local borehole data (conducted for Geothermal exploration) reveals the granite to be in excess of 80m thick beneath 7m of Quaternary deposits.

Beach Profile	The profile of the beach upper beach is <15˚, decreasing to <5˚ beyond the harbour wall. See Figure 4-150 **Figure 4-150 Harbour Approaches to Kerfissien.**  Note: Moderate Gradient of Beach
Erosion	There is very little evidence of coastal erosion at this landing.
Sea Defences	Some concrete sea defences have been installed at the base of the cliff at the eastern end of the beach to protect two outfalls from potential cliff slump. See Figure 4-144
Obstructions on beach	The main obstructions to the cable landing here are the granite outcrops and boulders strewn around the lower foreshore. Given the extensive amount of granite outcrop here, burial of the cable would be difficult if not impossible for most of the landing route to the HWM.
Offshore obstructions	The seaward approach to Kerfissien is complex and characterised by shallow water surrounding numerous unmarked rock outcrops. See Figure 4-151. Finding a feasible cable route through these rocks may not be possible. Cable lay and support vessels >15m and constrained by their draft would have difficulty negotiating safe passage into the harbour in all but calm conditions. See Figure 4-152 **Figure 4-151 Seaward Approach to Kerfissien Port** 

<table>
<tr><td>Offshore obstructions
Continued…</td><td colspan="6">Figure 4-152 Kerfissien Photo-Bathymetry – Source InfoTerra
  </td></tr>
<tr><td>Existing infrastructure</td><td colspan="6">Kerfissien is well connected to the surrounding region by the main coast road the D330. It is 5km from Plouescat and ~25km from Lesneven.
As well as good parking, there are toilet facilities next to the beach.</td></tr>
<tr><td>Distance LWM to contours</td><td>To 5 m</td><td>1.5km</td><td>To 10 m</td><td>1.7km</td><td>To 20 m</td><td>2.2km</td></tr>
<tr><td>Distance MHWM to MLWM</td><td colspan="6">~250 m</td></tr>
<tr><td>Cable Installation options</td><td colspan="6">For an open cut approach a beach pull from a separate location would be necessary at this location in order to get around the harbour wall. Finding a feasible route through the near shore rocks and shoals may prove difficult and result in multiple AC's in the inshore area.
A potentially less disruptive option would be to route the cable landfall to Kerfissien west Bay. The approach is also complex here however a single beach pull position may be possible.
Given the significant amount of obstructions affecting vessel access in this location HDD may be a viable method of facilitating a more feasible shore-end operation
Kerfissien west bay has significantly more rock outcrop than the harbour making burial and vehicular access here extremely difficult. See Figure 4-153, Figure 4-154 & Figure 4-155.

Figure 4-153 Kerfissien west Bay looking north
  </td></tr>
</table>

Cable Installation options Continued…	**Figure 4-154 Kerfissien west Bay looking west**  **Figure 4-155 Kerfissien west Bay looking north** 
Conclusions	Given the complexity of the rock formations in the approach to this landfall, landing the cable at Kerfissien would be difficult in all but calm conditions. From this initial assessment it appears that it would be unlikely that the cable could be buried to more than 1m in the thin sands that cover the granite bedrock. Therefore if an open cut method was attempted the depth of coverage may need to be supplemented by additional cable protection measures for example rock blasting prior to installation or rock dumping post installation. Rock dumping the cable in the intertidal zone may however require mitigation of the potential impact on the tourism associated with the beach could prove considerably costly either in terms of materials used or in the case of increased weather down time risk by potentially having to work off season. Due to the tourism value of this location, construction operations would most likely be requested to coincide with off peak periods by local authorities therefore increasing the risk of weather down time. The beach area fall within an area of outstanding natural beauty (Espace Remarquable) and hence construction work is not allowed in this area.

Historical Images

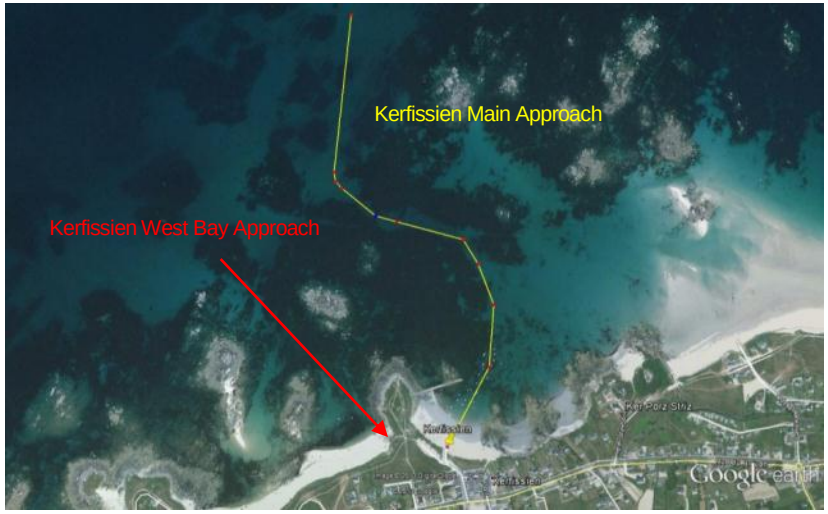
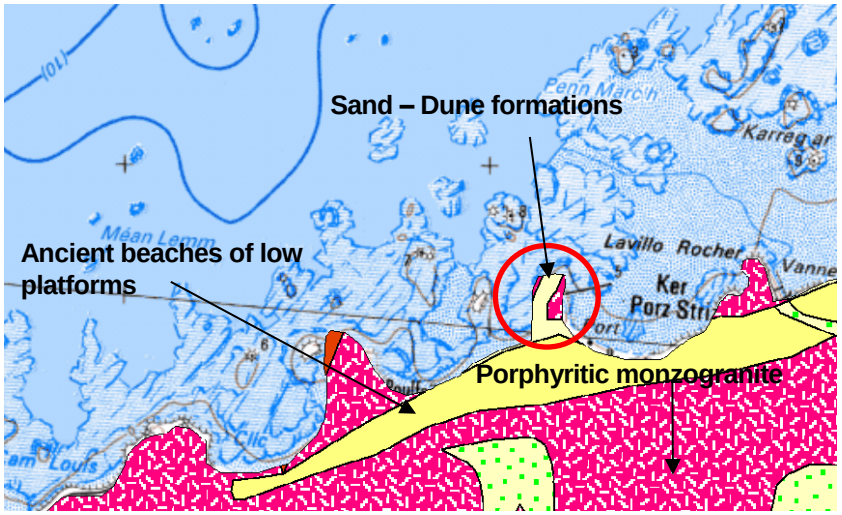


Figure 4-156 Kerfissien Overview showing potential cable route approaches to main beach and west Bay



* For a full geological key please see http://infoterre.brgm.fr/viewer/MainTileForward.do

Figure 4-157 Kerfissien Geology. Note distance to 10m contour

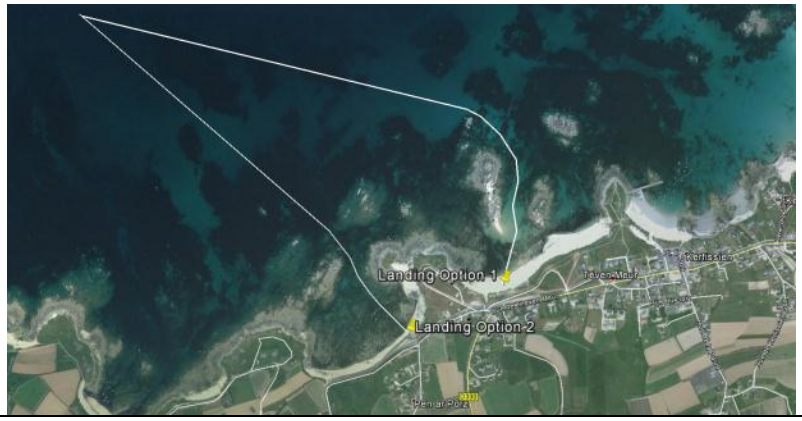
Figure 4-158 Kerfissien Beach

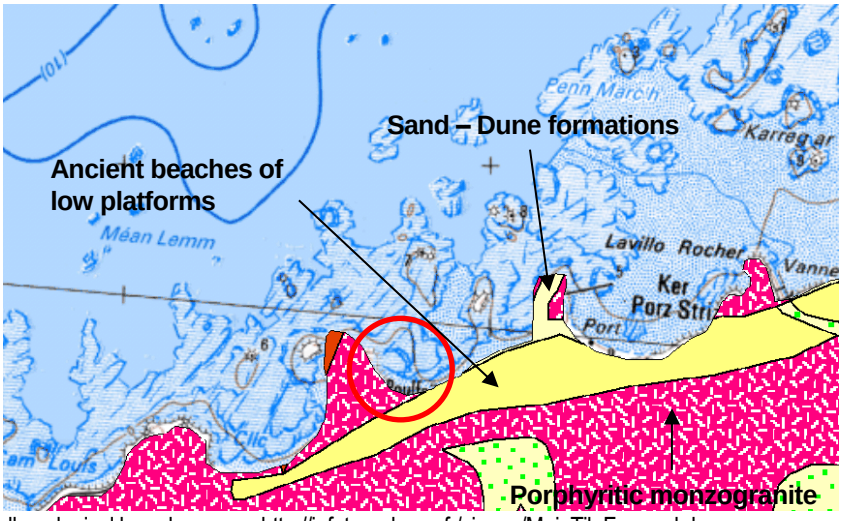
4.2.2.1 Environmental Constraints

The environmental constraints for Kerfissien Landfall are listed below:

Landfall	Site	Feature of Conservation Interest	Proximity to landfall	Constraints	Recommendations
Kerfissien	Espaces Remarquable (ER)	Are of Outstanding Natural Beauty	Proposed landfall is within the ER	Construction of a power cable is not allowed in this area	Landfall not considered a suitable option.

4.2.3 Poulfoën

Landing	Poulfoën
District	Plouescat
Position (WGS 84 UTM Zone 30N)	**48°41'17.53"N, 4°10'0.95"W**
Time & Tide	Date of Visit: 20-11- 2013 Nearest Port: Brignogan-Plage Time / Height (m) LW: 01:09 1.80 HW 06:58 8.05 LW: 13:29 1.80 HW: 19:17 7.80 2014 Tidal Ranges Highest Spring Range: 8.65m
Area Summary topographical description	Poulfoën is less than 1km from Kerfissien and comprises two bays separated by a granite headland on which there is a campsite. The potential landing site in the west bay, called Plage du Click faces 320˚T and is ~350m wide. The potential landing site in the east bay, called Plage de Poulfen, faces 340˚T and extends 400m to Kerfissien headland. This beach's detail has been covered in the Kerfissien site visit. See Figure 4-159 **Figure 4-159 Poulfoën Landing Options** 
Social Factors	Plage du Click is a beach with few facilities other than small car park and resort attracting many tourists during the summer months. The beach and those nearby are popular for bathing, and recreational fishing. Holiday accommodation and camping are available nearby. There is a 20 x 20m car park next to the beach. See Figure 4-160 **Figure 4-160 Car Parking Poulfoën**  There are few buildings close to this beach, consequently social impact would not be as great as at Kerfissien.

Access to Site	Access to the site is via the coast road, D330 and this road is suitable for use by heavy vehicles.
Access to beach	Access to the beach is available direct from the road via the concrete slipway, which would be wide enough for heavy plant. **Figure 4-161 Access to Poulfoën Beach** 
Plant storage area	Plant could be stored either on the car park or on the waste ground to the east of the car park.
Joint pit area & cable ducts	The proposed transition joint pit (TJP) area would be to the east of the car park between the road and the beach.
Composition of beach	The beach is almost entirely composed of Monsonitic Granite (see Figure 4-162) outcrop and boulders interspersed with small patches of sand. **Figure 4-162 Geology Associated with Poulfoën**  * For a full geological key please see http://infoterre.brgm.fr/viewer/MainTileForward.do This outcrop extends to the LW mark and beyond as seen by Aerial imagery. See Figure 4-159 Higher outcrop extends across the bay effectively cutting off the beach from the sea.
Beach Profile	The profile of the beach is approximately <10° however the outcropping rock make it extremely rugged.
Erosion	There is no evidence of coastal erosion at this landing. The lack of sand covering the rock suggests that this is a high energy environment and any sand in the lower foreshore gets washed away.

Sea Defences	The coast road (D330) bordering the beach is protected from the sea by large granite boulders. See Otherwise there are no sea defences at this location.
Obstructions on beach	Excessive amounts of Granite boulders, outcrops and Tors litter this beach. See Figure 4-163, Figure 4-164 & Figure 4-165.

