

## 8. LAND, SOILS AND GEOLOGY

### 8.1 Introduction

#### 8.1.1 Background and Objectives

McCarthy Keville O’Sullivan (MKO), on behalf of Hibernian Wind Power Ltd. (Hibernian), has carried out an assessment of the likely significant effects of the proposed extension of operation of the existing Carnsore Wind Farm, Nethertown, Co. Wexford (the Proposed Development), on the land, soils and geology of the receiving environment.

This Environmental Impact Assessment Report (EIAR) chapter provides a baseline assessment of the environmental setting of the Proposed Development in terms of land, soils, and geology, and discusses the potential likely significant effects of extending the wind farm’s operational life. This chapter also discusses any mitigation measures required to be put in place to limit any identified potentially significant impacts to soils and geology and provides an assessment of residual impacts and significance of effects. Hydrogeology and groundwater are not discussed in this chapter as they are discussed in detail in Chapter 9: Water of this EIAR.

#### 8.1.2 Statement of Authority

McCarthy Keville O’Sullivan Ltd. (MKO) is a specialist planning and environmental consultancy. Based in Galway but working nationwide, we deliver challenging and complex projects on behalf of our clients. MKO employs over 100 people across the company’s four planning, ecology, environmental and ornithology teams. Our multi-disciplinary service offering and broad range of nationwide experience add real value to our client’s projects.

MKO company experience spans the full range of industry sectors, including renewable energy, commercial development, roads and transport infrastructure, ports and marinas, tourism, energy infrastructure, retail, sport and leisure, quarrying and aggregates, manufacturing, education, housing, waste management, water, telecoms and other utilities.

Our areas of expertise and experience include a wide variety of environmental topics, including geology. We routinely are involved with carrying out impact assessments for land, soils and geology for a large variety of project types.

This chapter of the EIAR was prepared by Eoin Hurst and reviewed by Michael Watson.

Eoin Hurst is a Project Environmental Engineer with MKO with over 12 years of progressive experience in private sector civil and environmental engineering consultancy. Eoin holds a BE in Civil Engineering from NUI Galway and a MSc in Environmental Technology from Imperial College London. Prior to joining MKO in September 2019, Eoin worked as an Environmental Engineer with Tetra Tech in the United States.

Michael Watson is Project Director of the MKO Environment Team. Michael completed an MA in Environmental Management at NUI, Maynooth in 1999. He is a Professional Geologist (PGeo) and full member of IEMA (MIEMA) as well as a Chartered Environmentalist (CEnv). Michael joined MKO in 2014 having gained over 15 years’ experience in a Cork-based environmental & hydrogeological consultancy firm.

### 8.1.3 Relevant Legislation

The EIAR is prepared in accordance with the requirements of European Union Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the 'EIA Directive') as amended by Directive 2014/52/EU. The requirements of the following legislation are complied with:

- European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2001 – 2018;
- Directives 2011/92/EU and 2014/52/EU on the assessment of the effects of certain public and private projects on the environment, including Circular Letter PL 1/2017: Implementation of Directive 2014/52/EU on the effects of certain public and private projects on the environment (EIA Directive);
- S.I. No. 349 of 1989: European Communities (Environmental Impact Assessment) regulations and subsequent amendments (S.I. No. 84 of 1995, S.I. No. 352 of 1998, S.I. No. 93 of 1999; S.I. No. 450 of 2000; S.I. No. 538 of 2001); S.I. No. 30 of 2000 the Planning and Development Act, 2000; and S.I. 600 of 2001 Planning and Development Regulations and subsequent amendments, on the assessment of the effects of certain public and private projects on the environment;
- Planning and Development Act, 2000, as amended;
- S.I. No 296 of 2018: S.I. No. 296 of 2018: European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 which transposes the provisions of Directive 2014/52/EU into Irish law; and,
- The Heritage Act 1995, as amended.

### 8.1.4 Relevant Guidance

The land, soils and geology chapter of this EIAR was prepared having regard, where relevant, to guidance contained in the following documents:

- Environmental Protection Agency (2017): Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports;
- Environmental Protection Agency (2015): Draft - Advice Notes on Current Practice (in the preparation of Environmental Impact Statements);
- Environmental Protection Agency (2015): Draft – Revised Guidelines on the Information to be contained in Environmental Impact Statements;
- Environmental Protection Agency (2003): Advice Notes on Current Practice (in the Preparation of Environmental Impact Statements);
- Environmental Protection Agency (2002): Guidelines on the information to be contained in Environmental Impact Statements);
- European Commission (2017) Guidance on Screening;
- European Commission (2017) Guidance on Scoping;
- European Commission (2017) Guidance on the preparation of the Environmental Impact Assessment Report;
- Institute of Geologists Ireland (2013): Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements; and,
- National Roads Authority (2005): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.

