8 Soils, geology and groundwater

8.1 Introduction

This chapter draws on data made publicly available by the Department of Communications, Energy & Natural Resources and the Geological Survey of Ireland (GSI), via http://www.gsi.ie/Mapping.htm. Reference has also been made to the Geological Survey of Ireland 1:100,000 *Sheet 6, Geology of North Mayo*. The author has visited Belderra Strand and the location of the proposed onshore development.

This assessment was undertaken with reference to the Institute of Geologists of Ireland's *Guidelines – Geology in EIS* (2002). These guidelines identify the following geological issues as potentially significant in the assessment of linear projects (Project type 20):

- Nature of rock/soil
- Impact on groundwater
- Impact on geological heritage
- Impact on natural resources, such as resource sterilisation.

8.2 Receiving environment

The receiving environment comprises the onshore area, including Belderra Strand and the substation location in Ballymacsherron townland, the offshore seabed, the overall geology of the area, and any groundwater in the form of aquifers.

8.2.1 Onshore sediment and soil

Belderra Strand is a sandy beach flanked on either side by headlands of exposed rock. There are areas of erosion on the beach and adjacent land, as indicated by the presence of rounded cobbles and boulders. A dune complex, formed by wind-blown sand, is well developed to the north-east of Belderra Strand. The IFS soils data provided by the Department of Communication, Energy & Natural Resources (commonly referred to as the 'Teagasc soil data') and the Geological Survey of Ireland internet resource indicate that the immediate inland area behind Belderra Strand is wind-blown sand, the extent of which is limited in the vicinity of the proposed development. The extent of wind-blown sand significantly increases to the east and north-east of Belderra Strand, well outside the development footprint (Figure 8-1).

A geophysical survey to establish sediment thickness was undertaken at Belderra Strand by Minerex Geophysical Limited in 2010; the report is included in **Appendix 5**: Belmullet Wave Energy Connection Belderra Strand County Mayo Geophysical Survey[1]. The survey demonstrated that the sediment (primarily sand) is between 2 and 15m thick across the beach, becoming shallower towards the headland, and that there is sufficient depth of sand to bury a cable in a trench across the beach.

Further inland, the GSI mapping indicates the presence of glacial till and near-surface or exposed bedrock. Glacial till is a catch-all term for the poorly sorted soil deposited by some glacial processes, although it is frequently encountered as boulder clay – that is, poorly sorted gravel, cobbles and boulders in a clay matrix. The glacial till of the study area is derived from

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[1] Report Status: Draft, MGX Project Number: 5500, MGX File Ref: 5500d-005.doc, 10 November 2010, *Report on geophysical survey to establish sediment thickness at Belderra Strand* by Minerex Geophysical Limited.

the underlying metamorphic rocks, which consist primarily of gneiss. It is the result of glacial action during the last Ice Age, which ended approximately 10,000 years ago. To the south-east, beyond the development footprint, the mapping shows blanket peat.

The information available indicates that the groundwater resource vulnerability (Figure 8-2) is generally extreme to xtreme[2] across the substation development footprint, which implies an overburden thickness of less than 3m (extreme) and less than 1m (xtreme) – see Table 8-1. However, in the area immediately inland of the beach – the narrow zone associated with wind-blown sand – thicker soil may be anticipated, as the vulnerability in this area is shown to be high to low – that is, greater than 3m thick.

Table 8-1: GSI groundwater vulnerability rating criteria

	Hydrogeological conditions				
	Subsoil permeability and thickness				
	High permeability	Moderate permeability	Low permeability	Unsaturated zone	
Vulnerability rating	(sand/ gravel)	(sandy till)	(clayey till, clay, peat)	(sand and gravel aquifers only)	Karst features
Extreme	0 to 3m	0 to 3m	0 to 3m	0 to 3m	-
High	>3m	3 to 10m	3 to 5m	>3m	N/A
Moderate	N/A	>10m	5 to 10m	N/A	N/A
Low	N/A	N/A	>10 m	N/A	N/A

Note: N/A = not applicable

The topography in which the proposed development is located is generally gently sloping. This, together with the absence of blanket peat, indicates that there is negligible risk of slope instability.

A site investigation of the electricity substation site was undertaken by Glover Site Investigations Ltd in 2011. The investigation report is included in **Appendix 6**: Glover Substation Site Investigation report. This investigation indicates that the substation site is typically underlain by topsoil and thin peat (less than 1m thick if present) that overlies granular, sand-dominated soil of up to 4m thickness, which in turn overlies gneiss bedrock. As part of the investigation, infiltration and percolation tests were carried out that indicate that the substation site is suitable for on-site waste water treatment.

8.2.2 Offshore sediments

Extensive investigation of the sea bed has been undertaken in the design of the project to establish the appropriate routing of the marine cable (see Chapter 4). In general, the marine geomorphology comprises rock reefs extending westwards from the land, with sediment-filled basins between these reefs. The engineering preference is to lay the cable on sediment where it can be buried, and where possible to avoid rock, where the cable may need artificial protection. One of the objectives of the marine surveys was to find a submarine electricity cable route that as far as possible travels through sediment basins, rather than over exposed bedrock.

[2] As part of the Water Framework Directive studies, the Extreme (E) vulnerability category was revised to include a subdivision called Xtreme (X). This X vulnerability refers to areas where soil is less than 1m thick. It is shown separately on GSI groundwater vulnerability mapping.