Figure 4-163 Poulfoën beach looking north

Figure 4-164 Poulfoën beach looking north

Figure 4-165 Poulfoën beach looking north west

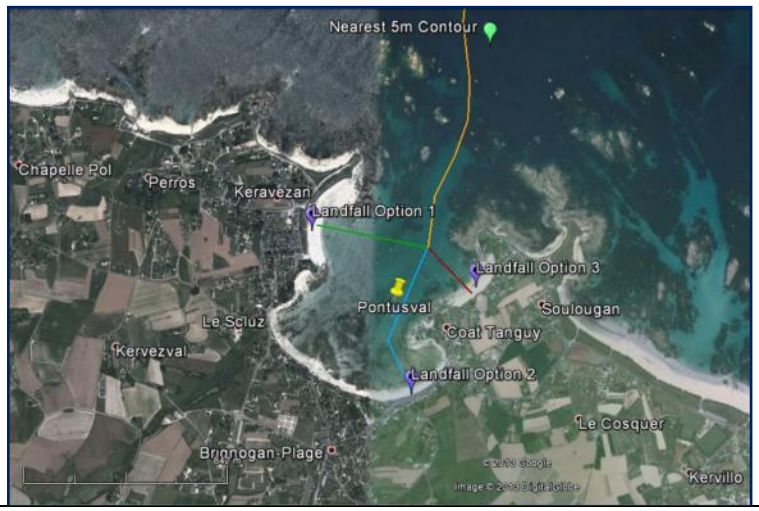
Offshore obstructions	There are numerous unmarked rocks and shoals on the approach to this beach.					
Existing infrastructure	Poulfoën is well connected to the surrounding region by the main coast road the D330. It is ~5km from Plouescat and ~25km from Lesneven.					
Distance LWM to contours	To 5 m	1.1km	To 10 m	1.4km	To 20 m	2.7km
Distance MHWM to MLWM	250 m					
Cable Installation options	Installing a cable here would present many difficulties due to high ratio of rock outcrop to sandy areas. It is likely that there would be little options for burial of the cable here except perhaps in the uppermost section of the storm beach where there is some sand. The option of blasting a clear path through the rock could be considered at this location. However the following rock dumping operations to achieve cable protection would entail driving vehicles over very rugged terrain which may be notably difficult for most wheeled vehicles. See **Error! Reference source not found.**. Also the cable pull to the landfall, through offshore rock outcrops, would have to need to be carefully planned to coincide with high spring tides and calm conditions. HDD could be considered at this landing however this would require further investigation from a specialist to assess the suitability of this location for this operation. Another consideration of HDD at this site is that the marine cable must have the sufficient tensile strength to withstand a pull through HDD ducts of up to around 1.5km in length where a water depth of around 10m should be reached.					
Conclusions	Whilst it could be possible to perform a shore-end by floated cable pull here, both the Plage du Click and the Plage de Poulfoën exhibit such extensive rock outcrop that it is likely that cable burial would only be made possible here by rock blasting to create a clear route and subsequent rock dumping. HDD would create less disruption to the local area but this may be challenging given the high level of granite bedrock. For either option the social impact would be lesser here than at Kerfissien.					

Historical Images	 **Figure 4-166 Slipway Access to Poulfoën Beach looking south**	 **Figure 4-167 Poulfoën Beach looking west**
November 2013 Site Visit Images	 **Figure 4-168 Poulfoën Beach looking south west**	

4.2.3.1 Environmental Constraints

Desktop review revealed that there are no protected sites within the vicinity of Poulfoën.

4.2.4 Pontusval

Landing	Pontusval / Brignogan Plage
District	Brignogan
Position (WGS 84 UTM Zone 30N)	**Landfall Option 1 48°40'19.82"N, 4°19'39.39"W** **Landfall Option 2 48°39'58.03"N, 4°19'19.27"W** **Landfall Option 3 48°40'12.25"N, 4°19'06.16"W**
Time & Tide	Date of Visit: 21-11- 2013 Nearest Port: Brignogan Plage Time / Height (m) LW: 01:42 2.05 HW 07:30 7.85 LW: 14:02 2.05 HW: 19:50 7.55 2014 Tidal Ranges Highest Spring Range: 8.65m Lowest Neap Range: 2.35m
Area Summary topographical description	The Port of Pontusval forms part of Brignogan-Plage, a small town ~11km north of Lesneven. The Port consists of a 3 main bays connected to the sea by a narrow rocky channel between Keravezan Point to the north west and Beg ar Scaf Point ~580m to the south east. The Port itself is sheltered from the wind and weather by the rock outcrop and narrow entrance, however the approach is exposed to the north west, north and east. The Port largely dries out at low tide. Three landfall options are available within the port as illustrated by Figure 4-169 Landfall Option 1. Plage des Crapauds : ~350m wide & faces 100˚T Landfall Option 2. Plage du Garo : s ~400m wide & faces 335˚T Landfall Option 3 : Plage de la Tour Blanche : ~300m wide & faces 315˚T **Figure 4-169 Pontusval Cable Landfall Options** 

Social Factors	Brignogan Plage is a seaside resort whose population is swollen in the summer months by many holiday makers attracted to its nearby beaches. The town offers hotels, guest houses, holiday homes, camping, restaurants and shops catering for the tourist trade. Numerous vessels <20m are moored within Pontusval port, which is mainly used for leisure boating, bathing and fishing purposes. There is a sailing school at the landfall Option 1 beach. The port is within a designated MEDDTL* – DIRENS** Nature Reserve. *Ministère de l'Écologie, du Développement durable, des Transports et du Logement (Ministry of Ecology, Sustainable Development, Transport and Housing) **Direction régionale de l'Environnement (Regional Directorate of Environment) All three proposed landfalls have a road and residential properties directly behind the beach which would be near to or crossed by the cable route. Consequently, the social impact of landing a cable here could be relatively high.
Access to Site	Landfall Option 1: Bypassing the centre of Brignogan using the Rue de Docteur Paugam, heavy plant may access to the site via the Rue de Naot Hir. This road joins the Rue de Keravezan which leads to a car park behind the Nautical Centre / Capitainerie. Heavy plant should negotiate these roads however some widening of the road next to the Nautical centre may be necessary for large plant to reach the slipway. Landfall Option 2: The Rue de la Corniche is directly next to this beach. In order to avoid going through the centre of Brignogan, this landfall is best accessed by heavy plant from the east via the Route de Lividic. Landfall Option 3: Similarly to Landfall 2 plant access to this site would best be approached from the east side of Brignogan. Good access to the site is available via the Route de Lividic through Soulogan.

Access to beach	Landfall Option 1: Moderate access is available to the beach via the slipway next to the Nautical Centre. See Figure 4-170. This may need modification to accommodate wide and heavy plant. **Figure 4-170 Landfall 1 Beach Access slipway**  Landfall Option 2: Moderate access is available to this beach via a narrow slipway at the end of the sea wall to seaward of the beach. See Figure 4-171. A wider slipway is also available on the other side of the bay. See Figure 4-172. Otherwise Access to the beach for heavy plant is limited here. **Figure 4-171 Landfall Option 2 looking east** 

Access to beach Continued….

Figure 4-172 Alternative Slipway Access to Landfall Option 2 looking south west

Landfall Option 3: Good access is available to this beach via a wide slipway connected to a small road. See Figure 4-173. A smaller and narrower secondary access slipway also connects this beach via a narrow track to the fields behind. See Figure 4-174.

Figure 4-173 Landfall 3 Beach Access 1

Figure 4-174 Landfall 3 Beach Access 2

Access to beach Continued….

Figure 4-175 Landfall 3 looking north east

Note occasional boulders and rock outcrop in beach.

Figure 4-176 Landfall 3 Access 2

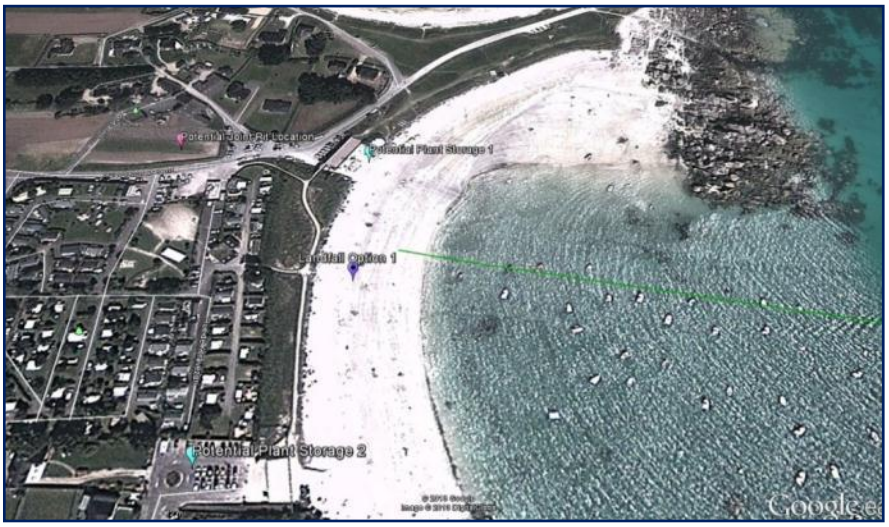
Note low cliffs to left of access road.

Plant storage area

Landfall Option 1: There is potential plant storage in the car park behind the Nautical centre. Alternatively there is a hard standing on the beach itself above HWM where small dinghies are currently stored. See Figure 4-177.

This area could be negotiated for temporary plant storage during construction perhaps in the off season months.

Figure 4-177 Potential Transition Joint Pit & Plant Storage Location Landfall



Landfall Option 2: Plant storage is limited on this beach. The car park at the eastern end offers good hard standing space however a low wall prevents plant getting onto the beach here. This could be modified to allow easier access to the beach without having to use the narrow slipway on the other side. See Figure 4-178.

Figure 4-178 Potential Transition Joint Pit & Plant Storage Location Landfall Option 2

Plant storage area Continued…	Landfall Option 3: Limited plant storage would be available on the road leading to the main access slipway. However ample hard standing storage space is available on the car park for the Plage de petit Lividig See Figure 4-179 **Figure 4-179 Potential Transition Joint Pit & Plant Storage Location Landfall Option 3** 
Joint pit area & cable ducts	Landfall Option 1: In Keravezan, there is a field to the north of the holiday home park behind the sailing club which offers a potential Transition Joint Pit (TJP) location. See Figure 4-177 Landfall Option 2: Siting the TJP at this location would require numerous planning consents. The marine cable would need to be ducted beneath the Rue Chanoine Bellec and then routed either adjacent to one of the dwellings or along Rue Chanoine Bellec to the open field behind. The TJP could then be constructed in this field. See Figure 4-178 Landfall Option 3: This location has the best potential for the TJP location as there is a field that borders the cliff behind the beach. HDD from this field would facilitate a TJP above HWM in an area >40m from the nearest dwelling. See Figure 4-179

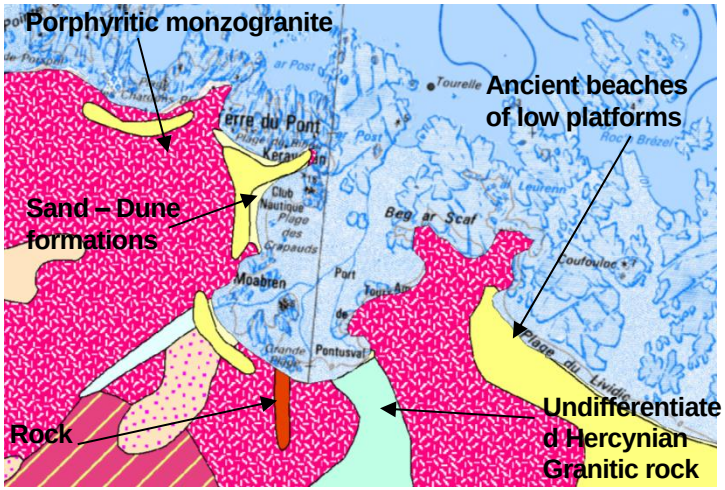
Composition of beach	The beach and local coast is composed largely of Porphyritic Monzogranite which outcrops dramatically in places as large sculpted blocks definitive of this region. See Figure 4-180. **Figure 4-180 Landfall 1 looking north east towards entrance to Pontusval**  The Monzogranite forms part of the Brignogan-Plouescat pluton intruded 292 million years ago during the Late Paleozoic Variscan (Hercynian) orogeny. Coarse white well sorted sand and cobbles cover the Monzogranite blocks in various thickness. Note: The term "Brignogan", is a well-documented in Geological literature as a definitive geological facies describing this type of igneous intrusion
	Landfall Option 1: This beach is composed mainly of coarse sand with significant block outcrops at north east end. Depth of sand over bedrock thins towards low water mark. See Figure 4-180. Landfall Option 2: The approach to the beach through the navigable channel is mainly composed of a thin layer of sand over bedrock which outcrops extensively in the northern part of the bay. The beach itself is mainly sand with minor rock outcrops near to the LWM. See Figure 4-181. **Figure 4-181 Landfall Option 2 looking north east**  Landfall Option 3: This beach is largely composed of sand with a soft cliff just above the HWM. Occasional large boulders sticking out through the sand are evident see Figure 4-175.
Beach Profile	Landfall Option 1: The beach slopes down to LWM by <5˚ Landfall Option 2: The beach slopes down to LWM by <5˚ Landfall Option 3: The beach slopes down to LWM by <5˚
Erosion	There is little evidence of coastal erosion at this location. The substantial granite rock outcrops either side of the port entrance protecting the coast from the force of the sea. Sand has been deposited in the lower energy bays and channels of the port which appears to be maintained throughout annual tide and weather conditions.

