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Acronyms and Abbreviations

BAT	Best available technology
BH	Borehole
CGS	County Geological Sites
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EPA	Environmental Protection Agency
GSI	Geological Survey Ireland
GW	Groundwater
IFS	Irish Forestry Soils
IGH	Irish Geological Heritage
IGI	Institute of Geologists of Ireland
ISIS	The Irish Soil Information System
ITM	Irish Transverse Mercator
m AOD	meters Above Ordnance Datum
m bgl	meters below ground level
pNHA	Proposed Natural Heritage Area
SHWW	Safety Health and Welfare at Work

Introduction

Background

6.1 This chapter of the Environmental Impact Assessment Report (EIAR) provides a description of the existing land, soils and geological setting at the regional and local scale, and an assessment of the impact of the proposed development on the land, soils and geological features of the area around the site at Killough Quarry, Holycross, Co. Tipperary.

6.2 The proposed bio-renewables facility, located within the 6.3 ha application area of the existing Killough hard rock quarry, involves relocating current aggregate stockpiles and demolishing a single-storey building to accommodate the new development. The quarry, in operation since the 1950's, will continue to support rock extraction, aggregate processing and value-added activities, such as concrete and asphalt production, alongside the proposed bio-renewables facility. WEW Engineering Ltd. and Fingleton White Group will lead the design and implementation of this facility, aligning with best available technology (BAT) standards.

6.3 The facility, covering approximately 4 ha, includes several structures such as a bio-conversion building, digestate handling area, and storage facilities for materials like chicken waste, cattle slurry, and grass silage, with the majority of feedstock deliveries scheduled from local farms. The plant will operate 24 hours a day, seven days a week, producing outputs like bio-methane, compressed bio-methane, green electricity, and organic fertilisers, while maximizing resource efficiency and minimizing waste through on-site reuse and nutrient recovery.

6.4 Energy produced will be utilised by the nearby quarry, with fertiliser distributed to local agriculture, and compressed bio-methane and CO_2 stored for transport to external sites. The anaerobic digestion process will convert organic matter to biofuels and methane, while capturing CO_2 for reuse, ensuring that all outputs are repurposed as valuable co-products.

6.5 The project's commitment to environmental stewardship is reflected in its closed-loop system design, with no waste by-products, supporting sustainable agricultural and industrial practices in the region. Key design features, including 16m high tanks and 17.5m high generator stacks, have been planned to align with operational requirements.

6.6 In summary, this bio-renewables facility aims to transform organic materials into energy and fertilizers, fostering a circular economy within the quarry site and providing environmental and economic benefits to the local community.

Scope of Work / EIA Scoping

6.7 This EIAR chapter is based on a desk study of the proposed development site / surrounding lands using published geological data, site photographs, and site visits previously carried out by SLR to the quarry site.

Consultations / Consultees

6.8 The Geological Survey of Ireland (GSI) was consulted during the preparation of this EIAR Chapter and publicly available information from the GSI was reviewed also. The GSI consultation response is available in Appendix 6-A.

Authors

6.9 This EIAR chapter relating to Land, Soils and Geology was prepared by:

- Nikolina Bozinovic - BSc, MSc (Engineering Geology and Hydrogeology) and Project Hydrogeologist with SLR Consulting Ireland; and

- Peter Glanville - Professional Geologist (EurGeol. PGeo.) and Technical Director with SLR Consulting Ireland.

Regulatory Background

EU Directives

6.10 The following European Union (EU) Directives relate to Land, Soils and Geology at the proposed development site in this EIAR:

- Environmental Impact Assessment Directive (2014/52/EU); and
- European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. 296 of 2018).

6.11 This chapter of the EIAR has been undertaken in accordance with the EU EIA Directive which regulates the environmental impact assessment process and information to be contained in EIARs.

Guidelines

6.12 This Land, Soils and Geology EIAR chapter has been prepared in compliance with the following guidelines:

- Environmental Protection Agency Guidelines on the Information to be Contained in Environmental Impact Assessment Reports. May 2022;
- European Commission, Environmental Impact Assessment of Projects - Guidance on the preparation of the environmental impact assessment report (Directive 2011/92/EU as amended by 2014/52/EU), Publications Office, 2017;
- Department of Environment, Heritage and Local Government, 2004. Quarries and Ancillary Activities, Guidelines for Planning Authorities;
- Environmental Protection Agency, 2006. Environmental Management in the Extractive Industry: Non-Scheduled Minerals;
- Geological Survey of Ireland - Irish Concrete Federation, 2008. Geological Heritage Guidelines for the Extractive Industry;
- Institute of Geologists of Ireland (2013) Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements;
- National Roads Authority (2008) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- The Institute of Quarrying Good Practice Guide for Handling Soils in Mineral Workings, (2021) and
- Transport Infrastructure Ireland (March 2013). Specification for Road Works Series 600 – Earthworks.

Planning Policy and Development Control

6.13 This section sets out the Planning Policy and Development Control relating to Land, Soils and Geology of relevance to the proposed development in the Tipperary County Development Plan 2022-2028.

6.14 The County Development Plan sets out conservation objectives in relation to natural heritage and landscape, including geology, in the county. An audit of Tipperary's geological heritage

sites was completed in 2019, and is contained within the list in the 'Geological Heritage of County Tipperary' (Geological Survey Ireland/Tipperary County Council, 2019) with corresponding individual site reports for the geological features set out in the audit[1]. The Council recognises that Geological/Geomorphological Sites and Areas are an intrinsic component of natural heritage, to be protected and promoted for their heritage value and for recreational and geo-tourism initiatives. The current development plan contains policies and objectives in relation to the natural heritage, and of note is **Policy 11-12** *'In assessing proposals for new development to seek to protect, support and conserve the geological heritage sites of Tipperary and their value as outlined in the Tipperary Audit of Geological Heritage Sites, (GSI/TCC, 2019).'*

6.15 The existing quarry and bio-renewables facility application site lie within the County Geological Site of 'Killough Hill' (details of which are provided in **Appendix 6-B** and **Figure 6-5**).

6.16 Section 3.4.6 of the Tipperary County Development Plan, in relation to a low-carbon society and climate action states that: *'The use of nature-based water management solutions, urban greening and Sustainable Urban Drainage Systems (SUDS) will be required by the Council, as a normal part of new development and as part of public realm and town centre enhancement in Tipperary, as addressed in Chapters 7 Town Centres and Place-making, and Chapter 11 Environmental and Natural Assets.'*

Receiving Environment

Study Area

6.17 For the purposes of this assessment, the study area comprises the application site and predominantly focuses on the surrounding area up to 5 km radius from the site; this is in line with the Institute of Geologists of Ireland's (IGI) guidelines (2013).

6.18 The IGI guidelines state that the minimum distance of 2 km should be reviewed in the context of the geological environment as well as the scale of development and increased to reflect the sensitivity of the subsurface. The IGI guidelines also state that maps should be sourced to allow for the review of any sensitive geological and hydrogeological conditions that exist beyond 2 km of the site boundary (from the outer limit of the planning and/or licence area) and presented at a scale of 1:50,000.

6.19 The baseline maps produced in this EIAR are at a scale of 1:50,000 and include an area up to c. 5 km radius from the lands under the control of the applicant.

Baseline Study Methodology

6.20 This section of the EIAR provides a description of the existing geological setting on both a local and regional scale, an assessment of the impact of the development on the geological features of the area and other geological aspects of the development.

6.21 The baseline study undertaken here for Land, Soils and Geology, involves a review of:

- published literature and information;
- Section 55 Geotechnical Assessment Killough Quarry, SLR, 2016;
- borehole information (2020);

[1] https://www.gsi.ie/en-ie/publications/Pages/The-geological-heritage-of-Tipperary.aspx

- GSI consultation response; and
- the findings from a walkover survey of the proposed development site.

6.22 This baseline information was considered in the context of the existing site, proposals for it and the geological conditions of the surrounding study area.

6.23 This chapter describes the receiving environment at and in the immediate vicinity of the site using the available baseline information gathered, specifically the:

- Context of the receiving environment - location/ magnitude/ spatial extent and trends of the environmental factors;
- Character of the receiving environment - distinguishing aspects of the environment being considered here;
- Significance of the receiving environment - the quality, value or designation is assigned to the existing environment; and
- Sensitivity of the receiving environment - how sensitive is the aspect of the environment to change.