A survey by Coastline Surveys Ltd focused on sediment in the top 2m of the sea bed, as this is the zone in which a marine cable would normally be placed. For a summary report, see www.seai.ie/amets/documents~~www.seai.ie/oceanenergy~~. The survey encountered the sediment/sea floor types shown in Table 8-2.

Table 8-2: Sediment/sea floor type

Code	Sediment description
I	Sand – fine to medium marine sand with occasional gravel and shells and rare thin organic beds
II	Glacial till
III	Sand – medium to coarse sand
IV	Bedrock – gneiss

The actual distribution of sediments along the proposed submarine electricity cable route, as identified by the survey, is set out in Table 8-3

Table 8-3: Distribution of sediments along the proposed submarine electricity cable route

Zone	From	To	Length	Soil Distribution (top 2m of sea bed)
1	0*	1.38	1.38 km	Sand (I), variable thickness, over bedrock (IV)
2	1.38	1.7	320 m	Bedrock (IV)
3	1.7	6.92	5.22 km	Sand (I)
4	6.92	10.8	3.88 km	Glacial till (II) with possible shallow occurrences of bedrock (IV)
5	10.8	17.68	6.88 km	Sand (III) underlain by glacial till (II)

** Due to the draft of survey ships, the seafloor survey commenced several hundred meters offshore; the 0 point is therefore not on Belderra Strand but the nearshore sea bed.*

Further offshore surveying was undertaken by the Marine Institute in 2011 – for more details, see www.seai.ie/amets/documents~~www.seai.ie/oceanenergy~~. This report generally supports the findings of the earlier survey, except in the area approximating to Zone 4, in which it reports bedrock at or near the surface. Taken together, the findings of the two surveys would suggest that, in Zone 4, bedrock is covered with a thin layer of cohesive sediment, and in this zone there is unlikely to be sufficient sediment to bury the cable.

As part of the investigation by Coastline Surveys Ltd, twenty-six sediment samples were submitted for chemical testing, and the results were compared with Irish and international guidelines for sediment quality. Analytes were typically found to be within acceptable sediment quality limits or below analytical limits of detection. This indicates a low to negligible risk to the marine environment.

8.2.3 Geological heritage

The geology of West Mayo is dominated by ancient (Precambrian) metamorphic rocks. The central part of the Mullet Peninsula, including the development footprint, is underlain by the Annagh Division, pre-Dalradian rocks that are some of the oldest rocks in Ireland. The Annagh

Division comprises gneisses, coarse crystalline rocks and banded metamorphic rocks, which are often described as orthogneiss – gneiss derived from the metamorphism of granitic rocks. The data provided by the DCENR for offshore geology under the INFOMAR programme indicates that the offshore geology comprises 'basement' and is therefore likely to consist of metamorphic rocks typical of west Mayo. The onshore geology is shown in Figure 8-3.

The bedrock of the area shows geological structures, such as faults and folds, which are expressions of its tectonic history. There is a fault beneath the southern end of Belderra Strand, lying on a north-west—south-east alignment, which falls within the development footprint of the cable route across Belderra Strand and the cable jointing bay. However, the presence of such a bedrock fault would not be expected to have any significant influence on the proposed development.

There are no records of mineral localities or mine/quarry workings within the development area. Typically mineral localities within the general area are recorded for their potential for decorative stone extraction. Consultation with the GSI has indicated that the coastal exposure of the Annagh Division rocks in the headlands to the north and west of Belderra Strand is of international importance and this section of coast has been recommended for NHA status. The project as proposed would not require any works on existing coastal exposures of rock and would therefore not impact upon the value of the recommended NHA.

8.2.4 Groundwater

The groundwater beneath Belderra Strand will be at the interface zone between the denser saline marine waters and the less dense freshwater. Inland from the beach, the groundwater would be fresh, but some seawater influence may be present, either from saline intrusion or from the effect of sea spray. Within the general area of the inland project elements, behind Belderra Strand, the topography generally falls towards the beach, which would indicate that groundwater flow would be westwards. It has been noted that there is a discharge of fresh water onto Belderra Strand – a nearby landowner has indicated that this is the discharge of drainage from agricultural lands in the hinterland of the beach, including the substation footprint.

Based on GSI mapping, the soils of the study area comprise a strip of wind-blown sand along the edge of the beach and glacial till, where present, inland. The wind-blown sand would be expected to be porous and permeable, and thus capable of storing and transmitting water. Site investigation across the substation site has found granular soils that might be of glacial or Aeolian origin. These could be expected to allow transmission of water in a similar manner to the dune sands.

The rocks of the study area are crystalline metamorphic rocks and would not be anticipated to have significant permeability or porosity, except in zones where fracturing had occurred due to weathering and/or tectonic processes. The bedrock beneath the site has been subject to faulting and folding, and zones of preferential flow may therefore be present. A crust of increased permeability bedrock is generally found in the upper zone of the bedrock, due to weathering of the rock, although this can be thin or absent in post-glacial settings. The site investigation on the substation site has not revealed a significantly weathered upper surface to the bedrock. The fracture flow (or secondary flow) of the bedrock would contrast with the pore flow (or primary flow) of the wind-blown sands.

