Step 3 - Performance Matrix Assessments

Celtic Interconnector Project

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EIRGRID

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Introduction

The Celtic Interconnector is a proposed electrical link which will enable the movement of electricity between Ireland and France. The project is following EirGrid's six-step approach to grid development as outlined in EirGrid's *Have your Say*[1] document. This approach facilitates engagement and consultation with stakeholders and the public which helps us to explore options fully and make more informed decisions.

As part of the approach, a comprehensive and consistent multi criteria analysis is applied to decision making. The multi criteria analysis facilitates a balanced consideration of the following constraints relating to project development:

- Economic;
- Technical;
- Deliverability;
- Environmental; and
- Socio-economic.

The project is currently nearing the end of Step 3 of the approach, 'What's the best option and what area may be affected?'. Two separate performance matrix assessments have been carried out in order to facilitate comparative assessment and shortlisting of the range of identified converter station location zone and landfall location options.

Separate baseline reports considering the constraints associated with both the onshore and offshore aspects of the project were prepared as an input to the comparative assessments. This document should be read in conjunction with the *Onshore Constraints Report*[2] and the *Offshore Constraints Report*[3], which are both available on the EirGrid website. A non-exhaustive summary of the key constraints / considerations as identified within both reports is provided in this document, however each of the reports should be referred to for a complete overview of the constraints considered for each of the identified options.

Each of the identified options has been assessed across the five constraints based on the scale shown in Figure 1 below and subsequently compared against each other.

Figure 1 – Performance Matrix Assessment Scale

[1] http://www.eirgridgroup.com/__uuid/7d658280-91a2-4dbb-b438-ef005a857761/EirGrid-Have-Your-Say_May-2017.pdf
[2] http://www.eirgridgroup.com/site-files/library/EirGrid/Celtic-Interconnector-Project-Step-3-Onshore-Constraints-Report.pdf
[3] http://www.eirgridgroup.com/site-files/library/EirGrid/Celtic-Interconnector-Project-Step-3-Offshore-Constraints-Report.pdf

Converter Station Location Zones

Fourteen broad geographic zones were identified for the converter station location zones (CSLZs). The options were assessed for:

- their suitability to accommodate a converter station;
- availability of an Alternating Current (AC) cable route between the converter station and the connection point at the existing Knockraha substation; and,
- availability of a Direct Current (DC) cable route from the converter station to an indicative common point[4] for all of the landfall location options.