6.24 This chapter was prepared with regard to the Guidelines on Geology in Environmental Impact Assessments issued by the Institute of Geologists of Ireland[2] and also the EPA guidelines[3].

6.25 The baseline study is a qualitative assessment of the available information based on professional experience and interpretation of the available quantitative data obtained through comprehensive fieldwork (see below).

Sources of Information

6.26 The following sources of information were consulted in the preparation of the receiving environment baseline study for Land, Soils and Geology.

- Geological Survey of Ireland (www.gsi.ie);
- Teagasc soil and subsoil mapping for Irish Forestry Soils Project (www.epa.ie);
- Irish Soils Information System (www.teagasc.ie/soils);
- Environmental Protection Agency (https://gis.epa.ie/EPAMaps/);
- Irish Geological Heritage Programme (www.gsi.ie); and
- Tailte Éireann - Surveying (www.osi.ie).

Site Investigations

6.27 The works carried out for assessing geology at the site included groundwater wells drilling (2020) and the Killough Section 55 SLR Geotechnical Assessment (2016). These site investigations data were used in this chapter to inform local soil and geology conditions.

6.28 The Section 55 Geotechnical Assessment Report was prepared by SLR in 2016, based on an inspection of the quarry carried out by SLR Geotechnical Specialists on the 15th March 2016.

[2] Guidelines for the Preparation of Soils, geology and Hydrogeology Chapters of Environmental Impact Statements
[3] Guidelines on the Information to be Contained in Environmental Impact Statements (2022).

6.29 Three groundwater monitoring wells have been drilled at the site in 2020, to provide information on the groundwater levels, refer to EIAR Chapter 7 - Water (Hydrology & Hydrogeology).

Land Baseline

6.30 Within the EIA EU Directive (2014/52/EU) Land is recognised as a 'natural resource' and the Directive also refers to the importance of the sustainable use of soil and the need to address the unsustainable increase in settlement areas over time ('land take'). Therefore, the issues of land as both a natural resource and land take must be considered in an assessment.

6.31 The introduction section to the EU Directive (2014/52/EU) notes that the:

'*final document of the United Nations Conference on Sustainable Development held in Rio de Janeiro on 20-22 June 2012, which recognises the economic and social significance of good land management, including soil, and the need for urgent action to reverse land degradation. Public and private projects should therefore consider and limit their impact on land, particularly as regards land take, and on soil, including as regards organic matter, erosion, compaction and sealing; appropriate land use plans and policies at national, regional and local level are also relevant in this regard'.*

6.32 Land can be considered to be a resource with a beneficial use to society, for example agricultural land use, extractive industry land use or urban residential land use. Unnecessary land take may result in the loss of this resource which has the potential to have adverse social and economic consequences for society. The current land use across the application area is mineral extraction which has a beneficial aspect for society through economic development importance.

6.33 In terms of land take, the proposed development will result in a use of the land for a bio-renewables facility and a loss of mineral extraction / aggregate storage over the application area.

Land Cover

6.34 The Corine land cover mapping is a standardised inventory of land cover across Europe which is split into 44 different land cover classes. The latest 2018 Corine land cover mapping for Ireland is based on the interpretation of satellite imagery and national in-situ vector data. Land cover is mapped to the standard CORINE classification system and data specifications.

6.35 The Corine land cover mapping (www.epa.ie) reflects land use at the time of survey, in this case the latest available land cover data for Ireland is 2018. There is a mix of land cover types in the vicinity of the site as shown in **Figure 6-1** and includes the following land cover types:

Table 6-1: Local cover within the study area

Land Cover Type	Description	Source
Mineral Extraction Sites	Land dedicated to quarrying and mining	CORINE Land Cover 2018
Agricultural Pasture	Grassland used for livestock grazing	CORINE Land Cover 2018
Non-Irrigated Arable Land	Cultivated land for crops without irrigation	CORINE Land Cover 2018
Forested Land	Predominantly coniferous tree cover	CORINE Land Cover 2018
Peat Bogs	Wetland areas with accumulated peat soil	CORINE Land Cover 2018

Land Cover Type	Description	Source
Transitional Woodland Shrub	Areas transitioning to forested land	CORINE Land Cover 2018

6.36 The application area is classified on the Corine land cover mapping as Mineral extraction Site.

Soils Baseline

6.37 Soil is defined as the top layer of the earth's crust and is formed by mineral particles, organic matter, water, air and living organisms. Soil is an extremely complex, variable and living medium and its characteristics are a function of parent subsoil or bedrock materials, climate, relief and the actions of living organisms over time.

6.38 Soil formation is an extremely slow process and can take thousands of years to evolve; soil can be considered essentially as a non-renewable resource.

6.39 As the interface between the earth, the air and the water, soil performs many vital functions; it supports food and other biomass production (forestry, biofuels etc.) by providing anchorage for vegetation and storing water and nutrients long enough for plants to absorb them. Soil also stores, filters and transforms other substances, including carbon and nitrogen, and has a role supporting habitats serving as a platform for human activity.

National Soils

6.40 The Irish Soil Information System (ISIS) project was undertaken by the EPA and Teagasc, and has gathered together existing information and data from soil survey work in Ireland, which has been augmented with new field data, leading to the production of a new national soil map at a scale of 1:250,000 (www.teagasc.ie/soils).

6.41 The ISIS project has identified a number of Soil Associations across Ireland, which are each comprised of a range of soil types (or 'Series'), each of them different in properties, with different environmental and agronomic responses. For each soil type, the properties have been recorded in a database maintained by Teagasc.

6.42 The soil association at the proposed development site has been classified as the Elton Series (ISIS Code 1000x); it is described as Fine loamy drift with limestones, see **Figure 6-2**. The soil combination is considered to be well draining.

6.43 The Elton association belongs to the Grey Brown Podzolics, Brown Earths (medium-high base status) subgroup. It is deep well drained mineral and widespread within the study area, covering c. 83% of study area, refer to **Table 6-2**.

6.44 According to *Soils of Tipperary North Riding*[4], the Elton Series, a minimal variant of Grey Brown Podzolic soils, covers 9.85% of North Tipperary by area and is especially productive for agricultural uses.

6.45 Found on low slopes in areas downstream of limestone formations, this well-drained loam to clay loam soil has a pH that remains relatively high in the sub-horizon. Its profile shows a consistent brown colour with minimal variation and is ideal for long-season grass production, as well as for crops like cereals, roots, and vegetables. The Elton Series is especially suitable for winter cereal production, though its weaker structure may challenge seedbed preparation and lead to weed issues with prolonged tillage.

[4] **Soils of Tipperary North Riding**, T. F. Finch and M. J. Gardiner National Soil Survey of Ireland, Teagasc, 1993

Table 6-2: Soils details within the 5 km radius of the site

Soil Type	Description	Location	Total area encountered within the study area (ha.)	Ratio within the study area (%)
Rock	Limestone at the surface over 23% of landholding area	c. 150 m east and northeast of application area	c. 25	0.24
Peat	Generally acidic, dark in colour, and can hold large amounts of water	Few patches north of the site and principally c. 1.5 km in southeast of the site	c. 1,063	10.38
River alluvium	Silty river alluvium; Typical Brown Alluvial Soils	c. 3.5 km east of the site along River Suir and c. 2.5 km west of the site, surroundings of River Lisnagonoge	c. 654	6.38
Fine loamy drift with limestones (Elton)	Luvisol: Well drained mineral soils	Principal soil type across whole study area	c. 8,461	82.67
Urban	Man made urban areas, mainly concrete and asphalt	c. 4,5 km north of the site (Thurles) and northwest of the site (Holycross)	c.34	0.33

Site Soils

6.46 The former soils at the site are mapped and described under the Teagasc Irish Forestry Soils (IFS) study as being predominantly deep well drained mineral soils, which are derived from mainly calcareous parent materials (IFS code BminDW). The former soils at the site have formed on limestone materials and are referred to as Luvisol.

6.47 According to Teagasc Drainage Manual 2022[5], Luvisols are distinguished by clay leaching from the topsoil into deeper layers, creating a subsoil richer in clay. Typically, they form over limestone bedrock or within glacial deposits. Due to the clay accumulation, these soils have moderate to imperfect drainage, especially in the subsoil layer. Despite this, Luvisol can be very productive for agriculture, particularly in areas where rainfall is moderate.