The GSI groundwater resource mapping of the Annagh Division, shown in Figure 8-4, indicates that the groundwater resource beneath the site is poor, and productive only in local zones (Pl). The wind-blown sand is shown to be a locally important gravel aquifer (Lg) – the majority of this aquifer is to the north of the proposed development, to the north-east of Belderra Strand. The GSI groundwater resource matrix is presented as Table 8-4.

Table 8-4: Matrix of groundwater protection zones

Vulnerability Rating	Source Protection		Resource Protection					
			Regionally Important		Locally Important		Poor Aquifers	
	Inner	Outer	Rk	Rf/Rg	Lm/Lg	Ll	Pl	Pu
Extreme (E)	SI/E	SO/E	Rk/E	Rf/E	Lm/E	Ll/E	Pl/E	Pu/E
High (H)	SI/H	SO/H	Rk/H	Rf/H	Lm/H	Ll/H	Pl/H	Pu/H
Moderate (M)	SI/M	SO/M	Rk/M	Rf/M	Lm/M	Ll/M	Pl/M	Pu/M
Low (L)	SI/L	SO/L	Rk/L	Rf/L	Lm/L	Ll/L	Pl/L	Pu/L

Rk = Major Aquifer, Regionally important limestone karst aquifer

Rf/Rg = Major Aquifer, Regionally important fractured bedrock or sand/gravel aquifer

Lm/Lg = Minor Aquifer, Locally important, moderately productive

Ll = Minor Aquifer, Locally important, productive only in local zones

Pl = Poor Aquifer, productive only in local zones

Pu = Poor Aquifer, unproductive

Note: Environmental risk decreases from the top left corner to the bottom right

The GSI has completed a preliminary evaluation of the vulnerability of groundwater in this area, using the matrix presented in Table 8-1 – see Figure 8-2). This preliminary evaluation has established areas of extreme vulnerability, where the rock is at or near the surface (X in Figure 8-2) and where the soil is less than 3m thick (E). The preliminary evaluation also established areas of high to low vulnerability (HL), but did not discriminate between areas of high, moderate and low vulnerability.

The GSI mapping shows the area to be dominated by X and E vulnerability, which implies a typical soil thickness of less than 3m and often less than 1m. At the substation site, there is also soil of a thickness and type that would be indicative of high vulnerability for bedrock groundwater.

The groundwater resource protection classification for the Annagh Division is Pl/H-X, which indicates that the groundwater resource is poor, with high to extreme vulnerability to contaminant ingress from the surface. This classification indicates that the bedrock groundwater resource would be suitable to support only domestic and limited-scale agricultural abstractions. The groundwater resource protection classification for the wind-blown sand and perhaps the sand-dominated soils beneath the substation site would be Lg/E-X, indicating that the groundwater resource is locally important with extreme vulnerability to contaminant ingress from the surface, and that the resource may support significant abstraction.

The GSI well records do not indicate any groundwater abstractions in close proximity to the proposed development. The only groundwater abstraction shown on the Mullet Peninsula is the well for the Belmullet group water scheme – this is located at the edge of the local gravel aquifer, 2km to the north-east of the proposed development. Although the sand beneath the substation site may be a stratigraphic continuation of the aquifer sands to the north-east, the topography and other factors (such as drainage) would suggest that the groundwater under the proposed development does not contribute to the source of this abstraction.

8.3 Potential impact of the development

Impacts of the development are considered for the construction, operational and decommissioning phases of the project in the marine and land-side environments.

8.3.1 Construction phase

Potential marine construction impacts

Where possible, the cable will be buried in marine sediments. This will require the temporary creation of a trench, either by cable ploughing or by jetting. After the cable is placed in it, the trench will be backfilled. This activity will displace sediment, the finer part of which will, at least temporarily, become suspended in the water. It is not anticipated that this will have a significant impact, as laboratory testing has shown that the sediments are not contaminated. The marine environment off the Mullet Peninsula is highly dynamic, and this suggests that any disruption of marine sediment would be rapidly ameliorated by natural sediment processes.

In areas of rock outcrop, it is expected that the cable will be placed on the surface and protected, for example by the placement of 'mattresses' or 'rock armour'. This is not anticipated to have any impact on the nature and distribution of marine sediments.

Wave energy converters will be anchored to the seabed using gravity anchors, suction bucket anchors or embedment anchors. The placement of anchoring systems may give rise to some small-scale sediment displacement. Scour protection using rock deposition may also be required to prevent erosion around anchoring systems. This is not anticipated to have any impact on the nature and distribution of marine sediments

Given the type of works, the nature of the project and the environmental setting, it is not anticipated that the marine aspect of the proposed development will have any discernible impact on sediments and geology.

Potential construction impacts on intertidal and Belderra Strand areas

The beach crossing will require the excavation of four trenches of between 1 and 2m in depth and approximately 1m in width across the beach from the low-water mark to the location of the cable jointing bay. It will be necessary to place the cable conduits at a depth that is sufficient to allow the beach surface to be reinstated without the possibility of cable exposure.

Construction works in the beach area present two principal potential impacts with regard to soil and geology:

- Disruption of the sediment profile, leading to increased erosion
- Damage to geological heritage

Belderra Strand is a high-energy and dynamic environment where the temporary disruption caused by the cable installation is not anticipated to have a short- or long-term effect on the geomorphology of the beach. It is possible that natural erosion and movement on the beach could expose the cable during extreme events, but this is a risk to the operational integrity of the cable rather than to the environment. Therefore risk of the project leading to enhanced erosion from the beach is considered to be low.