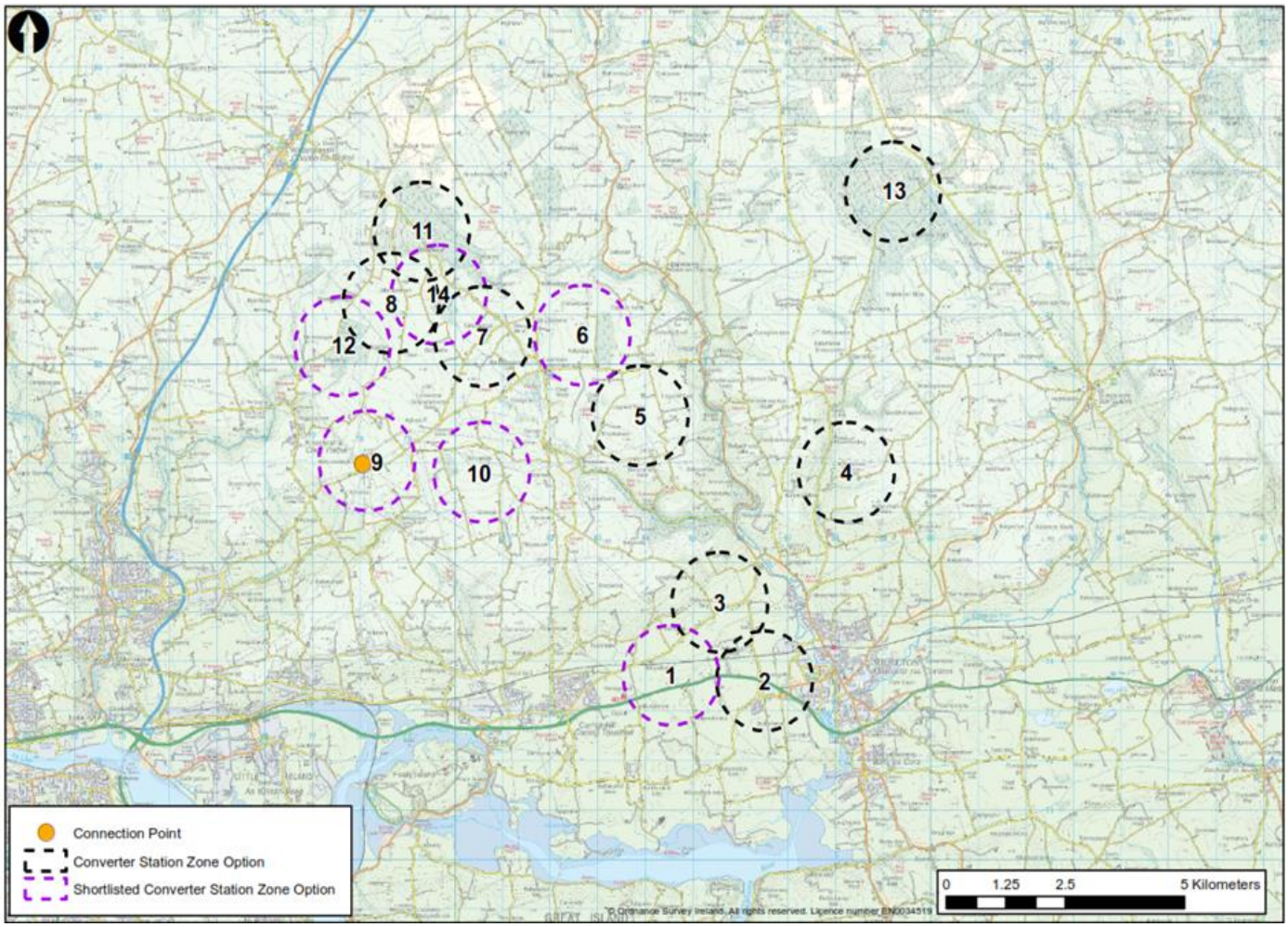

Figure 2 - Converter Station Location Zones

A non-exhaustive summary of the key onshore constraints associated with the identified converter station location zone options under consideration have been characterised and are listed in Table 1 overleaf, which is an extract from the *Onshore Constraints Report*.

[4] An indicative common point in the Midleton area was used solely for the purposes of ensuring a consistent approach to the evaluation of options.