6.48 The application site currently consists of rock at the surface and former luvisol type of soils which were previously stripped from the application area as part of the quarrying operations. The bedrock is derived from mainly calcareous parent materials (IFS code BminSW). The bedrock is classified as shallow well drained mineral (Mainly basic). Therefore, soils across the proposed development site are absent.

Subsoils Baseline

National Subsoils

6.49 The subsoils (Quaternary deposits) were deposited during the last 2 million years. The two principal types of quaternary subsoils in Ireland are glacial till, deposited at the base of ice sheets, and sand and gravel deposits associated with the melting of the ice sheets, and are generally termed glaciofluvial outwash sands and gravels. Other extensive quaternary

[5] **Teagasc Manual on Drainage - and Soil Management**, 2nd Edition, 2022

subsoils in Ireland include peat and river alluvium. Most Quaternary deposits in Ireland were deposited since the maximum of the last glaciation, the Midlandian, which occurred approximately 17,000 years ago.

6.50 The subsoils across Ireland have been mapped on a national basis by Teagasc as part of the EPA Soil and Subsoil Mapping Project for the Irish Forestry Soils (IFS) project. The subsoil mapping was undertaken at a national basis using existing Quaternary Geology maps, publications, remote sensing and field mapping and sampling.

6.51 Distribution of subsoils in the study area is presented as principally Till type occurring in form of Limestone till. The summary details of Limestone tills across North Co. Tipperary, according to the *North County Tipperary Groundwater Protection Scheme Main Report*[6] is presented in **Table 6-3** below.

Table 6-3: Summary details of Limestone tills across North Co. Tipperary

Parameter	Details
Primary Subsoil Type	Limestone Till
Parent Material	Derived mainly from Carboniferous limestone bedrock, with shaly limestone incorporated in areas near boundary zones with different rock types
Coverage	Covers 40-45% of North County Tipperary, extending from south of Nenagh to the Little Brosna River area
Associated Soil Types	Acid Brown Earths, Grey Brown Podzolics, with limited Gley soils
Primary Lithologies	Clean limestone types (Waulsortian Limestone, Borrisokane Calcarenite, Terryglass Calcarenite, and Oldcourt Formations)
Boundary Markers	Delineated by lithologic changes: sandstone and mudstone in the Arra Mountains (west), Knockanora and Borrisnoe foothills (east)
Secondary Distribution	Also found in southeastern North County Tipperary, along a north-south strip east of Thurles
Colour and Texture Variations	Ranges from light-brown/grey to dark brown/black depending on parent material and weathering; texture varies from sandy to silty
Proximity to Bedrock	Near bedrock and in thin deposits, the till matrix becomes coarser, with angular clasts, often resembling broken-up bedrock or immature till formations

6.52 Additionally, minor deposits of alluvium (sand and gravel), cutover peat, man-made materials, limestone sands and gravels and lake sediments are present in varying small proportions within the 5 km study area.

Site Subsoils

6.53 Former subsoils in the proposed development site have been mapped under the IFS project as Limestone till (boulder clay) derived mainly from Carboniferous limestone bedrock, surrounded by bedrock at or near surface within majority of landholding area see **Figure 6-3**.

6.54 Three groundwater monitoring boreholes(GW1, GW2 and GW3) have recorded bedrock near or at the surfaces outside the application boundary (refer to EIAR Chapter 7 – **Figure 7-5** for locations).

[6] **North County Tipperary Groundwater Protection Scheme Main Report**, DRAFT April 2002, GSI

6.55 Subsoils are not present at the current application site.

Bedrock Geology Baseline

Regional Setting

6.56 The geology of North Tipperary is predominantly composed of Carboniferous limestone across the lowland areas, transitioning to purer limestone as one moves southward through regions like Borrisokane.

6.57 To the north, this limestone is interbedded with shales. South of a fault near Knockshigowna, Devonian Old Red Sandstone and Silurian shales are exposed. The Black Hills, near Roscrea, also feature an Old Red Sandstone ridge.

6.58 The Arra Mountains, situated west of Lough Derg, consist mainly of Silurian and Ordovician shales, siltstones, and grits, with limestone drift covering their borders. In the Silvermines area, a geological fault facilitates successful heavy metal mining.

6.59 Devonian sandstone and conglomerates form the Silvermines ridge and parts of Keeper Hill, with early Palaeozoic shales surrounding them. The remaining lowland areas are underlain by Upper, Middle, and Lower Carboniferous limestone formations.

Local Geology

6.60 An assessment of the local geology at the site has been undertaken based on review of GSI mapping and database, existing exposures at the site, walkover surveys of the site, and groundwater well drilling undertaken at the site in 2020.

6.61 Within the study area there are several geological formations encountered, as presented in following **Table 6-4**.

Table 6-4: Geological formations encountered within the 5 km study area

Formation	Age	Lithology	Thickness (m)	Location relative to site
Ballyadams Formation	Lower Carboniferous	Pale grey crinoidal wackestone/ packstone limestone with clay wayboards	400-700 m	Central and majority of study area, underlaying the site area and small area at southeast of the study area, c. 3.5 km of the site
Clogrenan Formation	Lower Carboniferous	Cherty, muddy, calcarenitic limestone	>96 m	Two small patches within the landholding quarry area, and also outside the quarry boundary, in south direction of the study area, c. 1.5 km south of the site and c. 5 km southeast of the site
Durrow Formation	Lower Carboniferous	Shaly fossiliferous & oolitic limestone	200 m	Wider vicinity of the site, c. 1.5 km west of the site, c. 2.5 km north of the site, c. 3km east of the site and c. 3.5 km south of the site
Aghmacart Formation	Lower Carboniferous	Dark shaly micrite, peloidal limestone	Recorded as 109 m thick locally	Small patches c. 3.5 km northwest and southwest of the site
Crosspatrick Formation	Lower Carboniferous	Pale-grey cherty crinoidal limestone	Up to 60m recorded	Approximately 4 km northwest of the site, small proportion of study area

Formation	Age	Lithology	Thickness (m)	Location relative to site
Waulsortian Limestones	Lower Carboniferous	Massive unbedded lime-mudstone	Typically, 300 - 500 m thick	Small area of study area, c.4,5 km northwest of the site
Ballynash Member	Lower Carboniferous	Wavy-bedded cherty limestone, thin shale	9.4 m	Small patch of study area, c. 3.5 km northwest of the site
Suir Limestone Formation	Lower Carboniferous	Pale cross-bedded oolitic limestone	250 m	Small patch of study area, c. 3.5 km in southwest direction of the site

6.62 The Geological Survey of Ireland (GSI) 1:100,000 mapping shows the proposed development site is primarily underlain by the Ballyadams Formation, comprising of medium to dark-grey, crinoidal calcarenite wackestones and packstones, containing fossils like lithostrotioid corals and gigantoproductid brachiopods, particularly in the higher layers, see **Figure 6-4**.

6.63 It lies above the Aghamacart Formation and transitions upwards into the Clogrenan Formation. This formation is dated to the Asbian stage of the Carboniferous period and ranges in thickness from 400 to 700 meters in its type. The upper layers often exhibit cyclic structures, sometimes with clay wayboards.

6.64 According to the County Geological Site Report for Killough Hill (Appendix 6-B), the bedrock at Killough Hill consists of fossil-rich limestone from the Lower Carboniferous Ballyadams Formation (359-323 million years ago), deposited under ancient marine conditions. During the Quaternary Period, glacier movement sculpted the ridge, shaping it into a crag-and-tail feature where harder bedrock forms the up-ice 'crag,' while softer glacial till forms a trailing 'tail' down-ice.

6.65 Ballyadams limestone is characteristic of the 'Burren', with pale grey, fossiliferous layers containing corals and bryozoa, and micritic beds in its lower sections. Bedding layers increase in thickness with depth, dipping southward due to Variscan-age thrusting, while more recent Palaeogene and Neogene faults add strike-slip features.

6.66 Boreholes drilled in 2020 (GW1, GW2, and GW3) reached a depth of up to 101 m bgl, primarily encountering strong, medium-grey limestone with occasional minor zones of weak, weathered, and clay-rich sections. The dominant lithology across all boreholes is consistent with the Ballyadams Formation—a fossil-rich, clean limestone commonly quarried. Minor clay infill layers and fractured zones observed in GW1 and GW2 represent slight geological discontinuities. While these may affect groundwater flow or stability locally, they are minimal in extent and do not significantly disrupt the overall continuity of the limestone bedrock.

