Environmental Impact Assessment Report

NISA

North Irish Sea Array

Volume 4: Onshore Chapters

Chapter 21
Land and Soils (includes soils, geology and hydrogeology)

Statkraft

CIP
Copenhagen Infrastructure Partners

GoBe
APEM Group

ARUP

Contents

Tables

21. Land, Soils, Geology and Hydrogeology

21.1 Introduction

This chapter of the EIAR consists of an assessment of impacts from the proposed development on land, soil, geology and hydrogeology under the heading of Land, Soils, Geology and Hydrogeology (hereafter referred to as 'land and soils') landward of the High-Water Mark (HWM) during its construction, operation and decommissioning phases. The impacts of the proposed development on land take and land use are addressed in Volume 4, Chapter 26 Material Assets. The impacts of the proposed development on land, soils and sediments below the HWM are addressed in other chapters as set out in 21.2 below.

This assessment sets out the methodology followed (Section 21.2), describes the baseline environment (Section 21.3) and summarises the main characteristics of the proposed development which are of relevance to land and soils (Section 21.4). The evaluation of the potential impacts of the proposed development on land and soils are described (Section 21.5). Measures are proposed to mitigate and monitor these effects (Section 21.6) and any residual likely significant effects are described (Section 21.7). Transboundary effects are considered (Section 21.8), and cumulative effects are summarised in Section 21.8 and detailed in full in Section 38.3 of Volume 2, Chapter 38: Cumulative and Inter-Related Effects. The chapter then provides a reference section (Section 21.10).

The EIAR also includes the following:

- Detail on the competent experts that have prepared this chapter is provided in Appendix 1.1 in Volume 8;
- Detail on the extensive consultation that has been undertaken with a range of stakeholders during the development of the EIAR including those relating to land, soils, geology and hydrogeology is set out in Appendix 1.2; and
- A glossary of terminology, abbreviations and acronyms is provided at the beginning of Volume 2 of the EIAR.

A detailed description of the proposed development including construction, operation and decommissioning is provided in Volume 2, Chapter 7: Description of the Proposed Development – Onshore (hereafter referred to as the 'Onshore Description Chapter'), and the Construction methodology is described in Section 9.5 of Volume 2, Chapter 9: Construction Strategy – Onshore (hereafter referred to as the 'Onshore Construction Chapter').

21.2 Methodology

21.2.1 Introduction

The following sections outline the legislation and guidelines considered, and the adopted methodology for defining the baseline environment and undertaking the assessment in terms of land, soils, geology and hydrogeology.

The potential effects of the proposed development on this subject have been assessed by classifying the importance of the relevant attributes and quantifying the likely magnitude of any effect on these attributes. The figures which support this chapter are presented in Volume 7A of this EIAR (Figures 21.1-21.21). The appendices which support this chapter are presented in Volume 10 of this EIAR (Appendices 21.1 to 21.3).

21.2.2 Study Area

The land, soils, geology, and hydrogeology study area for the proposed development extends to a radius of 2km from the onshore development area (the portion of the proposed development boundary landward of the High Water Mark (HWM)), which is in line with the guidance documents listed in Section 21.2.3 below. The study area is shown on Figure 21.1.

For the purposes of this assessment, the proposed development has been sub-divided into subsections for ease of presentation, namely:

- Landfall Site
- Grid Facility
- Onshore Cable Route

Due to the proximity of the landfall site and grid facility within the site-specific environment (Section 21.3.3) they have been assessed together. The potential effects on the proposed development have been assessed individually in Section 21.5.

21.2.3 Relevant Guidance and Policy

This chapter has been prepared having regard to the following guidelines:

- Guidelines for the Preparation of Soil, Geology and Hydrogeology Chapters of Environmental Impacts Statements, IGI 2013; and
- National Roads Authority (NRA) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (hereafter referred to as the NRA Guidelines) (NRA 2008a).

Though the NRA is now known as Transport Infrastructure Ireland (TII), for the purpose of this chapter the guidelines mentioned above are referred to as the NRA Guidelines.

A full list of the documents referred to in the course of the assessment is provided in Section 21.10.

21.2.4 Data Collection and Collation

Data was compiled from publicly available datasets, the findings of ground investigations, design information, scheme walkover surveys carried out over multiple dates and seasons between August 2021 and February 2024 (see Section 21.2.4.3), and other sources, as outlined below.

21.2.4.1 Publicly Available Datasets

The publicly available datasets listed in Table 21.1 have been acquired and consulted in the assessment of the baseline conditions. These datasets were consulted throughout this assessment, and updated as new versions became available.

Table 21.1 Publicly available datasets

Source	Name	Description
Ordnance Survey Ireland Geohive (OSI) (now called Tailte Éireann)	Current and historical ordnance survey maps	Current and historical survey maps produced by the OSI
	Aerial photography	Current and historical survey maps produced by the OSI
Google	Aerial photography	Current aerial imagery produced by Google
Bing	Aerial photography	Current aerial imagery produced by Bing
Teagasc	Teagasc Soils Data	Surface soils classification and description
Geological Survey Ireland (GSI)	Quaternary Mapping	Geological maps of the site area produced by the GSI and available on GSI online map viewer
	Bedrock Mapping	
	Aggregate Potential Mapping	
	Mineral Localities	
	Geotechnical Sites	
	Bedrock Aquifer Mapping	
	Groundwater Vulnerability	

Source	Name	Description
	Groundwater Recharge	
	Groundwater Resources	
	Groundwater Flooding	
	National Landslide Database	
	Karst Database	
	Historic Mine Sites - Inventory and Risk Classification	
	Active Quarries and pits	
	County Geological Sites and Geological Heritage Areas	
	GSI, Memoirs	
Environmental Protection Agency (EPA)	Corine Land Cover 2018	These datasets are based on interpretation of satellite imagery and national in-situ vector data
	Historic Mine Sites - Inventory and Risk classification	
	River Network Map	
	EPA Licence & Permit Databases	Information on any EPA IE/IPC licences and Permits in the area
	EPA HydroNet	Reports of groundwater level monitoring points
	EPA Water Abstraction Register - December 2023	A register containing water abstractions of 25 cubic meters (25,000 litres) or more per day that have been registered with the EPA
	Waste Boundaries	Boundaries of all waste Facilities within Ireland that are or are going to be licensed by the EPA
National Parks and Wildlife Service	Designated Natural Heritage Areas (NHA), Special Protection Areas (SPA), Special Areas of Conservation (SAC) Sites	This dataset provides information on national parks, protected sites and nature reserves
National Monuments Service (2018) (Archaeological Survey of Ireland)	Archaeological Monuments	This dataset provides all recorded archaeological monuments
Department of Communications, Energy and Natural Resources	State Mining and Prospecting Facilities	A booklet contains a list of all current and prospecting mining facilities
	Historic Mine Sites - Inventory and Risk Classification	Inventory of Irelands Historic Mine Sites with investigations and potential risk posed by these sites

21.2.4.2 Ground Investigation

A list of the reports of the recent and historical ground investigation (GI) undertaken within the study area, which have been used in the assessment of the baseline conditions are presented in Table 21.2. These reports are publicly available from the GSI online map viewer geotechnical viewer (GSI (2019a) GSI Geotechnical Viewer).

Table 21.2 Existing ground investigations within the Study Area

Title	Contractor	Year	Location	Scope
Northern Motorway Site Investigation Lissenhall Overbridge Structure 8	John Barnett and Associates (JBA)	November, 1998	Northern Motorway	5 no. boreholes 8 no. rotary core boreholes 2 no. trial pits

Title	Contractor	Year	Location	Scope
Northern Motorway Site Investigation Airport Interchange North Structure 1(b)	John Barnett and Associates (JBA)	February, 1999	M1 Motorway to Grid Connection 220kV GIS Substation	8 no. boreholes 6 no. rotary core boreholes
Trial Pit Investigation at Estuary Road Malahide	O Connor Sutton Cronin Consulting Engineers / IGSL	July, 2004	Estuary Road Malahide	21 no. trial pits
Site Investigation for a Development at City Junction Business Park Belcamp Dublin	O Connor Sutton Cronin Consulting Engineers / IGSL	July, 2004	Estuary Road Malahide	21 no. trial pits
Site Investigation for a Development at City Junction Business Park Belcamp Dublin	Moylan Consulting Engineers / IGSL	November, 2004	Belcamp College Dublin	13 no. cable tool boreholes 22 no. trial pits
Site Investigation for a Development at Belcamp College Dublin	Moylan Consulting Engineers / IGSL	December, 2006	N32 Northern Cross Extension and R107 Malahide Road	3 no. boreholes 2 no. trial pits
Belcamp 220kV Station Site Investigation	Whiteford Geoservices Limited	October 2014	Belcamp Substation	2 no. boreholes 12 no. trial pits

Specific ground investigations carried out to inform the proposed development and EIAR are listed in Table 21.3. These provide useful verification for the data already compiled relating to the baseline environment. Refer to Appendix 21.1: Ground Investigation Reports, contained in Volume 10 (Technical Appendices – Onshore).

Table 21.3 Project Specific Ground investigations

Title	Location	Contractor	Year	Scope
North Irish Sea Array Ground Investigation, Landfall Investigation Factual Report	Landfall site and grid facility	Causeway Geotech	December 2022	11 no. boreholes 10 no. trial pits
North Irish Sea Array Ground Investigation, Cable Route Investigation Factual Report	Four areas along the Cable Route: Balbriggan, Blakes Cross, the M1 crossing and Malahide			2 no. boreholes 11 no. trial pits 9 no. trenches
NISA Additional GI, Ground Investigation Factual Report	Landfall and Cable Route		April 2023	6 no. boreholes 8 no. trial pits 1 no. soakaway
Geophysical Investigation for the North Irish Sea Array Onshore Infrastructure	Landfall site Grid facility Onshore cable route	Apex Geophysics	June 2022	Geophysical survey consisting of Electromagnetic (EM) Survey, Electrical Resistivity Tomography (ERT) and P-wave Seismic Refraction
Topographical Survey	Landfall site Onshore cable route (M1 Cross and Blakes Cross)	Paul Corrigan & Associates	September 2022	Topographic survey

21.2.4.3 Scheme Walkover

Multiple site walkover surveys were carried out at various times of the year between August 2021 and February 2024 to verify and confirm the findings of the desktop study.

21.2.5 Technical Limitations

The baseline data described and considered in this assessment includes existing data from desk study information available at the time in the region as well as dedicated field surveys commissioned specifically for the proposed development. The data collected provides comprehensive information on land, soils, geology and hydrogeology in the study area at the time of writing.

Based on the comparability of the results from the investigations commissioned specifically for the proposed development and the desk study of existing information on the baseline conditions, the information on the baseline conditions (as described in Section 21.3) is deemed sufficient.

21.2.6 Impact Assessment Methodology

The impact assessment for this chapter has been carried out in accordance with the NRA Guidelines (NRA 2008a) and the IGI Guidelines (IGI 2013).

The likely significant effects have been assessed by classifying the importance of the relevant attributes and quantifying the magnitude of any likely significant effects on these attributes. This has been undertaken in accordance with the IGI guidance which outlines a 13-step methodology that has four distinct elements:

- Initial Assessment;
- Direct and Indirect Site Investigation;
- Mitigation Measures, Residual Effects and Final Impact Assessment; and
- Completion of the Land, Soils, Geological and Hydrogeological Sections of the EIAR.

Initial Assessment

The 'Initial Assessment' presents a description of the past and present uses of the land across the relevant sites and route which may have a bearing on the proposed development. This includes a detailed description of the nature of the ground conditions beneath the relevant sites and route based on existing literature as well as site specific and neighbouring site investigation data.

Direct and Indirect Site investigation

Section 21.3 provides a summary of the data available from the historic and site-specific investigations carried out in relation to the proposed development. The information gathered on the baseline environment during ground investigations corresponds to the second element of the methodology, 'Direct and Indirect Site Investigation and Studies'.

Mitigation Measures, Residual Effects and Final Impact Assessment

A 'Feature Importance Ranking' is then assigned to each feature (likely to be affected by the proposed development based on guidance from the NRA and IGI). This facilitates the assessment of likely significant effects which has been undertaken in accordance with the guidance outlined in Section 21.2.3. The feature importance ranking in Tables 21.14 Table 21.29 is based on the Guidelines for the Preparation of Soil, Geology and Hydrogeology Chapters of Environmental Impacts Statements, IGI 2013 and Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes, NRA 2008.

The outcome from examining this available data is a Conceptual Site Model (CSM). The CSM is a summary of geological conditions beneath the proposed development that considers the likely significant effects of the proposed development.

Section 21.6 outlines the mitigation measures associated with the works in accordance with the above methodology. The final impact assessment includes a description of any residual impacts. The significance of any residual impact is determined based on the same methodology and reported in section 21.7.

21.3 Baseline Environment

21.3.1 Introduction

This section describes the existing conditions and important features in terms of the land, soils, geology and hydrogeology associated with the proposed development.

A Regional Overview (Section 21.3.2) is followed by a description of Site-Specific Environment (Section 21.3.3) and a Conceptual Site Model (CSM) (Section 21.3.4).

A full description and construction strategy of the proposed development is provided in the Onshore Description and Onshore Construction chapters.

21.3.2 Regional Overview

This section discusses the regional conditions within the study area, that is defined as 2km radius from the proposed development described in Section 21.2.2.

The regional geomorphology, topography, soils and subsoils, bedrock geology and hydrogeology are discussed in this section and are presented in Figures 21.1 to 21.10 of Volume 7A of this EIAR.

21.3.2.1 Regional Topography and Geomorphology

Topographically the region is generally undulating and gradually falls towards the coastline. The topography varies from 3mOD to 45mOD. The lower elevations within the region are generally located along the coastline and the higher elevations within the region are located along the R132 between Balrothery and the M1.

The geomorphology of the County Dublin region has been significantly affected by the last two glaciation events. Glacial erosion of pre-existing topographic features and deposition of thick glacial drift deposits, mainly till (boulder clay) resulted in a rather subdued post-glacial topography. These ice masses released large amounts of glacial and glaciofluvial sediments during ice retreat.

The glaciofluvial terraces, meltwater channels and mega scale glacial lineations are generally associated with river and stream crossings within the region. Major geomorphological features in the bedrock would have been destroyed by glacial erosion or are masked by the thick Dublin boulder clay.

Most of the region is classified, in terms of physiographic units by the GSI, as rolling ice-moulded sediments. There are localised areas in the north and south of the region which are classified as flat to undulating sediments. Hummocky sediments are found in the north of the region, close to the landfall site and grid facility. (Refer to Figure 21.1).

21.3.2.2 Regional Soils (EPA/Teagasc Classification)

Soils (i.e., the topsoil) comprise the unconsolidated geological deposits which overlie the subsoil. The main soils, as classified by Teagasc (Teagasc *et al. 2017*) are presented on Figure 21.2 in Volume 7A of this EIAR and have been listed in Table 21.4.

The north of the region is predominantly underlain by poorly drained mineral soils (surface water gleys / groundwater gleys acidic - AminPD) and deep well drained mineral soils, mainly acidic (acid brown earths / brown podzolic - AminDW). The soil type changes to deep well drained mineral soils, mainly basic (grey, brown podzolics / brown earths basic - BminDW) and poorly drained mineral soils (surface water gleys / groundwater gleys basic - BminPD) heading south along the onshore cable route.

Made ground is generally associated with urban developments with isolated occurrences of made ground associated with more minor anthropogenic activities. Alluvial deposits are generally associated with stream and river crossings.

Table 21.4 Summary of soil types in the region

Soil Code	Classification	Description	Location
Made Ground	Miscellaneous	Associated with urban development	Onshore cable route and the existing 220kV substation at Belcamp

Soil Code	Classification	Description	Location
MarSed	Miscellaneous	Marine/Estuarine sediments	Localised coastal areas within the region
AlluvMin	Alluvium	Mineral alluvium	River and stream crossings within the region
Lac	Alluvium	Lacustrine, Lake sediments undifferentiated	Localised areas within the north of the region
Topsoil - AminDW	Non calcareous Well drained - Deep	Acid Brown Earths / Brown Podzolic Deep Well drained mineral (Mainly acidic)	Landfall site, grid facility and north of the region
Topsoil - AminSW	Non calcareous Well drained - Shallow	Shallow Acid Brown Earths/Brown Podzolics Lithosols Regosols	Localised areas in the northwest of the landfall site and the grid connection point
Topsoil - AminPD	Non calcareous Poorly drained - Deep	Surface Water Gleys / Groundwater Gleys Acidic	Landfall site, grid facility and north of the region
Topsoil - AminSP	Non calcareous Poorly drained - Shallow	Surface water Gleys / Ground water Gleys	Landfall site, grid facility and north of the region
Topsoil - BminDW	Calcareous Well drained - Deep	Grey, Brown Podzolics / Brown Earths Basic	Central and southern areas within the region.
Topsoil - BminSW	Calcareous Well drained - Shallow	Renzinas / Lithosols	Central and southern areas within the region.
Topsoil - BminPD	Calcareous Poorly drained - Deep	Surface water Gleys / Groundwater Gleys Basic	Central and southern areas within the region.

21.3.2.3 Regional Subsoils (GSI Quaternary Classification)

The subsoil comprises the unconsolidated geological deposits which overly the solid geology. These subsoils, as classified by the GSI Quaternary mapping (GSI 2024a) are presented on the Figure 21.3 in Volume 7A of this EIAR and have been listed in Table 21.5.

During the Pleistocene epoch of the Quaternary, two glaciations covered County Dublin which gave rise to the deposition of glacial till (Dublin boulder clay). Typically, during the ice advance, boulder clays were deposited sub-glacially as lodgement till over the eroded bedrock surface, whilst moraine granular deposits were laid down at the glacier margins.

Subsequently, with the progressive retreat of the ice sheets from the region, granular fluvio-glacial deposits were laid down in places by melt waters discharging from the front of the glacier which are generally encountered as sand and gravel lenses within the glacial till deposits. The glacial deposits can exhibit significant lateral and vertical variations in grain size distributions over short distances.

The subsoils noted within the north of the region include Irish Sea Tills derived from Lower Palaeozoic sandstones and shales (IrSTLPSsS). Tills derived from Namurian sandstones and shales (TNSSs) are predominant between Skerries and Swords and Tills derived from limestones (TLS) and Irish Sea Till derived from limestones (IrSTLs) are noted between Swords and Balbriggan and within the southern extents of the region.

Table 21.5 List of subsoils (Quaternary) within the region

Soil Type	Description	Location
A	Alluvium	Stream crossing and areas influenced by water bodies
IrSTLPSsS	Irish Sea Till derived from Lower Palaeozoic sandstones and shales	Landfall site, grid facility, and north of the region

Soil Type	Description	Location
TLPsS	Till derived from Lower Palaeozoic sandstones and shales	Landfall site, grid facility, and localised areas in the north of the region
TNSSs	Till derived from Namurian sandstones and shales	Central area of the region
TLS	Till derived from limestones	Southern area of the region
IrSTLs	Irish Sea Till derived from limestones	Northern area of the region
IrsTBi	Irish sea derived from basic igneous rock	Northern area of the region
GLPSsS	Gravels derived from Lower Palaeozoic sandstones and shales	Northern area of the region and a localised pockets in the southern area of the region
GLs	Gravels derived from limestone	Southern area of the region
L	Lacustrine sediments	Northern area of the region
Rck	Bedrock outcrop or subcrop	Southern area of the region
Urban	Urban	Southern area of the region
MEsc	Estuarine silts and clays	Localised pockets within central area of the region

21.3.2.4 Regional Bedrock Geology

The bedrock geology of the region of the study area, as classified by the GSI 1:100,000 Bedrock Geology Map (GSI 2024a), is presented on Figure 21.4 in Volume 7A of this EIAR and has been listed in Table 21.6. The bedrock geology of the region is predominantly underlain by Lower Carboniferous limestones, Silurian sedimentary rocks and Ordovician volcanics.

After the Caledonian orogeny, a general subsidence occurred allowing a rise in sea level and subsequent invasion of the land. Consequently, Lower Carboniferous rocks are widespread throughout County Dublin where they were deposited in a warm, tropical environment, when the area was near the equator, prior to being moved northwards by continental drift.

Carboniferous sediments include the Malahide Formation, Walshestown Formation, Balrickard Formation, Loughshinny Formation, Mullaghfin Formation, Naul formation, Lucan Formation, Rush Conglomerate Formation, Tober Collen Formation, Waulsortian Limestone, Donabate Formation and Mudbank limestone.

The distribution of Silurian rocks in the Dublin region is limited to the north County Dublin coastline on a section to the south that includes Balbriggan. The basal Silurian rocks south of Balbriggan are Rhuddanian in age and are faulted against Ordovician rocks (Rickards, Burns and Archer, 1973). Silurian sediments within the region include Skerries Formation, Denhamstown Formation and Balbriggan Formation.

The Ordovician period is characterized by basalt to andesite sheets, pillow breccias and hyaloclastite, tuffs and mudstones. A lower mudstone and tuff-dominant Lowther Lodge Member and an upper pillow breccia and andesite dominant Bremore Member which form part of the Belcamp Formation is also present.

The structural geology within the region is highly variable and complex. A series of parallel faults running mainly in a south-west to north-east direction are indicated in the north of the region between Balbriggan and M1 Junction 5. The south of the region near Swords and Malahide has a series of north-west south-east trending faults with a series of southwest northeast anticlinal axes.