The geological heritage of the area is associated with the existing coastal rock outcrops. The proposed development will not affect these, and therefore there will be no impact. The car park area may be excavated to some extent.

Works on the beach will require the use of vehicles and mechanical plant. The risks associated with these works are comparable with those associated with the land-side construction works, the potential impacts of which are discussed below.

Potential impacts from landside works

The onshore works comprise three principal elements:

- Construction of the cable jointing bay
- Widening of the road to the substation site
- Construction of the substation

The cable jointing bay comprises a below-ground concrete rectangular box in which the marine and land cables are joined. This requires the excavation of soil and rock to sufficient depth (approximately 2m) and subsequent construction of the concrete structure.

Any road widening and construction will require the excavation of soil and rock, and subsequent placement of hardcore and surfacing material. Ducts for the land-side electricity cables will be installed in a trench in the middle of the existing road to the field where the substation is located. This may require excavation, backfilling and resurfacing. Concrete may be used for road and cable ducting works to ensure the integrity of the road and protection of the cable.

Development of the substation and the access road will require excavation of soil and possibly of rock to allow the construction of foundations, drainage, earthing grid, etc. The substation will include bunds for transformers and welfare facilities for site workers and visitors.

The excavation and management of soil to facilitate the development poses a number of possible environmental risks.

It reduces the natural protection of groundwater to contaminants at or near the ground surface and makes the groundwater more vulnerable to any losses of hydrocarbons, effluents or surface water run-off during construction.

- Hydrocarbons may be lost to the ground and subsequently the groundwater during fuelling of plant and vehicles, or from leakages from transformers prior to and during installation.
- Wastewater effluents may be generated by site facilities, such as toilets.
- Surface water run-off from the site may contain high levels of particulate matter associated with soil excavation.

The excavation of soil generates spoil; this may be stored temporarily on site or be used in landscaping works associated with the substation development. The storage and placement of excavated soils may generate surface water run-off with high particulate loads due to erosion by rain – this water may subsequently enter surface water or groundwater bodies, leading to a temporary reduction in water quality. If no appropriate reuse option is available, all excavated soil must be disposed of appropriately, in accordance with the waste regulations.

The development of the onshore infrastructure will require the construction of concrete structures and foundations. During such work, high alkalinity waters may be generated that could reduce the quality of the receiving water.

8.3.2 Operational phase

Potential operational impacts on marine and Belderra Strand areas

It is not anticipated that maintenance works will be carried out on the marine cable, and hence there will be no operational activities on the cable other than monitoring of its natural and artificial protection. However, in the worst case, where a section of cable needed to be replaced, the impact would be comparable to construction, which, with regard to sediment and geology, would be negligible to low.

On the marine side of the development, anchor points and some sections of cable will require rock armour to protect the infrastructure from marine currents and impacts. The placement of such rock armour is likely to have localised effects on the movement of sediment, with deposition on the up-current side and scouring on the down-current side. Given that the structure will not be of significant height, although it may be several kilometres long, it is not expected that it will have any significant impact on sediment movement within the high-energy environment of the bay – the impact on sediment movement will be much less than that arising naturally from rock outcrops and reefs.

Potential onshore operational impacts

The operation of the substation will require frequent inspection and maintenance visits and occasionally more intensive works, such as transformer oil change or topping up. There are only a limited number of risks from these activities.

During maintenance works, plant on site may need to be refuelled, and quantities of oil may need to be stored and handled for the purpose of maintaining electrical apparatus. Any losses of hydrocarbons during storage and transfer may impact on the quality of surface water and groundwater.

Some of the electrical plant at the substation, such as transformers, may contain oil for insulation purposes. If such plant were to suffer structural failure, a release of oil could result. The oil in electrical plant requires topping-up or replacement from time to time, and losses of oil may occur during these activities.

Effluent will be generated from the permanent welfare facilities at the substation; this will consist primarily of toilet and washing effluents, which will be discharged to a holding tank for removal and disposal in accordance with good practice. Clean water from the roofs of structures will be discharged directly to surface water, and other run-off will discharge to surface water via an interceptor.

8.3.3 Decommissioning phase

In general terms the potential impacts arising from decommissioning, with respect to soil, sediment and geology, closely resemble those arising from construction. However, if marine cabling were to be abandoned *in situ*, the impact of decommissioning would be less than that of construction. Similarly, if the substation were reconfigured for local electricity distribution, it would not require demolition, and the landside impact of decommissioning would be considerably less than that of construction.

8.4 Mitigation of potential impacts

8.4.1 Construction phase

Mitigation of potential offshore impacts

No significant impacts are anticipated with regard to sediment and geology offshore. Therefore no specific mitigation measures are anticipated to be required beyond normal practice.