Plate 6-1: Southern face (2016), view west (in direction of proposed development) showing Ballyadams Formation

Source: Section 55 Geotechnical Assessment Killough Quarry, SLR, 2016

6.67 The application area is covered by Ballyadams limestone at the surface.

Geological Structure

6.68 The Geological Survey of Ireland (GSI) mapping identifies a fault running north to south in the approximative middle area of the quarry. This fault separates the Clogrenan Limestone Formation on the western side from the Ballyadams Limestone Formation on the eastern side. The GSI 100K Bedrock map indicates that within the site, a general trend of dipping is indicated as 8 degrees in a southeast direction.

6.69 During a site visit in 2016, it was confirmed that the fault has a generally north-south orientation.

6.70 According to the 2016 Geotechnical Assessment report, jointing within the quarry varies in spacing, from closely spaced to widely spaced, with a predominant north-south orientation. Some localized discontinuities are present, though these are generally widely spaced and not continuous throughout the quarry. In some areas, these discontinuities dip directly out of the quarry face.

6.71 The quarry walls were observed to be dry, with no visible seepage lines. Bedding in the quarry is medium to thick (0.2–1.0 meters), and the rock layers have a gentle dip of about 8° to 12° toward the southeast.

Karstification

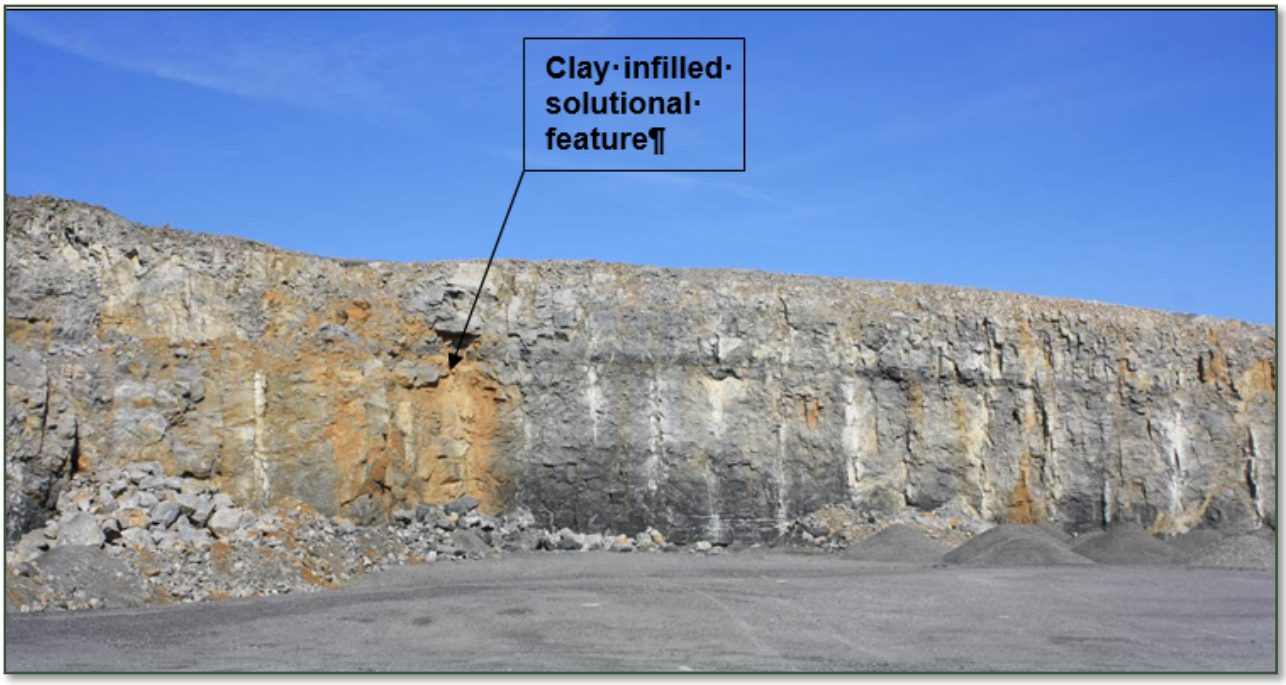
6.72 Karstification, the process by which limestone fractures enlarge through chemical dissolution, has led to various karst features in North Tipperary, including swallow holes, caves, enclosed depressions, turloughs, and sinking streams. These features offer pathways for contaminants to easily enter the groundwater.

6.73 On geological maps, such as the aquifer and hydrogeology data map and the interim groundwater vulnerability map, these karst features are marked as areas of "extreme" vulnerability due to their high susceptibility to pollution. While North Tipperary has fewer known karst features than counties like Cork, areas within 30 meters of karst features are particularly vulnerable. Additionally, some high-vulnerability areas may be missing from maps due to limited data on karst features in this region.

6.74 The closest recorded GSI karst feature is a swallow hole (GSI ID: 2015SWK008), c. 2.1 km upgradient and northwest of the site boundary, within the Durrow Formation.

6.75 Based on the GSI County Geological Site Report of Killough Quarry, epikarst features, or enlarged fractures from limestone dissolution, have developed at the surface, forming a limestone pavement at the northern ridge end and visible cavities deeper in the quarry. Karstic clay-filled pipes are also evident along the quarry faces.

Plate 6-2: View North on northern face of Killough Quarry (SLR, 2016)



**Source: Section 55 Geotechnical Assessment Killough Quarry (SLR, 2016)*

Site Investigation 2020

Borehole Information

6.76 Three groundwater monitoring wells were installed at the quarry site during August 2020. The locations of the boreholes are shown in **Figure 7-5** in Chapter 7 Water (Hydrology & Hydrogeology).

6.77 The depth of boreholes is to 101 m bgl. The bedrock was encountered at or near the surface; in all boreholes intersecting the Ballyadams Formation. Details of the drilled boreholes are presented in **Table 6-5** below.

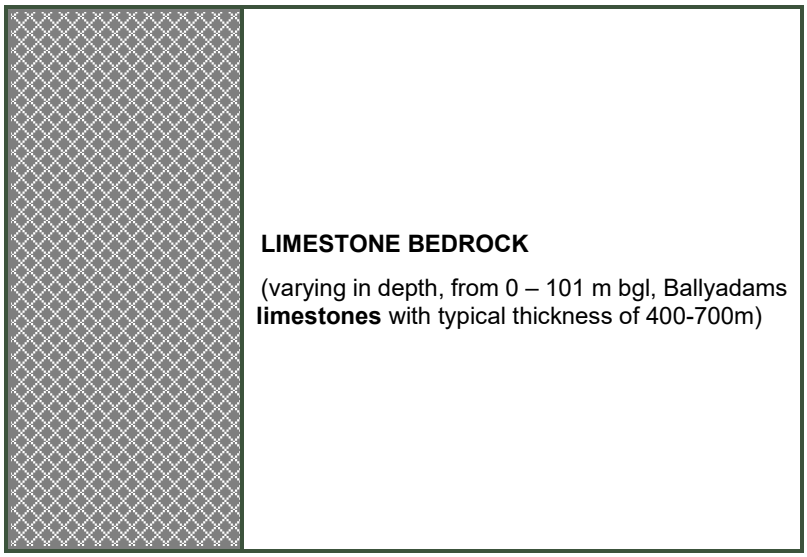
Table 6-5: Summary of site groundwater monitoring boreholes (2020)

BH ID	BH Date	ITM Coordinates	BH Elevation (m AOD)	BH Depth (m bgl)	GW Depth (m AOD)
GW1	08/2020	E:610835 N:651124	160.98	101	122.31
GW2	08/2020	E:611330 N:651040	186.14	101	95.33
GW3	08/2020	E:611322 N:650323	169.33	101	-

Geological Profile

6.78 Based on the information from the review of published geological information, site inspections, and the installation of the groundwater wells, the summarised geological profile at the site is presented on the **Diagram 6-1** bellow.

Diagram 6-1: Schematic Geological profile at the site



Geological Heritage

6.79 The Geological Survey of Ireland (GSI) Irish Geological Heritage (IGH) Programme has identified geological heritage sites in Ireland. The IGH programme has identified the geological heritage sites at and within the study area of the proposed development at Killough (www.gsi.ie).