## 8.2 Methodology

### 8.2.1 Desk Study

A desk study of the Proposed Development site and the surrounding study area was completed in June 2021. The desk study involved collecting all the relevant geological data for the wind farm site and study area. This included consultation with the following:

- Environmental Protection Agency (EPA) database ([www.epa.ie](http://www.epa.ie));
- Geological Survey of Ireland (GSI) - National Draft Bedrock Aquifer map;
- GSI - Groundwater Database ([www.gsi.ie](http://www.gsi.ie));
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 19 (Geology of Carlow-Wexford). (GSI, 1994);
- GSI – 1:25,000 Field Mapping Sheets; and,
- General Soil Map of Ireland 2nd edition ([www.epa.ie](http://www.epa.ie)).

### 8.2.2 Walkover Survey

A visual inspection of the existing Carnsore Wind Farm and surrounding area was undertaken by MKO on 16<sup>th</sup> April 2021. The purpose of the site inspection was to investigate the site for any surface indications of residual impacts to land, soils, and geology resulting from the historic construction and operation of the wind farm. Particular attention was paid to identifying any potential areas of soil erosion that might be the result of incorrect backfilling of excavations, or that may have arisen from operation of machinery and vehicles on the site. No evidence of any residual impacts to land, soils, and geology was observed.

### 8.2.3 Scoping and Consultation

The scope for this chapter of the EIAR has also been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties. This consultation process is outlined in Section 2.6 of this EIAR.

With respect to land, soils and geology relevance, there was a response from the GSI whom requested available details of previous site investigations in order to update their National Geotechnical database. This information was provided to GSI by MKO.

## 8.2.4 Impact Assessment Methodology

Using information from the desk study and site walkover visual assessment, an estimation of the importance of the soil and geological environment within the study area is assessed using the criteria set out in Table 8-1 (NRA, 2008).

Table 8-1. Estimation of Importance of Soil and Geology Criteria (NRA, 2008).

Importance	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a regional or national scale. Degree or extent of soil contamination is significant on a national or regional scale. Volume of peat and/or soft organic soil underlying route is significant on a national or regional scale.	Geological feature rare on a regional or national scale (NHA). Large existing quarry or pit. Proven economically extractable mineral resource.
High	Attribute has a high quality, significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and/or soft organic soil underlying site is significant on a local scale.	Contaminated soil on site with previous heavy industrial usage. Large recent landfill site for mixed wastes. Geological feature of high value on a local scale (County Geological Site). Well drained and/or high fertility soils. Moderately sized existing quarry or pit. Marginally economic extractable mineral resource.
Medium	Attribute has a medium quality, significance or value on a local scale. Degree or extent of soil contamination is moderate on a local scale. Volume of peat and/or soft organic soil underlying site is moderate on a local scale.	Contaminated soil on site with previous light industrial usage. Small recent landfill site for mixed wastes. Moderately drained and/or moderate fertility soils. Small existing quarry or pit. Sub-economic extractable mineral resource.

<p>Low</p>	<p>Attribute has a low quality, significance or value on a local scale.                  Degree or extent of soil contamination is minor on a local scale.                  Volume of peat and/or soft organic soil underlying site is small on a local scale.</p>	<p>Large historical and/or recent site for construction and demolition wastes.                  Small historical and/or recent landfill site for construction and demolition wastes.                  Poorly drained and/or low fertility soils.                  Uneconomically extractable mineral resource.</p>
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The criteria (EPA 2017) for the assessment of impacts require that likely impacts are described with respect to their extent, magnitude, type (*i.e.* negative, positive, or neutral) probability, duration, frequency, reversibility, and transfrontier nature (if applicable). The descriptors used in this environmental impact assessment are those set out in EPA (2017) Glossary of Impacts as outlined in Chapter 1 of this EIAR. In addition, the two impact characteristics, proximity and probability, are described for each impact and these are defined in Table 8-2.

In order to provide an understanding of this descriptive system in terms of the geological/hydrological environment, elements of this system of description of impacts are related to examples of potential impacts on the geology and morphology of the existing environment, as listed in Table 8-3.