Reference	Location	Key Constraints / Considerations
1	Ballyadam	• Approximately 7 kilometres straight line distance from Knockraha 220kV station, longer by road route. This exceeds the indicated maximum length of AC cable without reactive compensation. • AC cable route to Knockraha 220kV station will be challenging due to railway and bridge crossings. • Partially zoned for industry but surrounded by Prominent and Strategic Metropolitan Greenbelt Areas. Potentially limited flexibility in terms of micro-siting. • Encompasses the N25 Route Protection Corridor. • Includes karst features within areas of extreme aquifer vulnerability. • Potential drainage issues. • Low lying site within High Value Landscape. • Significant number of cultural heritage features on site.
2	Water Rock	• CSLZ boundary is approximately 9 kilometres straight line distance from Knockraha 220kV station, longer by road. This exceeds the indicated maximum length of AC cable without reactive compensation. • AC cable route to Knockraha 220kV station will be challenging due to the width of the trench required for the AC circuit and the narrow, tree lined roads between the zone and Knockraha 220kV station. • Encompasses built-up area of mixed commercial, retail and residential use. • Potentially limited flexibility in terms of micro-siting. Encompasses the N25 Route Protection Corridor. Partially zoned for residential and enterprise uses. Also, partially located within Prominent and Strategic Metropolitan Greenbelt Areas. • Includes a Geological Heritage Site and karst features. • Low lying within High Value Landscape. • Potential connectivity to proximate Natura 2000 sites. • Close proximity to a significant number of sensitive receptors.
3	Curragh	• CSLZ boundary is approximately 7 kilometres straight line distance from Knockraha 220kV station, longer by road. This exceeds the indicated maximum length of AC cable without reactive compensation. • AC cable route to Knockraha 220kV station will be challenging due to the width of the trench required for the AC circuit and the narrow, tree lined roads between the zone and Knockraha 220kV station. • Potentially limited flexibility in terms of micro-siting. The majority of the zone forms part of Prominent and Strategic Metropolitan Greenbelt Areas. The section to the south east is classed as a Built-Up area, zoned for residential development. The zone also incorporates part of a golf course. • Within a High Value Landscape. • Low lying and potentially overlooked by the R626 Leamlara to Midleton scenic route.
4	Elfordstown	• CSLZ boundary is approximately 9 kilometres straight line distance from Knockraha 220kV station, longer by road. This exceeds the indicated maximum length of AC cable without reactive compensation. • AC cable route to Knockraha will be challenging due to the width of the trench required for the AC circuit and the narrow, tree lined roads between the zone and Knockraha. Steep sections pose additional challenge. • Potentially limited flexibility in terms of micro-siting. The majority of the zone forms part of Prominent and Strategic Metropolitan Greenbelt Areas and is located within High Value Landscape. • Prominent and elevated zone. Includes National Space Centre which may limit screening potential. • Steep elevations to the east and west sloping down towards a ridge and a valley (with rock outcrops and a river flowing through it).
5	Lisgoold East	• CSLZ boundary is approximately 5 kilometres straight line distance from Knockraha 220kV station, longer by road. In terms of cable route length, it is likely that an AC underground cable would require the installation of reactive compensation. • AC cable route to Knockraha will be challenging due to the width of the trench required for the AC circuit and the narrow, tree lined roads between the zone and Knockraha. • An elevated zone in proximity to a scenic route and partially located within a High Value Landscape. • Located in proximity to the Lisgoold Development Boundary.
6	Leamlara	• CSLZ boundary is approximately 4 kilometres straight line distance from Knockraha 220kV station, however longer by road. In terms of cable route length, it is likely that an AC underground cable would require the installation of reactive compensation. • Limited road network in the zone could result in both AC and DC circuits routes in the same road - adequate space may not be available. • Incorporates part of the Leamlara Development Local Area Plan Boundary • An elevated zone. The forested area may offer screening but change of land use consent would be required. • Potential for ecological and cultural heritage impacts associated with tree felling.

Reference	Location	Key Constraints / Considerations
7	Ballynaglough	• CSLZ boundary is approximately 3 kilometres straight line distance from Knockraha 220kV station. In terms of cable route length, it is very likely that an AC underground cable could be installed without the requirement for reactive compensation. • The road network in the area appears to offer opportunities for independent routes for both AC and DC cable routes. • Majority of zone elevated and exposed. • Includes an area of forestry which may offer screening potential (considered under CSLZ 14). • Potential for ecological and cultural heritage impacts associated with tree felling.
8	Monatooreen	• Boundary is approximately 2 kilometres straight line distance from Knockraha 220kV station. In terms of cable route length, it is likely that an AC underground cable could be installed without the requirement for reactive compensation. • The road network in the zone is narrow however appears to offer opportunities for establishing AC and DC cable routes. • Majority of zone is elevated and exposed with potentially limited flexibility in terms of micro-siting. • Includes an area of forest which may offer screening potential (considered under CSLZ 14). • Potential for ecological and cultural heritage impacts associated with tree felling.
9	Knockraha	• Incorporates Knockraha 220kV station. An underground AC circuit will not require reactive compensation. • The length of the wider cable trench (AC) is short and the associated risk of establishing a route is low. • Existing infrastructure may limit flexibility in terms of micro-siting opportunities. • Elevated and exposed zone with potentially limited screening opportunities.
10	Pigeon Hill	• CSLZ boundary is approximately 1 kilometre straight line distance from Knockraha 220kV station. In terms of cable route length, it is likely that an AC underground cable could be installed without the requirement for reactive compensation. • Independent routes for the AC and DC circuits appear to be available within the local road network. • Elevated and exposed zone but potential opportunities for screening within the forested area. • Potential ecological and cultural heritage impacts associated with tree felling.
11	Moanbaun	• CSLZ boundary is approximately 4 kilometres straight line distance from Knockraha 220kV station, longer by road. In terms of cable route length, it is likely that an AC underground cable would require the installation of reactive compensation. • Independent routes for the AC and DC circuits appear to be available within the local road network. • Elevated areas within the zone with rock outcrops. • Potential opportunities for screening within the forested area but micro-siting options may be limited. • Adjacent to Maonbaun Woods amenity area. • Potential ecological and cultural heritage impacts associated with tree felling.
12	Kilquane	• CSLZ boundary is approximately 2 kilometres straight line distance from Knockraha 220kV station, however longer by road. In terms of cable route length, it is unlikely that an AC underground cable could be installed without the requirement for reactive compensation. • Establishing independent routes for the AC and DC circuits will be challenging within the local road network. • Potential opportunities for screening within the forested area. • Potential ecological and cultural heritage impacts associated with tree felling.
13	Ballynona	• CSLZ boundary is approximately 12 kilometres straight line distance from Knockraha 220kV station, longer by road. This exceeds the indicated maximum length of AC cable without reactive compensation. • AC cable route to Knockraha will be challenging due to the width of the trench required for the AC circuit and the narrow, tree lined roads between the zone and Knockraha. Steep sections pose additional challenge. • Potential opportunities for screening within the forested area. • Existing Irish Distillers site adjacent to forested area. • Children's burial grounds recorded within the zone. • Potential ecological and cultural heritage impacts associated with tree felling.
14	Ballyvatta	• CSLZ boundary is approximately 3 kilometres straight line distance from Knockraha 220kV station, in terms of cable route length, it is likely that an AC underground cable could be installed without the requirement for reactive compensation. • The road network in the zone is narrow however appears to offer opportunities for establishing AC and DC cable routes. • Potential opportunities for screening within the forested area. • Potential ecological and cultural heritage impacts associated with tree felling.