Sea Defences	Other than the sea wall supporting the road running along Brignogan Plage seafront, there is little requirement for man-made sea defences as the Port is naturally protected by the Monzogranite coastal features.					
Obstructions on beach	Landfall Option 1: Whilst the upper foreshore is clear of obstructions there is a significant rock outcrop that demarks the northern extent of the beach. This meets the LWM protecting the beach from direct access to the sea. Many mooring chains cross the lower foreshore – these may need to be temporarily removed and reinstalled post cable installation. Landfall Option 2: Bedrock outcrops in the lower foreshore and numerous mooring chains prevail at this site. Landfall Option 3: Boulders and rock outcrop on either side of the sandy beach.					
Offshore obstructions	The approach to the Port from seaward is narrow and hindered by many unmarked rocks, some submerged others permanently exposed above HW. See Figure 4-182 & Figure 4-183. **Figure 4-182 Rocks at Port Pontusval Entrance from Keravesan Point looking north east**  Note numerous unmarked rocks and navigation Tourelle (turret) at entrance.					
	Figure 4-183 Pontusval. Summertime Aerial View with 3 landing options  These extend >1km from the port entrance out to the nearest 10m contour.					
Existing infrastructure	Brignogan Plage is well connected by road to Lesneven ~11km to the south. The town offers many public amenities including car parking, tourist information, toilets & bus services as well as well-developed shopping and accommodation facilities					
Distance LWM to contours	To 5 m	1.0km	To 10 m	1.5km	To 20 m	2.3km

Distance MHWM to MLWM	Landfall Option 1 : ~ 850m Landfall Option 2 : ~1150m Landfall Option 3 : ~ 750m
Cable Installation options	The cable pull into the entrance to this port would be complex; the cable route having to deviate around the numerous rock outcrops. All of the 3 landfall options would require a separate cable pull location to reach achieve entrance to the harbour around the rocks in the harbour mouth to the preferred landfall option. In addition to the cable lay vessel, a shallow draft lay barge may be necessary to anchor close enough into the beach to facilitate a safe cable pull for an open cut installation. However, HDD could be considered here to avoid disruption to the beach, for whichever option, and to the harbour, the use of which would likely have to be completely stopped during cable installation operations for an open cut method. HDD could be considered from either or the east or west headlands but preference is given to the west side of the harbour as the distance to clear water is shorter. For an open cut approach, being closest to the harbour entrance, Landfall option 1 would be recommended due to it requiring the shortest pull. Given the ubiquitous rock outcrop of this area, it is unlikely that sufficient burial depth within the entire proposed route will be achieved without rock dumping the cable to ensure its integrity. Once ashore, the cable's route would need to traverse roads and residential properties at landfall options 1 & 2 however at option 3, the low cliff may be soft enough to install a duct to the beach and route the cable directly into the field behind the cliff. See Figure 4-176
Conclusions	From a provisional cable engineering perspective, landing the power cable here with an open cut method would involve a complex and long beach pull through a narrow, rocky tidal channel. Considerable coordination would be required to achieve this safely and without damage to the cable. Of the 3 beach options within Pontusval Port, Option 3 the east beach would be most preferred mainly because it is away from the main town and the area behind the beach has few buildings and there appears the rock outcrop appears to be well covered by sand. This is a prime tourist destination on the north west coast of Bretagne. Brignogan itself and the local surrounding area is well known for its picturesque nature with the beaches attracting thousands of holidaymakers during the summer months. Plans to install a buried high voltage cable here are likely to incur considerable objection amongst the local inhabitants and businesses. Of particular consideration will be the likely requirement to rock dump the cable within the port, mitigation efforts to minimise the consequent impact on the Port's navigation and view at low tide would need to be considered.

Historical Images

Figure 4-184 Landfall 1 looking south into Pontusval Port



* For a full geological key please see http://infoterre.brgm.fr/viewer/MainTileForward.do

Figure 4-185 Pontusval Geology

Figure 4-186 Landfall 3. looking south west

Figure 4-187 Landfall 1 looking south east towards Landfall 3

November 2013 Site Visit Images

Figure 4-188 Landfall 2 Beach Profile looking east

Figure 4-189 Landfall Option 2 looking north

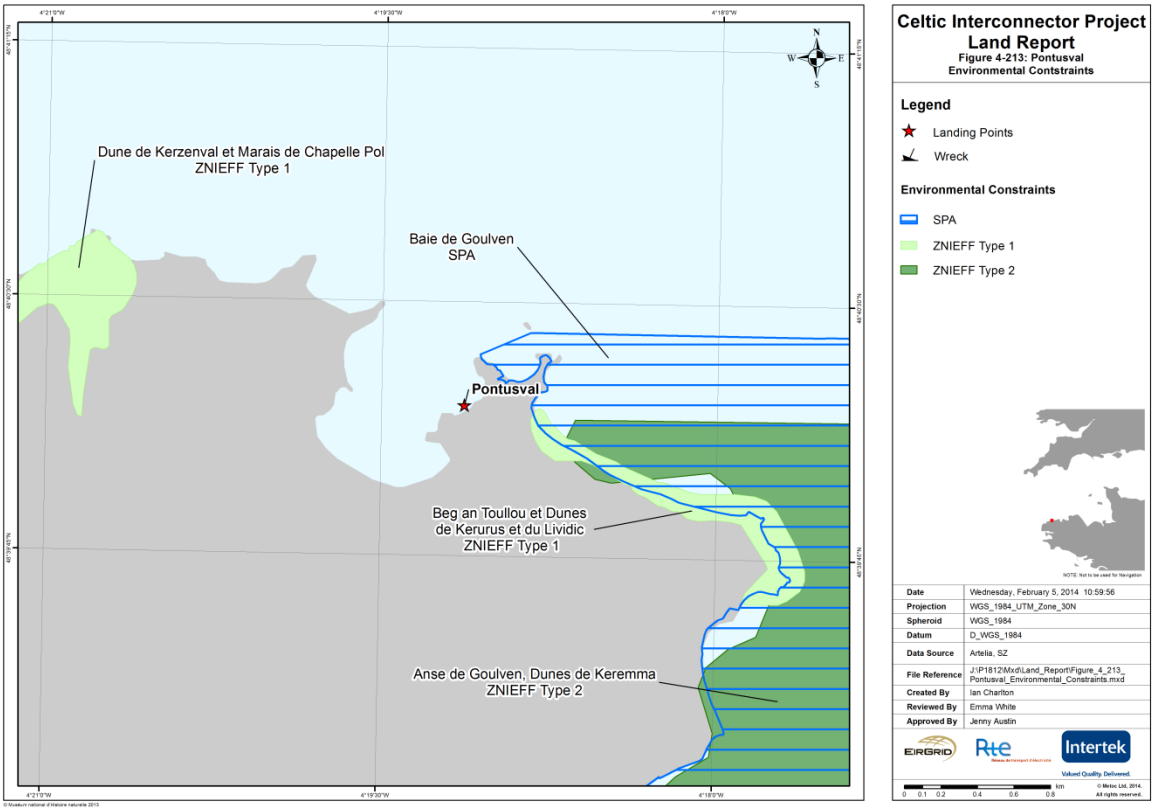
Figure 4-190 Low Tide looking south in to Plage du Garo (Landfall Option 2)
Note thin covering of sand and height rock outcrop within port.

4.2.4.1 Environmental Constraints

Below are the environmental constraints for the Pontusval landfall. Also see Figure 4-191.

Landfall	Site	Feature of Conservation Interest	Proximity to landfall	Constraints	Recommendations
Pontusval	Natura 2000 site at sea (Directives Oiseaux No. FR5312003 Baie de GOULVEN) and two ZNIEFF one type 1n°530002441 Dunes de KEREMMA and one type 2 n°530002408).		Located in close proximity.	The landing area is not located in a protected area, however it is in close proximity.	Discussion with the environmental authority.

Figure 4-191 Pontusval Environmental Constraints



4.2.5 Dibennou

Landing	Dibennou
District	Guisseny
Position (WGS 84 UTM Zone 30N)	**Landing Option 1:- 48°38'23.15"N, 4°25'39.63"W** **Landing Option 2:- 48°38'29.06"N, 4°26'02.55"W** **Landing Option 3:- 48°38'20.11"N, 4°25'27.09"W**
Time & Tide	Date of Visit: 21-11- 2013 Nearest Tidal Prediction: Brignogan-Plage Time Adjustment to Location Range Factor at Location Time / Height (m) LW: 02:01 2.05 HW 07:30 7.85 LW: 14.02 2.05 HW: 19:50 7.55 2014 Tidal Ranges Highest Spring Range: 8.65m Lowest Neap Range: 2.35m
Area Summary topographical description	The Dibennou site is located on the south west side of the entrance to the Tresseny estuary ~1km east of the village of Guissény. From LWM, the Tresseny estuary is ~ 2km long composed mainly of sand flats with minor drainage channels from the surrounding land. A significant headland protrudes to demark the western side of the entrance to the estuary. Composed of a granite base with sand dunes and topsoil above, this rises ~4m above HWM. The estuary is orientated east west and dries at low tide exposing a 2.2km intertidal zone. The mouth of the estuary is ~600m wide at Dibennou headland. There are three potential site options for landing the cable in this area. See Figure 4-192 Landing Option 1: Faces 345˚T and is ~140m wide Landing Option 2: Faces 270˚ T and is ~75m wide Landing Option 3: Faces 356˚T and is ~55m wide **Figure 4-192 Landing Options Dibennou** 

Social Factors	The beaches themselves are generally secluded and away from surrounding buildings, only one building sited within 50m of the beaches. There are a few drying moorings for vessels <10m on Dibennou beach. A small football stadium and sports centre is behind Dibennou beach. All beaches are popular tourist locations during the summer months for swimming, boating and walking. Options 1 & 2 may involve routing the cable through the small settlement of Nodéven which has less than 100 buildings. Option 3 would involve routing the cable through Terrohant, which has less than 50 buildings.
Access to Site	The access roads to Nodéven are good and suitable for heavy plant access. Access to Landing Option 1 is good via the route du Curnic east of Nodéven approximately 2km west of Guisseny. Turning right just before Nodéven on the Rue De Stade. Parking in the car park next to the sports field, with clear access 120m from the beach over rough ground. See Figure 4-193. **Figure 4-193 Landing Option 1**  Access to Landing Option 2 is reasonable via the Chemin du Dibennou road. However the final 150m to the beach is by a narrow footpath along the top of the dunes. This would require modification to allow heavy plant access. See Figure 4-194. **Figure 4-194 Landing Option 2**  Access to Landing Option 3 is good via the Chemin des Garennes behind the main football stadium with a 10 x 20m off road parking space available 50m from the beach. See Figure 4-195.

Access to Site Continued

Figure 4-195 Landing Option 3

Access to beach

Access to:

Landing Option 1: Three access points area available.

1. Via the footpath from the car park by the sports field See Figure 4-196.
2. Via a narrow track at western end of beach.
3. Via a second narrow track at western end of beach.

Note: None of the above access ways are presently suitable for Heavy plant access, however they could be modified. If so, Access 1 would be most preferable connecting the car park with the beach.

Figure 4-196 HWM Dibennou beach looking east across Tresseny Estuary towards Porz Huel

Landing Option 2: Access to this beach is presently not good, being a narrow footpath. This could be widened to allow heavy plant to traverse from the road to the beach. See Figure 4-197.

Figure 4-197 Option 2 Beach Profile looking south

Access to Beach Continued…

Landing Option 3: Access is reasonable over rough ground which may need a temporary track way to avoid compression damage to the soil by heavy wheeled or tracked vehicles. See Figure 4-198.

Figure 4-198 Access Points To Dibennou Beach

Plant storage area

For Landing Option 1, there is plenty of plant storage area adjacent to the sports fields between the car park and the beach. See Figure 4-199.

Figure 4-199 Potential Joint pit area by sports fields

Plant storage area Continued…	For Landing Option 2, storage could be at the end of the Chemin de Dibennou road. Otherwise it could be negotiated on the private land behind the beach. For Landing Option 3, Adequate storage for plant is available at the side of the road and on the present car park.
Joint pit area & cable ducts	For Landing Option 1: The proposed transition joint pit (TJP) area could be next to the football field behind Dibennou beach. For Landing Option 2: The TJP could be within the grounds of the house at the end of Dibennou point. For Landing Option 3: The TJP could be placed either in the field to the north of the Chemin des Garennes road or the field to the south of it.
Composition of beach	Landing Option 1: The beach is largely composed of well sorted coarse white sands, which are soft in the upper foreshore and backshore and hard down to the LWM. Both sand types would support heavy wheeled or tracked vehicles. Outcrops of Intrusive Granites are visible either side of the sand beach. The western headland being composed mostly of Granite with a thin layer of Holocene sediments on top of it. The granite is "Monzonitic" in composition and Hercynian in age (250 to 400 million years) forming part of the Leon Zone within the Armorican Massif. The Granite is extremely hard and resistant to weathering creating blocks, boulders and tors where the sea has exposed it. See Figure 4-200 **Figure 4-200 Tresseny Entrance looking north from Dibennou Headland**  Landing Option 2: The upper foreshore here is composed of fine well sorted white sands with significant Granite outcrops to the north. The lower foreshore is well compacted white sand which would support heavy vehicle usage. See Figure 4-201, Figure 4-202 & Figure 4-203.