## 8.2.5 Limitations/Difficulties Encountered

This EIAR has been prepared based on available desktop information and a site visit undertaken in April 2021.

As the site is an existing operational wind farm with extensive buried utilities in place, no intrusive ground investigations were required to be carried out.

No specific limitations or difficulties were encountered in the preparation of this EIAR.

Table 82. Additional Impact Characteristics.

Impact Characteristic	Degree/ Nature	Description
Proximity	Direct	An impact which occurs within the area of the proposed project, as a direct result of the proposed project.
	Indirect	An impact which is caused by the interaction of effects, or by off-site developments.
Probability	Low	A low likelihood of occurrence of the impact.
	Medium	A medium likelihood of occurrence of the impact.
	High	A high likelihood of occurrence of the impact.

Table 83 Impact descriptors related to the receiving environment.

Impact Characteristics		Potential Geological/Hydrological Impacts
Quality	Significance	
Negative only	Profound	Widespread permanent impact on: - The extent or morphology of a designated site - Regionally important aquifers. - Extents of floodplains. -Loss of a geologically sensitive site. Mitigation measures are unlikely to remove such impacts.
Positive or Negative	Very Significant/ Significant	Local or widespread time dependent impacts on: -The extent or morphology of a cSAC / ecologically important area. -A regionally important geological feature (or widespread effects to minor geological features). -Extent of floodplains. Widespread permanent impacts on the extent or morphology of a NHA/ecologically important area, Mitigation measures (to design) will reduce but not completely remove the impact – residual impacts will occur.
Positive or Negative	Moderate	Local time dependent impacts on: - The extent or morphology of a cSAC / NHA / ecologically important area. - A minor geological feature. - Extent of floodplains. Mitigation measures can mitigate the impact OR residual impacts occur, but these are consistent with existing or emerging trends
Positive, Negative or Neutral	Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Positive, Negative or Neutral	Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Neutral	Imperceptible	No impacts, or impacts which are beneath levels of perception, within normal bounds of variation, or within the bounds of measurement or forecasting error.

## 8.3 Receiving Environment

### 8.3.1 Pre-existing Environment

#### 8.3.1.1 Site Description and Topography

The Proposed Development is located approximately 8 kilometres (km) south of Rosslare Harbour and approximately 15km east of Kilmore Quay, in the seven townlands of Bunarge, Burrow, Bush, Nethertown, Shilmore, St. Vogue's and Summerstown, Co. Wexford. The approximate grid reference location for the centre of the site is E711919, N604394.

The Proposed Development consists of the existing Carnsore Wind Farm, with 14 no. turbines located predominantly on the eastern portion of the site. The eastern and southern site boundary are formed by the Co. Wexford coastline, the western boundary is formed by a local road (Lane of Stones) and the northern site boundary lies along a local road (Nethertown Lane), residential property and agricultural lands.

The Environmental Impact Assessment Report (EIAR) Study Area for the Proposed Development is approximately 77.4 hectares (ha). The total development footprint of the Proposed Development (i.e. the existing Carnsore Wind Farm) is approximately 1.72ha. The majority of the remaining area of 75.6ha is under agricultural use for grazing and rough pasture, with approximately 6.7ha along the western boundary consisting of undeveloped scrubland and sand dunes.

The local topography across the site slopes generally east-southeast towards the coastline. The elevation of the site ranges from approximately 3m to 16 metres above Ordnance Datum (OD), with the high point in the south-centre of the site, between turbine T4 and T5.

The dominant surrounding land use in the vicinity is agricultural, with scattered one-off housing and small settlements.

The Proposed Development contains approximately 3.2km of existing site roads, constructed of consolidated gravel with a running width of 4m. Access to the site is via the existing entrance from Nethertown Lane, at the northern site boundary, which in turn is accessed from the L3060 local road, approximately 360m to the west.

The location of the Proposed Development is shown on Figure 8-1.

#### 8.3.1.2 Soils and Subsoils

According to GSI mapping ([www.gsi.ie](http://www.gsi.ie)), the Proposed Development site is dominated two soil types: deep, well-drained mineral soils, mainly derived from acidic parent materials (Acid Brown earths/Brown Podzolics [AminDW]) across the northern portion of the site, and shallow, reasonably-drained mineral soil derived from mainly acidic parent materials (Rocky, peaty/non-peaty mineral complexes [AminSRPT]) across much of the southern portion of the site. There is also a band of well-drained, fine sands (Aeolian undifferentiated [AeoUND]) across the southwestern boundary of the site.