Table 21.6 Bedrock geology within the region

Geological Period	Formation	Description	Location
Carboniferous	Malahide Formation	Argillaceous bioclastic limestone, shale	Southern area of the region
	Walshestown Formation	Shale, sandstone, limestone	Northern area of the region
	Balrickard Formation	Coarse sandstone, shale	Northern area of the region
	Loughshinny Formation	Dark micrite and calcarenite, shale	Northern area of the region
	Mullaghfin Formation	Pale grey bioclastic limestone	Northern area of the region
	Naul formation	Calcarenite and calcisiltite	Northern area of the region
	Lucan Formation	Dark limestone and shale	Central and southern area of the region
	Rush Conglomerate Formation	Conglomerate, Shale and Limestone	Central area of the region
	Tober Collen Formation	Calcareous shale, limestone conglomerate	Southern area of the region
	Waulsortian Limestone	Massive, unbedded limes mudstones	Southern area of the region
	Donabate Formation	Red coarse sandstone and conglomerate	Southern area of the region
	Mudbank limestone	Limestone	Northern area of the region
Silurian	Skerries Formation	Sandstone and Siltstone	Northern area of the region
	Denhamstown Formation	Blue-grey greywackes sandstones and siltstones	Northern area of the region
	Balbriggan Formation	Mudstone and Sandstone	Northern area of the region
Ordovician	Belcamp Formation	Andesite, pillow breccia, tuff, mudstone	Northern area of the region

According to the GSI (2024a), there are five karst features located in the region. One of these features (3223NWK002) is located approximately 0.3km from the proposed development boundary in the south of the region. The other four karst features are located more than 1km from the proposed development boundary in the central area of the region. These karst features are summarised in Table 21.7 and also in the Section 21.3.3.7.

Table 21.7 Karst features within the region

Karst Feature	Feature Type	Location
3225SWK005 – 433	Spring	Central area of the region
3225SWK006 – 434	Spring	Central area of the region
3225SWK004 – 432	Spring	Central area of the region
3225SWK003 – 2735	Spring	Central area of the region
3223NWK002 – 429	Spring	Southern area of the region

21.3.2.5 Regional Geological Heritage

The basic designation for wildlife is the Natural Heritage Area (NHA). This is an area considered important for the habitats present or which holds species of plants and animals whose habitat needs protection. The GSI is compiling a list of geological / geomorphological sites in need of protection through NHA designation These sites will be compiled from the existing database of County Geological Sites (CGS) (GSI 2024a), as presented in Figure 21.5, and are listed in Table 21.8.

Table 21.8 Designated Geological Sites within the region

Designated Code*	Designated Site
MH008	Laytown to Gormanstown
DF001	Portraine Shore
DF002	Fancourt Shore
DF003	Lambay Island
DF004	Curkean Hill Quarry
DF005	Feltrim Quarry
DF006	Malahide Coast
DF007	Skerries to Rush
DF008	Ardgillan House Boulder
DF009	Bottle Quay
DF010	Hill of Howth
DF011	Irelands Eye
DF012	Shenicks Island
DF013	Balscaddan Bay
DF014	Claremount Strand
DF015	Milverton Quarry
DF016	Nags Head Quarry
DF017	Balrickard Quarry
DF018	Walshestown Stream Section
DF019	Rockabill
DF020	Malahide Point
DF021	Mulhuddart Holy Well
DF022	Hunstown Quarry
DC007	North Bull Island

*In the site code, MH indicates a site in County Meath, DF and DC indicates a site in the Fingal and Dublin City administrative areas respectively.

21.3.2.6 Regional Aquifer Type and Classification

The aquifers within the region, as classified by the National Draft Bedrock Aquifer Map (GSI 2024a) and Sand and Gravel Map (1:40,000, Mar 2024), are presented on Figure 21.6 in Volume 7A of this EIAR and have been listed in Table 21.9. The GSI has devised a system for classifying the aquifers in Ireland based on the hydrogeological characteristics, size and productivity of the groundwater resource. The aquifer classes and sub-classes are shown in the National Draft Bedrock Aquifer Map. There are three principal types of aquifer, corresponding to whether they are major, minor or unproductive resources whereby:

- Regionally Important Aquifers are capable of supplying regionally important abstractions (e.g. large public water supplies), or excellent yields (>400m^3/d)
- Locally Important Aquifers are capable of supplying locally important abstractions (e.g. smaller public water supplies, group schemes), or good yields (100-400m^3/d)
- Poor Aquifers are capable of supplying small abstractions (e.g. domestic supplies), or moderate to low yields (<100m^3/d).

The lower permeability glacial till soils which overlay the bedrock (gravelly clay / boulder clay) mean slow infiltration and restricted recharge to bedrock aquifers. The glacial till is not classified as an aquifer by the GSI.

Table 21.9 Aquifer types within the region

Aquifer Type	Description	Code	Location
Locally Important Aquifer	Bedrock which is Generally Moderately Productive	(Lm)	Landfall site, grid facility, and central area of the region
	Locally Important Aquifer Karstified	(Lk)	Localised areas within the north of the region
	Bedrock which is Moderately Productive only in Local zones	(Ll)	Central and southern areas of the region
	Locally Important Gravel Aquifer	(Lg)	Localised areas within the north of the region
Poor Aquifer	Bedrock which is Generally Unproductive except for Local zones	(Pl)	Northern, central, and southern area of the region.

Groundwater in the region has been divided into groundwater bodies for the purposes of Directive 2000/60/EC, the Water Framework Directive (WFD). The regional groundwater bodies (GWB) as defined by the GSI (2024a) are shown in Figure 21.6 in Volume 7A of this EIAR and presented in Table 21.10.

There are five GWB present within the region which are described below based on initial characterisation summaries by the GSI (2024b):

- Dublin GWB (IE_EA_G_008)
- Swords GWB (IE_EA_G_011)
- Lusk-Bog on the rig GWB (IE_EA_G_014)
- Balrothery GWB (IE_EA_G_043)
- Balbriggan GWB (IE_EA_G_039).

Under the WFD, the EPA assesses the water quality and risk status. The WFD status for the groundwater bodies in the region is 'good'. The risk of the groundwater bodies not maintaining the WFD status has been assessed, or is under 'review' by the EPA. This water quality status and risk for these water features is summarised in Table 21.10. Further information on the classification of groundwater bodies within the region is provided in Appendix 22.2 in Volume 10.

Dublin GWB (IE_EA_G_008)

This GWB occupies a large area extending across County Dublin from Malahide to Blackrock, west across the whole County and extending into Kildare and Meath as far as Kilcock. The area is mostly low-lying with very little surface topography. The boundaries of this GWB are defined to the south by the contact with the Granites and Lower Palaeozoic rocks, to the west and north by the extent of the Liffey catchment, and to the east by the coast. Groundwater flow occurs along fractures, joints and major faults. There are a number of warm springs located within this GWB, which suggest deep groundwater circulation is possible.

Recharge occurs diffusely through the subsoils and via outcrop. Most flow in this aquifer will occur near the surface. In general, the effective thickness of this aquifer is likely to be about 10m, comprising a weathered zone of a few metres and a connected fractured zone below this. At depths of between 30 -50 mBGL water strikes may be found in more isolated faults and fractures. Flow path lengths are typically less than 1km in length and groundwater discharges to the numerous streams and rivers crossing the aquifer, and to the springs and seeps towards the coast.

Swords GWB (IE_EA_G_011)

This GWB is located in the north of County Dublin. Elevations range from 100 m OD in the west at Ratoath, Co. Meath to sea level along the coast between Swords and Rush. The area is low lying with elevations reducing toward the east and also more locally towards the streams in the area. The GWB is composed of moderate permeability karstified limestone. The extent of this GWB is defined to the south by the boundary of Hydrometric Area 08 and to the north by a structural region boundary beyond which the Lucan formation is considered to be an Lm aquifer (Dunphy 2003).

Very small areas of low permeability impure limestones are incorporated with this GWB, since they are isolated and do not alter significantly the flow system. Groundwater flow occurs along fractures, joints and major faults.

There are a number of warm springs located within this GWB, which suggest deep groundwater circulation is possible. Recharge occurs diffusely through the subsoils and via outcrops. The aquifers within the GWB are generally unconfined but may become locally confined where the subsoil is thicker and / or lower permeability. Most flow in this aquifer will occur near the surface. In general, the effective thickness of this aquifer is likely to be about 10m, comprising a weathered zone of a few metres and a connected fractured zone below this. At depths of between 30 -50 mBGL water strikes may be found in more isolated faults and fractures. Flow path lengths are typically less than 1km in length and groundwater discharges to the numerous streams and rivers crossing the aquifer and to the springs and seeps towards the coast.

Lusk-Bog on the rig GWB (IE_EA_G_014)

This GWB is located in the North Dublin – East Meath area. The area is low lying with higher elevations to the east and some isolated hills along the centre. The GWB is composed of moderate permeability limestone, which in some places is karstified.

The extent of the groundwater body is defined to the west by the extent of Hydrometric Area 09, to the North by the contact with the Lower Palaeozoic strata and to the south by the extent of the Lm Lucan formation, which in turn is a boundary of a structural region (Dumphy 2003). Very small areas of low permeability impure limestones are incorporated with this GWB, since they are isolated and do not alter significantly the flow system. Karstification of the limestone and increased transmissivity has been found in the north close to the fault, which displaces the Lower Palaeozoic rocks alongside the limestone. This area has undergone structural deformation. Groundwater flow occurs along fractures and in place through solutionally enlarged karst conduits.

Recharge occurs diffusely through the subsoils and via outcrops. There may be some locations where recharge is more focused i.e., within enclosed depressions, which are common in a Karst landscape. The aquifers within the GWB are generally unconfined but may become locally confined where the subsoil is thicker and/or lower permeability and where the aquifer is overlain by Namurian Strata. Most flow in this aquifer will occur in a zone near the surface. In general, the majority of groundwater flow occurs in the upper 30 m, comprising a weathered zone of a few metres and a connected fractured zone below this. However, deep-water strikes in more isolated faults / fractures have been encountered to 90 mBGL in the more structurally deformed area. Flow path lengths are variable, from examining the drainage density, it is clear that in some instances groundwater flow paths of up to a couple of kilometres may exist, although distances of a few hundred metres are more likely. The groundwater discharges directly to the Irish Sea in the east and also to the north and south via baseflow to rivers. Analysis of water levels in the area of the Bog of the Ring has shown a direct connection between the Bog and the water table in areas where the subsoil is composed of permeable material. This GWB hosts the public water supply wells and source protection zone for the Bog of the Ring water supply.

Balrothery GWB (IE_EA_G_043)

This GWB is located in north County Dublin along the coast to the north and east of Skerries. There is an area of higher elevation in southern area of the GWB at Strifeland (96m OD) from which the elevation falls in all directions ultimately leading to the coast. The GWB is composed primarily of low permeability rocks, although localised zones of enhanced permeability do occur. The small areas of volcanic rocks may have a higher permeability. Recharge occurs diffusely through the subsoils and via outcrops. The aquifers within the GWB are generally unconfined but may become locally confined where the subsoil is thicker and / or lower permeability. Most flow in this aquifer will occur near the surface. In general, the majority of groundwater flow occurs in the upper 10m, comprising a weathered zone of a few metres and a connected fractured zone below this. Flow path lengths are relatively short, and in general are between 30 and 300 m. Groundwater discharges to the numerous small streams crossing the aquifer, and to the coast.

Balbriggan GWB (IE_EA_G_039)

This GWB is located in northern County Dublin around Balbriggan. The topography of the area slopes towards the coast with some small hills contained within the GWB, which act as sub-catchment level drainage divides. The GWB is composed primarily of moderate permeability rocks, with localized zones of enhanced permeability. The extent of the GWB is defined by the location of the volcanic rocks around Balbriggan. The small areas of volcanic rocks may have a higher permeability. Recharge occurs diffusely through the subsoils and via outcrops. The aquifers within the GWB are generally unconfined, but they may be locally confined where the subsoil is thicker and/or less permeable. Most flow in this aquifer will occur in a zone near the surface. In general, majority of groundwater flow occurs in the upper 30m, comprising a weathered zone of a few metres and a connected fractured zone below this.

However, deep-water strikes in more isolated faults / fractures can be encountered. Flow path lengths are relatively short, and in general are between 30 and 300m. Groundwater discharges to the numerous small streams crossing the aquifer and also directly to the coast.

Table 21.10 EPA WFD Groundwater Body status and risk

Water Feature	European Code	WFD Status (2016-2021)	WFD Risk	Location
Balrothery GWB	IE_EA_G_043	Good	Not at risk	North of the region
Balbriggan GWB	IE_EA_G_039	Good	Not at risk	North of the region
Dublin GWB	IE_EA_G_008	Good	Review	South of the region
Lusk-Bog on the rig GWB	IE_EA_G_014	Good	At risk	Centre of the region
Swords GWB	IE_EA_G_011	Good	Not at risk	South of the region

21.3.2.7 Regional Aquifer Vulnerability

Aquifer vulnerability of a groundwater body is the term used to describe the intrinsic geological and hydrogeological characteristics which determines the ease with which a groundwater body may be contaminated by human activities.

The vulnerability is determined by the travel time and the attenuation capacity of the subsoil which is a function of the permeability and thickness of the subsoils. For example, bedrock with a thick, low permeability subsoil is less vulnerable than bedrock with a thin high permeability, gravel overburden.

Aquifer vulnerability classification guidelines, as published by the GSI (2024c), are given in Figure 21.7 (Volume 7- Figures) and presented on Table 21.11.

The regional groundwater vulnerability varies significantly, ranging from areas of extreme groundwater vulnerability, which correspond to areas of bedrock outcrop, to low groundwater vulnerability where there are thicker deposits of moderate to low permeability subsoil.

Table 21.11 Aquifer vulnerability

Vulnerability Rating	Hydrogeological Conditions				
	Subsoil Permeability (Type) and Thickness			Unsaturated Zone	Karst Features
	High permeability (sand / gravel)	Moderate permeability (e.g. sandy subsoil)	Low permeability (e.g. clayey subsoil, clay, peat)	Sand/gravel aquifers only	<30m radius
Extreme (E)*	0 – 3.0m	0 – 3.0m	0 – 3.0m	0 – 3.0m	-
High (H)	>3.0m	3.0 – 10.0m	3.0 – 5.0m	>3.0m	Not applicable
Moderate (M)	Not applicable	>10.0m	5.0-10.0m	Not applicable	Not applicable
Low (L)	Not applicable	Not applicable	>10.0m	Not applicable	Not applicable

*Extreme (X) rock at or near surface or karst is a sub-category of extreme vulnerability where there is karst or outcrop and shallow subsoil (generally <1m in depth)

21.3.2.8 Regional Recharge

Recharge is the amount of rainfall that replenishes the aquifer. It is a function of the effective rainfall (i.e. rainfall minus evaporation and run off), the permeability and thickness of the subsoil and the aquifer characteristics.

Based on the GSI Groundwater Recharge mapping(GSI 2024a), recharge for the poor aquifers (Pl) within the region is not expected to exceed 100mm/yr, which reflects the low permeability of the aquifer and its limited capacity for water storage. The recharge for the locally important aquifer (Ll) is not expected to exceed 200mm/yr. The locally important gravel aquifer (Lg) within the region also generally has a recharge rate below 200mm/yr.

The range of annual groundwater recharge across the region is presented in Figure 21.8 (Volume 7- Figures).

This shows that as the area is predominately underlain by poorly productive aquifer with thick covering of subsoil (low vulnerability) the resulting recharge rate is relatively low.

21.3.2.9 Regional Groundwater Resources

Groundwater resources describe any large spring, well or borehole which is used as a groundwater abstraction source by domestic, agricultural, commercial, industrial, local authority or group water scheme users.

The groundwater resources for the region are presented on Figure 21.9 (Volume 7- Figures).

The GSI groundwater well and spring record database (GSI 2024a) indicates there are 133 groundwater resources features (14 springs and 119 boreholes) located within the 2km radius of the proposed development (landfall site, onshore cable route and existing Belcamp 220kV substation). The potential yields for these groundwater abstractions range between 38m^3/day and 2,714m^3/day. Two boreholes are classified as public supplies (PW02 & PW03 from Bog of the Ring), ten as industrial with the remainder being agricultural, domestic or not presenting any information regarding usage. The GSI database does not indicate if these abstraction points are active or inactive.

A groundwater Source Protection Zone (SPZ) for the Bog of the Ring Public Water Supply (PWS) is present in the north of the region which is intercepted by the onshore cable route. The scheme is served by four boreholes which abstract water from the underlying bedrock aquifer.

Groundwater abstractions of 25m^3/day or more are required to be registered with the EPA, as set out in the Water Abstraction Regulations (S.I. 261 of 2018). The EPA maintains a register of these groundwater abstractions (EPA, 2023). There are three registered groundwater abstractions located in the study area as summarised in Table 21.12 and Figure 21.9.

Table 21.12 EPA Registered Groundwater Abstractions within the Study Area

Registration No	Organisation Name	Number of Abstractions	Maximum Daily Volume Estimate for Registration (m3/d)	Purpose	Townland	Waterbody
R01652-01	Murphy International	1	400	Not specified	Baldrumman	Lusk-Bog of the Ring
R01566-01	An abstractor	1	30	Agriculture	Regeens	Lusk-Bog of the Ring
R01607-01	The Donabate Golf Club Company Limited By Guarantee	1	60	Recreation - Golf Course	Swords	Dublin

21.3.2.10 Regional Hydro-ecology Designated Sites

The National Parks and Wildlife Services (NPWS) is responsible for the designation of environmentally protected sites in Ireland and maintains a publicly available database of these sites. These sites include Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Natural Heritage Areas (NHAs). In addition to these sites, the NPWS also maintains a database of proposed Natural Heritage Areas (pNHAs).

Further information regarding the designated sites within the region is detailed in Chapter 23- Biodiversity. Note, only protected sites which are potentially groundwater dependant, are considered within this chapter. The ecological designated sites within the region are presented within Table 21.13 and presented on Figure 21.10.

Table 21.13 Ecological Designated sites within the region

Designated Site	Designation code	Status	Description	Potentially Groundwater Dependant	Location
Malahide Estuary	000205	pNHA, SAC, SPA	Mudflats and sandflats not covered by seawater at low tide.	No	Immediately adjacent to the proposed development.
Rogerstown Estuary	000208	pNHA, SAC and SPA	A small tidal embayment sheltered from the sea by a broad sand and shingle spit. Extensive areas of mud, sand and gravel are exposed at low tide.	No	Immediately adjacent to the proposed development.
Sluice River Marsh	001763	pNHA	Intact freshwater marsh	Yes	c. 300m east of the proposed development
Feltrim Hill	001208	pNHA	Exposed faces of Lower Carboniferous limestone.	No	c. 0.6km west of the proposed development
Bog of the Ring	001204	pNHA	Marsh with isolated wet areas	Yes	c. 0.3km west of the proposed development.
Knock Lake	001203	pNHA	Shallow artificial lake in farmland	No	c. 0.2km west of the proposed development.
Baldoyle Bay	000199	SAC, SPA and pNHA	Tidal estuary bay with mudflats and sandflats	No	c. 1.1km east of the proposed development.
North Dublin Bay	000206	SAC and pNHA	Inner part of north Dublin Bay which includes tidal mudflars and sandflats and North Bull Island	No	c.2km south east of the proposed development
North Bull Island	004006	SPA	Inner part of north Dublin Bay which includes North Bull Island	No	c.2km south east of the proposed development

21.3.3 Site Specific Environment

This section discusses the site-specific conditions within the study area for the proposed development described in Section 21.2.2. A full description of the onshore infrastructure of the proposed development is provided in the Onshore Description chapter and the construction strategy for the onshore infrastructure is detailed in the Onshore Construction chapter.

A list of figures from the site-specific environment are presented in Volume 7A of this EIAR.

21.3.3.1 Current and Historic Land Use of the Proposed Development

The current and historic land use is discussed in order to give context to any potential changes to land and soils that could influence the importance of a feature and the magnitude of any effects. The current land use is based on current aerial imagery and mapping available from OSI Geohive (OSI 2023), Google (Google 2023) and Bing (Bing 2023) and the Corine Land Cover maps (EPA 2018). The historic land use is based on the following OSI (OSI 2023) historic aerial imagery and historic maps:

- OSI 6-inch mapping produced between 1837 and 1842
- OSI 25-inch mapping produced between 1888 and 1913
- OSI 6-inch Cassini mapping produced between 1830 and 1930s
- OSI 1995 aerial photography
- OSI 2000 aerial photography
- OSI 2005 aerial photography.

Landfall site and Grid facility

The landfall site and grid facility are located north of Balbriggan, Co. Dublin. The current and historic land use at this location is agricultural. Soft sea cliffs are noted to the east of the landfall site and residential developments to the south towards Balbriggan. The landfall site lies to the east of the R132 and the grid facility to the west of the R132.

The 2018 CORINE land use dataset indicates that the land use in the landfall site and grid facility is predominantly non-irrigated arable agricultural land. Discontinuous urban fabric is located to the south of the landfall site and grid facility and intertidal flats are located to the north.

The historic maps do not show significant past developments within or around the proposed development. The landfall site, grid facility and the surrounding area has been used as agricultural land since at least the early 19th Century. The Dublin – Drogheda Railway was opened in 1844. Several single residences were constructed over the course of the 20th Century in and around the landfall site and grid facility.

Aerial photos from 1995, 2000, 2005, 2012, 2018, and 2021 were reviewed and indicate that the landfall site and grid facility has been continually used as agricultural land to the present day. Since 1995 there have been several large-scale residential developments in northern Balbriggan, located to the south of the landfall site and grid facility.

The archaeology survey identified a wide range of features of archaeological and potential archaeological interest including a number of enclosures and potential ring ditches/structures as well as possible burnt spread and features of industrial type activity. Refer to Section 25.3 of Volume 4, Chapter 25: Onshore Archaeology and Cultural Heritage for further information on historic land use of the onshore development area.

Onshore cable route

The onshore cable route passes through several urban areas including Balbriggan, Balrothery, the greater Swords area, Malahide, and Balgriffin. Most of the route will be located in the footprint of existing roads, including the R132, the R106 and the R107. There may be localised off road sections around Blakes Cross and near the Sluice Stream along the R107, where the onshore cable route may transverse agricultural land. The onshore cable route will cross the M1 motorway in agricultural lands west of the M1 Junction 4.

The 2018 CORINE land use dataset indicates that there are a range of land uses along the onshore cable route. The north of the study area around Balbriggan is dominated by discontinuous urban fabric. The land use between Balbriggan and Swords is classified as industrial and commercial units, pastures and non-irrigated arable land. There are also several industrial development sites along the R132, north and south of the M1 crossing.