Table 1 - Key constraints / considerations for the converter station location zones

Assessment Findings

A performance matrix assessment was carried out in order to facilitate shortlisting of the converter station location zone options, as shown in Figure 3 below.

	CSLZ 1 *Ballyadam*	CSLZ 2 *Water Rock*	CSLZ 3 *Curragh*	CSLZ 4 *Elfordstown*	CSLZ 5 *Lisgoold East*	CSLZ 6 *Leamlara*	CSLZ 7 *Ballynalough*
Economic							
Technical							
Deliverability							
Environmental							
Socioeconomic							

	CSLZ 8 *Monatooreen*	CSLZ 9 *Knockraha*	CSLZ 10 *Pigeon Hill*	CSLZ 11 *Moanabaun*	CSLZ 12 *Kilquane*	CSLZ 13 *Ballynona*	CSLZ 14 *Ballyvatta*
Economic							
Technical							
Deliverability							
Environmental							
Socioeconomic							

Figure 3 - Converter Station Location Zone Performance Matrix Assessment

Economic

- The main differentiators with this assessment criterion related to distance from the connection point. In general, locations that were closest to the connection point (by road) performed better as they avoid the need for additional equipment and had a reduced requirement for AC cabling, which is approximately three times more expensive per kilometre than DC cabling.

Technical

- All options performed similarly under this assessment criterion, apart from those locations that were closest by road to the connection point which performed better as they avoid the need for additional equipment to compensate for reactive power (required for AC cable routes greater than 4.6km in distance).

Deliverability

- The main differentiators with this assessment criterion related to the flexibility of potential route options in the local road infrastructure and the availability of independent routes for the AC and DC cables along with the potential for traffic and noise impacts during construction.

Environmental

- The main differentiators with this assessment criterion related to land use and land use planning, soils/geology, landscape/visual and proximity to sensitive receptors.

Socio-economic

- The main differentiators with this assessment criterion related to opportunities for visual screening and proximity to and density of sensitive receptors, including communities, recreation and tourism amenities.

Summary

- CSLZs 7, 9, 10 and 14 perform best for economic and deliverability considerations. This is largely due to the shorter AC cable route and the availability of a road network that is likely to accommodate independent routes for the AC and DC cables.
- CSLZ 7 is elevated and exposed, however there is a commercial forested area within the zone, which provides an opportunity for visual screening that is better incorporated by CSLZ 14.
- CSLZ 9 is also elevated and exposed and has limited screening opportunities, however siting a converter station in close proximity to Knockraha substation (the connection point), could mitigate a number of issues by way of avoidance.
- CSLZs 6, 10, 12 and 14 include commercial forested areas and may offer opportunities for screening of the infrastructure.
- CSLZ 1 did not perform as well under deliverability and environmental, however it has been recommended by stakeholders in feedback submitted to date.