6.80 GSI database indicates that the Killough Hill and quarry are encountered as a County Geological Audited Site.

6.81 This County Geological Site serves as a key example of well-exposed limestone from the Ballyadams Formation. The northern edge of the quarry and the surrounding ridge slopes have been designated as a proposed Natural Heritage Area (pNHA, site code 000959) due to the presence of unique limestone pavement and calcareous grassland in these areas.

6.82 Within the study area there are three additional County Geological Sites encountered, see **Table 6-6** bellow and **Figure 6-5**.

Table 6-6: Summary details of County Geological Sites encountered within the study area

Site Name:	Cabragh Wetlands	Toberadora	Ballytarsna M8 Road Cut
Site Code	TY018	TY067	TY012
Description	Comprises the Cabragh marshes which lie in a low-lying tributary valley of the River Suir, into which the main river floods in winter. The bedrock under the site is impure Lower Carboniferous limestone, but the marsh features themselves are post-glacial, formed in the last 11,000 years.	Toberadora is a roadside spring site, regarded as a sacred well, along the road between Holycross and Cashel. The spring is of karstic origin, formed in relatively impure limestones of the Durrow Formation, which are of Lower Carboniferous (Mississippian 359-323 Ma) age.	A road cutting through limestone bedrock on the M8 motorway between Junction 6 Horse and Jockey and Junction 7 Cashel North. Bedrock is Lower Carboniferous Durrow Formation, comprising marine shelf lithologies of shaley fossiliferous and oolitic limestone.
Site Importance	A local-scale geological and geomorphological diversity across the feature, across a relatively small area. The feature is already a pNHA (sitecode 001934).	This spring is worthy of recognition as a County Geological Site owing to the detailed mapping and modelling that led to the delineation of its zone of contribution and Source Protection Zones on behalf of the EPA in the early-2010s, and as it is in their monitoring network.	A good representative section for the Durrow Formation, and it is of County Geological Site importance. The rock exposures are a landmark and familiar feature along the M8 motorway between Cashel and Horse and Jockey.
Approx. area (ha)	59.47	0.12	9.2
Location relative to site:	2.7 km northwest of the north landholding boundary	c. 2.7 km west to southwest of the landholding boundary	c. 3 km south of landholding boundary

GSI Consultation Response

6.83 In response to a pre-application consultation letter dated 22nd October 2024 regarding the proposed bio-renewables development, the GSI recommended utilising and referencing their publicly available datasets for the environmental assessment and planning process, see Appendix 6-A.

6.84 This chapter addresses the relevant datasets recommended by the GSI pertaining to Land, Soils, and Geology.

6.85 Regarding this chapter, the GSI response stated that the audit for Co. Tipperary, conducted in 2019, identified the Killough Hill, Co. Tipperary, classified under IGH8 (Lower

Carboniferous) and IGH7 (Quaternary) themes, is an active quarry and a CGS exhibiting extensive Ballyadams Formation limestone.

6.86 The site includes areas designated as a proposed NHA (site code 000959) for its limestone pavement and calcareous grassland. While CGS status does not affect normal quarry operations, it encourages preserving representative geological features post-extraction. The Geological Survey Ireland requests that the operator assist with geological heritage goals by:

- allowing scientists access to quarry faces during operations to study new stratigraphies and assess the site's post-extraction significance; and
- leaving a representative section of the quarry face or including information panels for public education and tourism if appropriate, to enhance geological knowledge.

6.87 These actions are deemed to be more appropriately focused on the quarry site rather than the proposed bio-renewables application site.

6.88 The GSI has also advised regarding review of GSI database for geohazards, geological mapping, groundwater, geophysical data, geochemistry of soils, surface waters and sediments and relevant guidelines, with details provided in Appendix 6-A.

Sensitive Receptors

6.89 In terms of the land, soils and geology baseline considered here, the sensitive receptors identified from this baseline are:

- land for mineral extraction;
- Ballyadams karst bedrock; and
- Geological Heritage.

Impact Assessment

Evaluation Methodology

6.90 The evaluation of impacts of the proposed development is based on a methodology similar to that outlined in the 'Guidelines for the Assessment of Geology, Hydrology and Hydrogeology for National Road Schemes' published by the National Roads Authority (2009) and the Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements published by the IGI (2013).

Evaluation of Impacts

6.91 This assessment therefore will focus on the potential impact of the proposed development at the site.

6.92 The status and importance of existing Land, Soil & Geology attributes identified at the application site are outlined in **Table 6-7** below.

Table 6-7: Status & Importance: Land, Soil & Geology attributes

Attribute	Status / Occurrence	Importance
Land	The application land at the existing development has been used for storage of processed aggregate stockpiles. The land is well drained.	The land within the application area poses an economic value associated with mineral extraction; and according to Corine landcover the application area is classified as Mineral extraction sites. The application area is

Attribute	Status / Occurrence	Importance
		currently used as storage area for processed aggregate. The land has a high value of economic importance at local scale.
Soils	There are no soils at the site.	The local soils around the site are considered to be of moderate importance at a local scale as the former Elton soil are well drained and very productive for agriculture but limited in depth.
Subsoils	There are no subsoils at the site.	The local subsoils around the site are considered to be of moderate importance at a local scale as occurring in limited depth.
Geology	The limestone bedrock at the site has an economic value as a potential aggregate resource.	The site is outside of the permitted extraction area at Killough Quarry and therefore does not form part of the existing quarry resource.
Geological Heritage	The site itself is within a County Geological Site (Killough Hill).	Site serves as a key example of well-exposed limestone from the Ballyadams Formation. The northern edge of the quarry and the surrounding ridge slopes have been designated as a proposed Natural Heritage Area (pNHA, site code 000959) due to the presence of unique limestone pavement and calcareous grassland in these areas.

6.93 The magnitude of these impacts on the land, soils and geology attributes is assessed in **Table 6-8**, below.

Table 6-8: Magnitude of potential impacts on Land, Soil and Geology (with no mitigation)

Attribute	Impact of Proposal on Land, Soil and Geology	Magnitude of Potential Impact (with No Mitigation)
Land	Development of land for the purposes of bio-renewables facility which aims to transform organic materials into energy and fertilisers, fostering a circular economy within the quarry site and providing environmental and economic benefits to the local community.	Positive economic and environmental impact due to character of development.
Soils	Soils are not present at the application area.	No impact.
Subsoils	Subsoils are not present at the application area.	No impact.
Geology	Bedrock will not be extracted at the site. However, as the is a requirement for foundations and infrastructure at the site including for the foul wastewater collection tank and the water ponds, which will require the excavation and extraction of some rock material from the site.	Slight potential impact as some limestone rock will be removed tor the site development in particular for building foundations and the ponds.
Geological Heritage	Development activities will have a negligible impact on the geological	Not Significant as no existing geological exposures will be lost.

Attribute	Impact of Proposal on Land, Soil and Geology	Magnitude of Potential Impact (with No Mitigation)
	heritage as it will not result in the loss of any geological exposures at the site	

Direct Impacts

6.94 The nature of the development will entail the change in land use from mineral extraction to renewable energy production.

6.95 A direct impact will occur from the removal of a small volume of limestone bedrock at the site to facilitate the construction of the development, including building foundations and water ponds at the site.

Indirect Impacts

6.96 It is considered unlikely that development will have an indirect impact on the broader geological aspects of the environment outside the footprint of the proposed application area.

Cumulative Impacts

6.97 A planning search and review of available aerial photograph imagery has been undertaken within a 5 km radius of the site.

6.98 There will be no cumulative impacts on land, soil and geology. The development will not result in a cumulative impact on the geological heritage as the existing geological exposures in the quarry faces will remain.

Unplanned Events

6.99 Unplanned events within the application site, such as accidents do not have the potential to impact on the Land, Soils and Geology adjoining the site.

Human Health

6.100 From a land, soils and geology perspective, any potential impacts on human health from the proposed development would not be via the land use, soils and geology pathways but via other pathways such as air and water, which are addressed in the relevant chapters of this EIAR.

Interaction with Other Impacts

6.101 The interaction between soils / geology and water is addressed in EIAR Chapter 7 Water (Hydrology & Hydrogeology).

‘Do-nothing Scenario’

6.102 In a “do nothing scenario”, the proposed construction and operation of development and land activities would not proceed at the application site and the existing quarry area would remain in its current state.

Mitigation Measures

6.103 Mitigation measures are outlined below for the proposed development.

Construction Stage

Land and Soils

6.104 There will be no impact on land or soils as a result of the proposed development and therefore no specific mitigation measures will be required.