The land use between Swords and Belcamp is classified as discontinuous urban fabric, continuous urban fabric, industrial and commercial units and localised areas of pastures and non-irrigated arable land. The road network of north County Dublin is largely surrounded by agricultural land.

Historical maps show that the road network has remained relatively unchanged since the mid-19th Century with the exception of the M1 motorway. The onshore cable route passes through land which, historically, was a predominantly agricultural. During the 19th Century there were minor quarries and gravel pits active in the vicinity of the M1 crossing.

Aerial imagery shows that the urban centres along the onshore cable route, such as Balbriggan, Malahide, Balgriffin and Dublin City, have experienced widespread residential, industrial and commercial development since the mid-20th Century. The land surrounding the onshore cable route has remained relatively unchanged since 1995 and is generally agricultural in rural settings with minor industrial developments along road network.

The M1 motorway was constructed between 2000 and 2005. There has been development of single dwellings in the vicinity of the M1 crossing within this period. The existing Belcamp 220kV substation was constructed at some point between 2005 and 2013.

21.3.3.2 Geomorphology and Topography

The geomorphology and topography are discussed to give context to any potential changes in land and soils that could influence the importance of a feature and the magnitude of any effects. The geomorphology (GSI 2024a) and the topography are shown on Figure 21.11. A project specific topography survey was carried out at the landfall and grid facility sites.

Landfall site and Grid facility

The topography of the landfall site and grid facility is undulating and ranges from approximately 2.2mOD in the east to an elevation of 33.9mOD in the west. The coastline is made up of sandy beaches and rock outcrops which range in height between 1m and 8m. The coastline slopes consist of low-lying gentle slopes/cliffs to the north of the proposed development boundary at the landfall, and slopes/cliffs that are near subvertical ranging in height from 1m to 5m along the southern part of the proposed landfall.

The site walkover survey noted that most of the coastline is susceptible to coastal erosion with several slumps and recessed areas recorded. Minor sections of the coastline at the northern extent of the landfall site are more resistant to coastal erosion due to protection provided by exposed bedrock along the coastline and offshore.

A review of the historical records of coastal erosion at the site do not indicate any significant coastal retreat at the site. The Irish Coastal Protection Strategy Study (ICPSS) erosion mapping for the area denotes a "Medium Confidence" 2050 erosion line which is similar to the historic HWM shown on OSi maps, with a difference of ~10m at the worst case location within the site boundary. We note that the ICPSS does not account for the impact of sea level rise, therefore coastal erosion may be more significant than shown by this study. Predicted high water levels for 2100, including allowances for projected changes in sea level rise are ~1.4m above the current high-water mark (which does not include storm surge), based on the ICPSS mid-range future scenario for a 1 in 200 yr return period.

Surface water features at the landfall site include drainage ditches that act as field boundaries. These ditches outflow on the beach. The Flemington stream is located to the north of the landfall site and grid facility, outside of the proposed development boundary.

No notable geomorphological features were noted within the proposed development boundary at the landfall. Hummocky sands and gravels along the coastline were noted approximately 1.5km north of the proposed development.

Onshore cable route

The OSI geohive database indicates the topography across the proposed development ranges from a low of 3 to 5mOD along Estuary Road at the Malahide Estuary to a high of 45mOD in the Five Roads area.

A project specific topographical survey was carried out at the following locations:

- Blakes Cross Site 1 - located approximately 3km north of the M1 junction 4 interchange, in the townland of Corduffhall, where the topography ranges from approximately 6.8mOD to 12mOD.
- Blakes Cross Site 2 - located approximately 2.5km north of the M1 junction 4 interchange, in the townland of Coldwinters, where the topography ranges from approximately 2.6mOD to 5.3mOD.
- M1 Crossing site located either side of the M1 Motorway, north of the M1 Junction 4 interchange, in the townland of Lissenhall Little, where the topography ranges from approximately 5.7mOD to 11.4mOD.

The onshore cable route is predominantly along the road network (R132, R106 and R107). The onshore cable route has several off-road sections including sections along the R132 and Blakes Cross area. It crosses major infrastructure at the M1 Junction 4 and potentially interacts with 25 watercourses. The water crossings consist of culverted drainage ditches, minor streams, and bridge structures over larger streams.

The geomorphology within the study area is dominated by mega scale lineations. Hummocky sands and gravels are noted near Balbriggan and Swords. Glacial meltwater channels are generally associated with river and stream crossings. A glaciofluvial terrace is noted west and east of the R107 near Baskin Lane.

21.3.3.3 Soils (Teagasc Soil Classification)

The main soils within the study area, as classified by Teagasc (Teagasc et al. 2017) are presented on Figure 21.12 and are listed in Table 21.14 along with their importance with respect to drainage and fertility as determined. Where these soils are important features with respect to possible soft soils or contamination, their importance is detailed in Section 21.3.3.8 and Section 21.3.3.9.

Landfall site and Grid facility

The soils encountered within the landfall site and grid facility are predominantly topsoils consisting of poorly drained mineral soils (surface water gleys / groundwater gleys acidic - AminPD). Localised areas of shallow well drained mineral soils (brown earths/brown podzolics lithosols regosols - AminSW) are noted just to the north of the landfall site and grid facility. Urban deposits (made ground) are located to the south of the landfall site and grid facility in Balbriggan.

The intrusive investigation indicated the topsoil across the site had an average thickness of 0.2 to 0.3m and was generally brown sandy gravelly clay; and was generally described as soft brown, slightly sandy and slightly gravelly to clay, where sand is fine to coarse, and gravels are subangular to subrounded fine to coarse.

Onshore cable route

The northern area of the onshore cable route is predominantly underlain by poorly drained mineral soils (surface water gleys / groundwater gleys acidic - AminPD) and deep well drained mineral soils, mainly acidic (acid brown earths / brown podzolic - AminDW).

The soil type changes to deep well drained mineral soils, mainly basic (grey, brown podzolics / brown earths basic - BminDW) and poorly drained mineral soils (surface water gleys / groundwater gleys basic - BminPD) heading south along the cable route. Urban deposits (made ground) are also present and are associated with residential and industrial areas such as Balbriggan, Balrothery and Malahide. There are localised pockets of mineral alluvium (AlluvMIN) associated with river and stream crossings and a localised pocket of lacustrine deposits just south of Balrothery. Marine sediments are noted near the Malahide estuary.

Intrusive investigation indicated the topsoil across the onshore cable route had an average thickness of 0.1 to 0.5m and was generally described as brown sandy gravelly clay.

The made ground had an average thickness of 0.5m but was found at depths of up to 1.10m and was described as soft brownish yellow to grey, very sandy gravely silt, sandy subrounded fine to coarse gravel, slightly sandy very gravelly clay with high cobble content.

Table 21.14 Summary of soils within the proposed development

Soil Code	Description	Location (Study Area – 2km Buffer)	Importance	Justification for Importance rating
Made Ground	Associated with urban development.	Onshore cable route, and existing Belcamp 220kV station	Low	Poorly drained and / or low fertility soils
MarSed	Marine/Estuarine sediments	Localised areas within study area	Low	Poorly drained and / or low fertility soils
AlluvMIN	Mineral alluvium	Localised areas within study area	Medium	Moderately drained and / or moderate fertility soils

Soil Code	Description	Location (Study Area – 2km Buffer)	Importance	Justification for Importance rating
Lac	Lacustrine, Lake sediments undifferentiated	Localised areas within study area	Low	Poorly drained and / or low fertility soils
Topsoil - AminDW	Acid Brown Earths / Brown Podzolic	Landfall site, grid facility, northern area of the onshore cable route and localised pocket in the centra area of the onshore cable route	High	Deep well drained mineral (Mainly acidic)
Topsoil - AminSW	Brown Earths/Brown Podzolics Lithosols Regosols	Landfall site, grid facility, and northern area of the onshore cable route	Medium	Shallow well drained mineral (Mainly acidic)
Topsoil - AminPD	Surface Water Gleys / Groundwater Gleys Acidic	Landfall site, grid facility, and northern area of the onshore cable route.	Low	Mineral poorly drained (Mainly acidic)
Topsoil - BminDW	Grey Brown Podzolics / Brown Earths Basic	Central and southern area of the onshore cable route and existing Belcamp 220kV substation	High	Deep well drained mineral (Mainly basic)
Topsoil - BminSW	Renzinas / Lithosols	Central and southern area of the onshore cable route	Medium	Shallow well drained mineral (Mainly basic)
Topsoil - BminPD	Surface water Gleys / Groundwater Gleys Basic	Central and southern area of the onshore cable route and existing Belcamp 220kV substation	Low	Mineral poorly drained (Mainly basic)

21.3.3.4 Subsoils (GSI Quaternary Classification)

Superficial deposits (subsoil) comprise the unconsolidated geological deposits which overlie the solid bedrock geology. These soils, as classified by the GSI Quaternary mapping, are presented on Figure 21.13 and listed on the Table 21.14; along with their importance with respect to feature quality and significance as determined. Where these subsoils are important features with respect to possible soft soils or contamination, their importance is detailed in Section 21.3.3.8 and Section 21.3.3.9.

Landfall site and Grid facility

The subsoils at the landfall site are split between two major quaternary sediment deposits, Till, derived from Lower Palaeozoic sandstones and shales, and Irish Sea Till derived from Lower Palaeozoic sandstones and shales. Both tills are associated with the marine and coastal effects. The subsoils at the grid facility are noted as Irish Sea Till derived from Lower Palaeozoic sandstones and shales. One bedrock outcrop or subcrop is located within the landfall site and two outcrops were noted to the north of the landfall site.

The ground investigation indicated the subsoil thickness ranges from 1.2 to over 12.6m. The subsoils consisted of firm to very stiff, yellowish brown to dark brown, slightly sandy to sandy, slightly gravelly to gravelly Clay and firm to very stiff, greyish brown to dark grey, slightly sandy to sandy, slightly gravelly to gravelly Clay.

The geophysical investigation indicated that the subsoil thickness ranges from 0.4 to 11.5m and consists of slightly sandy, slightly gravelly silt/clay; soft to stiff on an average depth of 2.3m and becoming stiffer with depth.

Onshore cable route

The subsoils encountered within the northern area of the onshore cable route are predominately Irish Sea tills, derived from Lower Palaeozoic sandstones and shales, and Tills, derived from Lower Palaeozoic sandstones and shales.

Tills derived from Namurian sandstones and shales are identified between Swords and Skerries. The southern extents of the proposed development identified tills derived from limestones. There are localised areas of Irish Sea Till derived from limestones and a small area close to the M1 crossing which is underlain by Estuarine silts and clays deposits.

Made ground deposits are associated with urban areas such as Balbriggan, Balrothery and Malahide. Alluvial deposits are associated with streams or water crossings. Gravels derived from Lower Palaeozoic sandstones and shales are present to the north of the study area near Balrothery and south of the M1 crossing along the R132. Lacustrine deposits are noted around Balrothery. Rock outcropping or subcropping is noted within the study area north of Balbriggan and along the R107 near Feltrim.

The southern sections of the onshore cable route along the Malahide Road and the alternative route to the grid connection at Belcamp are predominately underlain by tills derived from limestones.

The ground investigations indicated the subsoil thickness varies from 0.7 to 6.2m and is generally described as soft to firm brown slightly gravelly to sandy clay and firm to very stiff slightly sandy and gravelly clay.

The geophysical investigation indicated the subsoils consist of slightly gravelly silt / clay and / or sandy gravelly silt / clay with small pockets of silty / clayey sand / gravel, being soft to firm to a depth of 0.7m and becoming stiffer with depth from 2.2 mBGL.

Table 21.15 Summary of subsoils within the proposed development

Soil Type	Description	Location (Study Area – 2km Buffer)	Importance	Justification for Importance rating
A	Alluvium	Landfall site, grid facility and existing Belcamp 220kV substation	Medium	Medium value on a local scale
IrSTLPSsS	Irish Sea Till derived from Lower Palaeozoic sandstones and shales	Landfall site, grid facility and northern extents of the onshore cable route	Low	Low value on a local scale
TLPsS	Till derived from Lower Palaeozoic sandstones and shales	Landfall site, grid facility and northern extents of the onshore cable route	Low	Low value on a local scale
TNSSs	Till derived from Namurian sandstones and shales	Central area of the onshore cable route	Medium	Medium value on a local scale
TLS	Till derived from limestones	Central and southern areas of the onshore cable route and existing Belcamp 220kV substation	Medium	Medium value on a local scale
IrSTLs	Irish Sea Till derived from limestones	Central and southern area of the onshore cable route	Medium	Medium value on a local scale
IrsTBi	Irish Sea derived from basic igneous rock	Northern area of the onshore cable route	Low	Low value on a local scale
GLPSsS	Gravels derived from Lower Palaeozoic sandstones and shales	Northern area of the landfall site and grid facility	Medium	Medium value on a local scale
GNSSs	Gravels derived from Namurian sandstones and shales	Northern area of the onshore cable route	Medium	Medium value on a local scale
GLs	Gravels derived from limestone	Central and southern area of the onshore cable route and northern of landfall site	Medium	Medium value on a local scale
MEsc	Estuarine silts and clays	Central area of the onshore cable route	Low	Low value on a local scale

Soil Type	Description	Location (Study Area – 2km Buffer)	Importance	Justification for Importance rating
L	Lacustrine sediments	Northern area of the onshore cable route	Low	Low value on a local scale
Rck	Bedrock outcrop or subcrop	Minor areas along the onshore cable route and landfall site	Low	Low value on a local scale
Urban	Urban	Southern area of the onshore cable route	Low	Low value on a local scale

21.3.3.5 Bedrock Geology

The bedrock geology of the study area, as classified by the GSI 1:100,000 Bedrock Geology Map (GSI 2024a) is presented in Figure 21.14 with the various formations listed in Table 21.16 along with their importance with respect to feature quality and significance as determined.

Landfall site and grid facility

The bedrock encountered within the landfall site and grid facility comprises the Belcamp Formation which is described as andesite, pillow breccia, mudstone and tuff. The Silurian Denhamstown Formation is characterised by greywacke sandstone and siltstone and is located to the north of the landfall site and grid facility. Bedrock faults are recorded to the north and west of the landfall site and grid facility. Bedrock outcrops are noted within landfall site and north of the landfall site.

The project specific ground investigation showed the bedrock can be generally described as extremely weak to medium strong, light grey to dark brown / grey tuff andesite and breccia and weak (locally very weak) to medium strong, indistinctly thinly laminated to massive, brown / light grey to dark grey / greyish black greywacke, mudstone and siltstone. The depth to top of bedrock ranged between 3m and 12.6m.

The geophysical investigation highlighted areas of shallow bedrock within the proposed development boundary and was generally consistent with the findings of the intrusive investigation. The geophysical investigation showed the bedrock conditions consisted of breccia, siltstone, sandstone, greywacke, tuff; and andesite that was slightly weathered to fresh with the exception of the breccia which is slightly weathered.

Onshore cable route

The bedrock along the onshore cable route traverses several rock formations. The northern extents of the study area are underlain by the Belcamp, Balbriggan, Skerries, Mullaghfin, Loughshinny and Naul Formation. The southern extents of the study area is underlain by the Lucan, Tober Collen, Malahide and Waulsortian Formations. This area is heavily faulted and folded. The faults are generally trend in a north-south direction with a number of east-west trending anticlinal folds.

The bedrock geology for the alternative cable route from the junction of Chapel Road to the R124 comprises the Lucan Formation, Waulsortian Limestones and the Malahide Formation.

The ground investigations at the M1 crossing identified the top of the bedrock ranging from 6.0 to 7.2m. The bedrock was generally described as medium to strong thinly laminated dark greyish black limestone and medium strong massive dark grey limestone with rare greyish white calcite veins. The limestone was partially weathered at some depths, usually when crossing some fractured zones.

The ground investigation at Blakes cross identified the depth to the top of bedrock ranging from 6.50m to 7.20m at Kinsealy. The bedrock can generally be described as moderately weak to medium strong dark grey limestone. The depth to the top of bedrock at Blakes cross ranged from 4.70m to 5.00m. The bedrock can generally be described as strong dark grey calcareous mudstone.

The geophysical investigation was consistent with the intrusive ground investigation and bedrock was interpreted as shale and limestone that is slightly weathered to fresh.

The existing Belcamp 220kV GIS substation is underlain by two major bedrock geological units, the Tober Colleen Formation and the Lucan Formation. The Tober Colleen Formation is composed of calcareous shale and limestone conglomerate. The Lucan Formation comprises dark limestone and shale. A synclinal fold axis runs south-west to north-east through the site.

Table 21.16 Bedrock geology within the proposed development

Formation	Description	Location (Study Area – 2km Buffer)	Importance	Justification for Importance rating
Malahide Formation	Limestone Argillaceous bioclastic limestone, shale	Central and southern area of the onshore cable route and the existing Belcamp 220kV substation	Medium	Medium value on a local scale
Walshestown Formation	Limestone	Northern area of the onshore cable route	Low	Low value on a local scale
Balrickard Formation	Sandstone and Shale	Northern area of the onshore cable route	Low	Low value on a local scale
Mullaghfin Formation	Limestone Pale grey bioclastic limestone	Northern area of the onshore cable route	Low	Low value on a local scale
Naul formation	Limestone Calcarenite and calcisiltite	Northern area of the onshore cable route	Low	Low value on a local scale
Lucan Formation	Limestone Dark limestone & shale	Central and southern area of the onshore cable route and existing Belcamp 220kV substation	Low	Low value on a local scale
Tolber Collen Formation	Calcareous shale Calcareous shale, limestone conglomerate	Existing Belcamp 220kV substation and central and southern area of the onshore cable route	Low	Low value on a local scale
Waulsortian Limestone	Limestone Massive, unbedded limes mudstones	Southern area of the onshore cable route and existing Belcamp 220kV substation	Low	Low value on a local scale
Donabate Formation	Sandstone & Conglomerate	Southern area of the onshore cable route	Low	Low value on a local scale
Mudbank Limestone	Limestone	Northern area of the onshore cable route	Low	Low value on a local scale
Skerries Formation	Sandstone and Siltstone	Northern area of the onshore cable route	Low	Low value on a local scale
Balbriggan Formation	Mudstone and Sandstone	N/A	Low	Low value on a local scale
Belcamp Formation	Andesite, pillow breccia, tuff, mudstone	Landfall site, grid facility, and northern area of the onshore cable route	Medium	Medium value on a local scale

21.3.3.6 Historic and Project Specific Ground Investigations

A summary of the ground conditions encountered by historical ground investigations adjacent to the proposed development is listed in Section 21.2.4.2. The project specific ground investigations are presented in Table 21.17 and Table 21.18.

Table 21.17 Summary of ground conditions expected to be encountered by the proposed development at the landfall site and grid facility

Strata	Description	Top of Strata (mBGL)	Average Thickness of Strata (m)
Topsoil	Brown sandy gravelly clay	0	0.45
Made Ground	Soft brown, slightly sandy, slightly gravelly to clay. Sand is fine to coarse, and gravel is subangular	0	0.3 to 0.9
Glacial Till – Brown	Firm to very stiff, yellowish brown to dark brown, slightly sandy, slightly gravelly clay. Sand is fine to coarse, and gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded of various lithologies, predominantly limestone	0 to 2.3	1.2 to 8.4
Glacial Till – Black	Firm to very stiff, greyish brown to dark grey, slightly sandy, slightly gravelly clay. Sand is fine to coarse, and gravel is angular to subrounded of mixed lithologies	2.2 to 5.7	2.2 to 12.6
Weathered Bedrock	Weathered rock (drillers description), recovered as brown slightly sandy very clayey angular fine to coarse gravel of siltstone	6.0 to 8.5	0.4 to 1.0
Bedrock Belcamp Formation	Extremely weak to medium strong, light grey to dark brown/grey tuff, andesite, breccia. Occasional calcite veins with random orientation (up to 90mm tick) within Andesite layers. Partially weathered to destructured: reduced strength, closer fracture spacing, discolouration on fractures surfaces. Breccia recovered as stiff light greyish brown slightly sandy gravelly clay with low cobble content. Sand is fine to coarse, and gravel is angular fine to coarse of breccia. Cobbles are angular of breccia	4.7 to 20.3	Not proven
Bedrock Denhamstown Formation	Weak (locally very weak) to medium strong, indistinctly thinly laminated to massive, brown/light grey to dark grey/greyish black Greywacke, Mudstone, Siltstone. Occasional to frequent greyish white calcite veins of various orientation (up to 160mm thick). Occasional pyrite crystals (up to 2mm diameter) in Mudstone layers. Partially to distinctly weathered: reduced strength, closer fracture spacing, discolouration, clay deposits and occasional white mineralisation on fracture spaces. Discontinuities throughout	3.0 to 24.6	Not proven

Table 21.18 Summary of ground conditions expected to be encountered by the proposed development at the onshore cable route

Strata	Description	Top of Strat (mBGL)	Average Thickness of Strata (m)
Blakes Cross			
Topsoil	Brown sandy gravelly clay.	0	0.1 to 0.5
Made Ground	Soft brownish yellow to grey, very sandy gravelly silt. Sand is subrounded fine to coarse. Gravel slightly sandy very gravelly clay with high cobble content; sand is fine to coarse and gravel is subrounded to subangular fine to coarse of mixed lithologies. Cobbles are of mixed lithologies.	0.1 to 0.5	0.5 to 0.6
Glacial Till – Brown	Soft to firm light brown to brown slightly sandy to slightly gravelly clay with low cobble content. Sand is fine to coarse and gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded.	0.3 to 0.4	0.7 to 0.9
Glacial Till – Black	Soft to stiff greyish brown to blackish grey with some orange mottling slightly sandy to slightly gravelly to gravelly clay with medium cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.	0.5 to 1.3	-
M1 Crossing			
Topsoil	Brown sandy gravelly clay.	0	0.05 to 0.5
Made Ground	Greyish brown to grey very sandy and clayey; subrounded to subangular and fine to coarse gravel of mixed lithologies with high cobble content (from mixed lithologies) and coarse gravel sized pieces of rebar.	0	> 1.10
Glacial Till – Brown	Soft brown slightly gravelly, slightly sandy to clay. Sand is fine to coarse and gravel is subangular to subrounded fine to medium.	0.3 to 0.5	>2.8 to 6.2
Glacial Till – Black	Firm to very stiff purplish, orangish, greyish brown, grey slightly sandy to very sandy and slightly gravelly to gravelly clay with a low to high cobble content. Sand is fine to coarse and gravel is subangular o subrounded fine to medium.	0.3 to 0.5	>2.8 to 6.2
Weathered Bedrock	Grey fractured weathered Mudstone.	5.0	1.7
Bedrock Malahide Formation	Medium to strong, thinly laminated to massive, grey to dark greyish black Limestone with occasional greyish white calcite veins of predominately subvertical orientation (up to 6mm thick) and closely spaced laminations of dark grey carbonaceous Mudstone. Largely un-weathered to partially weathered, slightly reduced strength, slightly closer fracture spacing, discolouration on some fracture surfaces. Discontinuities throughout.	6.7 to 7.2	-

21.3.3.7 Karst

Karst is a type of geological feature characterised by caves, caverns and other types of underground drainage resulting from the dissolution of the underlying bedrock. This typically occurs in areas of high rainfall with soluble rock.