Mitigation of potential impacts Belderra Strand and onshore

Throughout the construction phase, standard and recognised best practices to prevent water pollution will be observed, and best practice in soil excavation, handling and storage will be implemented. The following general measures will be implemented:

- All hydrocarbons will be managed appropriately to prevent their potential release to surface water or groundwater. All hydrocarbon containers, including transformers, will be stored in bunds. All above-ground tanks will be externally bunded. All transfer of hydrocarbons will be undertaken in a bunded area.
- The construction site will have an oil spill response plan in place with appropriately trained staff and containment equipment on the site to enable immediate control of any spills.
- Waste water effluents arising primarily from welfare facilities will be collected in storage tanks that will be emptied as required by a licensed waste liquid tanker and disposed of at an appropriately licensed treatment facility.
- Excavated materials from construction works will be deposited in pre-arranged locations where there is no danger of run-off into local watercourses. Stored excavated material will be placed on plastic sheeting and will be covered when not in use to mitigate the potential for elevated levels of particulates in run-off. All run-off water from soil storage locations shall be captured and discharged to appropriate receiving water after being clarified by an appropriate particulate removal apparatus. In addition to soil excavation, the site works may require exposure of large areas of soil; run-off water from such areas will be collected by temporary drainage and passed through settlement tanks or lagoons before discharging to surface water via an oil interceptor. Where soil is to be placed for landscaping purposes, the final formation face will be covered by an appropriate substrate to facilitate plant growth and minimise erosion.
- The method of disposal of all excavated materials will be fully catalogued so that reuse and waste trails can be audited.

In general, the quality of the receiving water will be protected by the collection where possible of site run-off, which will be discharged via sediment control and interceptor.

It is anticipated that the use of concrete will have only a minimal impact on groundwater quality and that losses of alkali waters to surface water and groundwater will be mitigated by normal construction good practice. Raw or uncured waste concrete will be disposed of by removal from the site.

Wash-down water from exposed aggregate surfaces, cast-in-place concrete and concrete trucks will be trapped on site to allow sediment to settle out and reach neutral pH before the clarified water is released to a drain system.

8.4.2 Operational phase

Mitigation of potential offshore impacts

No maintenance works, other than monitoring and inspection, are expected to be required for the offshore and beach portions of the proposed development. In the worst case, where the cable is damaged, the potential impacts and mitigation measures would be as detailed for the construction phase.

Mitigation of potential impacts on Belderra Strand and onshore areas

To mitigate the potential loss of hydrocarbons during maintenance activities all hydrocarbon containers shall be stored in impermeable bunds, which may be mobile bunds to aid maintenance activities. For above-ground tanks, double-skinned tanks shall not be considered sufficient containment – all shall be externally bunded. All transfer of hydrocarbons between containers and to plant and vehicles shall be undertaken in a bunded area.

An oil spill response plan shall be in place for the site and oil spill containment equipment shall be maintained at the site, so that appropriately trained personnel responding to an incident can take immediate steps to control any incident.

To mitigate any losses of oil from electrical apparatus such as transformers, all electrical apparatus containing oil shall be located within permanent concrete bunds constructed and tested to provide containment. Each bund shall be sized to hold 110% of the oil volume within the electrical apparatus it encloses, blind sumped and alarmed to allow the regular removal of clean rain water by means of pump. Rainwater pumped from each bund shall be discharged to the surface water drainage system via an oil interceptor. In the event of a spill, the liquid in the bund shall be removed by liquid waste tanker, as will the contents of the surface water drainage system oil interceptor.

Oil interceptors at the site shall be subject to six-monthly inspection and annual de-sludging to ensure that they retain full operational efficiency.

8.4.3 Decommissioning phase

The mitigation measures for decommissioning will be similar to those for construction, as detailed above in section 8.4.1. Given that some land-side infrastructure may be reused and marine-side infrastructure left *in situ*, the mitigation measures would be amended to reflect the reduced scope of work.

8.5 Residual impacts post mitigation

8.5.1 Construction phase

It is not anticipated that there will be any significant residual impacts arising from construction. However, marine works and cable installation are subject to localised sea bed conditions and weather effects that can not be fully mitigated in advance of the works, other than through the expertise and experience of the contractor employed to undertake the works.

8.5.2 Operational phase

It is not anticipated that there will be any significant residual impacts arising from the operation of the test sites, cable or substation, beyond those arising from normal best practice operation of such facilities.

However, the placement of sea-bed structures such as linear rock armour over some cable sections and anchor points will give rise to associated sediment deposition and scouring. This is likely to be a localised and insignificant operational impact, given that the environment is high energy and the structures will have heights less than a few metres. At worst, the impact is likely to be less than the natural effects arising from rock mounds and reefs outcropping from the sea bed.

8.5.3 Decommissioning phase

It is not anticipated that there will be any significant residual impacts arising from the decommissioning of the test sites, cables or substation, beyond those arising during construction. However, even with removal of cables and anchors, rock armour will be left in place on the sea bed, continuing the associated, if minimal, impact arising during the operational phase.

8.6 Conclusion

The electricity transmission cables in the sea bed offshore and in the beach of Belderra Strand are not anticipated to present any significant risks with respect to soil, sediment or geology during construction, operation or decommissioning. The construction of landside project components – cable jointing bay, land cable and substation – present limited risks to receiving waters during construction and further reduced risk during operation. These limited risks will be mitigated by the implementation of good construction practice and the provision of robust protection measures in the design of the substation.

The proposed development does not present any significant risks to soil or sediment, geology or groundwater during construction or subsequent operation.