Geology

6.105 Some limited bedrock excavation will be required for building foundations and water pond construction for the development at Killough. Standard best practice construction mitigation measures will be implemented at the site to manage any accidental fuel or oil leaks during construction. A comprehensive Construction and Environmental Management Plan will be prepared prior to construction, see chapter 2 of this EIAR.

Geological Heritage

6.106 There are no mitigation measures required for the geological heritage site during construction.

Operational Stage

6.107 For the operational stage of the proposed development the following mitigation measures will be implemented see Table 6-9 below.

6.108 There will be no impact on the geological heritage at the site during operations.

Table 6-9: Operational Stage Mitigation Measures

Category	Mitigation Measures
Limestone Karst Geology	All activities are carried out under cover in the shed with no emissions to the karst geology
	Use of sealed drainage systems to prevent infiltration to ground. Treat wastewater and runoff on-site using best practice wastewater treatment
	Ponds at the site will be lined to prevent any infiltration or potential contamination to the underlying geology
	Conduct regular inspections of infrastructure for leaks or failures.

Residual Impacts

6.109 The residual impacts on land, soil and geology are those impacts which remain following the implementation of the mitigation measures outlined above.

6.110 With the proposed mitigation measures in place at the site it is considered that there will be no significant residual impacts associated with the proposed development.

References

Geological Survey of Ireland (2007), 1:100,000 *Bedrock Geology of Ireland* (Digital Map).

Institute of Geologists of Ireland (2013), *Geology in Environmental Impact Statements*.

Teagasc (2004), Ireland Subsoil Parent Materials Map (digital version).

Teagasc (2007), Ireland Soils Map (digital version).

Creamer, R. & O'Sullivan, L., (2018) The Soils of Ireland

EPA Report No. 130 (2014), Irish Soil Information System Synthesis Report.

EPA (2008), Irish Soil Information System Final Technical Report 10.

Geological Survey of Ireland Bedrock Geology Sheet 18 (1:100,000).

The Institute of Quarrying Good Practice Guide for Handling Soils in Mineral Workings, (2021).

National Roads Authority (2006) A Guide to Landscape Treatments for National Road Schemes in Ireland.

Transport Infrastructure Ireland (March 2013). Specification for Road Works Series 600 - Earthworks.

Tipperary County Development Plan 2022-2028.

Soils of Tipperary North Riding, T. F. Finch and. J. Gardiner National Soil Survey of Ireland, Teagasc, 1993

Teagasc Manual on Drainage - and Soil Management, 2nd Edition, 2022

Section 55 Geotechnical Assessment Killough Quarry, SLR, 2016

Figures

Figure 6-1: Land Cover Map (1:50,000)

Figure 6-2: National Soils Map (1:50,000)

Figure 6-3: National Subsoils Map (1:50,000)

Figure 6-4: Bedrock Geology Map (1:50,000)

Figure 6-5: Geological Heritage Sites (1:50,000)

603000 E | 604000 E | 605000 E | 606000 E | 607000 E | 608000 E | 609000 E | 610000 E | 611000 E | 612000 E | 613000 E | 614000 E | 615000 E | 616000 E | 617000 E | 618000 E | 619000 E

657100 N | 656100 N | 655100 N | 654100 N | 653100 N | 652100 N | 651100 N | 650100 N | 649100 N | 648100 N | 647100 N | 646100 N | 645100 N

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Scale 1:50,000

Notes:

1. Extract from Ordnance Survey Discovery Series Map No. 66
2. Extract from EPA Corine Land Cover © EPA

Legend:

- Applicants Land Interest Area (c.108.3 hectares)
- Planning Application Area (c. 6.3 hectares)
- 5 km zone

Corine Land Cover Classification:

- Pastures
- Non-irrigated arable land
- Peat bogs
- Mineral extraction sites
- Mixed forest
- Coniferous forest
- Transitional woodland-shrub
- Broad-leaved forest

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Rev	Amendments	Date	By	Chk	Auth

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Figure Title
Corine Land Cover Map

Scale		SLR Project No.
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Date	Date	Date	Date
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Figure Number
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657100 N | 656100 N | 655100 N | 654100 N | 653100 N | 652100 N | 651100 N | 650100 N | 649100 N | 648100 N | 647100 N | 646100 N | 645100 N

N

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Notes:

1. Extract from Ordnance Survey Discovery Series Map No. 66
2. Extract from EPA Soil Map © EPA

Legend:

- Applicants Land Interest Area (c.108.3 hectares)
- Planning Application Area (c. 6.3 hectares)
- 5 km zone

Teagasc Soil Classification:

- Elton - Fine loamy drift with limestones
- Rock
- Peat
- River alluvium
- Urban

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Figure Title
National Soils Map

Scale		SLR Project No.
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Date	Date	Date	Date
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Figure Number
Figure 6-2

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Notes:

1. Extract from Ordnance Survey Discovery Series Map No. 66
2. Extract from EPA Subsoil Map © EPA

Legend:

- Applicants Land Interest Area (c.108.3 hectares)
- Planning Application Area (c. 6.3 hectares)
- 5 km zone

Subsoil Classification:

- The subsoils alluvium: post glacial sand and gravel deposits.
- Bedrock at or close to surface
- Cutover peat
- Limestone till (Carboniferous)
- Man made
- Limestone sands and gravels (Carboniferous)
- Lake sediments undifferentiated
- Sandstone till (Lower Paleozoic/Devonian)
- Shales and sandstones till (Namurian)
- Karstified limestone bedrock as surface

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Figure Title
Subsoils Map

Scale		SLR Project No.
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Date	Date	Date	Date
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Figure Number
Figure 6-3

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657100 N | 656100 N | 655100 N | 654100 N | 653100 N | 652100 N | 651100 N | 650100 N | 649100 N | 648100 N | 647100 N | 646100 N | 645100 N

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Notes:

1. Extract from Ordnance Survey Discovery Series Map No. 66
2. Extract from GSI Bedrock Geology Map © GSI

Legend:

- Applicants Land Interest Area (c.108.3 hectares)
- Planning Application Area (c. 6.3 hectares)
- 5 km zone

GSI Bedrock Geology Formations:

- Ballyadams Formation
- Clogrenan Formation
- Durrow Formation
- Aghmacart Formation
- Crosspatrick Formation
- Waulsortian Limestones
- Ballynash Member
- Suir Limestone Formation

GSI Karst data:

- Karst feature

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Bio-Renewables Production Facility at Killough Quarry, Holycross, Co. Tipperary

Figure Title
Bedrock Geology Map

Scale		SLR Project No.
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Date 10/24	Date 10/24	Date 12/24	Date 12/24

Figure Number **Figure 6-4** | Rev. **R0**

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657100 N | 656100 N | 655100 N | 654100 N | 653100 N | 652100 N | 651100 N | 650100 N | 649100 N | 648100 N | 647100 N | 646100 N | 645100 N

Ballyoughter Bridge

Cabragh Wetlands

Killough Hill

Toberadora

Ballytarsna M8 Road Cut

Laffansbridge Quarry

N

RECEIVED: 13/01/2025

Notes:

1. Extract from Ordnance Survey Discovery Series Map No. 66
2. Extract from GSI Geological Heritage Map © GSI

Legend:

- Applicants Land Interest Area (c.108.3 hectares)
- Planning Application Area (c. 6.3 hectares)
- 5 km zone

GSI Bedrock Geology Formations:

- Ballyadams Formation
- Clogrenan Formation
- Durrow Formation
- Aghmacart Formation
- Crosspatrick Formation
- Waulsortian Limestones
- Ballynash Member
- Suir Limestone Formation

GSI Geological Heritage data:

- Geological Heritage Audited Sites

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Scale 1:50,000

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Client: Roadstone Ltd.