GSI mapping for the site indicates that the majority of the site is underlain by granite till (TGr) with small areas of bedrock outcropping (RckNCa) in the centre-east portion of the site. The southwest boundary of the site is defined by wind blown sands (Ws) with marine beach sands (Mbs) present further west along the coastline.

The Teagasc soils map ([www.gis.teagasc.ie/soils/map](http://www.gis.teagasc.ie/soils/map)) identifies the soil association within the wider region of the site as sandy stoneless drift. These soils are generally moderately well-drained and suitable for cultivation. Previous investigations at the site reported soil depths of generally less than 3m depth. The local subsoils map is shown as Figure 8-2.

It was noted during the site walkover that most of the site is under agricultural use for pasture and rough grazing. There was evidence that crops had been grown on the northwest portion of the site previously. Low levels of soil erosion are likely due to farm machinery action. Several areas of rock (granite) outcropping were observed, primarily in the centre-east of the site, as depicted in Plate 8-1 below.



*Plate 8-1 Site topography and rock outcropping*

### 8.3.1.3 **Bedrock Geology**

Based on the GSI bedrock map of the region, the site of the Proposed Development is underlain by the Carnsore Granite (Caledonian Granite) formation (Cs) which consists of pink biotite granite with xenoliths. Silurian exposed granite bedrock outcrops are evident at the site. Notably, similar coarse crystalline granite extends from the coastal reefs around the site and beyond, also forming Tuskar Rock, 10km to the northeast.

The Carnsore Granite formation is classified by the GSI as a Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones (PI).

A bedrock geology map of the area is included as Figure 8-3. The bedrock and aquifer receptors at and adjacent the subject development is considered of Low value.



Map Legend

- Existing Turbines
- Study Boundary



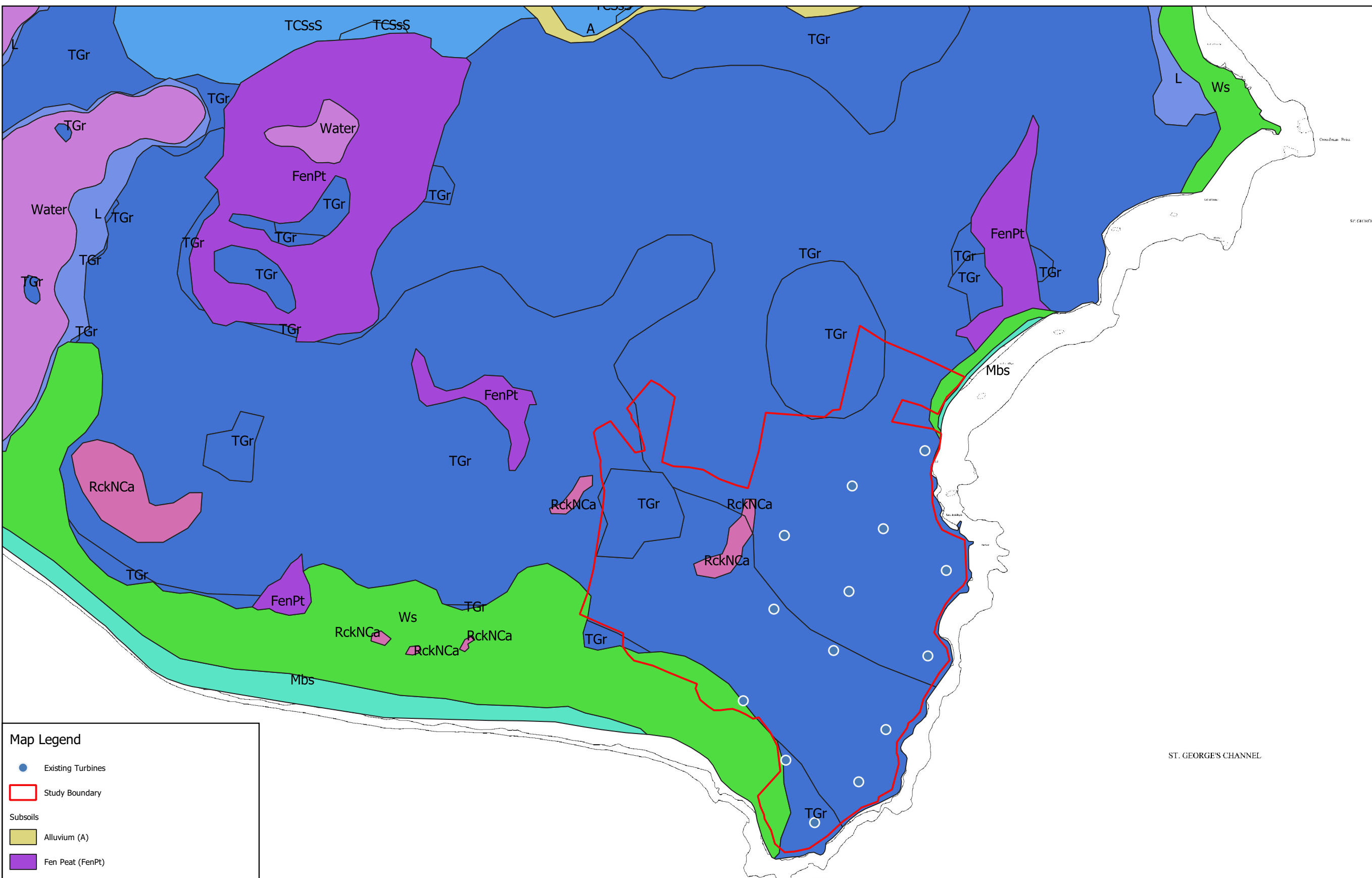
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Drawing Title	
Site Topography	
Project Title	
Carnsore Wind Farm EIAR	
Drawn By	Checked By
EH	MW
Project No.	Drawing No.
210202	Fig 8-1
Scale	Date
1:50000	22/06/21