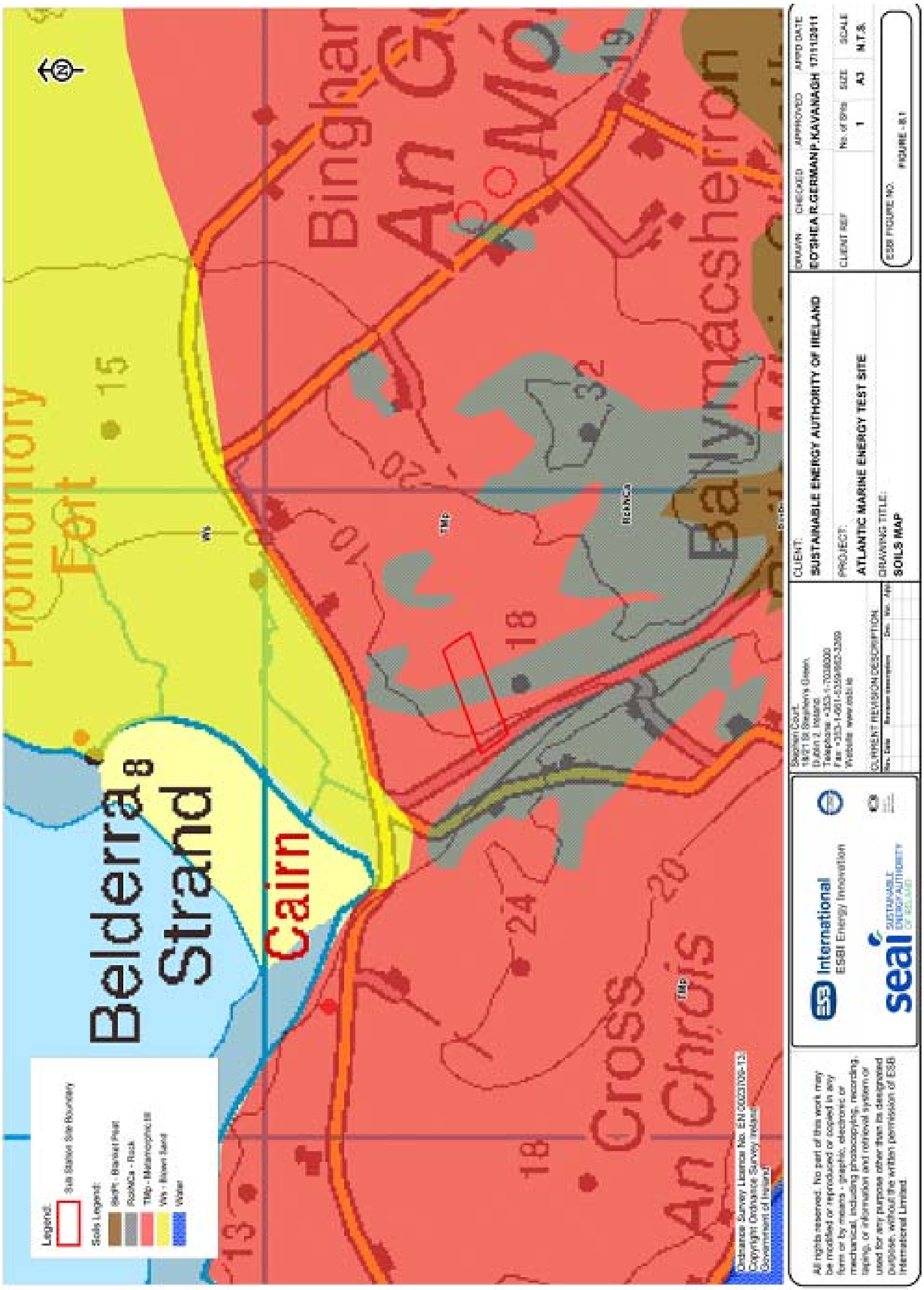

Figure 8-1: Soils map **(Copyright Geological Survey of Ireland)**