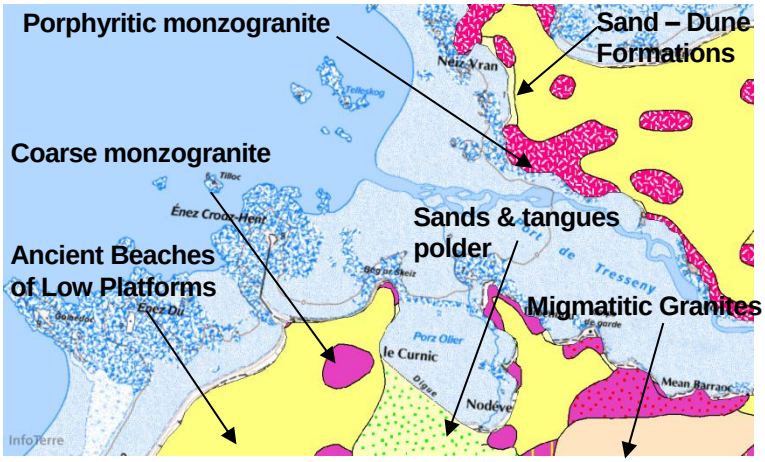
Composition of beach cont…

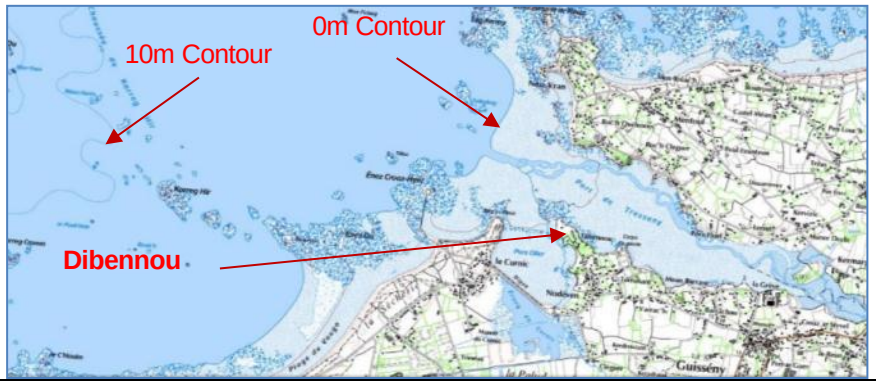
Figure 4-201 Option 2 Beach looking west

Figure 4-202 Option 2 Beach looking north west

Figure 4-203 Option 2 Beach looking north

Composition of beach cont…	Landing Option 3: The upper foreshore here is composed of fine well sorted white sands with significant Granite outcrops to the north. The lower foreshore is well compacted white sand which would support heavy vehicle usage as seen above for Landing Option 2.
Beach Profile	Landing Option 1: The beach slopes at <5˚ in the top section, followed by <2˚ to the LWM Landing Option 2: The beach slopes at <10˚ in the top section, followed by <2˚ to the LWM Landing Option 3 The beach slopes at <5˚ in the top section, followed by <2˚ to the LWM
Erosion	Landing Option 1: There is no evidence of coastal erosion at this landing. Wind and storm blown sand have been deposited on the upper foreshore Landing Option 2: There is no evidence of coastal erosion at this landing. Wind and storm blown sand have been deposited on the upper foreshore Landing Option 3: There is no evidence of coastal erosion at this landing. Wind and storm blown sand have been deposited on the upper foreshore
Sea Defences	Landing Option 1: A natural rise <3m high consisting of topsoil and sand forms a natural sea defence behind this beach. See Figure 4-204. There are no artificial sea defences in place. **Figure 4-204 Dibennou Beach looking south – Natural Sea Defences Visible**  Note: Drying small vessel mooring on the right. Landing Option 2: A natural sand dune atop the granite bedrock forms a natural defence to this beach. See Figure 4-200. Otherwise, there are no artificial sea defences in place here. Landing Option 3: This beach is defended by a natural cliff <2m high. Otherwise, there are no artificial sea defences in place here. See Figure 4-205. **Figure 4-205 Looking south east across Dibennou Beach up Tresseny Estuary** 

Obstructions on beach	Landing Option 1. Dibennou headland and associated granite outcrops on the west side of the beach form a significant obstruction blocking direct access to the sea. Routing to this landfall would therefore have to be around this headland. There are a few moorings on the foreshore which would require removal and post installation reinstatement. Otherwise there are no visible obstructions on the sandy beach. See Figure 4-204 and Figure 4-206.
Obstructions on beach Continued…	**Figure 4-206 Option 1 Dibennou Beach looking north east**  Landing Option 2. To the north of this beach significant Granite outcrops form an area which would need to be avoided if possible. See Figure 4-207. **Figure 4-207 Bedrock Geology. Dibennou & Surrounding Port de Tresseny. Source InfoTerre BRGM Fr**  * For a full geological key please see http://infoterre.brgm.fr/viewer/MainTileForward.do Landing Option 3. There are no significant obstructions on this beach other than Granite outcrops on the west side of the beach. See Figure 4-207.

<table>
<tr><td>Offshore obstructions</td><td>The water on the approaches to this landing is shallow, the 10m contour being ~4-5 km from the landing option sites.
Although there are numerous unmarked rocks in the approaches to Tresseny (See Figure 4-208) there remains space for a cable ship to manoeuvre within the predicted tidal ranges over what appears to be flat sandy seabed.
Figure 4-208 Near shore Approaches to Dibennou
 
</td></tr>
<tr><td>Existing infrastructure</td><td>Nodéven and Dibennou are served well by roads connecting the community to Plougerneau to the south west and Guissény to the east.
Electricity and fresh water are available in the village.</td></tr>
<tr><td>Distance LWM to contours</td><td>
<table>
<tr><td>To 5 m</td><td>3.5km</td><td>To 10 m</td><td>4.0km</td><td>To 20 m</td><td>4.6km</td></tr>
</table>
</td></tr>
<tr><td>Distance MHWM to MLWM</td><td>Option 1: ~750m
Option 2: ~300m
Option 3: ~1000m</td></tr>
<tr><td>Cable Installation options</td><td>Cable installation should be possible at all three landing option sites.

Landing Option 1: Cable installation here would involve at least one beach pull from a separate location. One to bring the cable into the entrance to Port of Tresseny, the other to pull it to the south west up to this beach.
Due to the extent of the shallow water depths at this site an additional shallow draft barge is likely to have to be utilised for this shore-end to reduce the length of the shallow water section of the cable sufficiently to allow a safe installation. Another method that could be explored here would be HDD, by drilling out to a more accessible water depth the shore-end operations could be simplified.
Achievable burial depth in the soft sands would be subject to the results of a geophysical and geotechnical survey to determine the optimised route. Subsequent burial should be feasible using a cable trenching and an excavator for the intertidal section.
The final section of the cable could be installed through the low cliff/dune at the back of the beach near to the footpath access (See Figure 4-196), using open cut method of excavation.
There is adequate room for plant storage behind the beach.
Access to the beach by widening and reinforcing one of the existing 3 points could be improved at reasonable cost.

Landing Option 2: The relative closeness of this option to deep water makes this option more suitable than Option 1 or 3. However, considerable improvement to the access road to the beach would need to take place in order to get installation machinery on and off the beach. Careful consideration of the land cable's route through private land in Nodéven and the Dibennou headland would be necessary here.
HDD operations here could be considered and here and if this method was used the bore should be able to reach deeper water depths from which need to be notably shorter than Options 1 or 3.</td></tr>
</table>

Cable Installation options cont…	Landing Option 3: At ~1km from the LWM this location presents a very long beach pull from a shallow draft vessel or barge. The route from offshore would also require change in direction necessitating at least one additional cable pull location. Burial operations would also be increased by ~1km for this landfall. HDD at this landing point is likely to at most reach just beyond the LWM. A barge would therefore still be required to install the nearshore section of the cable. It is generally recognised that installation and burial of cables over large intertidal areas are prone to incur difficulties as a result of short operational periods between tides and currents, and increased sensitivity to weather, especially where the presence of waves of any significant height will severely diminish the operational depth of a vessel. Adequate storage for equipment and access to the beach is available here.
Conclusions	Subject to geophysical and geotechnical survey, the wide extent of the sand at these beaches offers good potential for cable burial, and thus gives this site good potential for a landing location. The shallow approach to Dibennou would mean that a cable ship would be unlikely to be stationed any nearer than 4 km from the beach. See Figure 4-208. This relatively quiet undeveloped location would attract a lower level of social impact to the cable's installation than other proposed landfalls. Liaison will be necessary with relevant authorities on the likely impact of routing the cable through this location's Natura 2000 and ZNIEFF areas.

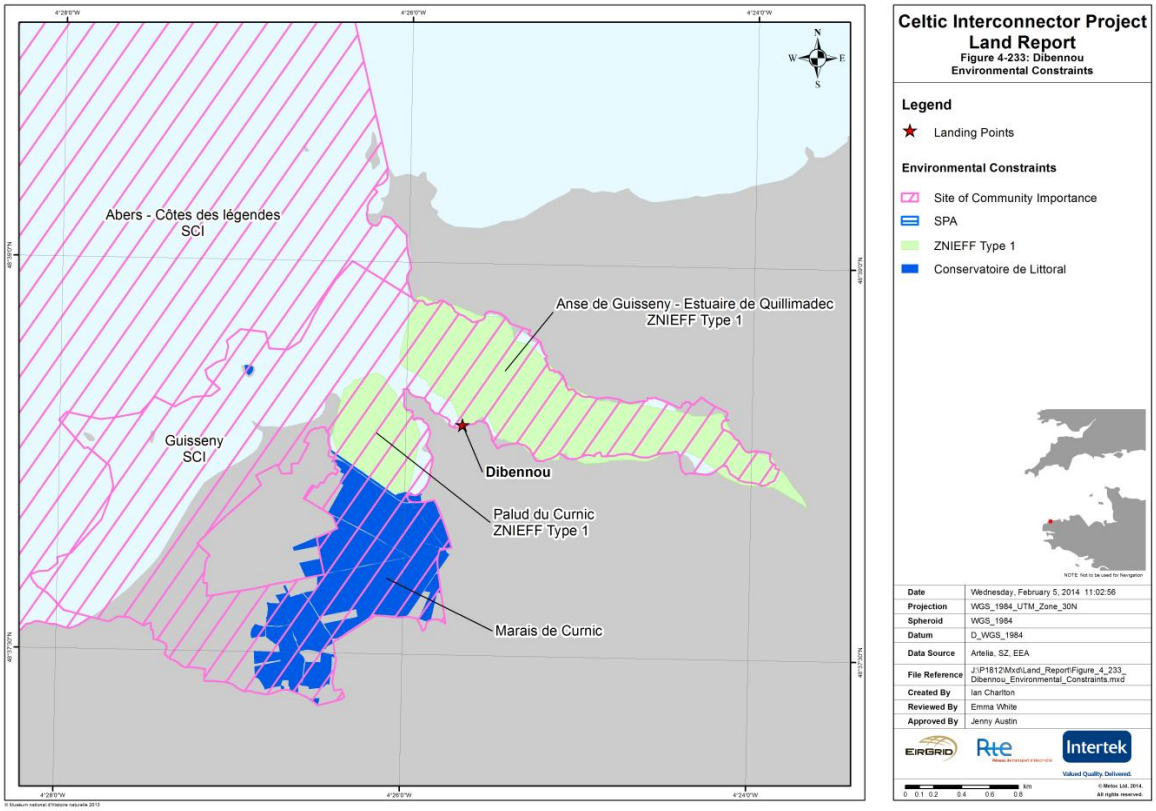
Figure 4-209 East Headland of Dibennou beach looking north

4.2.5.1 Environmental Constraints

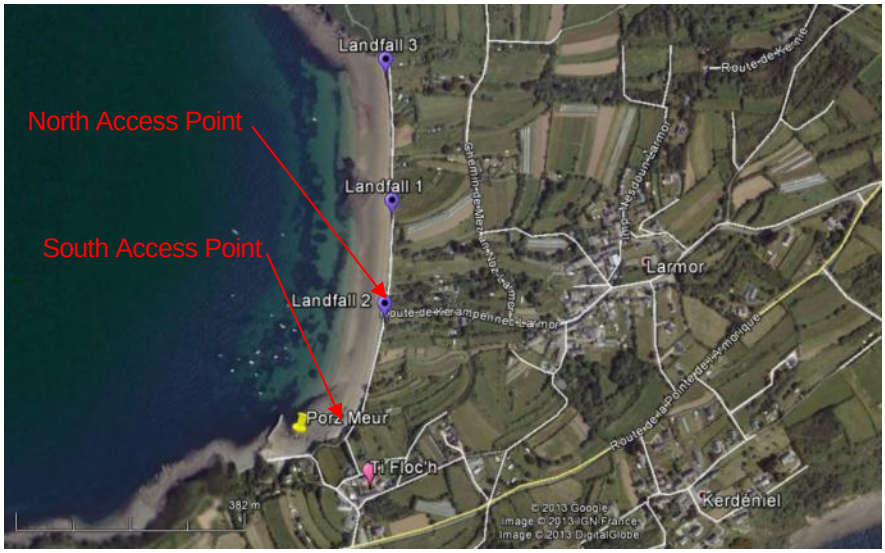
Below are the environmental constraints for the Dibbenou landfall. Also see Figure 4-210.