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**Map Legend**

- Existing Turbines
- Study Boundary

**Subsoils**

- Alluvium (A)
- Fen Peat (FenPt)
- Lacustrine Sediments (L)
- Marine beach sands (Mbs)
- Bedrock outcrop or subcrop (RckNca)
- Till derived from Cambrian sandstones and shales (TCSsS)
- Till derived from granites (TGr)
- Water
- Windblown sands (Ws)

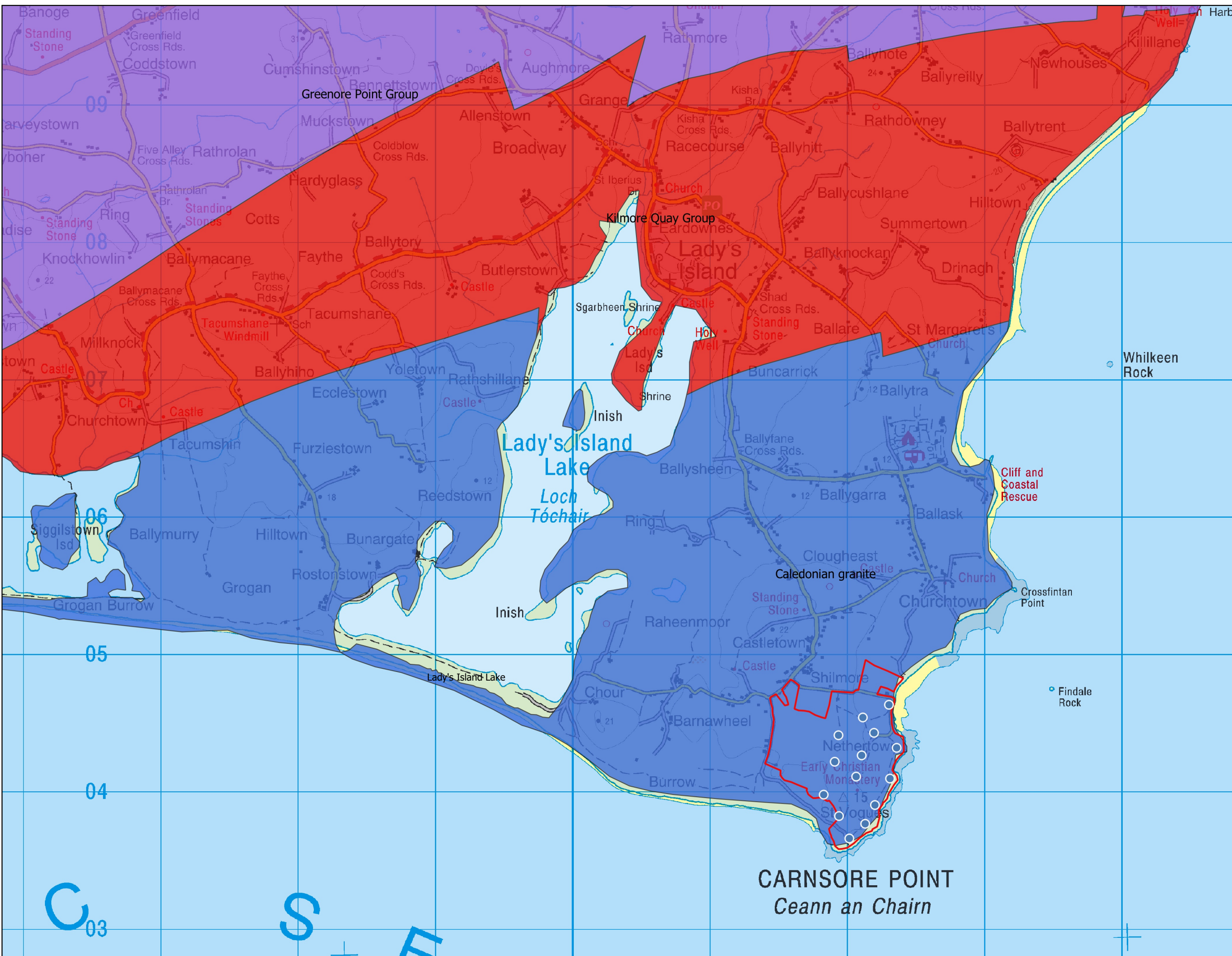
ST. GEORGE'S CHANNEL



Drawing Title	
Local Subsoils	
Project Title	
Carnsore Wind Farm EIAR	
Drawn By	Checked By
EH	MW
Project No.	Drawing No.
210202	Fig 8-2
Scale	Date
1:10000	22/06/21

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**Map Legend**

- Existing Turbines
- Study Area Boundary

**Bedrock Geology**

- Caledonian granite
- Greenore Point Group
- Kilmore Quay Group

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Drawing Title	
Bedrock Geology	
Project Title	
Carnsore Wind Farm EIAR	
Drawn By	Checked By
EH	MW
Project No.	Drawing No.
210202	Fig 8-3
Scale	Date
1:25000	22/06/21

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**CARNSORE POINT**  
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C03 S E



**Map Legend**

- EIAR Study Area
- Geoheritage Site Boundary

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Drawing Title	
<b>Geological Heritage Sites</b>	
Project Title	
<b>Carnsore Wind Farm</b>	
Drawn By	Checked By
EH	MW
Project No.	Drawing No.
210202	Fig 8-4
Scale	Date
1:50000	16/07/21

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#### 8.3.1.4 Geological Heritage and Designated Sites

There is one recorded Geological Heritage site within or adjacent to the development area. The Carnsore Point geological heritage site (WX012) incorporates the low-lying coastline forming the eastern and south/southwestern site boundary. This geological site is of significance due to the unique undeformed Carnsore Granite, which extends west to Lady's Island Lake and northeast to Tuskar Rock, also forming subtidal reefs from south of Carnsore Point north to Greenore Point. The site is also designated a Special Area of Conservation (SAC) [Carnsore Point SAC 002269] of particular significance due to the presence of reefs, mudflats and sandflats.