Project: Bio-Renewables Production Facility at Killough Quarry, Holycross, Co. Tipperary

Figure Title: Geological Heritage Sites Map

Scale		SLR Project No.
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Date: 11/24	Date: 11/24	Date: 12/24	Date: 12/24

Figure Number: **Figure 6-5** | Rev.: **R0**

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Appendices

Appendix 6-A: GSI Consultation Response

Appendix 6-B: The County Geological Site Report Killough Hill

Appendix 6-A:

GSI Consultation Response

An Roinn Comhshaoil,
Aeráide agus Cumarsáide
Department of the Environment,
Climate and Communications

Geological Survey
Suirbhéireacht Gheolaíochta
Ireland | Éireann

Shane McDermott
SLR Consulting Ireland
7 Dundrum Business Park
Windy Arbour
Dublin, D14 N2Y7

11 November 2024

Re: Proposed Bio-Renewables Facility, Killough Quarry, Co Tipperary
Your Ref: n/a
Our Ref: 24/383

Dear Shane,

Geological Survey Ireland is the national earth science agency and is a division of the Department of the Environment, Climate and Communications. We provide independent geological information and interpretation and gather various data for that purpose. Please see our website for data availability.

With reference to your email received on the 22 October 2024, concerning the proposed Bio-Renewables Facility, Killough Quarry, Co Tipperary, we recommend using our various data sets when conducting the EIAR, SEA, planning and scoping processes for developments, plans and policies. For more detailed information on how to access this data please access 'Data and Maps' Data & Maps (gsi.ie) on our 'Geoscience for planning' webpage. Use of our data or maps should be attributed correctly (please refer to each individual dataset's metadata for correct attribution).

For specific data available for Environmental Assessment and Planning topics please follow this link [Data by Environmental Assessment and Planning Topic (gsi.ie)], where you will find our data arranged by environmental assessment topic as illustrated below:

Land and soils
Soil • Subsoils (Quaternary Geology) • Tellus Geochemistry • Geotechnical *Geology* • Bedrock • Geophysics • Bedrock & Quaternary 3D

Water
Groundwater • Aquifers GW vulnerability, GWPSs (GWPPs) *Surface water* • Tellus Geochemistry *Estuarine & marine waters* • Marine and coastal *Flooding* • GWClimate • Karst

Climate Change
Carbon accounting / Carbon balance • Geothermal • Carbon capture and storage *Climate change trends* • National coastal change assessment

Cultural Heritage
Archaeology • Cherish *Underwater Archaeology* • Shipwrecks

Material Assets
Built Services • Natural resources (Minerals & Aggregates) • Active quarries

The Landscape
Landscape Appearance & Character • Physiographic units *Historical landscapes* • Historic mines

Other Relevant Data		
Natural (Geo) hazards • Landslide Susceptibility Mapping • Groundwater flooding • Coastal vulnerability • Subsidence • Radon	*Natural heritage* • Geoheritage (County Geological Sites) • Dimension Stone/Stone Built Ireland	

Geoheritage

Geological Survey Ireland is in partnership with the National Parks and Wildlife Service (NPWS, Department of Housing, Local Government and Heritage), to identify and select important geological and geomorphological sites throughout the country for designation as geological NHAs (Natural Heritage Areas). This is addressed by the Geoheritage Programme of Geological Survey Ireland, under 16 different geological themes, in which the minimum number of scientifically significant sites that best represent the theme are rigorously selected by a panel of theme experts.

County Geological Sites (CGSs), as adopted under the National Heritage Plan, include additional sites that may also be of national importance, but which were not selected as the very best examples for NHA designation. All geological heritage sites identified by Geological Survey Ireland are categorised as CGS pending any further NHA designation by NPWS. CGSs are now routinely included in County Development Plans and in the GIS of planning departments, to ensure the recognition and appropriate protection of geological heritage within the planning system. CGSs can be viewed online under the Geological Heritage tab on the online Map Viewer.

The audit for Co. Tipperary was carried out in 2019. The full report details can be found here. **Our records show that the quarry where the proposed deepening will be carried out is a County Geological Site.**

> **Killough Hill**, Co. Tipperary (GR 210962, 150550), under IGH themes: IGH8 Lower Carboniferous, IGH7 Quaternary. An extensive quarry cut into a long, prominent, steep-sided crag-and-tail feature. This CGS is an important representative site exhibiting fresh and extensive exposures of limestone of the Ballyadams Formation. The northern extremity of the quarry area, and the flanks of the ridge around it, have been designated a pNHA (sitecode 000959) owing to the presence of limestone pavement and calcareous grassland there. Link to site report: TY039.

As a working quarry, the listing as a County Geological Site has no implications for the normal operation of the quarry, subject to standard permissions and conditions under planning and environmental legislation. In the event of any future changes in quarrying operations, it would be desirable to consider retaining representative faces for geological purposes.

The Geological Survey would request that the operator might assist our geological heritage goals with the following (and ideally this would be written into the restoration / closure plan) and be included as a condition of planning as deemed appropriate by the planning authority:

1. Allowing access to quarry faces by appropriate scientists (upon request and with due regards to Health and Safety requirements) during quarrying to check for interesting new stratigraphies / relationships as they might become exposed and to establish if the quarry site is worthy of recognition post extraction and through aftercare/restoration planning.

2. If deemed appropriate in (1) above, leaving a representative section of the quarry face at the end of the quarry life or inclusion of information panels to promote the geology to the public or develop tourism or educational resources if appropriate depending on the future use of the site. Natural exposures are few, or deeply weathered, this measure would permit on-going improvement of geological knowledge of the subsurface.

We also encourage discussion on end-of-life plans for the quarry and would be happy to recommend ways to promote the geology to the public or develop tourism or educational resources if appropriate. Geological Survey Ireland would like to offer help with interpretative signs where interesting geological features have been exposed, if appropriate.

The Geoheritage Programme tries to promote a partnership between geological heritage and active quarrying, with such measures as those outlined in the 'Geological Heritage Guidelines for the Extractive Industry', which can be downloaded here. This document, written in association with Irish Concrete Federation, acts as a comprehensive guide in the sustainable extraction of natural resources while preserving the geological heritage of Ireland.

Other Comments

Should development go ahead, all other factors considered, Geological Survey Ireland would much appreciate a copy of reports detailing any site investigations carried out. The data would be redacted for confidentiality and added to Geological Survey Ireland's national database of site investigation boreholes, implemented to provide a better service to the civil engineering sector. Data can be sent to the Geological Mapping Unit, at mailto:GeologicalMappingInfo@gsi.ie.

We encourage you to use any other data sets referenced above for use in your Local area plan and associated environmental assessments.

If we can be of any further help, please do not hesitate to contact me Clare Glanville, or my colleague Trish Smullen at GSIPlanning@gsi.ie.

Yours sincerely,

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Geoheritage and Planning Programme
Geological Survey Ireland

Trish Smullen
Geologist
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The publicly available data referenced/presented here, should in no way be construed as Geological Survey Ireland support for or objection to the proposed development or plan. The data are made freely available to all and can be used as independent scientific data in assessments, plans or policies. It should be noted that in many cases these data are a baseline or starting point for further site specific assessments.

Appendix 6-B:

The County Geological Site Report Killough Hill

TIPPERARY - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Killough Hill**
Other names used for site	
IGH THEME	**IGH8 Lower Carboniferous, IGH7 Quaternary**
TOWNLAND(S)	**Killough, Sallsquarter, Aughnagomaun, Gaile**
NEAREST TOWN/VILLAGE	**Horse and Jockey**
SIX INCH MAP NUMBER	**47, 53**
ITM CO-ORDINATES	**611000E 651000N (centre of quarry)**
1:50,000 O.S. SHEET NUMBER 66	**GSI BEDROCK 1:100,000 SHEET NO. 18**

Outline Site Description
An extensive quarry cut into a long, prominent, steep-sided limestone ridge, which itself is a well-moulded crag-and-tail feature.

Geological System/Age and Primary Rock Type
Bedrock comprises Lower Carboniferous (359-323 Ma) fossil-rich limestone of the Ballyadams Formation, deposited in open marine conditions. The ridge has been shaped and moulded during the Quaternary Period, by glacier ice abrading the ridge top and flanks.

Main Geological or Geomorphological Interest
Killough Hill itself is a well-expressed crag-and-tail feature, with an up-ice 'crag' of bedrock moulded with a down-ice 'tail' of softer glacial till sediment. The quarry into Killough Hill produces stone for aggregates, chippings, railway ballast, lime dust, screenings, and drainage stone.

The Ballyadams Formation limestone rocks are the typical 'Burren' type limestone, and fossiliferous, clean and pale grey in colour. Some micritic beds are present near the base of the quarry. Fossils of coral colonies and bryozoa are found in places within the quarry rocks.