Landfall	Site	Feature of Conservation Interest	Proximity to landfall	Constraints	Recommendations
Dibbenou	Natura 2000 site at sea (Directives No. FR5300017 Abers - sides of legends and FR5300043 Guissény habitats).		Located in close proximity.	The landing area is not located in a protected area, however it is in close proximity.	Discussion with the environmental authority.

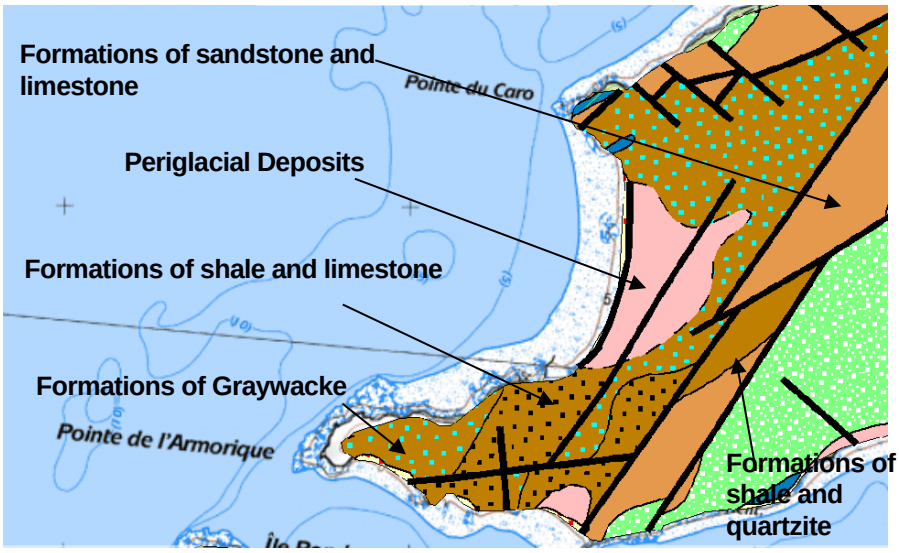
Figure 4-210 Dibbenou Environmental Constraints



4.2.6 Porz Meur

Landing	Porz Meur / Plage de Larmor
District	Plougastel-Daoulas
Position (WGS 84 UTM Zone 30N)	**48°19'47.40"N, 4°26'59.28"W**
Time & Tide	Date of Visit: 21-11- 2013 Nearest Port: Brest Time / Height (m) LW: 00:49 1.85 HW 06:43 6.60 LW: 13:12 1.90 HW: 19:04 6.35 2014 Tidal Ranges Highest Spring Range: 7.35m Lowest Neap Range: 1.85m
Area Summary topographical description	Porz Meur Beach is at the south west end of the Plougastel Peninsula between Pointe de l'Amorique in the south and Pointe du Caron on the north See Figure 4-211 & Figure 4-212. **Figure 4-211 Porz Meur Overview & Potential Cable Route to Beach**  **Figure 4-212 Porz Meur Beach Potential Landfall & Access Options** 

Area Summary topographical description Continued…	Porz Meur itself is a small village to the south west of the village of Larmor. Facing 275˚T and ~ 750m wide, the beach overlooks the Rade de Brest (the roadstead of Brest) towards the Baie de Roscanvel. The beach is linked to the Atlantic Ocean by the Goulet de Brest, a strait about 1.8km wide. This link is to the north west of the beach and affords the beach good shelter from Atlantic swells. The wave fetch from Roscanvel being ~6km The city and commercial port of Brest is located on the northern edge of the Rade de Brest ~6kmnorth of the beach. Brest city also has a military port for the French Navy. ~4km south west of the beach is a second French Naval base on the Île Longue peninsular. Nuclear Submarines are operated from here. Three main rivers drain into the Rade de Brest: the Penfeld, the Élorn (or river of Landerneau) and the Aulne (or river of Châteaulin). The land behind the beach slopes steeply up rock outcrop in the south, is relatively low lying in the middle and is marked by tapering cliffs which rise to ~ 4m at the northern end of the beach. There are 3 potential landfalls for the cable on this beach as illustrated in Figure 4-212 above.
Social Factors	Porz Meur has numerous moorings for vessels <20m at its southern end. There were 6 small boats seen at their moorings at the time of this site visit. Many more moorings would likely be in use during the summer months. The Association des Plaisanciers (Boaters Association) have a small temporary building in the southern Harbour. The bay is also a designated anchorage for small vessels. The beach is also used for recreational fishing and some bathing. Its rough composition and steep profile does not make it suitable for mass tourism. A notice close to landfall 2 indicates bathing is permitted and controlled between the months of June and September. Whilst there are many private residential properties in the district there are none within 100m of the beach. The area is known to be favoured by the wealthy of Brest as a location for a retirement or country retreat home.
Access to Site	Site access to Ti Floc'h the 8km from Plougastel Daoulas is good via the Route de la Pointe de l'Armorique. However once in Ti Floc'h access through the narrow winding streets to the beach is not suited to heavy goods vehicles. Better site access is available through the village of Larmor however the roads in this village are also single track but not so winding. There is no room for turning large vehicles until the beach is reached. See Figure 4-213. **Figure 4-213 Looking east from potential Landfall 2, Route de Kerampennec Larmor** 

Access to beach	There are two access points to the beach, one in the south the very steep and narrow Chemin de Ti Foc'h lane from the hamlet of Ti Floc'h. See Figure 4-214. **Figure 4-214 southern Access to Beach & Potential Plant Storage**  The other to the north connects the middle of the beach to Larmor via the Route de Kerampennec Larmor. See Figure 4-215 **Figure 4-215 Geology of Porz Meur and Surroundings**  * For a full geological key please see http://infoterre.brgm.fr/viewer/MainTileForward.do
Access to beach Continued…	Although there is no slipway at either access point, the beach is no more than 2m below the roadway and temporary ramps could be easily constructed to allow wheeled or tracked vehicles access to the beach.
Plant storage area	There is good plant storage behind the beach either on the track or in the fields behind the middle of the beach. There is also good hard standing for plant storage near to where the harbour wall meets the access road. See Figure 4-214.
Joint pit area & cable ducts	A TJP could be constructed behind the beach backshore within the fields at any of the three landfall options.

Composition of beach	The surface of the beach is strewn with shingle and cobbles composed of schist, slate and shell fragments. The general size of the shingle & cobbles increases northwards along the beach towards Pointe Caron where some small boulders found. This suggests that the northern end of the beach experiences higher average energy conditions than the south. Beneath the cobbles and shingle is coarse sand in the south and peri-glacial orange sandy clay in the north. A pronounced steep storm berm composed of well-rounded shingle and cobbles composed of slates and schists extends along the HWM see Figure 4-216 & Figure 4-217. **Figure 4-216 HWM from south End of Porz Meur Beach**  **Figure 4-217 HWM north End Porz Meur Beach**  Note: Tapering soft orange cliffs.

Composition of beach Continued…	Above the storm berm are low cliffs composed of clay, sand and slate fragments which taper from 4m in the north to less than 1m in the middle of the beach which is reinforced by man made large igneous boulders. To the south, rock cliffs taper upwards to a height of >6m above Porz Meur harbour and the access road. Some of this rock outcrops are within the foreshore near to the harbour wall. See Figure 4-216 & Figure 4-218. **Figure 4-218 Porz Meur Beach looking north**  Note: Rock outcrop in foreground An isolated rock outcrop occurs within the middle of the beach adjacent to proposed Landfall 1. See Figure 4-219
	Figure 4-219 Potential Landfall 1 looking west  Note Isolated Rock Outcrop in centre of beach.
Beach Profile	The beach slopes fairly evenly at <5˚
Erosion	There is evidence of coastal erosion at this beach, particularly in the cliffs at the north end of the beach. The cliff is composed of a soft peri glacial mud and fragmented slate which is friable and easily eroded during high spring tides and onshore storms. There is a history of minor landslides in this area. Prior to this landslide it had been possible to drive a vehicle along the top of the cliff which now only has a footpath.

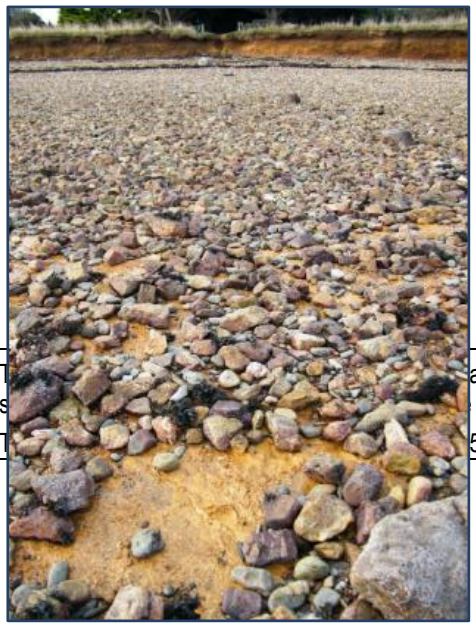
Sea Defences

Apart from the Sea Wall at Porz Meur harbour, the only sea defences present consist of roughly hewn boulders spread over 175m along the middle of the beach. See Figure 4-216, Figure 4-220 & Figure 4-221. These boulders substitute for the cliff that tapers southwards from the north of the beach, protecting the low lying land behind them.

Figure 4-220 north Access Point & Potential Landfall 2 looking north

Note Sea Defences in this portion of the beach

Figure 4-221 Beach Composition at potential landfalls 1 & 2



Obstructions on beach

T at the southern end of the beach. Otherwise there are s problems.

T 5m below the LWM

Offshore obstructions	The water depth on the approaches to the beach shelves ~2° to 10m. Beyond this, water depths in the Rade and Goulet de Brest descend to ~50m WD. The cluster of moorings at the southern end of the beach may interfere with laying the cable at landfall 2. It is likely that there are cables and perhaps pipelines within the Rade de Brest either for civilian or military use. This will be investigated further as part of the Route Investigation Report.					
Existing infrastructure	This beach is well connected to Plougastel Daoulas and from there to the E60 Autoroute which serves Brest and Quimper.					
Distance LWM to contours	To 5 m	0.3km	To 10 m	0.8km	To 20 m	2.7km
Distance MHWM to MLWM	~70m					
Cable Installation options	This beach has good potential for landing the power cable, given a relatively short cable pull. The three proposed landfalls would provide different options for installation. Landfall 1: One option would involve a beach pull with a winch or tow placed on the path atop of the low cliff. The beach could be trenched by open cut excavation to the specified burial depth. The trench could then be back filled with either beach material or local rock. A portion of the low cliff (<2m high) would need to be cut away in order lead the cable up into the open field behind the beach. The TJP could be placed in this field or further inland as convenient. Landfall 2: The open cut option to this landfall would, similarly to Landfall 1, entail a winch mounted on the beach road. Again an open cut excavation of a suitable trench could be performed here. Care to temporarily remove and replace existing sea defence boulders at this landfall would be needed. The option to then route the cable alongside the route de Kerampennec and around Larmor should be explored. The TJP could be placed in the privately owned land behind the landing point or further inland as convenient. Note: This landfall option appears to be the most likely to cause the most disruption to the local community and beach users. Landfall 3. Due to the 3-4m cliffs this landfall would require the installation of a duct under the cliffs emerging within the inter-tidal zone and the cable trenched thereafter.					

Cable Installation options	As at the other two landfalls, the outcrop of soft peri-glacial deposits of broken shale and mud that make up these cliffs (See Figure 4-222) extends some distance behind the cliff face, see 'Sy' (Sandy) annotation in Figure 4-215. It may be that this deposit provides a suitable medium for stable and secure burial of the cable. **Figure 4-222 Potential Landfall 3 Cliff Structure**  Alternatively HDD could be considered to minimise the disruption to the beach, this could be explored from atop the cliff to the 10m WD contour. The advantage of Landfall 3 is that it would cause least disturbance to the users of the beach and the area behind the cliffs connects directly with open countryside with no buildings See Figure 4-212. The TJP could be placed in the privately owned land or fields behind the landing point or further inland as convenient.
Conclusions	Porz Meur beach offers good potential for landing the cable with at least 3 beach entry point options. Subject to Geophysical survey the depth to the bedrock will dictate if this beach will meet burial specification. HDD would most likely be necessary through the cliffs, should the least disruptive north end landfall option be preferred. The short inter tidal zone and deep water within 1km of the LWM facilitate a straightforward beach pull from a cable ship anchored in the Rade de Brest. Consultation and agreement with the French Navy and Brest Harbour authority will be **critical** in the granting of permission to route the cable into this beach. The beach is not in a designated conservation or protected area

November 2013 Site Visit Images	 **Figure 4-223 Potential Landfall 3 looking south west**	 **Figure 4-224 Potential Landfall 1 looking east**

Figure 4-225 Pointe du Carco looking from Porz Meur Harbour

Figure 4-226 Looking west towards the Goulet de Brest

4.2.6.1 Environmental Constraints

Below are the environmental constraints for the Porz Meur landfall. Also see Figure 4-227 & Figure 4-228.