The Lady's Island Lake geological heritage site (WX028) and associated SAC [Lady's Island Lake SAC 000704] and Special Protection Area (SPA) [Lady's Island Lake SPA 004009] is located approximately 1.5km west of the Proposed Development. This is a nationally important habitat of coastal lagoons and reefs for several bird species, particularly terns. The locations of the geological heritage sites in relation to the Proposed Development are provided on Figure 8-4. The Proposed Development does not cross any designated sites although it does form a boundary with the coastal Carnsore Point SAC. Further assessment of potential impacts to designated sites are included in Chapter 6: Biodiversity and Chapter 7: Ornithology of this EIAR.

#### 8.3.1.5 Soil Contamination

According to the EPA online mapping (<https://gis.epa.ie/EPAMaps>), there are no licenced waste facilities on or within the immediate environs of the Proposed Development.

There are no historic mines at or in the immediate vicinity of the site that could potentially have contaminated tailings. The site walkover survey did not identify any evidence of potential soil contamination at or adjacent the Proposed Development and there is no record from the existing wind farm's operational phase of any environmental incidents with the potential to cause soil contamination.

#### 8.3.1.6 Economic Geology

The GSI Online Minerals Database accessed via the Public Data Viewer shows no commercial pits or quarries within the vicinity of the Proposed Development.

The GSI online Aggregate Potential Mapping Database shows that the Proposed Development is not located within an area mapped as being of 'Very High' or 'High' granular aggregate potential (i.e. potential for gravel reserves considered Low).