According to the GSI (2024a) there are five karst features located within the study area, four of these features (spring) are located approximately 1km from the proposed development. One karst feature (spring) is located approximately 0.3km from the onshore cable route. These features are presented in Table 21.19.

Table 21.19 Karst Features within Study Area

Karst Feature	Feature Type	Location	Importance	Justification for Importance Rating
3223NWK002 - 429	Spring	0.3km from the onshore cable route, in the southern area	Low	Low value on a local scale
3225SWK006 - 434	Spring	1km from the onshore cable route, in the central area	Low	Low value on a local scale

Karst Feature	Feature Type	Location	Importance	Justification for Importance Rating
3225SWK005 - 433	Spring	1.2km from the onshore cable route, in the central area	Low	Low value on a local scale
3225SWK003 - 3167	Spring	1.1km from the onshore cable route, in the central area	Low	Low value on a local scale
3225SWK004 - 338	Spring	1.1km from the onshore cable route, in the central area	Low	Low value on a local scale

21.3.3.8 Soft/and or Unstable Ground

Soft soils consist of peat, fine grained alluvium or very soft cohesive material and their presence within the study area could result in an effect if they require, for example, excavation and are therefore considered important features. Various sources of information were consulted in establishing these areas within the study area namely:

- Teagasc soil map (Teagasc et al. 2017)
- GSI Quaternary Map (GSI 2024a)
- GSI Landslide Events (GSI 2024a)
- Geohive Aerial imagery and mapping (Geohive 2023)
- Project Specific Ground Investigation data, and
- Site Walkover Survey.

The GSI database shows no recorded landslide events within the study area. The coastline of the proposed development consists of low-lying sand slopes.

The soft soils identified within the study area are detailed in Table 21.20 along with their importance as determined by Box 4.1 of the NRA Guidelines (NRA 2008a).

Table 21.20 Soft soils within the proposed development

Feature	Description	Location	Importance	Justification for Importance Rating
Alluvial deposits	Typically found along current and historic watercourses	Minor areas of the onshore cable route and the existing 220kV substation at Belcamp.	Medium	Volume of soft soil underlying the proposed development is small and of a local scale.
Sea cliffs	Consisting of sand and glacial deposits	Landfall	Medium	Volume of soft soil underlying the proposed development is small and of a local scale.

21.3.3.9 Contaminated Land

The following sources of information were consulted in assessing the potential for areas of contaminated land:

- CORINE land cover mapping (EPA 2018)
- Teagasc soil map (Teagasc et al. 2017)
- EPA Maps (2022)
- OSI mapping (OSI 2022), and
- The project specific ground investigations carried out to inform the proposed development and EIAR are listed in Table 21.2 and Table 21.3. These provide useful verification for the data already compiled relating to the baseline environment.

The known potential sources of contamination relevant to the proposed development identified within the study area are detailed in Table 21.21 along with their importance as determined.

Soil samples of made ground and natural ground were collected and tested during the ground investigation.

Given these soils may require disposal off-site, the samples were classified as wastes using the following methodology:

- The soils were classified according to the EPA document "Waste Classification, List of Waste & Determining if Waste is Hazardous or Non-hazardous, Valid from July 2018". The HazWasteOnline cloud-based software was used to perform this classification.
  - If the material was classified as '17 05 03*' as defined in the EPA 2018 guidance referenced above, the material is hazardous under the Waste Framework Directive 2008/98/ EC and must comply with the Regulation (EC) No 1013/2006 on shipment of waste (Waste Shipment Regulations) requirements for hazardous waste.
  - Alternatively, if the material is classified as '17 05 04 – Soil and Stones excluding those included in 17 05 03*'. The material is non-hazardous under Waste Framework Directive 2008/98/ EC and Waste Shipment Regulations and must comply with the Waste Shipment Regulations requirements for non-hazardous waste.
- Once the List of Waste code is assigned to the soil sample, the materials are further classified according to the Council Decision 2003/33/EC establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC (Waste Acceptance Criteria (WAC)). This classification will determine the type of landfill at which the material will be accepted.
- Naturally occurring materials may be considered for disposal to a Soil Recovery Facility (SRF) which have different waste acceptance criteria relating to the geochemistry of the underlying soils at the facility location. These samples were assessed against the SRF limits for suitability for disposal to facilities located in granitic (Domain 6) and limestone (Domain 4) type environments.

Landfall site and grid facility

Based on the samples recovered during the project specific ground investigation, one sample was classified as non-hazardous.

Onshore cable route

The features described in the Table 21.21 are located within the 2km, but are not crossed by the onshore cable route. Based on the samples recovered during the project specific ground investigation, three samples were classified as non-hazardous and two samples were classified as hazardous.

Table 21.21 Summary of Potential Sources of Contaminated Land Adjacent to the Proposed Development

Feature	Description	Location	Importance	Justification for Importance Rating
Historic Quarry	2 disused quarries have been identified on the OSI maps, which of one has been backfilled and the for the other one there is no information related. Additional 10 pits were identified within the 2km radius of the onshore cable route	Both quarries are located approximately 1.0km from southern area of the onshore cable route	Low	Assumed backfield with inert material. Degree or extent of soil contamination is minor on a local scale
Active Quarry	Feltrim Quarry, aggregates and fill materials	Approximately 1.0km from the southern area of the onshore cable route and within one of the quarries mentioned above	Low	No waste material. Degree or extent of soil contamination is minor on a local scale
Waste Facilities	Fingal Co. Co., Nevitt Landfill EPA Licensed Area (W0231-01): Disposal of non-hazardous waste	Approximately 1km west of the onshore cable route	Medium	Non-hazardous waste.

Feature	Description	Location	Importance	Justification for Importance Rating
				Degree or extent of soil contamination is moderate on a local scale
	Bord Na Móna Recycling Limited (Advanced Environmental Solutions (Ireland) Limited) EPA Licensed Area (W0222-01): Disposal of non-hazardous waste	Approximately 0.5km from the central area of the onshore cable route	Medium	Non-hazardous waste. Degree or extent of soil contamination is moderate on a local scale
	Fingal Co. Co., Balleally Landfill. EPA Licensed Area (W0009-03): Disposal of non-hazardous waste	Approximately 1.5km from the central area of the onshore cable route	Medium	Non-hazardous waste. Degree or extent of soil contamination is moderate on a local scale
Petrol Stations	A number of petrol stations were identified along the onshore cable route. Northern Area: Sailln Garage - approximately 0.12km from the onshore cable route. JH McLouglin Dublin- approximately 0.5km from the onshore cable route. Texaco Scanlans - approximately 0.2km from the onshore cable route. Central Area: Applegreen Southbound MSA Lusk East - approximately 0.5km from the onshore cable route. Applegreen M1 - approximately 1km from the onshore cable route. Applegreen - within the onshore cable route Top Oil Blake Cross Service Station - within the onshore cable route Maxol Service Sation Turvey - within the onshore cable route Southern Area: Applegreen Swords Rd Mountgorry Malahide - within the onshore cable route Circle K Main Street Malahide - approximately 1.5km from the onshore cable route Applegreen Malahide Rd Saint doolaghs - within the onshore cable route Green Fuel Ireland - approximately 1.0km from the onshore cable route Certa - approximately 0.2km from the onshore cable route. Circle K Balgriffin - approximately 0.35km from the onshore cable route Texaco Malahide Road - approximately 1.0km from the onshore cable route TopOil Grange Park Ave Grange - approximately 1.7km from the onshore cable route Circle K Donaghmede - approximately 1.5km from the onshore cable route	Onshore cable route	Medium	Degree or extent of soil contamination is moderate on a local scale

Feature	Description	Location	Importance	Justification for Importance Rating
Project Specific Ground Investigation	Three samples were classified as non-hazardous	TP09 Landfall TP21 Blakes Cross TP108 Onshore Cable Route	Medium	Degree or extent of soil contamination is moderate on a local scale
Project Specific Ground Investigation	Two samples were classified as hazardous	ST02 Bremore Cottages ST31 Malahide Road	Medium	Degree or extent of soil contamination is moderate on a local scale
Old Landfills close to Belcamp	Unlicensed Landfill	Belcamp	Medium	Degree or extent of soil contamination is moderate on a local scale

21.3.3.10 Mineral Aggregate Resources

The following datasets were consulted to assess the effect of the proposed development on the economic geology of the study area:

- GSI aggregate potential mapping (GSI 2024a)
- GSI mineral localities (GSI 2024a), and
- GSI active quarries (GSI 2024a).

There are no active pits, mines or quarries and no mineral localities identified within the study area. There is one quarry located 1km from the onshore cable route, which is identified as Feltrim Quarry.

There are four non-metallic mineral localities and one metallic mineral locality within the study area. These are presented on Table 21.22 together with the mineral of interest and locality description. Three of the four non-metallic mineral localities are located in the south of the study area. One is situated west of the R107 at Feltrim quarry and two east of the R107 adjacent the Dublin-Drogheda railway. The fourth non-metallic mineral locality is identified within Balbriggan. These are summarised in Table 21.23.

The granular aggregate potential is presented on Figure 21.16 and the crushed rock aggregate potential is presented on Figure 21.17. The aggregate potential of the landfall and grid facility and along the onshore cable route is summarised in Table 21.22 and Table 21.23.

Landfall site and grid facility

No granular aggregate potential was noted within the proposed development boundary at the landfall site and grid facility.

The GSI aggregate potential mapping shows the crushed rock aggregate potential at this location is mainly classified as a low potential. At the northern and eastern extents of the landfall site and in the grid facility region the potential ranges from moderate to high.

Onshore cable route

The granular aggregate potential ranges from very low to moderate south of Balbriggan between Balrothery and north of Blakes Cross. The granular aggregate potential ranges from very low to very high south of Blakes Cross to Belcamp, with the area of very high potential noted was noted near Estuary Road.

The alternative cable route shows localised pockets of low to moderate granular aggregate potential along Chapel Road and the R124.

The GSI aggregate potential mapping shows the crushed rock aggregate potential along the onshore cable route ranges from very low to very high. The northern parts of the study area range from low to very high. The crushed rock potential within the central extents of the onshore cable route ranges from moderate to high. The crushed rock potential in the southern extents of the onshore cable route generally ranges from very low to high potential.

The crushed aggregate potential for the alternative cable route along Chapel Road and the R124 ranges from low to very high.

Table 21.22 GSI Non-metallic and metallic mineral located within the 2km radius from the proposed development

Mineral Type and Reference	Description	Location	Importance	Justification for Importance Rating
Limestone (in general) 3031	Non-metallic • Large active quarry in Carboniferous, producing a full range of aggregates and concrete blocks	Approximately 1km from the southern area of the onshore cable route	Low	Uneconomically extractable mineral resource
Clay, brick 3259	Non-metallic • Brick field	Approximately 1km from the southern area of the onshore cable route	Low	Uneconomically extractable mineral resource
Clay, brick 3258	Non-metallic • Site of brick works that supplied good class red bricks to Dublin	Approximately 1.2km from the southern area of the onshore cable route	Low	Uneconomically extractable mineral resource
Clay, brick 3267	Non-metallic • Brick field and yard marked on old 6-inch map	Approximately 0.1km from the onshore cable route and landfall site	Low	Uneconomically extractable mineral resource
Pyrite 5327	Metallic • Iron pyrites in greenstones and grits noted on old 6-inch map	Approximately 1.5km from the northern area of the onshore cable route	Low	Uneconomically extractable mineral resource

Table 21.23 GSI Aggregate potential for the proposed development

Feature	Potential	Location	Importance	Justification for Importance Rating
Crushed rock aggregate potential	Very low	Widespread along the onshore cable route	Low	Uneconomically extractable mineral resource
	Low	Landfall site, grid facility, the onshore cable route, and existing Belcamp 220kV substation	Low	Uneconomically extractable mineral resource
	Moderate	Landfall site and grid facility, localised areas along the onshore cable route	Medium	Sub-economic extractable mineral resource
	High	Localised area within the landfall site and localised areas along the onshore cable route	High	Extractable mineral resource
	Very High	Localised areas in the southern section of the onshore cable route	High	Extractable mineral resource
Granular aggregate potential	Very Low	Widespread along the onshore cable route	Low	Uneconomically extractable mineral resource
	Low	Widespread along the onshore cable route	Low	Uneconomically extractable mineral resource
	Moderate	Localised areas along the onshore cable route	Medium	Sub-economic extractable mineral resource
	High	Localised areas along the onshore cable route and at the existing Belcamp 220kV substation.	High	Extractable mineral resource
	Very High	Localised areas along the onshore cable route	High	Extractable mineral resource

21.3.3.11 Geological Heritage Areas

Geological Heritage Areas are designated as part of the Irish Geological Heritage Programme, which is a partnership with the GSI (2024a) and the Department of Environment, Heritage and Local Government.

No geological heritage areas were identified within the proposed development boundary. There are six Geological Heritage areas located within the 2km radius of the proposed development. these are listed in Table 21.24. Refer also to Figure 21.5.

Table 21.24 Summary of the Geological Heritage Areas within the proposed development

Geological Heritage	Description	Location	Importance	Justification for Importance Rating
Laytown to Gormanston	Coastal plain, including sea cliffs. Flat to gently undulating glacial outwash plain of sand or gravel.	Approximately 0.75km north of the landfall site and grid facility	High	Geological feature of high value on a local scale (County Geological Site)
Fancourt Shore	Coastal cliffs and foreshore. Coastal exposures of near complete Silurian succession (slates, sandstones and volcanics) dated by its graptolite fossils.	Approximately 1.2km from the onshore cable route	High	Geological feature of high value on a local scale (County Geological Site)
Ardgillan House Boulder	Single large boulder on access path to Ardgillan House. A boulder composed of Ordovician pillow lavas, displaying concentric cooling structures.	Approximately 1.9km from the onshore cable route	High	Geological feature of high value on a local scale (County Geological Site)
Balrickard Quarry	Disused quarry. Exposed faces of Upper Carboniferous sandstone and shale	Approximately 0.9km from the onshore cable route	High	Geological feature of high value on a local scale (County Geological Site)
Walshestown Stream Section	Exposures of Upper Carboniferous (Namurian) shale, sandstone and limestone along the banks of a 1.5km stream section.	Approximately 0.9km from the onshore cable route	High	Geological feature of high value on a local scale (County Geological Site)
Feltrim Quarry	Working quarry on Feltrim hill. Exposed faces of Lower Carboniferous limestone, shale (Waulsortian mudmound), locally fossiliferous.	Approximately 0.5km from the onshore cable route	High	Geological feature of high value on a local scale (County Geological Site)
Malahide Point	Dunes and a sand/shingle beach. A large dune system and beach formed by a long sand and shingle spit.	Approximately 2.0km from the onshore cable route	High	Geological feature of high value on a local scale (County Geological Site)

21.3.3.12 Aquifer Type and Classification

The GSI Bedrock Aquifer mapping (2024a) for the proposed development presented in Figure 21.18 indicates that there are five aquifer types within the proposed development boundary as summarised in Table 21.25.

The landfall site and grid facility are underlain by a locally important aquifer (Lm). The northern extents of the study area are underlain by a locally important aquifer (Lk). An explanation of the aquifer classification codes is provided in Table 21.9 above.

The onshore cable route also interacts with two locally important aquifers, Lm and LI in the central and southern extents of the study areas, respectively. The alternative cable route from the junction of Chapel Road and the Malahide Road to the R124 is underlain by a locally important aquifer (LI). The existing Belcamp 220kV substation area is underlain by a poor (Pl) aquifer.

There are no gravel aquifers mapped within the study area.

Table 21.25 Summary of Aquifer types within the proposed development

Aquifer Type	Description	Location	Importance	Justification for Importance Rating
Locally Important Aquifer	Bedrock which is Generally Moderately Productive (Lm)	Landfall site, grid facility, and central areas of the onshore cable route	Medium	Attribute has a medium quality or value on a local scale
	Locally Important Aquifer – Karstified (Lk)	Northern extents of the onshore cable route	Medium	Attribute has a medium quality or value on a local scale
	Bedrock which is Moderately Productive only in Local zones (Ll)	Central and southern areas of the onshore cable route	Medium	Attribute has a medium quality or value on a local scale
	Locally Important Gravel Aquifer (Lg)	Localised area 1.5km from the northern of the landfall site and grid facility	Medium	Attribute has a medium quality or value on a local scale
Poor Aquifer	Bedrock which is Generally Unproductive except for Local zones (Pl)	Minor areas along the onshore cable route and existing Belcamp 220kV substation	Low	Attribute has a low quality or value on a local scale
	Bedrock which is Generally Unproductive (Pu)	Minor area 1km from the northern of the landfall site and grid facility	Low	Attribute has a low quality or value on a local scale

21.3.3.13 Groundwater Vulnerability

Groundwater vulnerability within the study area ranges from extreme, where bedrock is close or at the surface to low vulnerability, in areas where thick subsoil deposit is present, as shown on Figure 21.19 (GSI 2024a) .

Landfall site and grid facility

The GSI groundwater vulnerability mapping shows the groundwater vulnerability within the landfall site ranges from high to low, with an area of extreme groundwater vulnerability noted within the northern development boundary. The groundwater vulnerability within the grid facility is moderate with localised areas classified as high.

Onshore cable Route

The GSI groundwater vulnerability mapping shows the groundwater vulnerability along the onshore cable route ranges from extreme rock at or near surface to low groundwater vulnerability. In the central area of the onshore cable route and around Belcamp substation the vulnerability is generally classified as low. The groundwater vulnerability along the alternative cable route from the junction of Chapel Road and the Malahide Road to the R124 ranges from low to extreme rock at or near the surface.

21.3.3.14 Groundwater Recharge

The GSI groundwater recharge map is presented on Figure 21.20. The annual recharge within the study area generally ranges from 1mm to 100mm/year. There are localised areas in the north of the study area ranging from 201mm to 250mm/year.

The groundwater recharge at the landfall site ranges mainly from 1mm to 50mm, with slightly higher groundwater recharge ranging from 51mm to 100mm/year noted in the northwest and east parts of this area.

The groundwater recharge at the existing Belcamp 220kV substation ranges from 1mm to 50mm/year.

21.3.3.15 *Groundwater Resources*

A groundwater Source Protection Area for the Bog of the Ring Public Water Supply is located south of Balbriggan in the townlands of Balrickard (Table 21.26). This feature has extremely high importance and supplies 4,000m^3/day. The scheme is served by four boreholes named as PW2, PW3, PW4 and PW5 which were drilled in 2000 and abstract water from the underlying aquifer bedrock related to the Loughshinny Formation.

Groundwater abstractions over 25m³/d are required to be registered with the EPA under the Abstraction Registration Regulations (S.I. 261 of 2018). There are three EPA registered groundwater abstractions situated within the proposed development study area.

The groundwater resources within the study area are summarised in Table 21.26 and presented on Figure 21.21.

Table 21.26 Groundwater abstractions

Abstraction	Description	Location	Ground Waterbody	Distance to Proposed Development (km)	Importance	Justification for Importance Rating
Bog of the Ring PWS	Inner Protection Area (SI) and Outer Protection Area (SO) from the Bog of the Ring Public Water Supply	Northern area of the onshore cable route	Hynestown, Lusk – Bog of the Ring, Duleek, Balbriggan and Balrothery	Underlies the onshore cable route	Very High	Regionally important potable water source supplying >2500 homes
R01652-01: Murphy International	Abstraction registered with EPA	Baldrumman townland, west of the onshore cable route	Lusk – Bog of the Ring	0.7	High	Locally important potable water source supplying the equivalent of >1000 homes.
R01566-01	Abstraction registered with EPA	Regeens town, east of the onshore cable route	Lusk – Bog of the Ring	1	Medium	Potable water source supplying supplying the equivalent of >50 homes
R01607-01: Donabate Golf Club	Abstraction registered with EPA	Southern area, west of the onshore cable route	Dublin	1.6	Medium	Potable water source supplying the equivalent of >50 homes

21.3.3.16 Groundwater Quality and Levels

Table 21.27vpresents a summary of the monitoring stations related to the Bog of the Ring water supply and the groundwater levels recorded in the study area. These are monitored by the EPA as part of the national water monitoring network with monitoring commencing in 2009.

Table 21.27 Bog of the Ring Boreholes

Location	Station Name	Easting	Northing	Groundwater Elevation (mOD)	Groundwater Level (mBGL) Last 12 months median
Onshore cable route, in the southern area	Bog of the Ring OW2D (Active)	317601	260279	35.08	16.40
	Bog of the Ring HR2D (Active)	318669	258819	38.32	36.64
	Bog of the Ring OW3S (Active)	318642	260235	34.97	31.62

As part of the project specific ground investigation, groundwater monitoring standpipes were installed in BH01, BH06, and BH17 located at the landfall site, BH09 located at the M1 crossing and BH16 located at the grid facility site. The groundwater monitoring results are included in Appendix 21.1.