Landfall	Site	Feature of Conservation Interest	Proximity to landfall	Constraints	Recommendations
Porz Meur	Natura 2000 site at sea (Directives Oiseaux No. FR5310071 and Directive Habitats FR5300046 Rade de BREST) and one ZNIEFF type 2 n°530005463 Baie de DOUALA – Anse de POULNIC).		Located in close proximity.	The landing area is not located in a protected area, but the path from the sea to the land crosses the Parc National Marin FR9100001 IROISE.	Discussion with the environmental authority.

Figure 4-227 Porz Meur Environmental Constraints

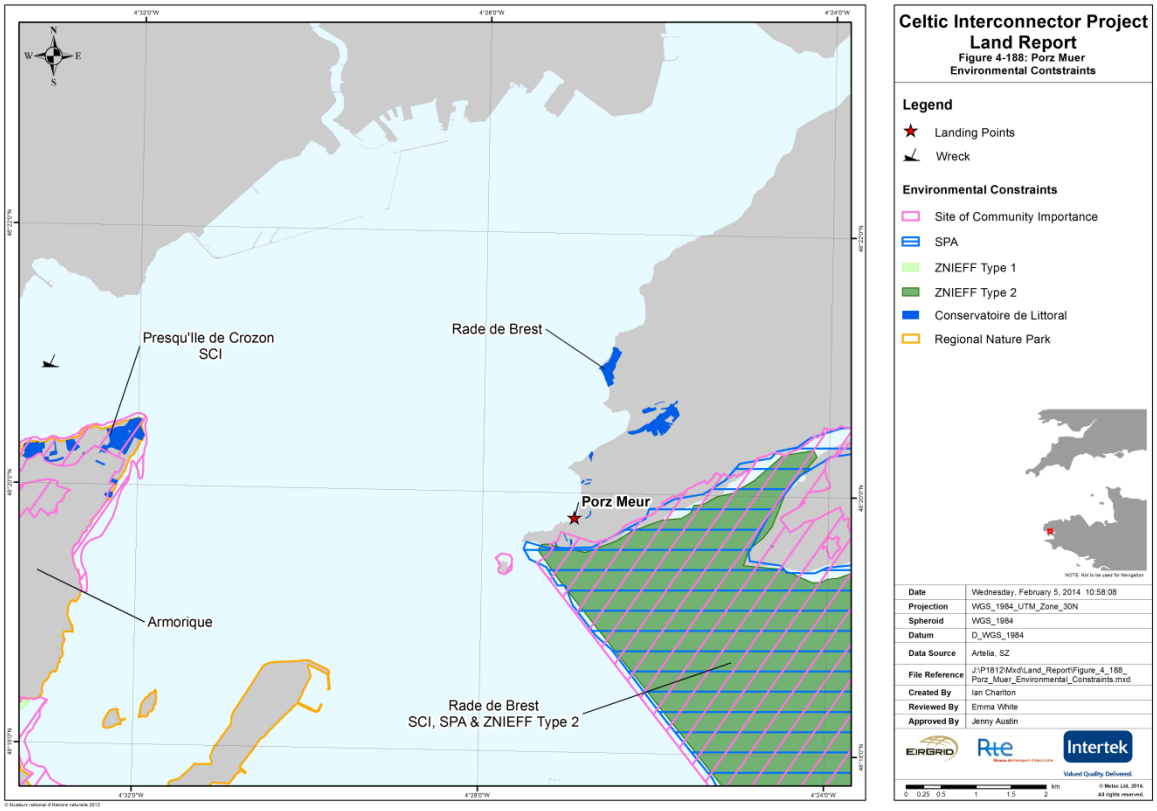
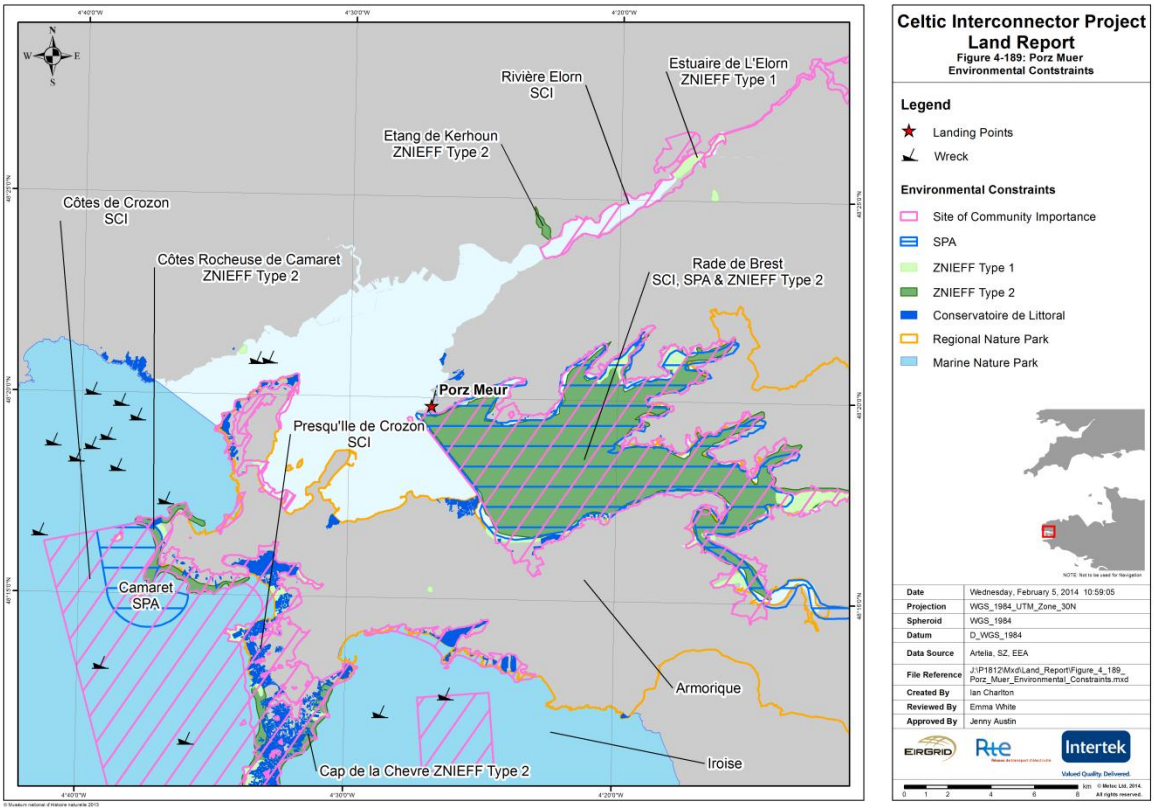


Figure 4-228 Porz Meur Environmental Constraints



5 LANDFALL RANKINGS

5.1 INTRODUCTION

Following the site visits to both French and Irish landfalls, two workshops were conducted as per below:

- Landfall workshop with EirGrid and ESBI (Irish land consultant), Dublin, 28th Nov 2013.
- Landfall workshop with RTE, Artelia and C&S Conseils (French land consultant), Paris, 12th Dec 2013.

The purpose of the workshops was to discuss the findings of the site visits and to collectively rank the landfall sites in order of preference based on a number of agreed marine and land constraints. This section summarises the results of the ranking workshops.

5.2 RANKING METHODOLOGY

In order to facilitate the ranking of landfall options a risk ranking matrix was developed. The purpose of this risk ranking exercise is to identify the least constrained landfall location(s) from a marine and land perspective. The land report and subsequent route investigation report are part of a wider feasibility study to inform the scope of further marine survey. The matrix lists the key criteria (including technical, financial, environmental and human aspects) for consideration on both the land and marine side. Each criterion is assigned a weighting factor based on its relative significance in terms of its impact on the feasibility of the marine and land elements of the landfall operations. Criteria which have a lower impact and can be more easily mitigated receive a lower weighting. It is important to note that further environmental studies will be undertaken as part of an EIA in later stages of the project.

For each landfall site a score is assigned to each criterion, higher scores being assigned to criterion that have the least impact. The scoring system is provided below:

0	Unacceptable
2	Strongly Adverse
4	Adverse
6	Neutral
8	Favourable
10	Strongly Favourable

The weighting and scoring was agreed collectively between the team of experts present at the workshops, who included marine and land cable engineers, environmental consultants & planners.

During the French workshop it was agreed that, given the political nature of many of the land constraints and the variability of such constraints during the planning stages, the French landfalls would be ranked on marine constraints alone. All French landfall sites were considered technically feasible from a land perspective (as per C&S Conseils land report "RTE France Irlande Rapport Intermédiaire 081113")

The results have been presented in a matrix format in Table 5-1.

Note: Due to the majority of the French landfall options being areas with several landing points rather than specific beaches, to facilitate the scoring of the ranking matrix, a discussion was held to establish which landing point to base the scoring on. The best case scenario, i.e. least constraints present for both marine and land, was identified for each of the landing points within the six sites. The landfalls were then scored relative to that specific point. The scored options for each area are as follows:

- Mogueric: Option 4.
- Kefissien: N/A (only one option).
- Poulfoën: West Bay.
- Porz Meur: Option 3.
- Pontusval: Option 3.
- Dibennou: Option 2.

5.3 IRISH MATRIX RANKINGS

Table 5-1 Irish Matrix Rankings

Requirement			Weighting	Inch	Ballycroneen	Ballinwilling	Redbarn	Claycastle	Rathmoylen	Baginbun	Fethard	Bannow	Cullenstown	Weighted scores									
Ref	Description	Parameters (High score given to)		Score					Score					Inch	Ballycroneen	Ballinwilling	Redbarn	Claycastle	Rathmoylen	Baginbun	Fethard	Bannow	Cullenstown
Intertek Marine Constraints																							
	Vessel access	Ease of access for beach and nearshore activities	18%	8	9	7	4	3	5	7	3	3	7	1.44	1.62	1.26	0.72	0.54	0.9	1.26	0.54	0.54	1.26
	Beach Composition	Most suitable composition/least likely to impact survey and installation ops	15%	6	6	6	9	9	6	6	2	5	7	0.9	0.9	0.9	1.35	1.35	0.9	0.9	0.3	0.75	1.05
	Amenity Impact	Least impact on local amenities	10%	7	7	9	4	4	8	8	5	8	3	0.7	0.7	0.9	0.4	0.4	0.8	0.8	0.5	0.8	0.3
	Areas Requiring Permissions/Permits (i.e. Environmentally Protected Area)	Proximity to protected / restricted areas	10%	10	10	9	8	4	10	4	3	7	5	1	1	0.9	0.8	0.4	1	0.4	0.3	0.7	0.5
	Exposure	More sheltered locations reduce risk of impacts from wind, waves and currents during survey and installation	10%	4	4	6	7	6	4	9	6	7	5	0.4	0.4	0.6	0.7	0.6	0.4	0.9	0.6	0.7	0.5
	Working/Site Area	Availability & suitability of potential working area	9%	7	8	10	10	10	4	6	7	7	9	0.63	0.72	0.9	0.9	0.9	0.36	0.54	0.63	0.63	0.81
	Coastal Erosion	Least extent of erosion apparent	8%	7	6	4	7	7	8	7	6	7	5	0.56	0.48	0.32	0.56	0.56	0.64	0.56	0.48	0.56	0.4
	Obstructions & Existing Infrastructure	Least obstructions to route both on beach and nearshore	8%	4	5	8	8	8	2	8	2	6	8	0.32	0.4	0.64	0.64	0.64	0.16	0.64	0.16	0.48	0.64
	Access to Beach	Best access to beach for heavy plant	6%	7	6	8	10	7	6	3	2	9	9	0.42	0.36	0.48	0.6	0.42	0.36	0.18	0.12	0.54	0.54
	TJP location	Availability of potential area for JP	6%	7	8	9	8	8	6	5	7	8	7	0.42	0.48	0.54	0.48	0.48	0.36	0.3	0.42	0.48	0.42
			100%																				
	SUB TOTAL MARINE													***6.79***	***7.06***	***7.44***	***7.15***	***6.29***	***5.88***	***6.48***	***4.05***	***6.18***	***6.42***
ESBI Land Constraints																							
	Amenity		30%	8	7	8	4	4	7	6	6	8	7	2.4	2.1	2.4	1.2	1.2	2.1	1.8	1.8	2.4	2.1
	Ecology		20%	8	8	7	6	6	8	4	2	7	7	1.6	1.6	1.4	1.2	1.2	1.6	0.8	0.4	1.4	1.4
	Access to site		15%	8	7	9	8	8	6	5	7	7	8	1.2	1.05	1.35	1.2	1.2	0.9	0.75	1.05	1.05	1.2
	Site/working area		15%	8	8	9	8	9	5	5	7	7	8	1.2	1.2	1.35	1.2	1.35	0.75	0.75	1.05	1.05	1.2
	TJP Location		10%	7	8	9	8	8	6	5	7	8	7	0.7	0.8	0.9	0.8	0.8	0.6	0.5	0.7	0.8	0.7
	Cultural heritage		5%	6	6	6	6	5	6	5	6	5	6	0.3	0.3	0.3	0.3	0.25	0.3	0.25	0.3	0.25	0.3
	Existing established infrastructure		5%	6	7	7	7	7	6	6	6	6	6	0.3	0.35	0.35	0.35	0.35	0.3	0.3	0.3	0.3	0.3
			100%																				
	SUB TOTAL LAND													***7.7***	***7.4***	***8.05***	***6.25***	***6.35***	***6.55***	***5.15***	***5.6***	***7.25***	***7.2***
	SUMMARY LAND AND MARINE																						
	Marine													3.4	3.53	3.72	3.58	3.15	2.94	3.24	2.03	3.09	3.21
	Land													3.85	3.7	4.03	3.13	3.18	3.28	2.58	2.8	3.63	3.6
													Score (out of 10)	7.25	7.23	7.75	6.70	6.32	6.22	5.82	4.83	6.72	6.81