Conclusion

It is therefore proposed to shortlist the following converter station location zones for further assessment in Step 4.

- **CSLZ 1 – Ballyadam,**
- **CSLZ 6 – Leamlara,**
- **CSLZ 9 – Knockraha,**
- **CSLZ 10 – Pigeon Hill,**
- **CSLZ 12 – Kilquane,**
- **CSLZ 14 – Ballyvatta.**

Landfall Locations

Five options were identified for the landfall locations, as shown in Figure 4 below. The options were assessed for:

- their suitability to accommodate an offshore DC cable route from the landfall location out to the 12nm Territorial Waters limit; and,
- availability of an onshore DC cable route from the landfall location towards an indicative common point[5] for all of the converter station location zone options.

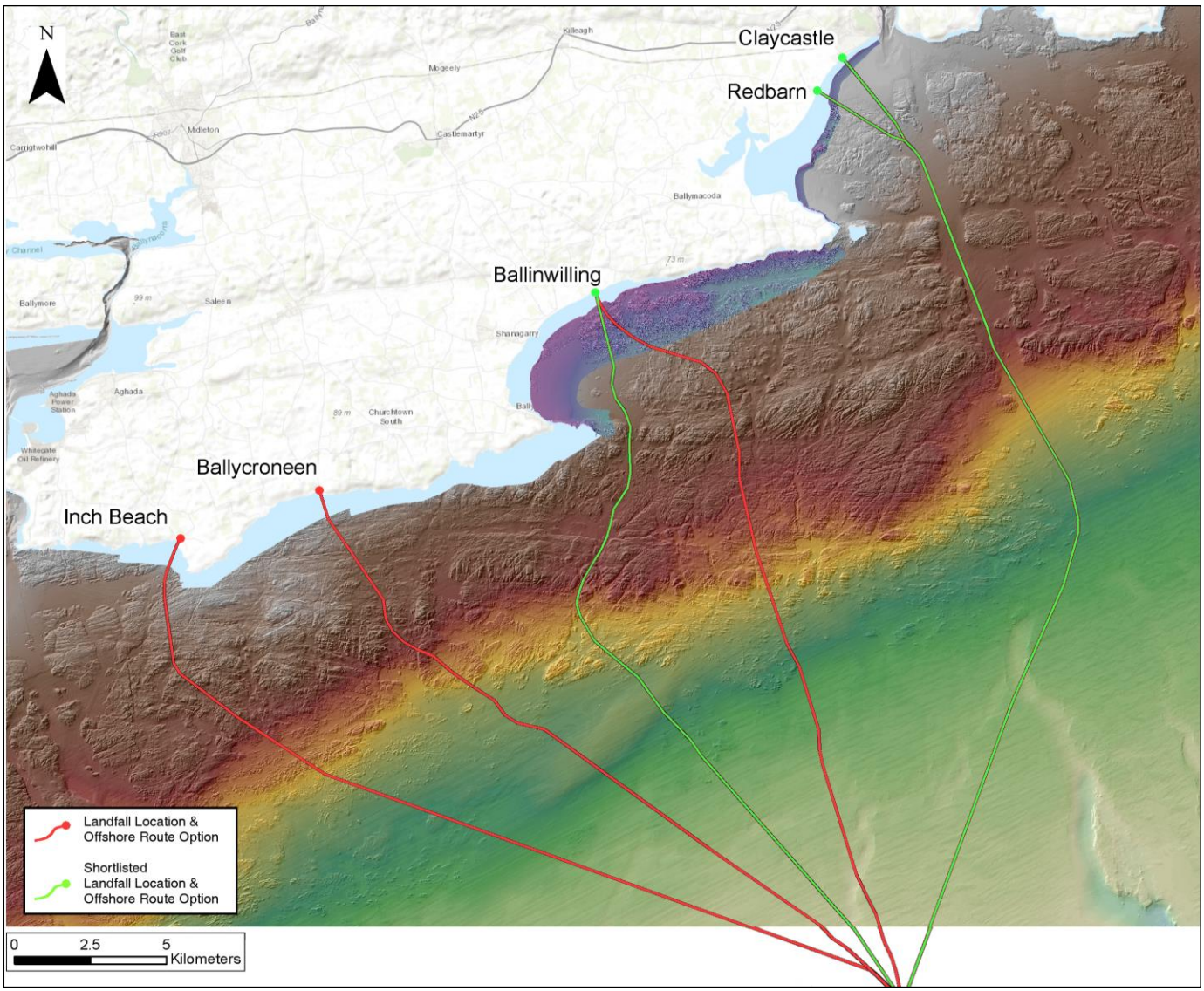

Figure 4 - Landfall Locations

A non-exhaustive summary of the key onshore and offshore constraints associated with the identified landfall location options under consideration have been characterised and are listed in Table 2 overleaf, which is a combined extract from the *Onshore Constraints Report* and the *Offshore Constraints Report.*