### 8.4 Characteristics of the Development

The Proposed Development consists of a 14 no. turbine wind energy development, constructed in 2002. The turbines are Vestas 850 kilowatt (kW) models of 75m in height, with a total generating capacity of 11.9 megawatts (MW). The existing operational wind farm includes a substation and control building, site roads, a met mast and associated underground electrical cabling. The Proposed Development is connected to the National Grid via approximately 1.2km of buried 38kV transmission line and approximately 11.2km of overhead line, running in a general north and northwest direction from the wind farm to the Killinick 38kV substation, approximately 9.4km northwest of the wind farm (straight line distance). The grid connection is subject to a separate planning permission (ABP Ref. PL26.124600) and is relevant to this EIAR only in terms of cumulative projects. Further site details are provided in Chapter 4 of this EIAR.

The original construction of the wind farm in 2002 required the excavation of soil and subsoil to facilitate turbine foundation construction and trenching for the cable ducts. Significant excavations were not required, and all disturbed areas appear to have been returned to their pre-construction grades.

## 8.5 Likely, Significant Impacts and Mitigation Measures Implemented

### 8.5.1 Do-Nothing Scenario

The ‘Do-Nothing’ scenario entails the decommissioning of the existing wind farm once the current planning permission expires (2022) and restoration of the site to its original use as agricultural lands for pasture and crops.

Condition 9 of the original Planning Application to An Bord Pleanála (ABP) (ABP Ref. PL26.116487) states the following in relation to decommissioning of the wind farm:

*‘On full or partial decommissioning of the wind farm or if the wind farm ceases operation for a period of more than one year the masts and turbines concerned (including foundations) shall be dismantled and removed from the site. The site shall be reinstated (including all access roads) and all decommissioned structures shall be removed within three months of decommissioning.’*

Should the Decommissioning Plan as set out in the Condition be implemented it may lead to environmental effects on geology and soils due to the potentially extensive ground works required to remove existing access tracks and the turbine foundations. Local subsoils are not expected to be significantly affected during these potential decommissioning works, however a more environmentally sensitive approach is outlined for the end of the proposed extended operational period (i.e. in 15 years), as set out below. The effect of decommissioning is considered **neutral** in the context of the EIAR.

### 8.5.2 Construction Phase Impacts

As the Proposed Development consists of the extension to the operational period of an existing wind farm, no construction related excavations, groundworks or other intrusive works are planned. Therefore, **no impacts or significant effects** to the subsurface environment (soils or geology) will occur.

### 8.5.3 Operational Phase Impacts

No impacts on soils and geology have occurred, or are anticipated, during the operational phase. The operational phase of the development will not involve further disturbance to the topsoil, subsoils and geology of the area. Routine operational and maintenance works are anticipated to be required throughout the lifespan of the Proposed Development. These works are likely to include minor upgrades or replacements of turbine components, and mechanical/electrical components related to the substation. There is potential for limited use of plant and machinery as part of this maintenance work. There would be **no significant impacts** on soils and geology associated with any future maintenance works.

#### 8.5.3.1 Contamination of Soil by Leakages and Spillages

During routine maintenance works plant and machinery may require refueling on-site and so hydrocarbons may be present. Managed incorrectly, there is the risk of spills and leaks associated with these operations impacting on land and soils.

**Pathway:** Topsoil, subsoil and bedrock pore space.

**Receptor:** Topsoil, subsoil and bedrock.

**Potential Impact:** Negative, direct, slight, short term, medium probability impact on topsoil, subsoils and bedrock.

### Mitigation Measures

- All plant and machinery to be serviced before being mobilised to site;
- No plant maintenance completed on-site, any broken down plant removed from site to be fixed;
- Refuelling completed in a controlled manner using drip trays at all times;
- Mobile bowsers, tanks and drums stored in secure, impermeable bunded storage areas away from open water;
- Only designated trained operators authorised to refuel plant on-site;
- Procedures and contingency plans set up to deal with emergency accidents or spills; and,
- Highest standards of site management maintained, and utmost care and vigilance followed to prevent accidental contamination or unnecessary disturbance to the site and surrounding environment during works.

### Residual Impact

The implementation of the above mitigation measures will result in a residual **Neutral, Imperceptible, direct, short term, unlikely impact** to land, topsoil, subsoils or bedrock. There was no recorded or observed evidence of storage of significant quantities of hydrocarbons or other chemicals, nor any leakages or spillages of hydrocarbons during the site walkover.