The beds in the quarry get much thicker with depth, and dip gently towards the south. These have been studied in detail and are considered to be ramps and flat thrusts associated with the Variscan orogeny (320-280 Ma), and also have Variscan age north to north-northwest trending veins. These weaknesses are again offset by Palaeogene and Neogene age (65-2 Ma) strike-slip faults. Joints in the rock are also present and visible, closer to the surface, and were formed more recently than Neogene times.

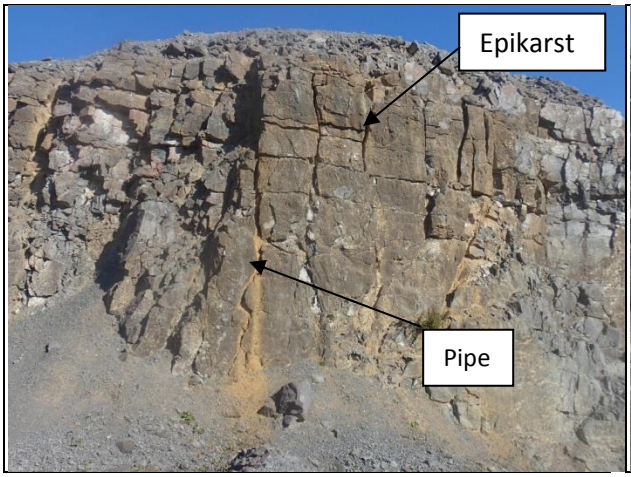
The limestone in Killough Hill has a well-developed layer of epikarst – enlarged fractures from dissolution of the limestone, in the upper few metres. This forms the limestone pavement at the northern end of the ridge, and is also seen in section in the quarry in the hill. Evidence of karstic cavities is also present at depth in the quarry, and a number of clay-filled pipes may be seen throughout the faces.

Site Importance – County Geological Site
This County Geological Site is an important representative site exhibiting fresh and extensive exposures of limestone of the Ballyadams Formation. The northern extremity of the quarry area, and the flanks of the ridge around it, have been designated a pNHA (sitecode 000959) owing to the presence of limestone pavement and calcareous grassland there.

Management/promotion issues
As a working quarry, the listing as a County Geological Site has no implications for the normal operation of the quarry, subject to standard permissions and conditions under planning and environmental legislation. In the event of any future changes in quarrying operations, it would be desirable to consider retaining representative faces for geological purposes. As an operating quarry, the site is not suitable for any general promotion. The crag and tail feature is well seen from the M9 motorway, to its east.

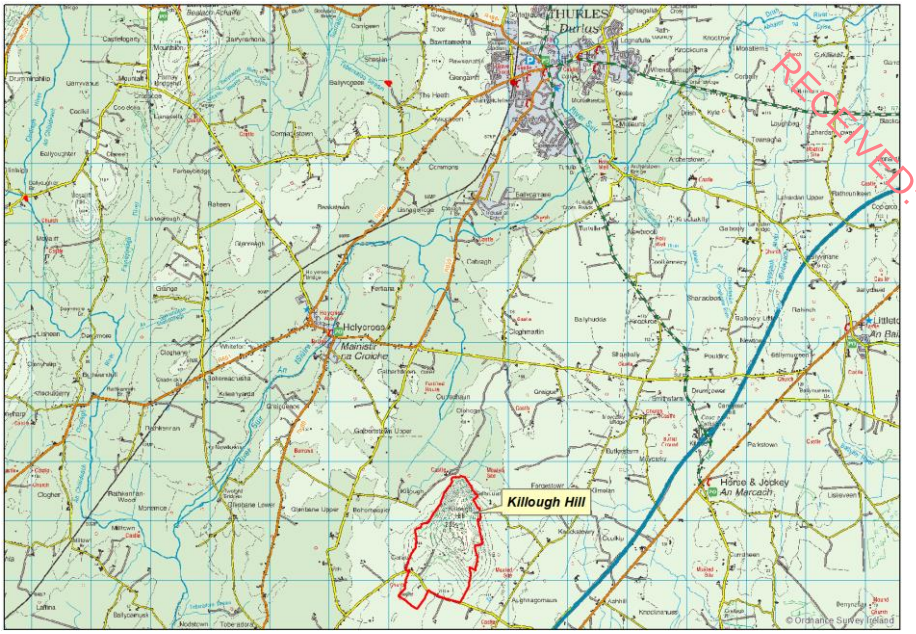
Killough Hill crag and tail, viewed from the east.

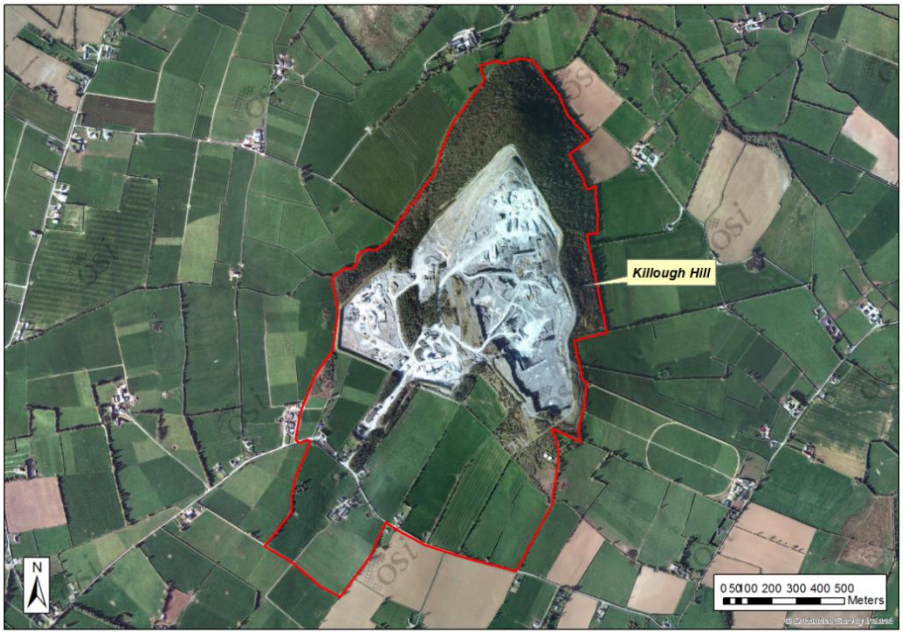
Gently dipping beds in the southern face of Killough Hill quarry.

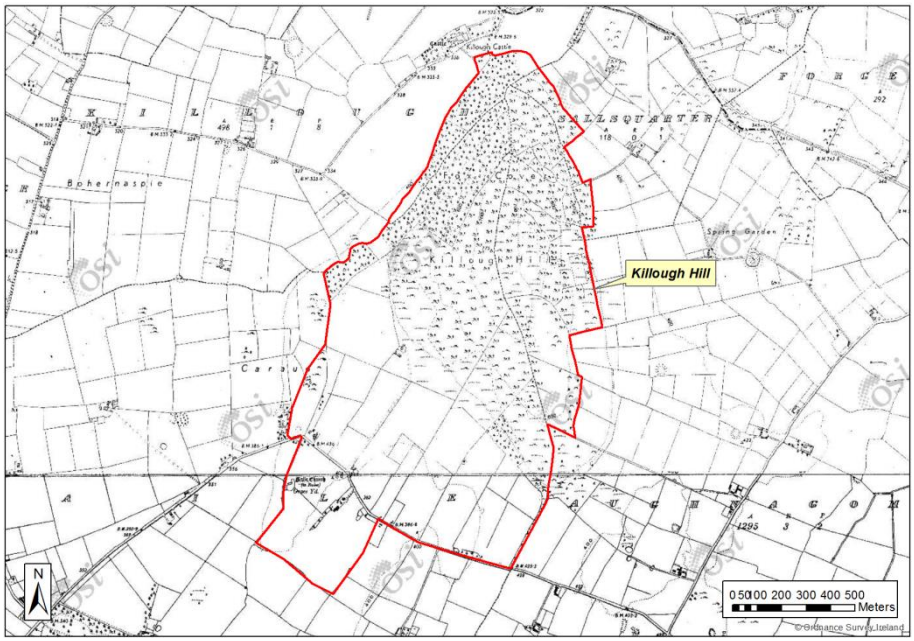


Epikarst in the uppermost portion of the exposed limestone, and a clay-filled 'pipe' within the rock.

Thick bedded, micritite limestone towards the base of the quarry.







Gallagher *et al*. 2019. Geological Survey Ireland.