5.4 FRENCH MATRIX RANKINGS

Table 5-2 French Matrix Ranking

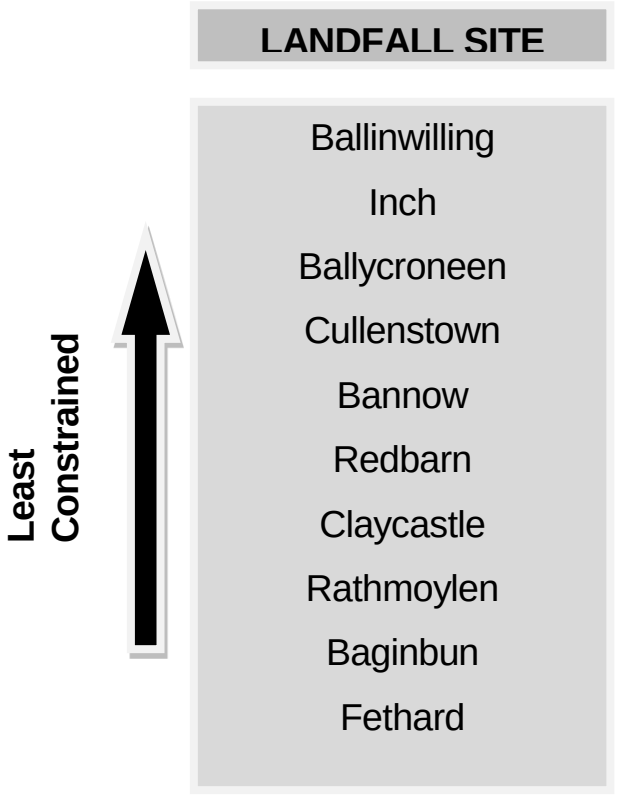
Requirement			Weighting	Moguériec	Kerfissien	Poulfoën	Porz Meur	Pontusval	Dibennou	Weighted scores					
Ref	Description	Parameters (High score given to)		Score						Moguériec	Kerfissien	Poulfoën	Porz Meur	Pontusval	Dibennou
Intertek Marine Constraints															
	Vessel access	Ease of access for beach and nearshore activities	18%	6	2	3	8	7	2	1.08	0.36	0.54	1.44	1.26	0.36
	Beach Composition	Most suitable composition/least likely to impact survey and installation ops	15%	3	2	2	8	6	9	0.45	0.3	0.3	1.2	0.9	1.35
	Amenity Impact	Least impact on local amenities	10%	3	3	4	2	4	6	0.3	0.3	0.4	0.2	0.4	0.6
	Areas Requiring Permissions/Permits (i.e. Environmentally Protected Area)	Proximity to protected / restricted areas	10%	9	0	9	5	7	5	0.9	0	0.9	0.5	0.7	0.5
	Exposure	More sheltered locations reduce risk of impacts from wind, waves and currents during survey and installation	10%	7	5	5	9	3	5	0.7	0.5	0.5	0.9	0.3	0.5
	Working/Site Area	Availability & suitability of potential working area	9%	9	6	7	7	8	7	0.81	0.54	0.63	0.63	0.72	0.63
	Coastal Erosion	Least extent of erosion apparent	8%	9	8	8	5	8	5	0.72	0.64	0.64	0.4	0.64	0.4
	Obstructions & Existing Infrastructure	Least obstructions to route both on beach and nearshore	8%	7	3	4	7	7	7	0.56	0.24	0.32	0.56	0.56	0.56
	Access to Beach	Best access to beach for heavy plant	6%	8	7	7	6	8	4	0.48	0.42	0.42	0.36	0.48	0.24
	Transition Joint Pit location	Availability of potential area for Transition Joint Pit	6%	5	6	3	5	7	7	0.3	0.36	0.18	0.3	0.42	0.42
			100%												
	TOTAL MARINE									***6.3***	***3.66***	***4.83***	***6.49***	***6.38***	***5.56***

5.5 FINDINGS

5.5.1 Irish Findings

Figure 5-1 summarises the output of the risk ranking exercise in terms of assessing the most suitable landfalls to consider for marine survey.

Figure 5-1 Irish Landfall Ranking



The three least constrained sites from a combined land and marine perspective are Ballinwilling, Inch and Ballycroneen. They are all located in the Knockraha study area and were all scored above 7.

Ballinwilling Beach scored the highest marine score of 7.44, this is due to its isolated location, good vehicular access to the beach, plenty of space for site equipment and TJP location and also a gently sandy beach which is conducive to either open-cut or HDD. This site also has minimal nearshore and offshore obstructions in relation to the other Irish landfall sites. The nearest environmentally protected area (proposed) is ~0.3km away. The land constraints scores for Ballinwilling are also the highest of the Irish sites hence the two scores combined together (7.75) put Ballinwilling as the least constrained landfall for the Irish side.

With regard to the other sites, Inch Beach and Ballycroneen Beach were ranked as the next least constrained landfalls in terms of combined marine and land constraints scores (7.25 & 7.23 respectively). This is because both Inch and Ballycroneen beaches are popular surfing locations and are closer to areas of denser habitation, hence the social impacts of a cable landing here would be higher. There is less safe working space on these beaches and there are obstructions both nearshore and offshore (for example the Kinsale gas pipeline

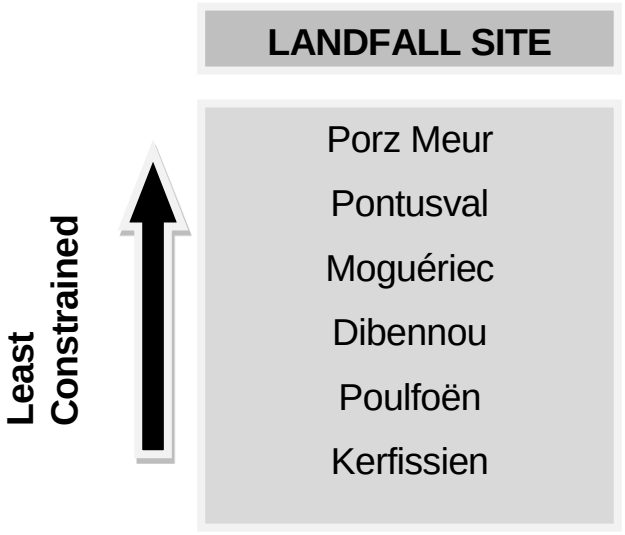
landing at Inch Beach). However they are less exposed to the weather and they also appear well protected from erosion. Also there are no environmentally protected areas within the vicinity.

As a group the Knockraha Landfall sites are ranked higher and less constrained compared to the Great Island Sites for both marine and land constraints based on the above rankings.

5.5.2 French Findings

Figure 5-2 summarises the output of the risk ranking exercise summarises the output of the risk ranking exercise in terms of assessing the most suitable landfalls to consider for marine survey.

Figure 5-2 French Landfall Ranking



- Porz Meur Landfall was considered the least constrained site from a marine perspective with a score of greater than six. The high marine score reflected the landfall's sheltered location, good vessel access and sandy beach composition. It is worth noting that the landfall is also considered positively from a land perspective, based on current environmental protection and planning designations. Porz Meur is also not within any environmentally protected areas but is in close proximity to a Natura 2000 area and a ZNIEFF type 2 area.
- Pontusval also scored above 6 in the marine scoring and is considered the next best option for landfall. The high marine score reflected the good access, working/site area and low coastal erosion. Pontusval is not within any environmentally protected areas but is in close proximity to a SPA and ZNIEFF type 1 & 2 areas. Pontusval is also favourable from a land perspective, based on planning and environmental considerations.
- Moguériec was ranked third. Its slightly lower score was due to minor permitting/planning constraints but good working/site area and low coastal erosion. The preferred landing position in this area Tévenn Beach is not in close proximity to any environmentally protected areas.
- Dibbenou and Poulfoën scored less well due to aspects such as poor vessel access and access to site. As well as poor beach composition and few options for the TJP location.

- Due to the near-shore area being within an Espace Remarquable, Kerfissien is seen to be strongly constrained and was scored lowest from a marine perspective, as such Kerfissien is recommended to be discarded from further consideration.

6 CONCLUSIONS & RECOMMENDATIONS FOR FURTHER WORK

Following the site visits, workshops and ranking exercises the following landfall sites are recommended as the preferred from the given options:

Irish Landfalls

1) Ballinwilling Beach

2) Inch Beach

3) Ballycroneen Beach

French Landfalls

4) Porz Meur

5) Pontusval

6) Moguériec

All of the above landfalls appear technically feasible via various installation methods, as detailed in the site summary tables in Section 4.

The suitability of the above landfalls are subject to the results of the following additional studies/assessment;

Seabed obstructions and sediment composition

Although some data regarding seabed sediment is available from the Admiralty and British Geological Survey charts, they are regional in nature and are not detailed enough to enable installation planning and burial operations. Unknown wrecks, UXO and other obstacles may also exist which are not listed on the Admiralty charts or within the purchased SeaZone data.

A geophysical and geotechnical survey should be carried out to identify obstructions and define the seabed morphology and geology along the cable route in due course.

Ground composition at landfall sites

As HDD is a recommended installation method option for most of the landfall sites, it is important to assess the ground composition and stability for HDD suitability to determine the viability of the project. Although HDD is suitable for a wide range of soil conditions, drilling through very soft or un-consolidated soils could lead to destabilisation of the ground. Drilling though fractured rock could lead to the loss of drilling fluid, this in turn will lead to jamming of the drill bit and collapse of the borehole.

A ground survey should be carried out to assess the suitability of the soil for HDD operations at the landfall sites.

Permits, consents & stakeholders

As limited consultation with stakeholders has been carried out due to the early stage of this project, the opinions of the majority of the consenting bodies are unknown. It is important to have early engagement with the consenting bodies to identify any potential issues and allow sufficient time to manage them. For example the Porz Meur landfall consultation and agreement with the French Navy and Brest Harbour authority could be critical in the granting of permission to route the cable to this beach. Also the result from consultation with the Kinsale gas pipeline owners at Inch Beach could impact upon the feasibility of the landfall.

It is recommended that early engagement with the consenting bodies be carried out as soon as possible.

It is also important to note that the findings of this report will contribute to a Marine Route Investigation Study which will assess the marine constraints in the offshore and near shore vicinities of potential route corridors. The findings from the Route Investigation Report will therefore influence the final landfall ranking and ultimately which landfalls(s) are taken forward to survey.

Appendix A Cable Landing Installation Methods

A.1 Cut Trench

Cut trenching methodology is the simplest method of installing a cable landing, but it is the method by which there is the most visual impact and is not suitable from a technical or environmental perspective in many circumstances.

In simplest terms a trench is opened by means of excavation with land based plant, and the cable or cable duct, lowered or pulled into the resultant trench.

Figure A 1 Example of sheet-piled Landing Trench

Example of sheet-piled cut trench.

In this case large dimensions for pipeline landing.

Note cross bracing struts for trench support.

Frequently, because of the depth of the required trench and the soils through which the construction activities are being undertaken, it is necessary to sheet-pile the sides of the trench. This prevents collapse of the side walls and provides a safer environment through which the cable or duct is to be installed.

One of the major drawbacks of the cut trench method is the amount of ground disturbance necessary in order to excavate the trench to the necessary depth. This is often very unpopular with local inhabitants, so can cause local objections to an installation program.

With the cut trench method it is also necessary to temporarily excavate any existing infrastructure such as sea walls, roads or sea defences. It is therefore not a popular method on well-developed coastlines.

For large pipeline projects, the dimensions of the assets to be installed often preclude other installation options, and it is therefore necessary to use this methodology. However, due to the relatively small dimensions of the ducting required through which power cables are to be installed, alternative less intrusive methods are often favoured.

Steel cross braces are sometimes installed across the resultant piled trench at the tops of the piles to further ensure the integrity of the trench.

Figure A 2 Further example of sheet-piled Landing Trench

Example of sheet-piled cut trench.

Steel pipe ducts already installed.