[5] An indicative common point in the Midleton area was used solely for the purposes of ensuring a consistent approach to the evaluation of options.

Location	Key Constraints
Inch Beach	**Onshore** • Limited space available for a construction laydown area. • The route will need to cross an existing gas main and Ballycroneen Bay Geological Heritage Area. • Potential to cause damage and disturbance to habitats and species (including protected birds). • A number of sensitive receptors to temporary nuisance and disturbance impacts associated with the installation of a cable. **Offshore** • Potential for extensive Rock-Cutting and remedial external protection. • Increased risk of damage during installation due to requirements for rock cutting. • Existing Pipeline limiting approach route. • Exposed to weather from Southwest which could hamper installation. • High submarine noise levels during rock cutting operations. • Challenging landfall requiring rock cutting operations.
Ballycroneen Beach	**Onshore** • Small suitable space for a construction laydown area at the landfall. • Proposed route to Ballycroneen beach passes a section of tree lined roadway. • Proposed route from Inch Beach/Ballycroneen beach passes through Cloyne Conservation Area. • Potential to cause damage and disturbance to habitats and species (including protected birds) • Approximately 960 metres from Ballycroneen Bay Geological Heritage Area. **Offshore** • Potential for Rock-Cutting and remedial external protection 11.5km. • Increased risk of damage during installation due to requirements for rock cutting. • High submarine noise levels during rock cutting operations. • Challenging landfall requiring rock cutting operations.
Ballinwilling Strand (Western Approach) (BW2)	**Onshore** • There is limited space at the proposed landfall area for a construction laydown area but some space may be available in the carpark. • The route to Ballinwilling will need to pass over a number of bridges with limited deck space along the route. • Potential to cause damage and disturbance to habitats and species (including protected birds). • Approximately 3 kilometres from Ballycotton Bay Geological Heritage Area. • Proximate to Ballycotton, Ballymona and Shanagarry pNHA (site code 000076). • Approximately 2 kilometres from Ballycotton Bay SPA / Ramsar Site. • Approximately 6.5 kilometres from Ballycotton Islands pNHA. • Sparsely populated and undeveloped. **Offshore** • Potential for impact on fishing during construction. • Potential for Rock-Cutting and remedial external protection along 6km of the route. • Increased risk of damage during installation due to requirements for rock cutting. • High concentration of dense boulders. • High submarine noise levels during rock cutting operations. • Challenging landfall requiring rock cutting operations.
Ballinwilling Strand (Eastern Approach) (BW1)	**Onshore** • There is limited space at the proposed landfall area for a construction laydown area but some space may be available in the carpark. • The route to Ballinwilling will need to pass over a number of bridges with limited deck space along the route. • Potential to cause damage and disturbance to habitats and species (including protected birds). • Approximately 3 kilometres from Ballycotton Bay Geological Heritage Area. • Proximate to Ballycotton, Ballymona and Shanagarry pNHA (site code 000076). • Approximately 2 kilometres from Ballycotton Bay SPA / Ramsar Site. • Approximately 6.5 kilometres from Ballycotton Islands pNHA. • Sparsely populated and undeveloped. **Offshore** • Potential for Rock-Cutting and remedial external protection along 15.2km of the route. • Increased risk of damage during installation due to requirements for rock cutting. • Challenging seabed gradients for installation equipment. • High submarine noise levels during rock cutting operations. • Challenging landfall requiring rock cutting operations.