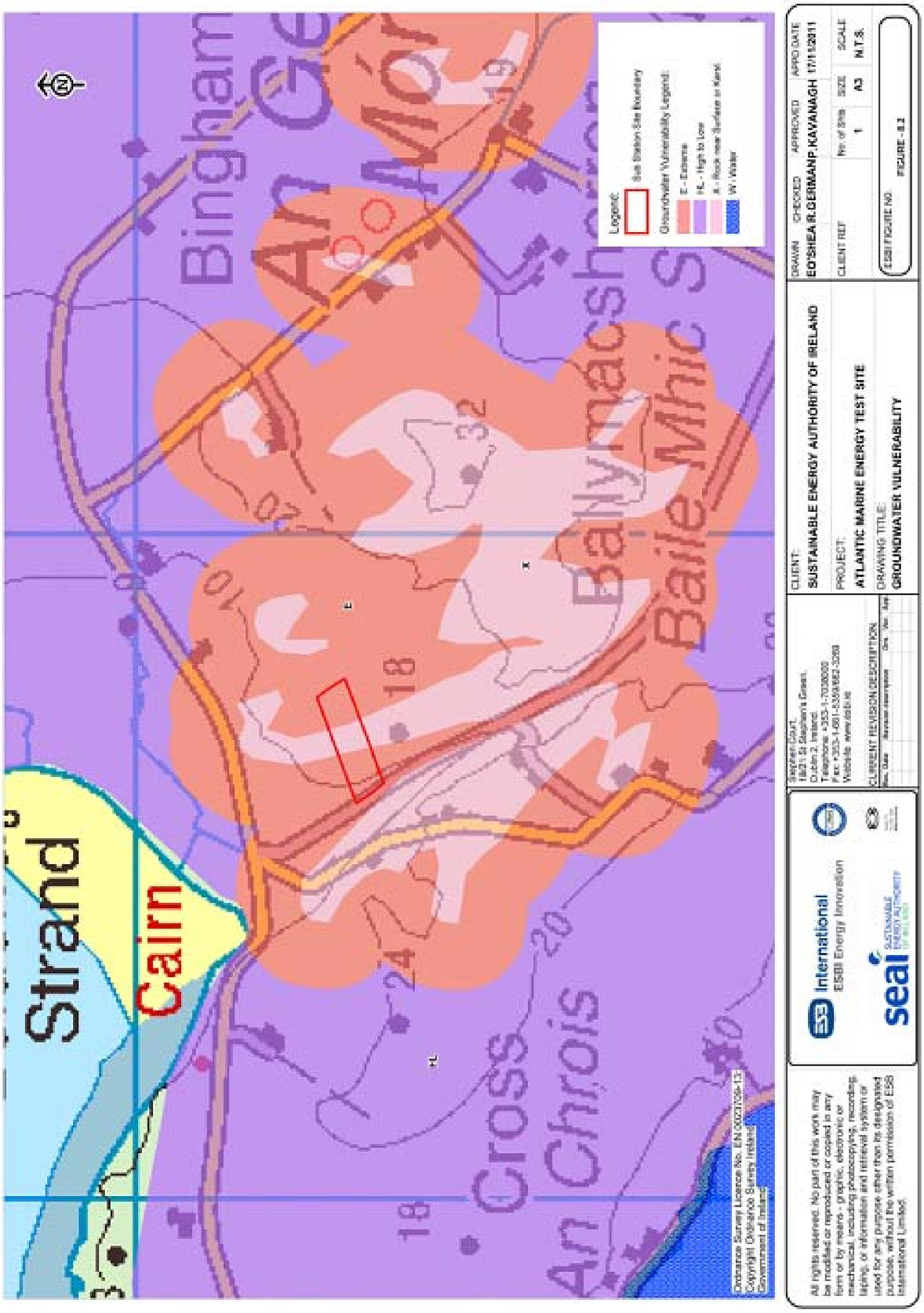

Figure 8-2: Groundwater vulnerability [(Copyright Geological Survey of Ireland)]