Note cross bracing struts for trench support.

Even with non-destructive methods such as HDD, which is discussed below, it is sometimes necessary to construct a sheet piled pit on the beach at which point the portion of cable though the duct and the offshore cable section can be joined. This takes the form similar to that shown in Figure A2.

On completion of the construction activities, the steel piles are removed and the site reinstated.

A.2 Horizontal Directional Drilling

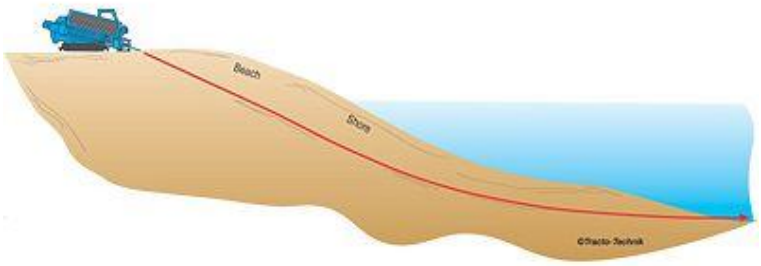
The most common method by which cable landings are now constructed is Horizontal Directional Drilling, or HDD.

HDD is a steerable trenchless method of installing underground pipes, conduits and cables in a shallow arc along a prescribed bore path by using a surface launched drilling rig, with minimal impact on the surrounding area. Directional drilling is often used when trenching or excavating is not practical or cost effective. Directional drilling minimizes environmental disruption. It is suitable for a variety of soil conditions. Installation lengths up to 2000m have been completed, and diameters up to 1,200mm have been installed on shorter runs. Pipes can be made of materials such as PVC, polyethylene, ductile iron, and steel.

The method comprises a three stage process, the first stage drills a pilot hole on the designed path and the second stage enlarges the hole by passing a larger cutting tool known as the back reamer. Depending on the diameter of the hole required will determine how many times the second stage is required. The third stage places the product or casing in the enlarged hole. The directional control capabilities assist the rig operator in making necessary changes in the direction of the drill head

Horizontal directional drilling is done with the aid of viscous fluid known as drilling fluid. It is a mixture of water and usually bentonite or polymer is continuously pumped to the cutting head or drill bit to facilitate the removal of cuttings, this also assists in stabilizing the bore hole, cool the cutting head and lubricate the passage of the product pipe.

Figure A 3 Schematic of Typical HDD Construction Method



Schematic of HDD from beach to offshore location.

The location and guidance of the bore is a very important part of the drilling operation, as the drill head is underground and not visible. There are two types of locating equipment for locating the drill head the walk-over locating system or a wire-line locating system. Both systems utilise a transmitter behind the drill head, this registers depth, roll, pitch and temperature data. This information is transmitted through the ground to the surface in a walk-over system. At the surface a receiver manually positioned over the transmitter relays steering directions to the operator. In a wire-line system, this information is transmitted through a cable in the drill string. Both systems have their own merits depending on the type of job being undertaken.

Figure A 4 HDD Components

A 300 tonne drill rig.

Typical HDD construction site layout.

A.3 Auger Boring

In very tight confines it is still possible to use drilling technology to construct conduits under existing infrastructure through which cables may be installed. However, this generally takes place over very short distances.

The method used for this approach is referred to as Auger Boring, and this can take the form of either “Guided” or “Non-guided” methods.

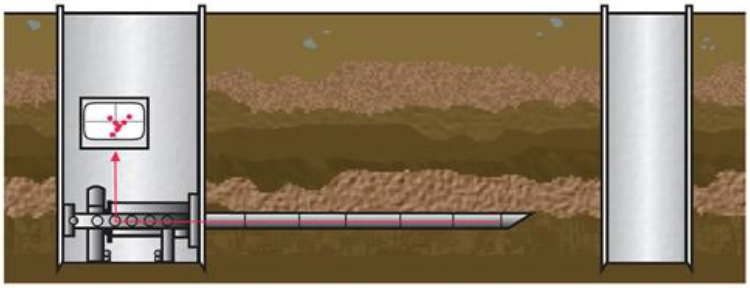
A.3.1 Guided Auger Boring

Directional or Guided Auger Boring is a technique whereby a product is installed between two prepared shafts, usually manholes. It can be conducted in all displaceable soils over a distance of up to 100m, and the duct that is installed is a steel casing.

The boring rig is set up in the launch shaft and the laser guided probe is then jacked through the ground to the reception exit shaft.

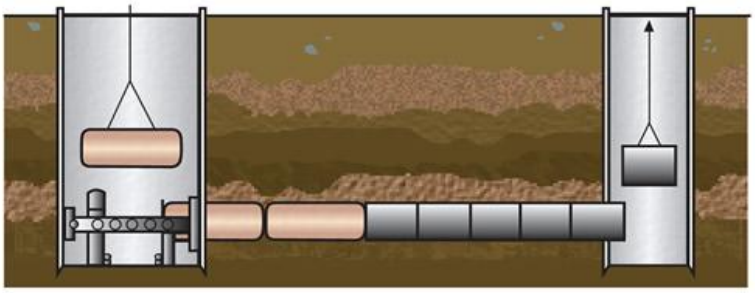
Assisted by pilot rods equipped with optical passage, steering head, and theodolite with CCD (close circuit digital) camera and monitor, open-guided boring can be carried out in displaceable ground. The pilot pipe is pushed through the ground towards the target shaft. The direction is monitored by the CCD camera throughout the whole process. The direction of the head is adjusted by rotating the pilot pipes to guide the steering head on the cross hair image on the guidance monitor.

Figure A 5 Guided Auger Boring Techniques



The double pilot rod allows the internal rod to turn the steering head; whilst the outer steel sleeve takes all the ground friction.

The precision-guided bore made by the pilot pipe is then followed by the steel cased auger sections which enlarges the bore to the same size as the product pipes.



The product pipes are then jacked through whilst the casings are being retrieved in the reception pit.

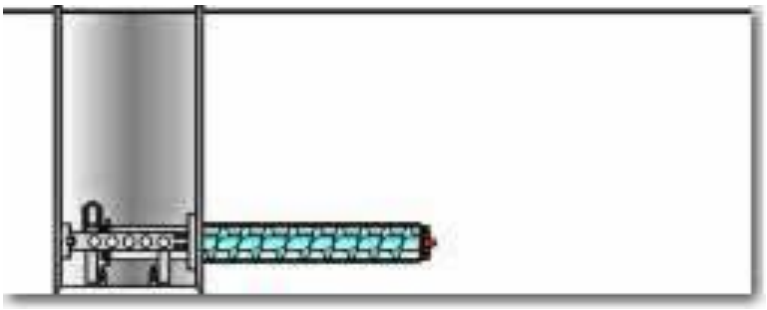
On completion of the duct installation then cable can be pulled through. Naturally it is necessary to consider the minimum bend radius of the cable, and onward route, when designing the access pits for the auger bore.

A.3.2 Non Guided Auger Boring

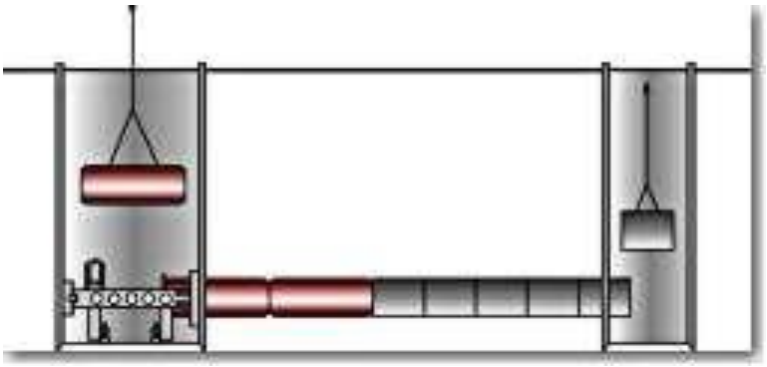
Protective steel piping is jacked into the ground from a launch shaft correctly constructed for the jacking forces involved. The bore head loosens the earth at the drill head, which is then conveyed back to the launch shaft by the auger.

This is basically the same method as above but without the use of the pilot rod. It is therefore a less accurate approach.

Figure A 6 Non Guided Auger Boring Techniques



With non-guided boring, the exact alignment of the machine is more important. The longer the jacking shaft, the more accurate the borehole, as it is possible to work with longer casings.



When connections are being bored from a launch shaft to a target shaft (open - open), the product pipes, which are the same diameter, push out the steel casings containing the auger sections.

The non-guided method may be more suitable for landing operations where the bore could exit directly onto a beach slope. However, both auger boring methods are of restricted use because of the distances currently achievable with this technology.

Auger boring can also be carried out using the same type of access pit as for HDD. So may be suitable for something similar to a straight line run under a sea wall for instance.

A.4 Construction Site Footprints

Depending on the method of construction chosen for the landing construction, a construction site will have to be established in order to install the ducts and cables.

As can be seen above, the most intrusive method of construction is the cut trench option. The amount of equipment involved and the extent of the excavation can be considerable. The actual footprint of the work will be linear along the alignment of the pipeline, but the width of the construction site could well be 50m either side of the trench width to allow access for machinery and somewhere to store the spoil.

The extent of the physical intrusion of a cut trench and dredged channel in a nearshore area can be seen in Figure A7.

Figure A 7 Beach activity during cut trench operations

Cut trench excavation for pipeline landing in Spain for 2 x 26" Gas pipelines.

Excavators and bulldozer on beach and backhoe dredger working offshore.

Later full reinstatement to pre-construction condition.

Cut trench for duct installation in Ireland for 2 x 500MW cables plus 1 fibre optic cable.

Short term visual impact. Later full reinstatement to pre-construction condition. Many local objections raised due to visual impact.

The method of construction which creates the least visual impact is HDD, however even this requires that a temporary construction site is established.

Appendix B Key Environmental Designations within the Study Area

Designation	Description
Special Areas of Conservation (SAC)	Under the EC Habitats Directive (92/43/EEC) and relating to habitat types with certain species/habitats listed for protection in the Annexes of the Directive.
Candidate Special Area of Conservation (cSAC):	European Designation. A site has been submitted to European Commission (EC), but has not yet had formal approval from Europe.
Site of Community Importance(SCI)	European Designation. Following approval for designation the cSAC is considered to be a Site of Community Importance (SCI) by the European Commission until it is formally designated by a nations government.
Special Protection Areas (SPA)	European designation. Special Protection Areas (SPA) are statutory designated sites that are classified under European Union (EU) law in accordance with Article 4 of the EC Directive on the conservation of wild birds (79/409/EEC) (known as the Birds Directive). They are classified for rare and vulnerable birds, listed in Annex I of the Birds Directive, and for regularly occurring migratory species.
Ramsar sites	International designation. Designated under the Convention of Wetlands (Iran, 1971), which requires member states to designate wetlands that meet the criteria for inclusion on the List of Wetlands of International Importance (Ramsar list).
Natural Heritage Areas (NHA)	Irish designation. This is an area considered important for the habitats present or which holds species of plants and animals whose habitat needs protection.
Annex 1 Habitat	European Designation. Member States to take measures to maintain or restore natural habitats and wild species listed on the Annexes to the Habitats Directive at a favourable conservation status, introducing robust protection for those habitats and species of European importance.
Important Bird Areas Zones Importantes pour la Conservation des Oiseaux (ZICO)	International. Non statutory. These are areas of major interest harbouring wild birds staff considered of European importance. These are areas that are home to significant numbers of birds, whether species crossing staging, wintering or breeding, reaching numerical thresholds at least one of three criteria: global significance, European significance, importance in the European Union.
Important Natural areas for Fauna and Flora (ZNIEFF1)	French designation. It is areas with a biologic interest including rare species, protected or endangered species. These areas do not have a formal designation, but are restrictive for settlement projects.
Important Natural areas for Fauna and Flora (ZNIEFF2) Zones Naturelles d'Importance pour la Faune et la Flore	French designation. They are extensive rich natural areas, which offer important biological potentiality. Usually, they are bigger and less sensitive than ZNIEFF type 1. They do not have any formal designation.
Regional Nature Park Parc naturel régional (PNR)	French designation. The establishment in France between local authorities and the French national government covering an inhabited rural area of outstanding beauty, in order to protect the scenery and heritage as well as setting up sustainable economic development in the area.
Marine Nature Park	French designation. IUCN category V area. To protect and sustain important landscapes/seascapes and the associated nature conservation and other values created by interactions with humans through traditional management practices.
Biosphere Reserve	Biosphere reserves are sites established by countries and recognized under UNESCO's Man and the Biosphere (MAB) Programme to promote sustainable development based on local community efforts and sound science.
Biotope Protection Order Arrêté de protection de biotope	French designation. Offers protection to conservation of species of fauna and flora of community interest, especially as a framework of the Natura 2000 network (mainland France and Corsica) and also as a tool for the protection of

Designation	Description
	globally threatened species (overseas).
Nature Reserve Réserve Naturelle	French designation. It is offered a high national protection for areas with important natural and ecological interest.
Espace Remarquables	Areas of outstanding natural beauty preserved under the Article L146-6 of the planning code. Construction in these areas is prohibited.