Location	Key Constraints
Redbarn Beach	**Onshore** • Limited space for a construction laydown area at the proposed landfall area. • The cable route to Redbarn beach will need to pass along narrow and winding roads with a number of bridges with limited deck space along the route. • Potential to cause damage and disturbance to protected habitats and species (including birds). • Bounded to the rear (north west) by sand dunes. Ballyvergan Marsh pNHA to the northeast. • Proximate to Ballymacoda Bay SPA. • Approximately 2.5 kilometres from Ballymacoda (Clonpriest and Pillmore) SAC/(p)NHA. • Ballymacoda Bay is a Shellfish Designated Area, licensed for clams, oysters and mussels. • Approximately 3 kilometres from Ballycroneen Bay Geological Heritage Area. • Potential site of medium archaeological potential, associated with a. possible sub-surface depression identified in the geophysical survey at Redbarn Beach. **Offshore** • Up to 2km of rock cutting in shallow water at the landfall. • Short length of rock cutting and therefore reduced risk of damage to cable during installation. • Sheltered from weather during installation. • High submarine noise levels during rock cutting operations. • Challenging landfall requiring rock cutting operations.
Claycastle Beach	**Onshore** • Space for a construction laydown area may be available at the car park, but this may require permissions. • A narrow road leading to the beach complicated by railway crossing which may require works in a pNHA. • Potential to cause damage and disturbance to protected habitats and species (including birds). • Bounded to the east and west by Ballyvergan Marsh pNHA. • Ballymacoda Bay SPA (site code 004023) / Ramsar site located approximately 2 kilometres to the south. • Ballymacoda Bay SAC (site code 000077) and Ballymacoda (Clonpriest and Pillmore) pNHA (site code 000077) located approximately 4.5 kilometres to the south. • Blackwater Estuary SPA / Ramsar Site located approximately 3 kilometres to the northeast. • Blackwater River SAC and Blackwater River and Estuary pNHA are located approximately 2 kilometres to the northeast. • An area of peat deposits (including a submerged forest), of archaeological potential, have been recorded at Claycastle Beach. • Densely populated and popular resort with a number of particularly sensitive receptors. **Offshore** • Very good sediment coverage with no rock cutting required. • An area of peat deposits (including a submerged forest), of archaeological potential, have been recorded at Claycastle Beach. • No rock cutting and therefore reduced risk of damage to cable during installation. • Sheltered from weather during installation. • Lower level of submarine noise during construction as no rock cutting required. • Straightforward landfall as no rock cutting operations required.

Table 2 - Key constraints / considerations for the landfall locations

Assessment Findings

A performance matrix assessment was carried out in order to facilitate shortlisting of the landfall location options, as shown in Figure 5 below.

	Inch	Ballycroneen	Ballinwilling		Redbarn	Claycastle
			BW2	BW1		
Economic						
Technical						
Deliverability						
Environmental						
Socioeconomic						

Figure 5 - Landfall Location Performance Matrix Assessment

Economic

- The main differentiators with this assessment criterion related to the distances of each route (both onshore and offshore) and the geological conditions associated with the seabed off the East Cork coast. In general, the western routes were shorter in distance but were more challenging in terms of installation through rocky seabed than the eastern routes. However, there wasn't a significant difference overall between the options under this criterion.

Technical

- All options performed the same under this assessment criterion.

Deliverability

- The main differentiators with this assessment criterion related to the flexibility of potential route options (both onshore and offshore). Due to the more challenging seabed conditions on the western routes, these routes performed worse as the implementation timeline and installation risk would be increased due to the requirement for specialist installation and protection equipment.

Environmental

- For the offshore environment the main differentiators with this assessment criterion related to the potential for higher levels of disturbance to the marine environment associated with rock cutting i.e. submarine noise. For the onshore environment the main differentiators related to proximity to sensitive receptors.

Socio-economic

- The main differentiators with this assessment criterion related to communities, recreation and tourism onshore and fisheries along the offshore route options. It is noted that the landfall location will be fully re-instated following completion of the works and as such disruption is anticipated to be largely temporary in nature.

Summary

- The Redbarn Beach and Claycastle Beach options perform best and share much of their route (both onshore and offshore) with only a minor difference in the final approach to each landfall. These options are largely free of challenging conditions (rocky seabed) in the offshore section.
- Out of the western options, the Ballinwilling Strand 2 option is considered to perform better on balance as it requires the least amount of rock cutting.

Conclusion

It is therefore proposed to shortlist the following landfall locations for further assessment in Step 4:

- **Ballinwilling Strand 2 (BW2),**
- **Redbarn Beach,**
- **Claycastle Beach.**