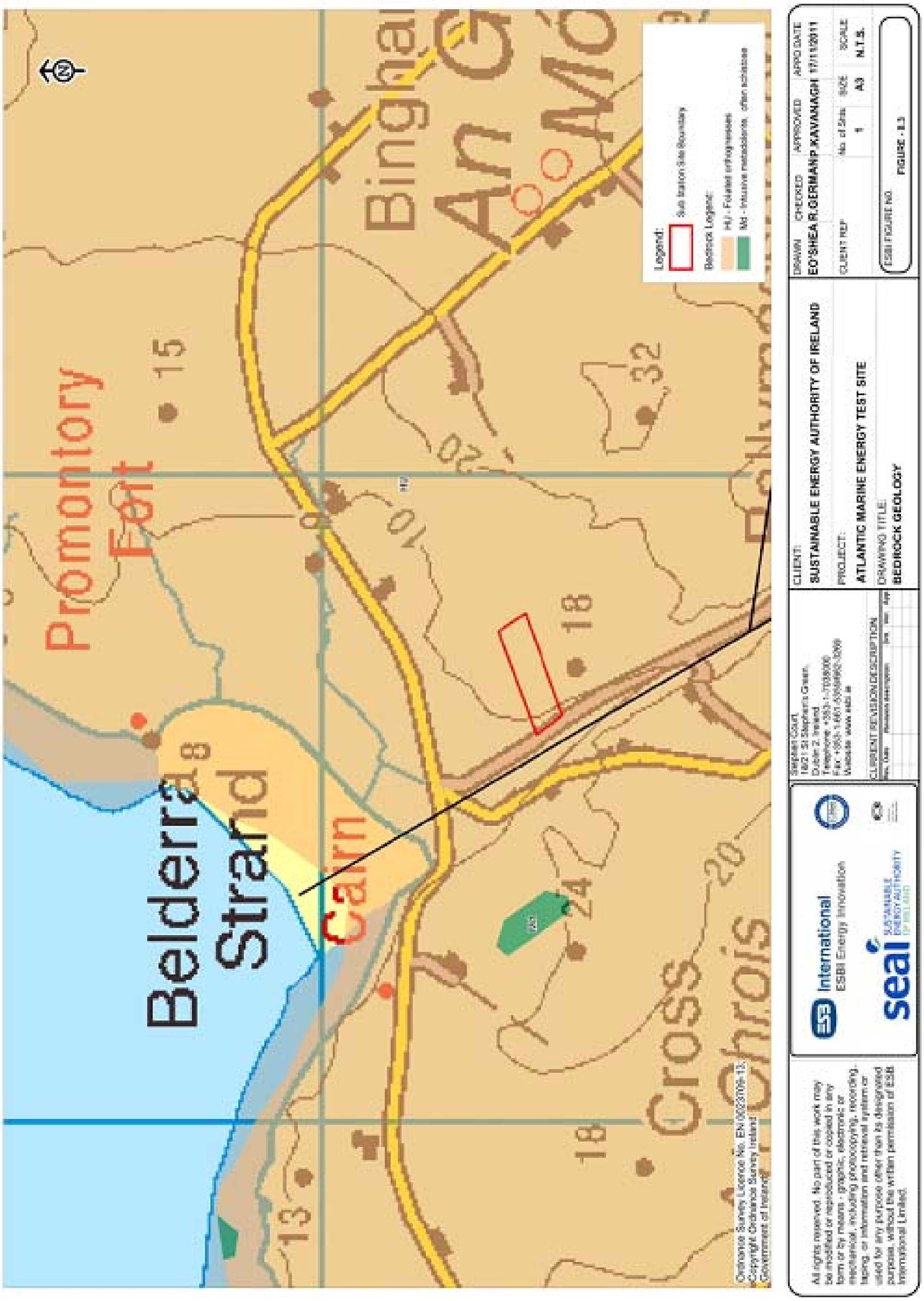

Figure 8-3: Bedrock geology [(Copyright Geological Survey of Ireland)]

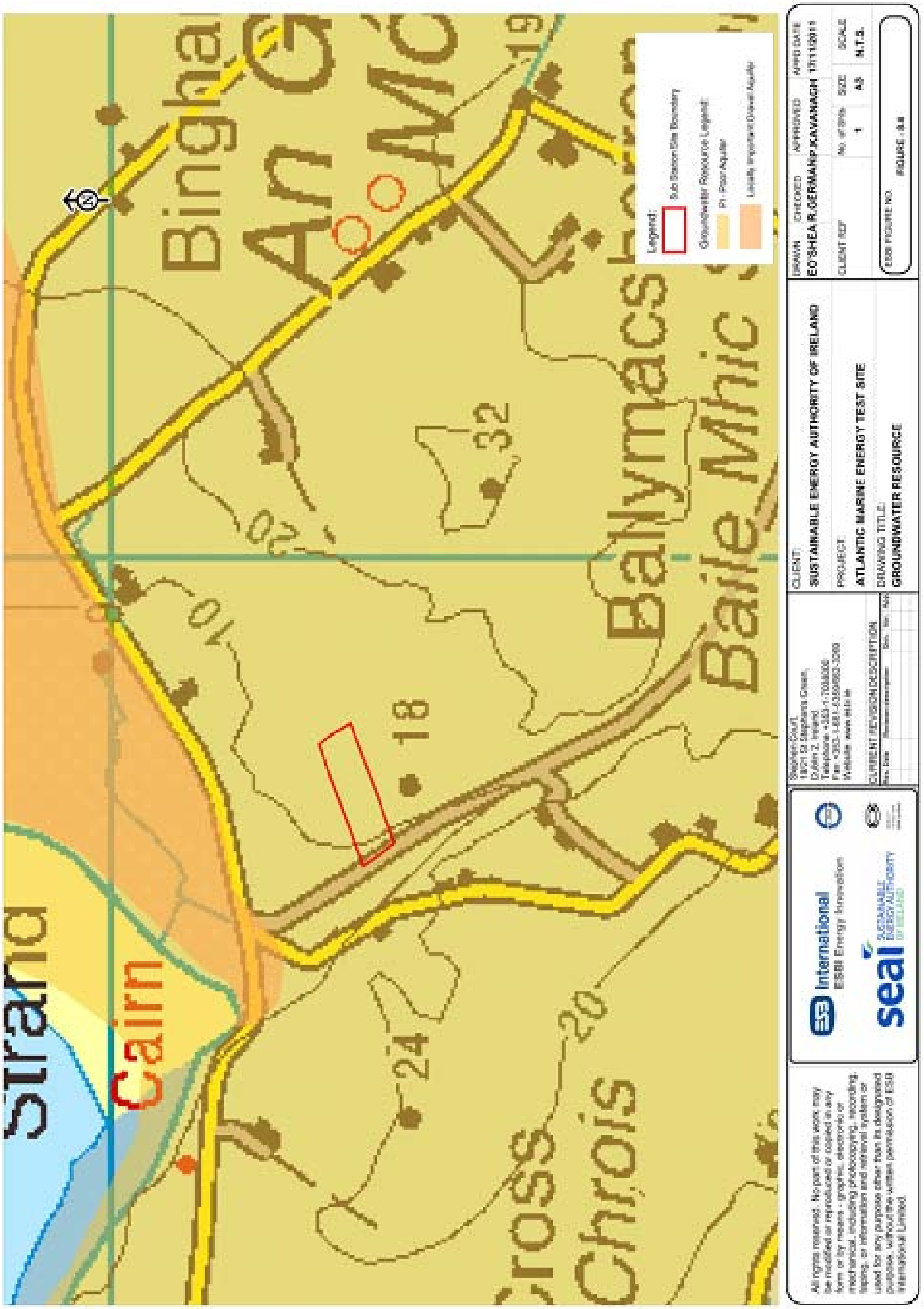

Figure 8-4: Groundwater resource (Copyright Geological Survey of Ireland)