The ground investigation report (Causeway Ground Investigation Report, 2022) states that groundwater was not noted during drilling at any of these borehole locations. However, the casing used in supporting the borehole walls during drilling may have sealed out groundwater strikes. The results of monitoring of groundwater levels in the installations in 2022 are presented in Table 21.28.

Table 21.28 Groundwater Monitoring Standpipes installed during the ground investigations

Location	Hole ID	Easting	Northing	mOD	Depth (m)	Groundwater Level (mBGL) May 2022	Groundwater Level (mBGL) June 2022	Groundwater Level (mBGL) Sept 2022	Groundwater Level (mBGL) Dec 2022
Landfall site and grid facility	BH01	719758	765371	3.53	17.55	1.10	1.28	2.19	0.44
	BH06	719454	765155	11.95	8.88	0.8	0.86	0.72	0.66
	BH16	718796	764822	31.97	8.75	1.71	1.79	2.25	1.49
	BH17	719790	765252	5.85	14.28	3.90	3.95	4.54	1.17
Onshore cable route	BH09	718991	749337	11.83	13.0	3.65	5.38	5.31	5.23

21.3.3.17 Hydro-ecology

Groundwater dependant habitats within the study area that have the status of SPA, SAC, NHA and pNHA are listed in Table 21.29, with their importance as determined. These are also shown in Figure 21.22. The project ecologists have also identified an area of habitat type GS4 wet grassland/GM1 Marsh at Blakes Cross South, along the margins of the Deanestown Stream. This habitat is of local ecological importance due to its semi-natural characteristics, limited occurrence in the wider area and species diversity. The extent to which these habitats are groundwater or surface water dependant has not been determined and as a conservative approach it is assumed that they are groundwater dependant.

Table 21.29 Groundwater Dependant Habitats within the proposed development study area

Feature	Description	Designation Code	Status	Location	Importance	Justification for Importance Rating
Sluice River Marsh	Intact freshwater marsh	001763	pNHA	c. 300m east of the proposed development.	Very High	Groundwater supports wetland and/or surface water body ecosystem with a high value on a regional or national scale
Bog of the Ring	Marsh with isolated wet areas	001204	pNHA	c. 0.3km west of the proposed development.	Very High	Groundwater supports wetland and/or surface water body ecosystem with a high value on a regional or national scale
GS4 wet grassland/ GM1 Marsh	Semi-natural grassland	n/a	n/a	Within proposed development boundary at Blakes Cross	High	Attribute has a high quality or value on a local scale

21.3.3.18 Summary of Features of Importance

The feature importance ranking based on the Guidelines for the Preparation of Soil, Geology and Hydrogeology Chapters of Environmental Impacts Statements, IGI 2013 and Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes, NRA 2008 are summarised below.

Features with an importance ranking of low are not considered further as they will not result in a significant effect according to Box 5.4 of the NRA Guidelines (NRA 2008a). Features with an importance ranking of medium or higher are summarised in Table 21.30 and the impact of the proposed development on these schemes is assessed in Section 21.4.

Table 21.30 Summary of Land, Soils, Geology and Hydrogeology features with medium to high importance within the study area

Category	Feature	Location	Description	Importance	Justification for Importance Rating
Soil Fertility	AlluvMIN	Localised areas within study area	Mineral alluvium	Medium	Moderately drained and / or moderate fertility soils
	Topsoil - AminSW	Landfall site, grid facility, and northern area of the onshore cable route	Brown Earths/Brown Podzolics Lithosols Regosols	Medium	Shallow well drained mineral (Mainly acidic)
	Topsoil - BminSW	Central and southern area of the onshore cable route	Rendzinas / Lithosols	Medium	Shallow well drained mineral (Mainly basic)
	Topsoil - AminDW	Landfall site, grid facility, northern area of the onshore cable route and localised pocket in the centra area of the onshore cable route	Acid Brown Earths / Brown Podzolic	High	Deep well drained mineral (Mainly basic)
	Topsoil - BminDW	Central and southern area of the onshore cable route and at the existing Belcamp 220kV substation	Grey, Brown Podzolics / Brown Earths Basic	High	Deep well drained mineral (Mainly basic)
Subsoils Quality and Significance	A	River and stream crossings	Alluvium	Medium	Medium value on a local scale
	GLPSsS	Northern area of onshore cable route	Gravels derived from Lower Palaeozoic sandstones and shales	Medium	Related to AminSW (Mineral well drained -Mainly acidic) Medium value on a local scale
	GLs	Central and southern area of the onshore cable route and northern of landfall site	Gravels derived from limestone	Medium	Related to BminSW (Mineral well drained -Mainly basic) Medium value on a local scale
	IrSTLs	Central and southern area of the onshore cable Route	Irish Sea Till derived from limestones	Medium	Related to BminDW (Mineral well drained -Mainly Acid) High value on a local scale
	TNSSs	Central area of the onshore cable route	Till derived from Namurian sandstones and shales	Medium	Related to AminDW (Mineral well drained -Mainly basic) High value on a local scale
	TLS	Central and southern areas of the onshore cable route and at the existing Belcamp 220kV station	Till derived from limestones	Medium	Related to BminDW (Mineral well drained -Mainly Acid) High value on a local scale
Bedrock Quality and Significance	Malahide Formation	Central and southern area of the onshore cable route	Limestone Argillaceous bioclastic limestone, shale	Medium	Medium value on a local scale

Category	Feature	Location	Description	Importance	Justification for Importance Rating
	Belcamp Formation	Landfall site, grid facility, and northern area of the onshore cable route	Andesite, pillow breccia, tuff, mudstone	Medium	Medium value on a local scale
Contaminated Land	Fingal Landfill, Nevitt	Approximately 1km west of the onshore cable route	EPA Licensed Area (W0231-01) Disposal of non-hazardous waste	Medium	Non-hazardous waste. Degree or extent of soil contamination is moderate on a local scale
	Bord Na Móna Recycling Limited (Advanced Environmental Solutions (Ireland) Limited)	Approximately 0.5km from the onshore cable route, in the central area	EPA Licensed Area (W0222-01) Disposal of non-hazardous waste	Medium	Non-hazardous waste. Degree or extent of soil contamination is moderate on a local scale
	Fingal County Council	Approximately 1.5km from the onshore cable route, in the central area	EPA Licensed Area (W0009-03) Disposal of non-hazardous waste	Medium	Non-hazardous waste. Degree or extent of soil contamination is moderate on a local scale
	Petrol Stations	A number of petrol stations were identified during the walkover along the onshore cable route	Current and historic petrol stations	Medium	Degree or extent of soil contamination is moderate on a local scale
	Project Specific Ground Investigation	TP09 Landfall TP21 Blakes Cross TP108 Onshore Cable Route	Three samples were classified as non-hazardous	Medium	Degree or extent of soil contamination is moderate on a local scale
	Project Specific Ground Investigation	ST02 & ST31 Onshore Cable Route	Two samples were classified as hazardous	Medium	Degree or extent of soil contamination is moderate on a local scale
	Old Landfills close to Belcamp	Belcamp	Unlicensed Landfill	Medium	Degree or extent of soil contamination is moderate on a local scale
Mineral Aggregate Resources	Crushed rock aggregate potential	Landfall site, small pocket of the grid facility and localised areas along the onshore cable route	Moderate potential	Medium	Sub-economic extractable mineral resource
		Localised area within the landfall site and localised areas along the onshore cable route	High potential	High	Extractable mineral resource
		Localised areas in the southern section of the onshore cable route	Very high potential	High	Extractable mineral resource

Category	Feature	Location	Description	Importance	Justification for Importance Rating
	Granular aggregate potential	Localised areas along the onshore cable route	Moderate potential	Medium	Sub-economic extractable mineral resource
		Localised areas along the onshore cable route and at the existing Belcamp 220kV substation.	High potential	High	Extractable mineral resource
		Localised areas along the onshore cable route	Very high potential	High	Extractable mineral resource
Geological Heritage Areas	Laytown to Gormanston	Approximately 0.75km north of the landfall site and grid facility	Coastal plain, including sea cliffs. Flat to gently undulating glacial outwash plain of sandur gravel.	High	Geological feature of high value on a local scale (County Geological Site)
	Fancourt Shore	Approximately 1.2km from the onshore cable route	Coastal cliffs and foreshore. Coastal exposures of near complete Silurian succession (slates, sandstones and volcanics) dated by its graptolite fossils.	High	Geological feature of high value on a local scale (County Geological Site)
	Ardgillan House Boulder	Approximately 1.9km from the onshore cable route	Single large boulder on access path to ardgillan house. A boulder composed of Ordovician pillow lavas, displaying concentric cooling structures.	High	Geological feature of high value on a local scale (County Geological Site)
	Balrickard Quarry	Approximately 0.9km from the onshore cable route	Disused quarry. Exposed faces of Upper Carboniferous sandstone and shale	High	Geological feature of high value on a local scale (County Geological Site)
	Feltrim Quarry	Approximately 0.9km from the onshore cable route	Working quarry on Feltrim hill. Exposed faces of Lower Carboniferous limestone, shale (Waulsortian mudmound), locally fossiliferous.	High	Geological feature of high value on a local scale (County Geological Site)
	Malahide Point	Approximately 0.5km from the onshore cable route	Dunes and a sand/shingle beach. A large dune system and beach formed by a long sand and shingle spit.	High	Geological feature of high value on a local scale (County Geological Site)
Aquifer Classification	Locally Important Aquifer	Landfall site, grid facility, and central areas of the onshore cable route	Bedrock which is Generally Moderately Productive (Lm)	Medium	Attribute has a medium quality or value on a local scale
		Minor areas on the southern of the onshore cable route	Locally Important Aquifer - Karstified (Lk)	Medium	Attribute has a medium quality or value on a local scale
		Localised area 1.5km from the northern of the landfall site and grid facility	Locally Important Gravel Aquifer (Lg)	Medium	Attribute has a medium quality or value on a local scale
		Central and southern areas of the onshore cable route	Bedrock which is Moderately Productive only in Local zones (Ll)	Medium	Attribute has a medium quality or value on a local scale

Category	Feature	Location	Description	Importance	Justification for Importance Rating
Groundwater resources	Bog of the Ring PWS	Southern area of the onshore cable route	Inner Protection Area (SI) and Outer Protection Area (SO) of the Bog of the Ring Public Water Supply	Very High	Regionally important potable water source supplying >2500 homes
	GW Abstraction R01652-01	Baldrumman townland, c. 0.7km west of the onshore cable route	Groundwater abstraction registered with EPA	High	Locally important potable water source supplying >1000 homes
	GW Abstraction R01566-01	Regeens town, c. 1km east of the onshore cable route	Groundwater abstraction registered with EPA	Medium	Potable water source supplying >50 homes
	GW Abstraction R01607-01	Southern area, c. 1.6km west of the onshore cable route	Groundwater abstraction registered with EPA	Medium	Potable water source supplying >50 homes
Hydro-Ecology	Sluice River Marsh	c. 300m east of the proposed development.	pNHA	Very High	Groundwater supports wetland and/or surface water body ecosystem with a high value on a regional or national scale
	Bog of the Ring	c. 0.3km west of the proposed development.	pNHA	Very High	Groundwater supports wetland and/or surface water body ecosystem with a high value on a regional or national scale
	GS4 wet grassland/GM1 Marsh	Within proposed development boundary at Blakes Cross	Semi-natural grassland	High	Attribute has a high quality or value on a local scale

21.3.4 Conceptual Site Model

A tabulated Conceptual Ground Model (CSM) for the landfall site, grid facility and onshore cable route (including grid connection to the existing 220kV substation at Belcamp) which was developed based on the public available data and with the specific ground investigation data, are respectively presented in Table 21.31 to Table 21.33.

The graphical CSM for the landfall site, grid facility and M1 crossing is outlined in Appendix 21.2. The CSM includes the factual data within the study area that was gathered during the GIs. See Appendix 21.1 for the available ground investigation data.

Table 21.31 Landfall site Conceptual Site Model

Material	Dominant Earthworks Type	Excavated Volume Fill (m^3)	Reused Volume (m^3)	Exported Volume (m^3)
Topsoil	Cut	6,100	3,900	2,200
Subsoil		1,600	700	900
HDD bore material		3,800	0	3,800

Table 21.32 Grid Facility Conceptual Site Model

Material	Dominant Earthworks Type	Excavated Volume Fill (m^3)	Reused Volume (m^3)	Exported Volume (m^3)
Topsoil	Cut	15,900	4,700	11,200
Subsoil		31,500	800	30,700

Table 21.33 Onshore cable route Conceptual Site Model

Material	Dominant Earthworks Type	Cut (m^3)	Fill (m^3)	Exported Volume (m^3)
Topsoil	Cut	17,500	13,800	3,700
Subsoil		4,900	2,200	2,700
Surface course (asphalt)		1,700	1,200	500
Base/Binder course (asphalt)		6,700	4,700	2,000
Sub-Base (crushed stone)		8,300	5,900	2,400
Capping (crushed stone)		12,500	0	12,500
Road sub-grade		30,100	0	30,100
HDD bore material		8,800	0	8,800

21.3.4.1 Environment Type

The environment of the study area have been classified in accordance with the generic types of geological / hydrogeological environments classified in the IGI (2013) guidelines to describe and encompass the variety of subsurface environments likely to be found in Ireland. These are:

- Type A – Passive geological / hydrogeological environments e.g. areas of thick low permeability subsoil, areas underlain by poor aquifers, recharge areas, historically stable geological environments
- Type B – Naturally dynamic hydrogeological environments e.g. groundwater discharge areas, areas underlain by regionally important aquifers, nearby spring rises, areas underlain by permeable subsoils
- Type C – Man-Made dynamic hydrogeological environments e.g. nearby groundwater abstractions, nearby quarrying or mining activities below the water table, nearby waste water discharges to ground, nearby geothermal systems

- Type D – Sensitive geological / hydrogeological environments e.g. potentially unstable geological environments, groundwater source protection zones, karst
- Type E – Groundwater dependent eco systems e.g. wetlands, nearby rivers with a high groundwater component of base flow.

The environment Based on the derived CSM, most of the study area is classified as a Type A Environment. The other types identified within the study area are C, D and E, which are summarized in Table 21.34.

A 'Feature Importance Ranking' is then assigned to each feature (likely to be affected by the proposed development based on guidance from the NRA and IGI). This facilitates the assessment of likely significant effects which has been undertaken in accordance with the guidance outlined in Section 21.2.3.

Table 21.34 Types of environments identified in the study area

Type	Criteria	Location
Type C	Quarrying or Mining Activities: Feltrim Quarry (Active), (Low importance)	Approximately 1.0km from the southern area of the onshore cable route and within one of the quarries mentioned above
Type D	Karst Features: Five springs (Low importance)	0.3km from the onshore cable route, in the southern area
		1km from the onshore cable route, in the central area
		1.2km from the onshore cable route, in the central area
		1.1km from the onshore cable route, in the central area
		1.1km from the onshore cable route, in the central area
	Groundwater Protection Zone: Bog of the Ring PWS (Very High Importance)	Northern area of the onshore cable route
Type E	Groundwater dependant habitat: (Sluice River Marsh pNHA (Very High Importance)	Located approximately 0.5km from the southern area of the onshore cable route
	Groundwater dependant habitat: Bog of the Ring pNHA (Very High Importance)	Located approximately 0.3km from the northern area of the onshore cable route

21.3.4.2 Activities/Environmental Matrix

The IGI guidelines recommend that an Activities / Environment Matrix be prepared to identify the type of investigations required, which depend on the nature of the baseline environment and the construction and operation activities proposed.

Table 21.35 outlines the activities that the IGL guidelines recommend be undertaken during construction and operation, and the investigations, assessments and surveys that have been carried out to consider. As can be seen from Table 21.35, the recommended investigations have been completed.

Table 21.35 Details of works required under the IGI guidelines and how they were undertaken on the site

Work required under Activity and Type Class (based on the IGI guidelines)	Details of works completed to date
Earthworks	
Intrusive site works to characterise nature, thickness, permeability and stratification of soils, subsoils. Project specific ground investigation carried out across the proposed development	Project specific ground investigation carried out across the proposed development
Storage / transmission of leachable and/or hazardous materials	
Establish nature and quantity of leachable materials	Collection of soil samples. Analysis for quality, including Waste Acceptance Criteria and waste classification screening
Site works to fully characterise nature, thickness, permeability and stratification of soils, subsoils, bedrock geology	Project specific ground investigation carried out across the proposed development
Works to determine groundwater-surface water interaction	Collection of groundwater and surface water samples for water quality analysis within the site.

Work required under Activity and Type Class (based on the IGI guidelines)	Details of works completed to date
Excavation of materials above the water table	
Site works to fully characterise nature, thickness, permeability and stratification of soils, subsoils, bedrock geology and in order to define the resource volume/weight according to the Pan-European Reserves and Resources Reporting Committee (PERC) Reporting Standard	Project specific ground investigation carried out across the proposed development
Excavation of materials below the water table	
Site works to fully characterise nature, thickness, permeability and stratification of soils, subsoils, bedrock geology and in order to define the resource volume/weight according to the PERC Reporting Standard	Project specific ground investigation carried out across the proposed development
Lowering of groundwater levels by pumping or discharge	
Intrusive site works to characterise nature, thickness, permeability and stratification of soils, subsoils.	Project specific ground investigation carried out across the proposed development

21.4 Characteristics of the Proposed Development

A description of the proposed development is provided in the Onshore Description chapter and construction activities are described in the Onshore Construction chapter.

21.4.1.1 Landfall Site

The main elements of the proposed development at the landfall will include:

- Two 220kV high voltage alternating current (HVAC) offshore export cables from the high water mark (HWM) to the transition joint bays (TJBs)
- A temporary compound – the landfall HDD contractor compound - for the export cable horizontal directional drilling (HDD) activity from onshore to offshore, and associated access track
- Two transition joint bays (TJBs) located close to the coastline to allow connection between offshore export cables and onshore export cables including a permanent access track. Each offshore export cable gets split out into 3 No. smaller cables, each located in a separate duct, once onshore
- Two 220kV HVAC underground onshore export cables approximately 1km to 1.5km long, connecting the TJBs to the compensation substation within the grid facility
- HDD crossing of the Dublin-Belfast railway line and open cut trench crossing of the R132
- Fibre optic cables, for operation and control purposes, laid underground with the onshore export cables
- Underground joint bays at approximately 300 – 800m intervals along underground cable routes to facilitate cable installation and future operation and maintenance; and
- Two temporary HDD contractor compounds for the railway crossing, and associated access tracks.

21.4.1.2 Grid Facility

The grid facility will be comprised of two separate elements as follows:

- The compensation substation; and
- The Bremore substation.

A cable will connect the compensation substation to the Bremore substation.

The compensation substation and Bremore substation will comprise various structures, buildings and electrical equipment.

21.4.1.3 Onshore Cable Route

From the Bremore substation, a double circuit consisting of 6 No. 220kV HVAC cables along with fibre optic communication and earthing cables will be laid underground from the grid facility site to the existing substation at Belcamp and the consented Belcamp extension project (F23A/0040). The onshore cable will be laid in a single trench with a minimum depth of cover of 950mm. The double circuit technology allows for the trench to be divided in two at certain sections of the route in order to navigate areas of high utility congestion. Refer to Section 7.5 of the Onshore Description Chapter for further information on the onshore cable technology.

The onshore cable route will be approximately 33-35km in length. It will have strategically positioned joint bays located along the cable route at approximately 300m to 800m spacings, to facilitate cable installation. These will also facilitate the operation and maintenance of the cable during the operational lifetime of the proposed development.

The onshore cable will be routed along public roads as much as possible apart from sections of the route the connection point (existing Belcamp substation), and where it is necessary to divert the route off the road for engineering reasons.

21.5 Potential Effects

21.5.1 Do-Nothing Scenario

In the case where the proposed development does not proceed there would be no resulting effects on land, soils, geology and hydrogeology along the route of the proposed development. The effect would therefore be neutral.

21.5.2 Construction Phase

The potential land, soils, geology and hydrogeology effects during the construction phase are presented in this section, along with their effect significance. These potential effects also relate and interact with other environmental factors which are described within the EIAR. Specific interactions are outlined in Section 21.8 and 21.9.

The magnitude of the potential effects is expressed in accordance with the criteria for rating impact significance and magnitude as set out in Table C4 and Table C5 of the IGI Guidelines (IGI 2013) and Box 5.1 of the NRA Guidelines (NRA, 2008a).

The rating of significant environmental impacts is expressed in accordance with the Table C6 of the IGI Guidelines (IGI 2013) and Box 5.4 (NRA 2008a).

21.5.2.1 Landfall site

Construction activities at the landfall site will have the following potential effects on land, soils, geology and hydrogeology as discussed below and summarised Table 21.36. As demonstrated in Table 21.35, there no significant effects are anticipated to arise from construction activities at the landfall site.

- Loss or damage of topsoil
- Loss of solid geology
- Earthworks haulage
- Effect on the surrounding ground
- Loss of future quarry or pit reserve (Loss of mineral or aggregate resources)
- Loss or damage of part proportion or all of a Geological Heritage Area
- Loss or damage of proportion of an aquifer
- Damage of an aquifer due to accidental spills or leaks
- Change to groundwater regime.

Though the magnitude of the effect may vary depending on the scale of activities and location of the activity relative to the affected important feature, only the maximum magnitude of the effect of the proposed development is discussed.

Loss or damage of topsoil

Topsoil is a non-renewable source which if removed or damaged can result in a permanent irreversible negative effect. There are a few ways this could happen:

- There is the potential for materials, such as oil, lubricants and hazardous chemicals on site to be spilled resulting in the pollution of the topsoil
- Permanent loss of topsoil through soil sealing by replacing topsoil with impervious material
- Excavated soil materials will be stockpiled. Materials that are stockpiled incorrectly can be exposed to compaction, erosion and weathering which reduces the quality of the resource and its organic content
- Excavations in areas of unknown contaminated ground for the construction works may mobilise pollution contained in the soils into the nearby topsoil
- Permanent damage to topsoil through compaction (over-compaction resulting in soil sealing), waterlogging and erosion. These could be caused by trafficking of plant, regrading of slopes inappropriately and storage of materials in areas not intended to be paved as part of the proposed development; and
- Excavation and disposal of topsoil instead of its reuse or reinstatement.