### Significance of Effects

Based on the assessment above **No Significant Effects** on land, topsoil, subsoils or bedrock as a result of leakages or spillages due to future maintenance works are expected.

### Significance of Effects

**No Significant Effects** on land, soils and geology environment are envisaged during the operational stage of the Proposed Development.

## 8.5.4 Decommissioning Phase

The potential impacts associated with future decommissioning of the Proposed Development in circa 15 years will be similar to those associated with a typical wind farm construction but of a reduced magnitude, due to the reduced scale of the proposed decommissioning works, as outlined in Chapter 4, Section 4.8 of this report.

During decommissioning, it may be possible to reverse or at least reduce some of the potential impacts caused during the initial construction of the wind farm by rehabilitating construction areas such as turbine bases and hard standing areas. This will be done by covering with local topsoil and reseeding with a local native mix to encourage vegetation growth and reduce run-off and sedimentation.

Condition 9 of the original Planning Application (ABP Ref. PL26.116487) is set out in Section 8.5.1 above.

It is considered that this Condition is not appropriate, from an environmental perspective, for the Proposed Development. Upon decommissioning of the Proposed Development in 15 years, the wind turbines will be disassembled in reverse order to how they were erected. All above-ground turbine components will be separated and removed off-site for reuse or recycling. The disassembly and removal of the turbines will not have an impact on the subsurface environment (soils and geology) at the site.

It is proposed to leave turbine foundations in place underground and to cover with earth and reseed as appropriate. Leaving the turbine foundations in-situ is considered a more environmentally prudent option, as to remove that volume of reinforced concrete from the ground could result in significant environmental nuisances such as noise, vibration and dust.

It is proposed to leave underground cables in place where they are unlikely to be impacted by typical agricultural works. It is proposed that site roadways will be left in situ, as appropriate, to facilitate agricultural and amenity uses by the local community. A decommissioning plan will be agreed with the local authority at least three months prior to decommissioning of the Proposed Development.

Other impacts such as possible soil compaction and contamination by fuel leaks will remain but will be of reduced magnitude. Mitigation measures to avoid these potential impacts will be implemented.

However, as noted in the Scottish Natural Heritage report (SNH) Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms (SNH, 2013) reinstatement proposals for a wind farm are made far in advance, so within the 15-year lifespan of the Proposed Development, technological advances and preferred approaches to reinstatement may change. According to the SNH guidance, it is, therefore:

*'Best practice not to limit options too far in advance of actual decommissioning but to maintain informed flexibility until close to the end-of-life of the wind farm'.*

**No significant effects** on the subsurface soils and geology are envisaged during the decommissioning stage of the Proposed Development.

### 8.5.5 Potential Cumulative Impacts

Potential cumulative effects on geology and soils between the Proposed Development and other developments in the vicinity, including all those listed in Section 2.7.2 of this EIAR, were also considered as part of this assessment. The operational Richfield Wind Farm is the nearest wind energy development to the Carnsore Wind Farm site, located approximately 15.5km to the west. The Richfield development was subject to an EIA that identified mitigation measures to ensure that no significant impact to land, soils or geology would occur.

Beyond cumulative wind farm assessment in the study area, the existing 38kV grid connection (underground and overhead line) was also assessed for potential effects upon soils and geology. The grid connection is composed of approximately 1.2km of buried 38kV transmission line and approximately 11.2km of overhead line, from the wind farm to the Killinick 38kV substation. The grid connection is an existent linear infrastructure and there are no associated potential impact pathways which could lead to significant effects in combination with the Proposed Development.

Due to the limited scale of other developments in the vicinity, there is little potential for significant impacts to land, soil, and geology resulting from those developments. Therefore, **no significant cumulative impacts** on land, soils and geology environment are anticipated during the operational phases of the Proposed Development.

### 8.5.6 Summary

The Proposed Development (extension of operation of Carnsore Wind Farm) does not involve any construction works including excavations or otherwise that may have the potential to impact local soils or underlying geology. Historically, groundworks including excavations for turbine foundations, and trenching for laying of cables, formed part of the construction of the wind farm in 2002.

During the site walkover a large proportion of the development site was observed to be in use for agriculture (pasture and rough grazing) with some limited soil erosion evident along tracks and margins due to farming activity.



Storage and handling of small quantities of hydrocarbons/chemicals may be required during the operational phase however **No Significant Effects** are likely.

**No Significant Impacts** to the land, soil and geology at the site have occurred, or are anticipated, during the proposed extension of the wind farm's operational phase.