The Onshore Construction chapter highlights that excavations will be required at the landfall site (see Section 9.5). It is expected that much of the topsoil and overburden will be stripped and temporarily stored separately at a designated excavated material storage area adjacent to the temporary compound within the proposed development.

Topsoil will be stripped at the landfall site to accommodate the construction of temporary access tracks and for the temporary contractor compounds to support Horizontal Directional Drilling (HDD) operations and cable construction from the HDD operations to the grid facility. Where topsoil and subsoil are stripped to accommodate the works outlined above, all the above effects have the potential to occur at these locations.

The magnitude of this potential effect is expected to be small adverse and the significance of this potential effect is slight

Loss of Solid Geology

Excavation of rock will occur as part of the HDD process for both the offshore export cables HDD and the HDD at the railway line crossing. Where possible, excavated material will be reused in the proposed development if it can be shown to fulfil an appropriate engineering specification.

Given the small quantity of rock which may be excavated as outlined in Table 21.31, it is expected to be of medium importance. It would be uneconomic to extract it and there are readily available alternative sources of similar bedrock available. The magnitude of this potential effect is expected to be small adverse and the significance of this potential effect is slight.

Earthworks Haulage

During earthworks, heavily loaded large earthmoving vehicles will travel through the landfall site causing ground vibrations, soil compaction and disturbance of natural ground on unfinished road surfaces. This will also result in increased traffic on the roads to and from the landfall site, although internal haul roads (access tracks) would be used where possible. Increased noise, dust and vibration will also be generated.

These works are expected to have a low importance given the volume of the material to be removed. The magnitude of this potential effect is small adverse. The significance of the potential effect is imperceptible and will not be considered further.

Volume 5, Chapter 27: Air Quality (hereafter referred to as the 'Air Quality' Chapter) and Volume 5, Chapter 30: Noise and Vibration (hereafter referred to as the 'Noise and Vibration' Chapter) provides more information on dust, noise and vibration.

Section 24.4 of Volume 4, Chapter 24: Traffic and Transport (hereafter referred to as the 'Traffic' Chapter) provides more information on earthworks haulage within the proposed development.

Effect on the surrounding ground

The soil and rock excavation during the construction process at the landfall site has the potential to induce movement and settlement of the surrounding ground.

Two HDDs will be required within the landfall site east of the Dublin to Belfast railway: the landfall HDD contractor compound from which the offshore export cable will be constructed, and the Railway HDD entry site contractor compound from which the onshore export cable underneath the Dublin to Belfast railway will be constructed. Two separate HDD bores will be required at both locations. Following the completion of the offshore export cable installation at the landfall HDD contractor compound, the Transition Joint Bays (TJBs) will be installed at this location.

The likelihood of instability or collapse of the cliff as a result of the HDD process is considered to be low, given the distance to the sea cliffs, the proposed depth of the HDD below the base of the cliff and in turn the proposed depth of the HDD below the coastline.

The TJBs will be approximately 80m inland from the current HWM. In order for this location to be impacted by coastal erosion, the coastal retreat would have to increase significantly from the less than 0.1m per year currently observed. It is therefore considered that the risk of coastal erosion impacting the TJBs before 2065 is low.

The magnitude of this potential effect is expected to be small adverse and the significance of this potential effect is slight.

Loss of future quarry or pit reserve

The sterilisation of land through land-take because of the development or the excavation of soil and rock during construction has the potential to diminish future quarry and pit reserves of mineral and aggregate resources.

This can result in a permanent irreversible loss of aggregate or mineral resources. in-situ characteristics of the land, soils, geology and hydrogeology of the area. The land and soils on a local scale will be negatively affected by the construction of new facilities and the removal of soil and rock.

The magnitude of this effect is expected to be negligible as there will be a very slight permanent irreversible change on a local scale compared to the 'do nothing' and 'do minimum' scenarios. As the aggregate potential is of medium and high importance the resulting significance of this negligible effect is imperceptible and will not be considered further.

Loss or damage of proportion of Geological Heritage Area

The sealing, contamination or excavation of soil and rock during construction can diminish the value of geological heritage areas. This can result in a permanent irreversible loss of the in-situ characteristics of the land, soils, geology and hydrogeology of the area.

Laytown to Gormanstown CGS is located approximately 750m north of the proposed development and given no works are planned directly adjacent to CGS, the magnitude of this effect is expected to be negligible. As the importance of the Geological Heritage Area is high, the resulting significance is imperceptible and therefore will not be considered further.

Loss or damage of proportion of aquifer

This bedrock is classified as a locally important aquifer and is moderately productive (Lm). The removal of a proportion of an aquifer can reduce its ability to provide baseflow to groundwater dependant habitats and / or water supplies and result in an irreversible loss of the in-situ characteristics of the hydrogeology.

The HDD drill bores are expected to have a maximum outer diameter of approximately 1,016mm removing a small portion of the bedrock aquifer. Similarly, excavations required for the landfall site construction will also remove or damage localised areas of the underlying bedrock.

These activities will be localised and are considered insufficient to affect the overall integrity of the underlying aquifer. Therefore, loss of the aquifer due to the HDD drilling and excavations is expected to be a negligible effect , and the resulting significance is considered imperceptible and will not be considered further.

Damage of the aquifer due to accidental spills or leaks

Potential pollutants associated with construction activities (i.e. fuel and lubricants etc.) will be stored at the temporary Bremore cable contractor compound at the landfall site. The HDDs for the offshore export cable landfall and the railway crossing will require a drilling fluid to cool and lubricate the drill head. Bentonite will be used, which comprises 95% water and 5% bentonite clay which is a non-toxic, natural substance. It will be a closed system, with drilling fluid recirculated, the drill cuttings recovered, and drilling fluid reused.

As it is non-toxic, the bentonite will not have a significant effect on ground water quality.

If potential spills or leaks from the associated construction equipment do occur, they may potentially contaminate the groundwater beneath the proposed development. These would be temporary effects. The magnitude of this potential adverse effect on the locally important aquifer is considered to be moderate leading to a significance rating of moderate.

Change to groundwater regime

Localised pumping of excavations may be required as part of the construction phase at structures and deep trenches in order to allow works to be carried out in dry excavations. Where excavation goes below the existing groundwater table this could lead to a temporary change in the groundwater flow or levels within the Locally Important aquifers underlying the proposed development.

Since the pumping is expected to be limited, temporary and localised, the magnitude of this impact expected to be negligible. As the importance of the Locally Important aquifers is medium, the resulting significance is imperceptible and will not be considered further.

Reinstatement

Following the excavation at the landfall site along with all other associated works during construction, the site will be reinstated to its original condition as far as practicable with the replacement of excavated materials where appropriate. If the excavated materials are not suitable for re-use, then equivalent materials may be imported for reinstatement. Acceptable materials for import may include materials classified as by products from excavations in natural soils under Regulation 15 of S.I. No. 323/2020 – European Union (Waste Directive) Regulations 2020.

Table 21.36 Summary of predicted construction phase effects at Landfall site.

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Loss or Damage of Topsoil									
Topsoil	AminSW & Amin DW	Landfall site	Medium	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Slight
Loss of Solid Geology									
Bedrock quality and significance	Belcamp Formation	Landfall site	Medium	Loss of Solid Geology	Negative	Permanent	Local	Small adverse	Slight
Earthworks Haulage									
Ground vibrations, soil compaction and disturbance of natural ground	N/A	Landfall site	Medium	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Imperceptible
Effect on the Surrounding Ground									
Surrounding ground	N/A	Landfall site	Medium	Sea cliffs located at least approximately 0.5km from the HDD compound	Negative	Permanent	Local	Small adverse	Slight
Loss of Future Quarry or Pit Reserve									
Crushed rock aggregate potential	Moderate Potential	Landfall site	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
	High Potential	Landfall site	High	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Loss or damage of proportion of Geological Heritage Area									
Geological Heritage Area	Laytown to Gormanston	Approximately 0.75km north of the landfall site	High	Loss or damage of proportion of Geological Heritage Area	Negative	Permanent	Local	Negligible	Imperceptible
Loss or Damage of Proportion of Aquifer									
Locally Important Aquifer (Lm)	Bedrock which is Generally Moderately Productive	Landfall site	Medium	Loss or damage of proportion of aquifer through excavation.	Negative	Permanent	Local	Negligible	Imperceptible

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Damage to aquifer due to accidental spillage									
Locally Important Aquifer (Lm)	Bedrock which is Generally Moderately Productive	Landfall site	Medium	Damage to proportion of aquifer due to accidental spillages.	Negative	Temporary	Local	Moderate adverse	Moderate
Change to Groundwater Regime									
Locally Important Aquifer (Lm)	Bedrock which is Generally Moderately Productive	Landfall site	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible

21.5.2.2 Grid facility

Construction activities at the grid facility will have the following potential effects on land, soils, geology and hydrogeology as discussed below and summarised in Table 21.36. As demonstrated in Table 21.36, there are no significant effects anticipated to arise from construction activities at the grid facility.

- Loss or damage of topsoil and subsoil
- Earthworks haulage
- Effect on the surrounding ground
- Loss of future quarry or pit reserve
- Loss or damage of proportion of Geological Heritage Area
- Loss or damage of proportion of aquifer
- Damage to aquifer due to accidental spills
- Change to groundwater regime.

Though the magnitude of the effect may vary depending on the scale of activities and location of the activity relative to the effected important feature, only the maximum magnitude of the effect of the proposed development is discussed.

Loss or damage of topsoil and subsoil

Topsoil is a non-renewable source which if removed or damaged can result in a permanent irreversible negative effect. There are a number of ways this could happen.

- There is the potential for materials on site to be spilled resulting in the pollution of the topsoil
- Permanent loss of topsoil through soil sealing by replacing topsoil with impervious material
- These excavated soil materials will be stockpiled using appropriate methods to minimise the impacts of weathering. Materials that are stockpiled incorrectly can be exposed to compaction, erosion and weathering which reduces the quality of the resource and its organic content
- Excavations in areas of unknown contaminated ground for the construction works may mobilise pollution contained in the soils into the nearby topsoil
- Permanent damage of topsoil through compaction (over-compaction resulting in soil sealing), waterlogging and erosion. This would be due to the trafficking of plant, regrading of slopes and storage of materials in areas not intended to be paved as part of the proposed development; and
- Excavation and disposal of topsoil instead of its reuse or reinstatement.

The Onshore Construction chapter highlights that excavations will be required at the grid facility. It is expected that much of the topsoil and overburden will be stripped and temporarily stored separately at a designated excavated material storage area adjacent to the grid facility contractor compound.

Topsoil will be stripped at the grid facility to achieve the final platform level to accommodate the haul roads and the substation. The grid facility is located close to the landfall site and will have a footprint of approximately 100m x 300m. Where topsoil and subsoil are stripped to accommodate the works outlined above, all the above effects have the potential to occur at this location.

The magnitude of this potential effect is small adverse, and the significance of this potential effect is slight.

Earthworks Haulage

During earthworks, heavily loaded large earthmoving vehicles will travel through the grid facility causing ground vibrations, soil compaction and disturbance of natural ground on unfinished road surfaces. This will also result in increased traffic on the roads to and from the grid facility, although internal haul roads (access tracks) will be used where possible (connection to the grid facility). Increased noise, dust and vibration will also be generated.

These works are expected to have a low importance given the volume of the material for removal, as outlined in Table 21.31. The magnitude of the effect of this would be small adverse. The significance of the potential effect is imperceptible and will not be considered further.

The Air Quality chapter and Noise and Vibration chapter provide more information on dust, noise and vibration.

Section 24.4 of The Traffic chapter provides more information on earthworks haulage within the proposed development.

Effect on the surrounding ground

The soil excavation during the construction process at the grid facility has the potential to induce movement and settlement of surrounding ground. The removal of soil for the haul roads and the grid facility could result in minor ground vibrations with effects felt in the immediate vicinity of the works.

These works may also give rise to noise and vibration effects and may result in the generation of dust. The Air Quality chapter and Noise and Vibration chapter provide more information on such effects.

These works are expected to have a low importance given the underlying soils generally removed that are firm to stiff clay. The magnitude of the effect of this activity is small adverse. The significance of the potential effect is imperceptible and will not be considered further.

Loss of future quarry or pit reserve

The sterilisation of land through development or the excavation of soil and rock during construction can diminish future quarry and pit reserves. This can result in a permanent irreversible loss of the in-situ characteristics of the land and soils area. The land and soils on a local scale will be negatively affected by the construction of new facilities and the removal of soil and rock.

The magnitude of this effect is negligible as it results in an insufficient permanent irreversible change on a local scale to affect the integrity of the land and soils above the do nothing and do minimum scenario. As the aggregate potential is of medium and high importance the resulting significance of this negligible effect is imperceptible and will not be considered further.

Loss or damage of proportion of Geological Heritage Area

The sealing, contamination or excavation of soil and rock during construction can diminish the value of geological heritage areas. This can result in a permanent irreversible loss of the in-situ characteristics of the land, soils, geology and hydrogeology of the area.

Since there is no works planned directly adjacent to the Laytown to Gormanston CGS, the magnitude of this effect is considered negligible. As the importance of the Geological Heritage Area is high, the resulting significance is imperceptible and therefore will not be considered further.

Loss or damage of proportion of aquifer

This bedrock is classified as a locally important aquifer and is moderately productive (Lm). The removal of a proportion of an aquifer can reduce its ability to provide baseflow to groundwater dependant habitats and/or water supplies and results in an irreversible loss of the in-situ characteristics of the land, soils, geology and hydrogeology.

The haul roads and the grid facility excavations are expected to be localised. These activities are considered insufficient to affect the overall integrity of the underlying aquifer, therefore, loss of aquifer will have a localised, permanent effect which is considered imperceptible and will not be considered further.

Damage of aquifer due to accidental spills

The mobilisation of contaminants into the aquifer either through accidental spillage or disturbance of contaminated ground during excavation may reduce the quality of the groundwater within the aquifer.

If potential spills or leaks from the associated construction equipment do occur, they may potentially contaminate the groundwater beneath the proposed development. These are short-term effects. The magnitude of this potential adverse effect on the locally important aquifer is considered to be moderate leading to a significance rating of moderate.

Change to groundwater regime

Localised pumping of excavations is expected to be required as part of the construction phase at structures and deep trenches in order to allow works to be carried out in dry excavations. Where excavation goes below the existing groundwater table this could lead to a temporary change in the groundwater flow or levels within the locally important aquifers underlying the proposed development.

Since the pumping is expected to be limited, temporary and localised, the magnitude of this impact is considered negligible. As the importance of the locally important aquifer is medium, the resulting significance is imperceptible and will not be considered further.

Reinstatement

Following the excavation at the grid facility along with all other associated works during construction, the site will be reinstated to its original condition as far as practicable with the replacement of excavated materials where appropriate. If the excavated materials are not suitable for re-use, then equivalent materials may be imported for reinstatement. Acceptable materials for import may include materials classified as by products from excavations in natural soils under Regulation 15 of S.I. No. 323/2020 – European Union (Waste Directive) Regulations 2020.

Table 21.37 Summary of predicted construction phase effects at Grid facility

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Loss or Damage of Topsoil and subsoil									
Topsoil	AminSW & Amin DW	Grid Facility	Medium	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Slight
Earthworks Haulage									
Ground vibrations, soil compaction and disturbance of natural ground	N/A	Grid facility	Medium	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Imperceptible
Effect on the Surrounding Ground									
Surrounding ground	N/A	Grid facility	Medium	Effect on the surrounding ground (firm to stiff clay)	Negative	Permanent	Local	Small adverse	Imperceptible
Loss of Future Quarry or Pit Reserve									
Crushed rock aggregate potential	Moderate Potential	Localised pocket within the grid facility	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Crushed rock aggregate potential	High Potential	Localised pocket within the grid facility	High	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Loss or damage of proportion of Geological Heritage Area									
Geological Heritage Area	Laytown to Gormanston	Approximately 0.75km north of the landfall site	High	Damage of a Geological Heritage Area	Negative	Permanent	Local	Negligible	Imperceptible
Loss or Damage of Proportion of Aquifer									
Locally Important Aquifer (Lm)	Bedrock which is Generally Moderately Productive	Grid facility	Medium	Loss or damage of proportion of aquifer through excavation.	Negative	Permanent	Local	Negligible	Imperceptible
Damage of aquifer due to accidental spills									
Locally Important Aquifer (Lm)	Bedrock which is Generally Moderately Productive	Grid facility	Medium	Damage to proportion of aquifer due to accidental spillages.	Negative	Temporary	Local	Moderate adverse	Moderate
Change to Groundwater Regime									
Locally Important Aquifer (Lm)	Bedrock which is Generally Moderately Productive	Grid facility	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible

21.5.2.3 Onshore cable route

Construction activities at the onshore cable route will have the following potential effects on the land, soils, geology and hydrogeology as discussed below and summarised in Table 21.37. As demonstrated in Table 21.37, there are no significant effects anticipated to arise from construction activities along the onshore cable route.

- Loss and damage of topsoil and subsoil;
- Loss of Solid Geology;
- Earthworks haulage;
- Effect on the surrounding ground;
- Excavation of Potentially Contaminated Ground;
- Loss of future quarry or pit reserve;
- Loss or damage of proportion of Geological Heritage Area;
- Loss or damage of proportion of aquifer;
- Damage of the aquifer due to accidental spills;
- Change to groundwater regime;
- Damage of Groundwater Protection Zones; and
- Loss or damage of a groundwater dependant habitat.

Though the magnitude of the effect may vary depending on the scale of activities and location of the activity relative to the effected important feature, only the maximum magnitude of the effect of the proposed development is discussed.

Loss and damage of topsoil and subsoil

Topsoil is a non-renewable source which if removed or damaged can result in a permanent irreversible negative effect. There are a number of ways this could happen:

- There is the potential for materials on site to be spilled resulting in the pollution of the topsoil
- Permanent loss of topsoil through soil sealing by replacing topsoil with impervious material
- These excavated soil materials will be stockpiled using appropriate methods to minimise the impacts of weathering. Materials that are stockpiled incorrectly can be exposed to compaction, erosion and weathering which reduces the quality of the resource and its organic content
- Excavations in areas of unknown contaminated ground for the construction works may mobilise pollution contained in the soils into the nearby topsoil
- Permanent damage of topsoil through compaction (over-compaction resulting in soil sealing), waterlogging and erosion. This would be due to the trafficking of plant, regrading of slopes and storage of materials in areas not intended to be paved as part of the proposed development; and
- Excavation and disposal of topsoil instead of its reuse or reinstatement.

Section 9.5 of the Onshore Construction chapter highlights that excavations will be required throughout the onshore cable route. It is expected that much of the topsoil and overburden will be stripped and temporarily stored separately at designated excavated material storage area or as close as possible to the excavation within the proposed development.

Topsoil will be stripped at the onshore cable route to accommodate the trenches, haul roads/access tracks, platforms for the HDD crossings and temporary construction compounds and working areas along the onshore cable route. Where topsoil and subsoil are stripped to accommodate the works outlined above, all the above effects have the potential to occur at these locations.

The magnitude of this potential effect is small adverse, and the significance of this potential effect is slight.

Loss of Solid Geology

Excavation of rock will be removed as part of the HDD process for the M1 HDD. Where possible, excavated material will be reused in the proposed development if it can be shown to fulfil an appropriate engineering specification. If the excavated rock does not meet an appropriate engineering specification, it will be reused in landscaping.

Given the small quantity of rock which may be excavated as outlined in Table 21.34, it is considered a medium importance, it is uneconomic to extract it and there are readily available alternative sources of similar bedrock available. The magnitude of this potential effect is small adverse and the significance of this potential effect is slight.

Earthworks Haulage

During earthworks, heavily loaded large earthmoving vehicles will travel through the temporary construction working areas of the onshore cable route, causing ground vibrations, soil compaction and disturbance of natural ground on unfinished road surfaces. This will also result in increased traffic on the roads along the proposed onshore cable route. Increased noise, dust, vibration will also be generated.

These works are expected to have a low importance given the volume of the material for removal is low on a local scale. The magnitude of the effect of this would be small adverse. The significance of the potential effect is imperceptible.

The Air Quality Chapter and Noise and Vibration Chapter provide more information on noise, dust and vibration.

Section 24.4 of the Traffic Chapter provides more information on earthworks haulage within the proposed development.

Effect on the surrounding ground

The soil and rock excavation during the construction process along the onshore cable route has the potential to induce movement and settlement of surrounding ground. The removal of the bedrock for the HDD process will be carried out using mechanical excavation during HDD operations which could result in minor ground vibrations with effects felt in the immediate vicinity of the works.

These works may also give rise to noise and vibration effects and may result in the generation of dust. The Air Quality Chapter and Noise and Vibration Chapter provide more information on such effects.

These works are expected to have a mostly low importance, with some areas with medium importance, given the quantity of underlying soils to be excavated is medium and that settlement is likely to be small since the soil will be excavated. The magnitude of the effect of this activity would be small adverse.

The significance of the potential effect is imperceptible and will not be considered further.

Excavation of potentially contaminated ground

Excavations in areas of unknown contaminated ground for the construction works may mobilise pollution contained in the soils into the nearby topsoil. This may potentially lead to a risk to the surrounding environment or underlying soil if not dealt with in an appropriate manner in accordance with the EPA guidance on Land Contamination. The underlying soil could be impacted from the exposure of previous buried hazardous material, in an unlicensed dumping site for example.

There are a few potential sources of contamination along the onshore cable route as identified in Section 21.3.3.9.

The magnitude of this impact is small adverse, as there is no evidence of contamination on these sites, and they are characterised only as potential sources of contamination regarding their activities. As the potential contaminated ground is of medium importance the resulting significance of the permanent small adverse impact is slight.

Loss of future quarry or pit reserve

The sterilisation of land through development or the excavation of soil and rock during construction can diminish future quarry and pit reserves. This can result in a permanent irreversible loss of the in-situ characteristics of the land and soils area. The land and soils on a local scale will be negatively affected by the construction of new facilities and the removal of soil and rock.

The magnitude of this effect is negligible as it results in an insufficient permanent irreversible change on a local scale to affect the integrity of the land and soils above the do nothing scenario. The aggregate potential ranges from high to low importance. The resulting significance of this negligible effect is imperceptible and will not be considered further.

Loss or damage of proportion of Geological Heritage Area

The sealing, contamination or excavation of soil and rock during construction can diminish the value of geological heritage areas. This can result in a permanent irreversible loss of the in-situ characteristics of the land, soils, geology and hydrogeology of the area.

The Laytown to Gormanston CGS is located approximately 750m north of the proposed development, The Fancourt Shore geological heritage area, which is characterised as coastal cliffs and foreshore is located approximately 1.2km north of the onshore cable route. The Ardgillan House Boulder, a single large boulder on an access path to Ardgillan house, is located approximately 1.9km north of the onshore cable route. The Feltrim Quarry is located approximately 0.5km from the onshore cable route west of the Malahide Road. The Malahide Point, described as a large dune system and beach formed by a long sand and shingle spit, is located in the south of the onshore cable route. The Balrickard Quarry is located approximately 0.9km from the onshore cable route.

The Geological Heritage Area's importance are listed as high, but as the proposed works on the onshore cable route are located a sufficient distance away from the Geological Heritage Areas, the resulting significance is imperceptible, and therefore will not be considered further.

Loss or damage of proportion of aquifer

Most of the area is classified as a locally important aquifer where bedrock which is moderately productive only in local zones (LI) and where bedrock is generally moderately productive (Lm), with a small area classified as a locally important karstified aquifer (Lk) a few areas classified as a poor aquifer (Pl). The removal of a proportion of an aquifer can reduce its ability to provide baseflow to groundwater dependant habitats and or water supplies and results in an irreversible loss of the in-situ characteristics of the land, soils, geology and hydrogeology.

The HDD drill bore, for the onshore cable route, is expected to have a maximum outer diameter of approximately 1,016mm removing a small portion of the bedrock aquifer. Similarly, excavations required for the onshore cable route will also remove or damage localised areas of the underlying bedrock. These activities are localised and considered insufficient to affect the overall integrity of the underlying aquifer. Therefore, the magnitude of the loss or damage of the aquifer is considered to be negligible and the impact on the Locally Important aquifer is imperceptible and will not be considered further.

Damage of the aquifer due to accidental spills

Potential pollutants associated with construction activities (i.e. fuel and lubricants etc.) will be stored at designated compounds along the onshore cable route. As it is non-toxic, the bentonite to be used for the HDD process, would not have a significant effect on ground water quality. Section 9.5 of the Onshore Construction chapter provides more information on the HDD construction method.

If potential spills or leaks from the associated construction equipment do occur, they may potentially contaminate the groundwater beneath the proposed development. These are potential temporary effects.

The magnitude of this potential impact on the locally important aquifers (Ll, Lm and Lk) could potentially be moderate adverse leading to a significance rating of moderate.

Change to groundwater regime

Localised pumping of excavations are expected to be required as part of the construction phase at structures and deep trenches in order to allow works to be carried out in dry excavations. Where excavation goes below the existing water table this could lead to a temporary change in the groundwater flow or levels within the locally important aquifers (Ll, Lm and Lk) underlying the proposed development.

Since the pumping is expected to be limited, temporary and localised for the onshore cable route, the magnitude of this impact is considered negligible. As the importance of the locally important aquifer is medium, the resulting significance is imperceptible and will not be considered further.

Damage to Groundwater Resources

Groundwater resources including large spring, well or borehole may be impacted by the removal of the abstraction itself or changes to the groundwater regime or groundwater quality within the abstractions zone of contribution.

The Bog of the Ring Outer Source Protection Area (SO) crosses the onshore cable route south of Balbriggan. The portion of onshore cable route which crosses the Bog of the Ring SO is predominantly within areas of low aquifer vulnerability, with small areas of medium to extreme vulnerability. In these smaller areas of high and extreme vulnerability the aquifer is more susceptible to groundwater contamination due to accidental spillage during construction related activities (i.e. fuels or lubricants) or the mobilisation of contaminants during the removal of contaminated soil. As these areas of high and extreme vulnerability are relatively small and located at the edge of the SO boundary the impact is considered to be small adverse and temporary. As the Bog of the Ring PWS is of very high importance, the significance of this effect is moderate.

EPA registered groundwater abstraction R01652-01 is located approximately 0.7km west of the proposed development and situated downgradient of the proposed development. Upgradient, the onshore cable route crosses small areas of medium to extreme vulnerability which are more susceptible to groundwater contamination due to accidental spillage during construction related activities (i.e. fuels or lubricants) or the mobilisation of contaminants during the removal of contaminated soil. If spills or leaks associated with construction occur, this may potentially contaminate the groundwater beneath the proposed development which may be connected to the groundwater abstraction. The magnitude of this potential adverse impact on this abstraction of high importance is considered to be small leading to a significance rating of slight.

EPA registered groundwater abstractions R01566-01 and R01607-01 are located approximately 1km and 1.6km, east and west respectively of the proposed development. Considering that these abstractions are located upgradient of the proposed development, the abstraction rates are relatively small and there is considerable distance between the proposed development and the abstractions, the potential for loss or damage to the abstractions is considered to be a negligible impact. The abstractions are of medium importance and the resulting significance of the impact is imperceptible and will not be assessed further.

Loss or damage of a groundwater dependant habitat

Loss or damage of a groundwater dependant habitat can occur through changes to the groundwater regime or changes to the groundwater quality. Construction of the onshore cable route may have a potential impact on the groundwater regime where there is temporary dewatering of excavations below the water table. Groundwater quality in the aquifer may be altered in the short term, due to accidental spillage of pollutant (i.e. fuels or lubricants) during construction related activities or temporarily due to mobilisation of contaminants during the removal of contaminated soil.

The Bog of the Ring pNHA is located approximately 0.3km west of onshore cable route and is separated from the cable route by the MATT_010 watercourse. The underlying bedrock in this area is a Locally Important aquifer which typically has relatively short pathways and the groundwater flow tends to follow the topography. The groundwater flow in the region is toward the north and groundwater will discharge into the closest surface water features (e.g. MATT_010) where there is a connection between the groundwater and the river. However, the aquifer is confined in this area by thick subsoil deposits (low vulnerability) and the MATT_010 is unlikely to be in connection with the groundwater at this stretch of the watercourse.

Furthermore, the watercourse is unlikely to be losing water back into the pNHA and the flow is more likely to be discharging from the pNHA into the river. Therefore, if there was a pollution event associated with the onshore cable route construction which entered the MATT_010 upstream of the pNHA which coincided with elevated river levels (above the groundwater level), any discharge into the pNHA would be temporary and limited and there would be an negligible impact on the pNHA groundwater quality. Therefore, considering the distance of the pNHA and its hydraulic separation from the cable route, the potential for changes to the groundwater regime or groundwater quality at the pNHA are considered negligible. The Bog of the Ring pNHA is of very high importance, resulting in an imperceptible impact and this will not be assessed further.

The Sluice River Marsh is located approximately 300m east of the proposed development. The Sluice Stream which crosses the onshore cable route is likely to be hydraulically connected with the downstream Sluice River Marsh. Due to the distance of the marsh downstream of the proposed development the potential for alteration to the groundwater regime within the marsh as a result of any dewatering associated with the construction phase is negligible.

Accidental spills and pollution incidents associated with the onshore cable route have the potential to influence the groundwater quality at the Sluice Marsh pNHA. The onshore cable route is located upgradient of the Sluice Marsh pNHA. The area is classified as moderate to high vulnerability, with the small area of high vulnerability located directly adjacent to the Sluice Stream. As the excavations for the cable are shallow it is anticipated that the bedrock will not be encountered, and the presence of low permeability subsoil will limit the pathway for any pollution to enter the groundwater. However, as there is potential for a limited hydrogeological connection between the cable route and the pNHA, there is potential for a pathway for pollution as a result of accidental spills. This is considered to be a small adverse impact. The Sluice Marsh pNHA is of very high importance and the resulting significance impact is moderate.

At Blakes Cross South, the entirety of the Deanstown Stream including the GS4 wet grassland/GM1 Marsh habitat will be avoided using HDD at this location. As it is non-toxic, the bentonite to be used for the HDD process, would not have a significant effect on ground water quality. If potential spills or leaks from the associated construction equipment do occur, there it limited potential for the contamination to enter the bedrock aquifer as the bedrock vulnerability is classified as low. The magnitude of this potential temporary impact on the GS4 wet grassland/GM1 Marsh habitat is considered to be small adverse. As the habitat is of high importance the significance rating is slight.

Reinstatement

Following the excavations required for the onshore cable route along with all other associated works during construction, the temporary cable construction corridor will be reinstated to its original condition as far as practicable with the replacement of excavated materials where appropriate. If the excavated materials are not suitable for re-use, then equivalent materials may be imported for reinstatement.

Acceptable materials for import may include materials classified as by products from excavations in natural soils under Regulation 15 of S.I. No. 323/2020 – European Union (Waste Directive) Regulations 2020.

Table 21.38 Summary of predicted construction phase effects at Onshore Cable Route.

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Loss or Damage of Topsoil & Subsoil									
Topsoil	AlluvMIN	Minor areas of the onshore cable route	Medium	Loss or damage of topsoil or subsoil	Negative	Permanent	Local	Negligible	Imperceptible
	BminSW	Southern area of the onshore cable route	Medium	Loss or damage of topsoil or subsoil	Negative	Permanent	Local	Small adverse	Slight
	AminDW	Northern area of the onshore cable route	High	Loss or damage of topsoil or subsoil	Negative	Permanent	Local	Small adverse	Slight
	BminDW	Central and southern area of the onshore cable route	High	Loss or damage of topsoil or subsoil	Negative	Permanent	Local	Small adverse	Slight
Subsoil	A	River and stream crossings	Medium	Loss or damage of topsoil or subsoil	Negative	Permanent	Local	Small adverse	Slight
	GLPSsS	Northern area of onshore cable route	Medium	Loss or damage of topsoil or subsoil	Negative	Permanent	Local	Small adverse	Slight
	GLs	Central and southern area of the onshore cable route and northern of landfall site	Medium	Loss or damage of topsoil or subsoil	Negative	Permanent	Local	Small adverse	Slight
	IrSTLs	Central and southern area of the onshore cable Route	Medium	Loss or damage of topsoil or subsoil	Negative	Permanent	Local	Small adverse	Slight
	TNSSs	Central area of the onshore cable route	Medium	Loss or damage of topsoil or subsoil	Negative	Permanent	Local	Small adverse	Slight
	TLS	Central and southern areas of the onshore cable route and at the existing Belcamp 220kV station	Medium	Loss or damage of topsoil or subsoil	Negative	Permanent	Local	Small adverse	Slight
Loss of Solid Geology									
Bedrock quality and significance	Malahide	Southern area of the onshore cable route	Medium	Loss of Solid Geology	Negative	Permanent	Local	Small adverse	Slight
Earthworks Haulage									
Ground vibrations, soil compaction and disturbance of natural ground	N/A	Onshore cable route	Medium	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Imperceptible

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Effect on the Surrounding Ground									
Surrounding ground	N/A	Onshore cable route	Medium	Effect on the surrounding ground (firm to stiff clay)	Negative	Permanent	Local	Small adverse	Imperceptible
Excavation of Potentially Contaminated Ground									
Disposal of non-hazardous waste area	Fingal Landfill, Nevitt	Approximately 1.0km west of the onshore cable route	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
	Bord Na Móna Recycling Limited (Advanced Environmental Solutions (Ireland) Limited)	Approximately 0.5km from the onshore cable route, in the central area	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
	Fingal County Council	Approximately 1.5km from the onshore cable route, in the central area	Medium	Excavation of potentially contaminated ground	Negative	Permanent	Local	Small adverse	Slight
	Petrol Stations	A number of petrol stations along the onshore cable route.	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
	Two samples were classified as non-hazardous	TP21 Blakes Cross TP108 Onshore Cable Route	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
	Two samples were classified as hazardous	ST02 & ST31	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
	Old Landfills close to Belcamp	Unlicensed Landfill - Belcamp	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Loss of Future Quarry or Pit Reserve									
Crushed rock aggregate potential	Moderate Potential	Areas along the onshore cable route	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
	High Potential	A few areas along the onshore cable route	High	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
	Very High Potential	Minor areas in the southern of the onshore cable route	High	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Granular aggregate potential	Moderate Potential	Small pocket in the central area and other small areas in the southern area of the onshore cable route	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
	High Potential	Minor areas of the onshore cable route	High	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
	Very High Potential	Minor areas of the onshore cable route	High	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Loss or Damage of Proportion of Aquifer									
Locally Important Aquifer (Lm)	Bedrock which is Generally Moderately Productive	Central areas of the onshore cable route	Medium	Loss or damage of proportion of aquifer through excavation.	Negative	Permanent	Local	Negligible	Imperceptible
Locally Important Aquifer (Ll)	Bedrock which is Moderately Productive only in Local zones	Minor areas on the southern of the onshore cable route	Medium	Loss or damage of proportion of aquifer through excavation.	Negative	Permanent	Local	Negligible	Imperceptible
Locally Important Aquifer (Lk)	Locally Important Aquifer - Karstified	Central and southern areas of the onshore cable route	Medium	Loss or damage of proportion of aquifer through excavation.	Negative	Permanent	Local	Negligible	Imperceptible
Damage of the Aquifer due to accidental spills									
Locally Important Aquifer (Lm)	Bedrock which is Generally Moderately Productive	Central areas of the onshore cable route	Medium	Damage to proportion of aquifer due to accidental spillages.	Negative	Temporary	Local	Moderate adverse	Moderate
Locally Important Aquifer (Ll)	Bedrock which is Moderately Productive only in Local zones	Central and southern areas of the onshore cable route	Medium	Damage to proportion of aquifer due to accidental spillages.	Negative	Temporary	Local	Moderate adverse	Moderate
Locally Important Aquifer (Lk)	Locally Important Aquifer - Karstified	Minor areas on the southern of the onshore cable route	Medium	Damage to proportion of aquifer due to accidental spillages.	Negative	Temporary	Local	Moderate adverse	Moderate

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Change to Groundwater Regime									
Locally Important Aquifer (Lm)	Bedrock which is Generally Moderately Productive	Central areas of the onshore cable route	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible
Locally Important Aquifer (Ll)	Bedrock which is Moderately Productive only in Local zones	Minor areas on the southern of the onshore cable route	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible
Locally Important Aquifer (Lk)	Locally Important Aquifer - Karstified	Central and southern areas of the onshore cable route	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible
Damage of Geological Heritage Areas									
Geological Heritage Area	Laytown to Gormanston	Approximately 0.75km northern of the landfall site	High	Loss or damage of proportion of Geological Heritage Area	Negative	Permanent	Local	Negligible	Imperceptible
	Fancourt Shore	Approximately 1.2km from the onshore cable route, in the northern area	High	Loss or damage of proportion of Geological Heritage Area	Negative	Permanent	Local	Negligible	Imperceptible
	Ardgillan House Boulder	Approximately 1.9km from the onshore cable route, in the northern area	High	Loss or damage of proportion of Geological Heritage Area	Negative	Permanent	Local	Negligible	Imperceptible
	Feltrim Quarry	Approximately 0.5km from the onshore cable route, in the southern area	High	Loss or damage of proportion of Geological Heritage Area	Negative	Permanent	Local	Negligible	Imperceptible
	Malahide Point	Area located in the border of the 2km radius, in the southern region of the onshore cable route	High	Loss or damage of proportion of Geological Heritage Area	Negative	Permanent	Local	Negligible	Imperceptible
	Balrickard Quarry	Approximately 0.5km from the onshore cable route, in the southern area	High	Loss or damage of proportion of Geological Heritage Area	Negative	Permanent	Local	Negligible	Imperceptible

Feature	Description	Location	Importance	Impact	Quality	Duration	Scale	Magnitude	Significance
Loss or Damage of a Groundwater Resource									
Groundwater Resources	Bog of the Ring PWS	Northern area of the onshore cable route	Very high	Loss or Damage of a Source Protection Area	Negative	Temporary	Local	Small adverse	Moderate
	GW Abstraction R01652-01	Baldrumman townland, c. 0.7km west of the onshore cable route	High	Loss or damage of groundwater abstraction	Negative	Temporary	Local	Small adverse	Slight
	GW Abstraction R01566-01	Regeens town, c. 1km east of the onshore cable route	Medium	Loss or damage of groundwater abstraction	Negative	Temporary	Local	Negligible	Imperceptible
	GW Abstraction R01607-01	Southern area, c. 1.6km west of the onshore cable route	Medium	Loss or damage of groundwater abstraction	Negative	Temporary	Local	Negligible	Imperceptible
Loss or Damage of a Groundwater Dependant Habitat									
Groundwater Dependant Habitat	Bog of the Ring pNHA	Approximately 0.3km from the northern area of the onshore cable route	Very High	Loss or Damage of a Groundwater Dependant Habitat	Negative	Temporary	Local	Negligible	Imperceptible
	Sluice River Marsh	Approximately 300m from the southern area of the onshore cable route	Very High	Loss or Damage of a Groundwater Dependant Habitat	Negative	Temporary	Local	Small adverse	Moderate
	GS4 wet grassland/ GM1 Marsh	Within proposed development boundary at Blakes Cross	High	Loss or Damage of a Groundwater Dependant Habitat	Negative	Temporary	Local	Small adverse	Slight

21.5.3 Operational Phase

The operational phase of the proposed development will have an overall imperceptible permanent effect on the land, soils, geology and hydrogeology.

A summary of the operational effects is outlined in Table 21.38 which demonstrates there are no significant effects anticipated to arise during the operational phase of the proposed development.

Land will be reinstated to its original use post construction at the landfall site and along the onshore cable route. Potential negative effects on land and soils from these elements of the development during the operational phase will be possible as a result of any ongoing maintenance or inspection of the proposed development, in the event of any accidental leakage of oil, petrol or diesel, allowing contamination of the surrounding environment.

The grid facility will be comprised of a compensation substation and Bremore substation, both will be unmanned and operated remotely. However they will receive occasional visits for inspection and maintenance. Routine operational checks, 6 to 8 times per month are envisaged per compound, with each visit resulting in one or two vehicles at a time, generally during normal working hours.

Annual maintenance activities will be undertaken, over a period of circa one week and this may require up to 6 vehicles per day per compound during shifts over a 24-hour period.

Coolant, which may be glycol or distilled water, and diesel for the standby generator with be the only liquids stored in bulk in compensation station. Diesel for the standby generator will be the only liquid stored in bulk in Bremore substation.

Site roads will be paved. Site surfacing (other than site access roads) will consist of clean, hard 300mm natural gravel or crushed stone to a compacted and lightly rolled.

Potential sources of impact from the operation of the proposed development effecting land, soils, geology and hydrogeology are spills or leaks from maintenance vehicles, from the refilling of the bulk diesel or glycol tanks or leaks from the generators.

Spills or leaks from the grid facility during operation may potentially contaminate the soil or groundwater beneath it. These would be short-term effects. The magnitude of these potential effects on the soil would be slight adverse and on the locally important aquifer is considered to be moderate adverse leading to a significance rating of moderate.

Table 21.39 Summary of Predicted Operational Phase Effects.

Feature	Description	Importance	Effect	Quality	Duration	Scale	Magnitude	Significance
Topsoil	AminSW	Medium	Loss or damage of topsoil	Negative	Permanent	Local	Small adverse	Imperceptible
	BminSW	Medium		Negative	Permanent	Local	Small adverse	Imperceptible
	AminDW	High		Negative	Permanent	Local	Small adverse	Imperceptible
	BminDW	High		Negative	Permanent	Local	Small adverse	Imperceptible
AlluvMIN	Mineral alluvium	Medium	Loss or damage of topsoil and subsoil	Negative	Permanent	Local	Small adverse	Imperceptible
Bedrock Geology	Lucan Formation	Medium	Loss or damage of bedrock geology	Negative	Permanent	Local	Small adverse	Imperceptible
	Belcamp Formation	Medium	Loss or damage of bedrock geology	Negative	Permanent	Local	Small adverse	Imperceptible
Aquifers	Locally Important Aquifer (Lm) Bedrock which is Generally Moderately Productive	Medium	Loss or damage of proportion of aquifer through pollution	Negative	Permanent	Local	Small adverse	Imperceptible
	Locally Important Aquifer (Ll) Bedrock which is Moderately Productive only in Local zones	Medium	Loss or damage of proportion of aquifer through pollution	Negative	Permanent	Local	Small adverse	Imperceptible
	Locally Important Aquifer (Lk) Locally Important Aquifer - Karstified	Medium	Loss or damage of proportion of aquifer through pollution	Negative	Permanent	Local	Small adverse	Imperceptible

21.5.4 Decommissioning

The decommissioning of the of the proposed development is described in the Onshore Description chapter.

The compensation station will be decommissioned when the proposed development ceases operation. The Bremore substation will not be decommissioned as it will form part of the wider transmission network owned by EirGrid. The operational life of these assets will be approximately 40 years.

When it becomes appropriate to decommission the proposed development, all above ground structures (i.e. access track, marker posts, link) between the TJB and the grid facility will be removed and the sites will be returned to their previous state. It is not proposed to remove any planting. The cabling will be removed but below ground ducting will remain in place.

Items / equipment which are decommissioned will be removed for appropriate management, based on the waste regulations at the time of decommissioning.

The onshore cable route will form part of the wider transmission system and will not be decommissioned.

It is anticipated that the decommissioning process will involve similar activities as the construction process, but these will be undertaken in reverse with the removal of above ground structures between the landfall site and grid facility. As the removal of the underground structures may have more of an environmental impact if they were to be removed, these features will remain in-situ. The exact approach will be detailed in the Decommissioning Plan and Programme.

The potential effects on land, soils, geology and hydrogeology will be due to the presence of machinery on site to undertake decommissioning activities.

A summary of the decommissioning effects is outlined in Table 21.38 which demonstrates that no likely significant effects are expected arising from the decommissioning phase of the proposed development.

The proposed decommissioning effects of the proposed development on the geological and hydrogeological attributes identified are listed below:

- Effect on the surrounding ground
- Effect on groundwater quality and groundwater dependant ecosystems.

21.5.4.1 Effects on the surrounding ground

Removal of above ground structures, crushed stone, and reinstatement with topsoil has the potential to induce movement and settlement of surrounding ground. The demolition works could result in minor ground vibrations.

These works may also give rise to noise and vibration effects and may result in the generation of dust. The Air Quality Chapter and Noise and Vibration Chapter provide more information on such effects.

The magnitude of this impact is expected to be small adverse. The significance of the potential effect is imperceptible.

21.5.4.2 Effect on groundwater quality and groundwater dependant ecosystems

The activities which may impact the groundwater quality beneath the proposed scheme during the decommissioning phase include accidental spillages of polluting materials on site during the works.

If this occurs it may potentially contaminate the groundwater beneath the proposed development and negatively affect the groundwater quality. The level of activity on the landfall site, and along the onshore cable route will be very minor, as there are very few above ground structures at these locations. The potential effects are considered to be a temporary small adverse impact on the locally important aquifer underlying study area resulting in a significance rating of imperceptible. There is a small potential impact on the groundwater dependant habitats in the event of an accidental spillage but given their distance from the site the potential impact is expected to be small and therefore the significance of the potential impact is slight.

Table 21.40 Summary of Decommissioning effects

Feature	Importance	Magnitude of Effect		Significance of Effect
	Ranking	Ranking	Justification	
Effects on surrounding ground	Low	Small adverse	Due to the nature of the works and short term works the effect is anticipated to low	Imperceptible
Effect on groundwater quality and groundwater dependent ecosystems	Very high	Small adverse	Due to the distance from the works.	Slight

21.6 Mitigation and Monitoring Measures

The following sections outline the mitigation and monitoring measures designed to avoid or minimise those effects identified in Section 21.5 for the construction, operational and decommissioning phases of the proposed development.

21.6.1 Construction Phase

The mitigation strategy outlined in this section will be implemented during the construction phase of the proposed development. The strategy will be incorporated into the overall Onshore Construction Environment Management Plan (CEMP), which is included in Volume 8, Appendix 9.1. The Onshore CEMP will be updated by the contractor prior to the commencement of construction.

A summary of the pre-mitigation and post-mitigation effects is contained in Table 21.40.

21.6.1.1 General

Best construction management practice (daily site clean-ups, use of disposal bins, etc.) will be carried out at working areas during construction, and the proper use, storage and disposal of all substances and their containers will help prevent soil contamination. For all activities involving the use of potential pollutants or hazardous materials, there will be a requirement to ensure that the material such as concrete, fuels, lubricants and hydraulic fluids will be carefully handled and stored to avoid spillages or leaks. Potential pollutants will also be adequately secured against vandalism and will be provided with proper containment according to codes of best practice. Any spillages or leaks will be immediately contained, and contaminated soil removed from site and disposed of in a licensed waste facility.

Potential soil and water pollution will be minimised by the implementation of best construction practices. Such practices will include adequate bunding for oil containers, wheel washers and dust suppression on site roads, and regular plant maintenance.

Best construction management practices, as outlined in the Construction Industry Research and Information Association (CIRIA) Control of Water Pollution from Construction Sites – Guidance for consultants and contractors (Masters-Williams et al. 2001) will be reflected in the CEMP.

An Emergency Response Plan has been prepared and included in the CEMP and will be further developed by the appointed contractor prior to the commencement of works and regularly updated, identifying the actions to be taken in the event of a pollution incident. The Emergency Response Plan will address the following:

- Secure oil and chemical storage in over-ground bunded areas, limited to the minimum volume required to serve immediate needs with specified delivery and refuelling areas
- All refuelling to take place in bunded enclosures and a minimum of 50m from any watercourse, or coastline. The only exception to this would be plant of limited mobility such as HDD rigs: for refuelling of these items, a small mobile fuel bowser of will be used for refuelling, drip trays and plant nappies would be utilised to mitigate any potential spill of fuel during refuelling, and additional supervision employed
- Emergency spill kits will be retained at sensitive locations, with portable kits provided to plant and equipment operators

- Cessation of work and development of measures to contain and/or remove pollutant should an incident be identified
- Silt traps will be employed and maintained in appropriate locations
- Temporary interception bunds and drainage ditches will be constructed up slope of excavations to minimise surface runoff ingress and in advance of excavation activities
- Excavation and earthworks will be suspended for review as required during and immediately following periods of heavy rainfall to minimise sediment generation and soil damage.

21.6.1.2 Mitigation of potential effects

Loss or damage of topsoil and subsoil and Loss of Solid Geology

All earthworks will be undertaken in accordance with TII Specification for Road Works (SPW) Series 600 Earthworks and project specific earthworks specifications ensuring that all excavated material and imported material is classified using the same methodology so as to allow maximum opportunity for the reuse of materials on site.

Excavated topsoil will be stockpiled using appropriate methods to minimise the effects of weathering. Care will be taken in reworking this material to minimise dust generation, groundwater infiltration and generation of runoff.

In order to reduce the compaction and erosion of topsoil outside the areas of direct construction, haul routes will be along predetermined routes within the proposed development and deliveries will be along predetermined routes outside the proposed development. Where compaction occurs due to truck movements and other construction activities on unfinished surfaces, remediation works will be undertaken to reinstate the ground to its original condition. Where practical, compaction through trafficking of any soil or subsoil which is not part of the works and intended to remain in-situ within the proposed development will be avoided.

The contractor will ensure that any excavated topsoil, subsoil or rock is assessed for re-use within the proposed development ensuring the appropriate handling, processing and segregation of the material. Where practical the removal of excavated material from the proposed development will be avoided. Any surplus suitable excavated material that is not required in the proposed development, will be reused on other projects where possible. The reuse of this material as a by-product on other construction sites would be subject to Article 27 notification to the EPA. This material would have to be shown to be suitable for such use and subject to appropriate control and testing according to earthworks specifications. Alternative the surplus excavated material will be recovered at suitable authorised waste facilities.

Effects on the surrounding ground

Monitoring of ground settlement, horizontal movement will be implemented during construction activities where required to ensure that the construction does not exceed the design limitations.

Foundation type and method of construction and cable installation methodology have been selected to control ground settlement. The foundation types are described within Section 9.5 of the Onshore Construction chapter.

Excavation of Potentially Contaminated Land

Excavations in made ground will be monitored by an appropriately qualified person to ensure that any localised areas of contamination encountered are identified, segregated and disposed of appropriately and to ensure soils are consistent with the descriptions and classifications according to the waste acceptance criteria testing carried out as part of the site investigations. Any identified localised areas of contamination will be segregated and stored in an area where there is no possibility of runoff generation or infiltration to ground or surface water drainage. Care will be taken to ensure that the contaminated material does not cross-contaminate clean soils elsewhere throughout the site.

Samples of ground suspected of contamination will be tested for contamination during the detailed investigation and material excavated from these areas will be disposed of to a suitably licensed or permitted site in accordance with the current Irish waste management legislation.

Any dewatering in areas of contaminated ground will be designed to minimise the mobilisation of contaminants into the surrounding environment. Where dewatering in such areas is unavoidable the water will be adequately treated prior to discharge.

Pollution of soil and groundwater

Good construction management practices will be employed to minimise the risk of transmission of hazardous materials as well as pollution of adjacent watercourses and groundwater.

Measures to be implemented to minimise the risk of spills and contamination of soils and waters will include:

- Employing only competent and experienced workforce, and site-specific training of site managers, foremen and workforce, including all subcontractors, in pollution risks and preventative measures
- Ensure that all areas where liquids (including fuel) are stored, or cleaning is carried out, are in designated impermeable areas that are isolated from the surrounding area and within a secondary containment system, e.g., by a roll-over bund, raised kerb, ramps or stepped access
- The location of any fuel storage facilities will be considered in the design of all construction compounds and will be fully bunded. These are to be designed in accordance with relevant and current guidelines and codes of best practice at the time of construction
- All concrete mixing and batching activities will be located in designated areas away from watercourses and drains
- Potential pollutants will be adequately secured against vandalism in containers in a dedicated secured area
- Provision of proper containment of potential pollutants according to relevant and current codes of practice and legal requirements
- Thorough control during the entire construction stage to ensure that any spillage is identified at early stage and subsequently effectively contained and managed
- Spill kits to be provided and to be kept close to the HDD and temporary construction compounds. Staff to be trained on how to use spill kits correctly.

Landfall site, grid facility and onshore cable route

- Any groundwater or rainwater that collects in the HDD drilling pit or in a trench, or other excavation, will be pumped away onto adjacent land, not directly into waterways
- Bentonite (or similar HDD drilling head lubrication material), which comprises 95% water and 5% bentonite clay which is a non-toxic, natural substance, will be used on site. It will be within a closed system, with drilling fluid recirculated, the drill cuttings recovered, and drilling fluid reused. Residual amounts of bentonite will be left in situ following the drilling process posing a negligible risk due to the inert nature of bentonite.
- In order to minimise the likely migration of drilling fluids through the subsurface to waterbodies the following measures will be employed:
  - Exit and entry points for the HDD will be enclosed by silt barriers (e.g. straw or silt fence) to prevent any runoff into surface water bodies
  - If pressure drops during drilling or if there is a lack of returns the drilling will stop immediately to allow an assessment of a potential leakage of drilling fluid into the surrounding formation. A leak-stopping compound may be used to prevent the leak from migrating further into the formation. If the

leak-stopping compound is not successful, the drilling direction may need to change to avoid the area where the leak occurred.

- If damming and over-pumping is adopted for the open cut watercourse crossings the water will be discharged through a filtering medium to limit silt carry over or bed disturbance downstream of the crossing point
- There will be no tracking of machinery within watercourses other than that related to the temporary works associated with construction of the watercourse crossings for the onshore cable route
- Where short-term over pumping or flume pipes are required, equipment will be sized to accommodate surface water flow that might reasonably be expected over the period in question.

21.6.1.3 Monitoring during construction

As stated above, all excavations will be monitored in accordance with good practice and guidelines at the time of the works.

Any excavation and stockpiled material will be monitored to ensure the stability of slopes and to ensure that the materials designated for disposal are consistent with the descriptions and classifications according to the waste acceptance criteria testing carried out as part of the site investigations.

Visual monitoring will be undertaken as part of the regular site audits during the construction of the proposed development to ensure existing surface water drainage runoff and natural infiltration to ground is not affected by the proposed development.

21.6.2 Operational Phase

Diesel storage tanks in the grid facility will be bunded. If glycol is used as a coolant in the compensation station, the bulk glycol tank will be bunded. Surface water runoff from impermeable yard areas and site roads in the grid facility will be managed and treated prior to discharge. Refer to Section 7.4.5 in the Onshore Description Chapter.

21.6.3 Decommissioning

The mitigation measures, described above for the construction phase which are relevant to decommissioning, updated to reflect good practice at the time, will be implemented for the decommissioning phase.

21.7 Residual Effects

21.7.1 Construction Phase

With the employment of the above mitigation measures and standard good construction practices, it is considered that there will be no significant residual effects on land and soils, geology and hydrogeology as a result of the construction of the proposed development.

Table 21.41 Summary of Predicted Construction Effects Following the Implementation of Mitigation and Monitoring Measures

Feature	Description	Importance	Location	Effect	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Topsoil	AminSW	Medium	Landfall site	Loss or damage of topsoil and subsoils	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
	BminSW	Medium	Southern area of the onshore cable route	Loss or damage of topsoil and subsoils	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
	AminDW	High	Northern area of the onshore cable route	Loss or damage of topsoil and subsoils	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
	BminDW	High	Central and southern area of the onshore cable route	Loss or damage of topsoil and subsoils	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Subsoils quality and significance	Alluvium	Medium	Minor areas of the onshore cable route	Loss or damage of topsoil and subsoils	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Bedrock quality and significance	Malahide Formation	Medium	Northern area of the onshore cable route	Loss of Solid Geology	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
	Belcamp Formation	Medium	Central area of the onshore cable route, landfall site and grid facility	Loss of Solid Geology	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Locally Important Aquifer (Lm)	Bedrock which is Generally Moderately Productive	Medium	Central areas of the onshore cable route, landfall site and grid facility	Loss or damage of proportion of aquifer through pollution	Negative	Permanent	Local	Moderate adverse	Moderate	Negligible	Imperceptible

Feature	Description	Importance	Location	Effect	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Locally Important Aquifer (Ll)	Bedrock which is Moderately Productive only in Local zones	Medium	Minor areas on the southern of the onshore cable route	Loss or damage of proportion of aquifer through pollution	Negative	Permanent	Local	Moderate adverse	Moderate	Negligible	Imperceptible
Locally Important Aquifer (Lk)	Locally Important Aquifer - Karstified	Medium	Central and southern areas of the onshore cable route	Loss or damage of proportion of aquifer through pollution	Negative	Permanent	Local	Moderate adverse	Moderate	Negligible	Imperceptible
Surrounding ground	Sea cliffs located adjacent to HDD works	Medium	Landfall site	Loss or damage of coastal cliff	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Possible contaminated lands	Fingal Landfill, Nevitt	Medium	Approximately 1.0km west of the onshore cable route	Degree or extent of soil contamination is moderate on a local scale	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
	Bord Na Móna Recycling Limited (Advanced Environmental Solutions (Ireland) Limited)	Medium	Approximately 0.5km from the onshore cable route, in the central area	Degree or extent of soil contamination is moderate on a local scale	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
	Fingal County Council	Medium	Approximately 1.5km from the onshore cable route, in the central area	Degree or extent of soil contamination is moderate on a local scale	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible

Feature	Description	Importance	Location	Effect	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
	Petrol Stations	Medium	A number of petrol stations along the onshore cable route.	Degree or extent of soil contamination is moderate on a local scale	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
	Two were classified as non-hazardous during Project Specific Ground Investigation	Medium	TP09 landfall TP21 Blakes Cross	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
	Two samples were classified as hazardous	Medium	ST02 & ST31	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
	Old Landfills close to Belcamp	Medium	Unlicensed Landfill - Belcamp	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Groundwater Resources	Bog of the Ring PWS	Very High	Northern area of the onshore cable route	Loss or damage of groundwater protection zone	Negative	Permanent	Local	Small adverse	Moderate	Negligible	Imperceptible
	GW Abstraction R01652-01	High	Baldrumman townland, approximately 0.7km west of the onshore cable route	Loss or damage of groundwater abstraction	Negative	Temporary	Local	Small adverse	Slight	Negligible	Imperceptible
Groundwater Dependant Habitat	Sluice River Marsh	Very high	Approximately 300m from the southern area of the onshore cable route	Loss or Damage of a Groundwater Dependant Habitat	Negative	Temporary	Local	Small adverse	Moderate	Negligible	Imperceptible

Feature	Description	Importance	Location	Effect	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
	GS4 wet grassland/ GM1 Marsh	High	Within proposed development boundary at Blakes Cross	Loss or Damage of a Groundwater Dependant Habitat	Negative	Temporary	Local	Small adverse	Slight	Negligible	Imperceptible

21.7.2 Operational Phase

There will be no significant residual effects on land and soils, geology and hydrogeology as a result of the operation of the proposed development.

21.7.3 Decommissioning

With the employment of the above mitigation measures , it is considered that there will be no significant residual effects on land and soils, geology and hydrogeology as a result of the decommissioning phase of the proposed development.

21.8 Transboundary Effects

Considering the nature and location of the proposed development as described in the Onshore Description chapter and Onshore Construction chapter no transboundary effects on land, soils, geology and hydrogeology are predicted.

21.9 Cumulative Effects

A long list of "other projects", which were deemed to be potentially relevant to be included in the cumulative impact assessment, was compiled (see Section 38.3 of Volume 6, Chapter 38: Cumulative and Inter-related Effects (hereafter referred to as the 'Cumulative and Interrelated Effects Chapter')). A screening exercise of the "long list" was carried out to determine whether each project has the potential to give rise to likely significant cumulative effects from a land and soils, geology and hydrogeology perspective with the proposed development. Many of the other projects were screened out for a number of reasons including the location, scale and nature of the project. Those projects which were "screened in" were carried forward for assessment. The results of the assessment are presented in Appendix 38.1 of the Cumulative and Interrelated Effects chapter.

The assessment concluded that there are no likely significant direct or indirect cumulative effects with the potential to cause a significant effect on land and soils, geology and hydrogeology during the construction, operation or decommissioning phases of the proposed development.

21.10 References

Bing Maps (2019). Bing Maps. [Online] Available at: https://www.bing.com/maps/

Masters-Williams H, Heap H, Kitts H, Greenshaw L, Davis S, Fisher P, Hendrie M and Owens D (2001) Control of water pollution from construction sites. Guidance for consultants and contractors (C532D), CIRIA, London

DCENR (2019). Exploration and Mining Viewer. [Online] Available from spatial.dcenr.gov.ie/ExplorationAndMining/SpatialViewer/index.html

EPA (2008). Environmental Research Centre Report Series No. 12. A Framework for the Assessment of Groundwater-Dependent Terrestrial Ecosystems under the Water Framework Directive. Strive EPA Programme 2007 – 2013.

EPA (2023) EPA Water Abstraction Register - August 2023, Available: https://www.epa.ie/publications/monitoring--assessment/freshwater--marine/epa-water-abstraction-register.php

EPA (2011). Strive Report Series No. 100. Evaluating the Influence of Groundwater Pressures on Groundwater-Dependent Wetlands. Strive EPA Programme 2007 – 2013.

EPA (2022). Guidelines on the Information to be contained in Environmental Impact Assessment Reports;

EPA (2024a). EPA Maps. [Online] Available from https://gis.epa.ie/EPAMaps/

EPA (2024b). Hydronet. [Online] Available https://epawebapp.epa.ie/hydronet/#Groundwater

GSI (2024a) . Geological Survey Ireland Spatial Resources. [Online] Available from https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228

GSI (2024b) Groundwater bodies. [Online] Available: https://www.gsi.ie/en-ie/programmes-and-projects/groundwater/activities/understanding-ireland-groundwater/Pages/Groundwater-bodies.aspx#:~:text=The%20Groundwater%20Body%20(GWB)%20is,groundwater%20and%20linked%20surface%20waters.

GSI (2024c) Groundwater Vulnerability. [Online] Available from https://www.gsi.ie/en-ie/programmes-and-projects/groundwater/activities/understanding-ireland-groundwater/groundwater-vulnerability/Pages/default.aspx

Google Maps (2024) Google Maps. [Online] Available from http://www.google.com/maps/

ICPSS Irish Coastal Protection Strategy Study Available from thttps://www.gov.ie/en/publication/eed0fb-irish-coastal-protection-strategy-study icpss/#:~:text=The%20Irish%20Coastal%20Protection%20Strategy%20Study%20%28ICPSS%29%20is,risks%20associated%20with%20coastal%20flooding%20and%20coastal%20erosion.

IGI (2013) Guidelines for the Preparation of Soil, Geology and Hydrogeology Chapters of Environmental Impact Statements.

NMS (2019). National Monuments Service - Archaeological Survey of Ireland. [Online] Available from https://data.gov.ie/dataset/national-monuments-service-archaeological-survey-of-ireland

NPWS (2020). Proposed / Designated NHA, SPA, SAC Sites. [Online] Available from http://webgis.npws.ie/npwsviewer/, accessed May 2019;

NRA (2008a). Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.

NRA (2008b). Environmental Impact Assessment of National Road Schemes – A Practical Guide.

OSI (2019). Current and historical Ordnance Survey maps and aerial photography available for the study area. [Online] Available from http://map.geohive.ie/mapviewer.html

Teagasc, Agency, E. P. and Ireland, G. S. (2017). Teagasc Soils Data - Surface Soils Classification and Description. [Online] Available from https://secure.dccae.gov.ie/arcgis/rest/services/THIRD_PARTY/TeagascSoils/MapServer

TII (2013) Specification for Road Works Series 600 - Earthworks (including Erratum No. 1, dated June 2013) CC-SPW-00600

Directives and Legislation.

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy

Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration

S.I. No. 122/2014 - European Union (Drinking Water) Regulations 2014

S.I. No. 149/2012 - European Communities Environmental Objectives (Groundwater) (Amendment) Regulations 2012

S.I. No. 219/2008 - European Communities (Water Policy) (Amendment) Regulations 2008

S.I. No. 261/2018 - European Union (Water Policy) (Abstractions Registration) Regulations 2018

S.I. No. 272/2009 - European Communities Environmental Objectives (Surface Waters) Regulations 2009

S.I. No. 293/1988 - European Communities (Quality of Salmonid Waters) Regulations 1988

S.I. No. 327/2012 - European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2012

S.I. No. 350/2014 - European Union (Water Policy) Regulations 2014

S.I. No. 366/2016 - European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016

S.I. No. 386/2015 European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2015

S.I. No. 389/2011 - European Communities Environmental Objectives (Groundwater) (Amendment) Regulations 2011

S.I. No. 413/2005 - European Communities (Water Policy) (Amendment) Regulations 2005

S.I. No. 464/2017 - European Union (Drinking Water) (Amendment) Regulations 2017

S.I. No. 722/2003 - European Communities (Water Policy) Regulations 2003

S.I. No. 9/2010 - European Communities Environmental Objectives (Groundwater) Regulations 2010

S.I. No. 93/2010 - European Communities (Water Policy) (Amendment) Regulations 2010

Water Services Acts (2007 to 2017)