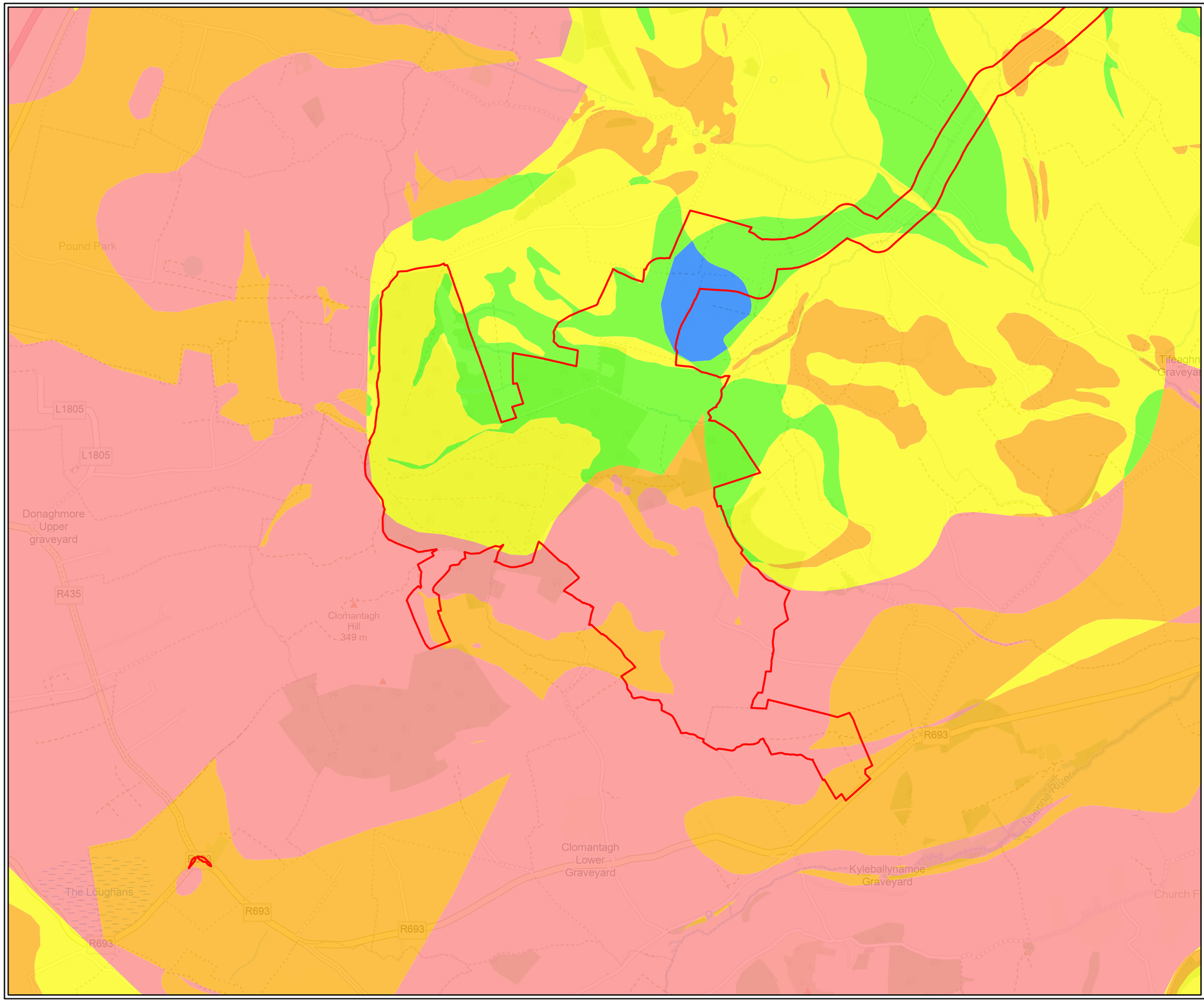
Geological Survey Ireland
Map data © OpenStreetMap contributors, Microsoft, Facebook, Google, Esri Community Maps contributors, Map layer by Esri
Esri, HERE, Garmin, FAO, NOAA, USGS
Creative and Commons Attribution 4.0 International (CC BY 4.0) licence https://creativecommons.org/licenses/by/4.0/
Mapping Reproduced Under Licence from the Ordnance Survey Ireland
Licence No. CYAL50368274 © Government of Ireland

Path: R:\Map Production\2026\P26-112\Workspaces\P26_112_Figures\P26_112_Figures.aprx





Legend

- Site Boundary

Crushed Rock Aggregate Potential

- Very High potential
- High potential
- Moderate potential
- Low potential
- Very Low potential

TITLE: Crushed Rock Potential			
PROJECT: Killoshulan Wind Farm			
FIGURE NO:	4		
CLIENT:	MKO		
SCALE:	1:25,000	**REVISION:**	0
DATE:	07/10/2026	**PAGE SIZE:**	A3

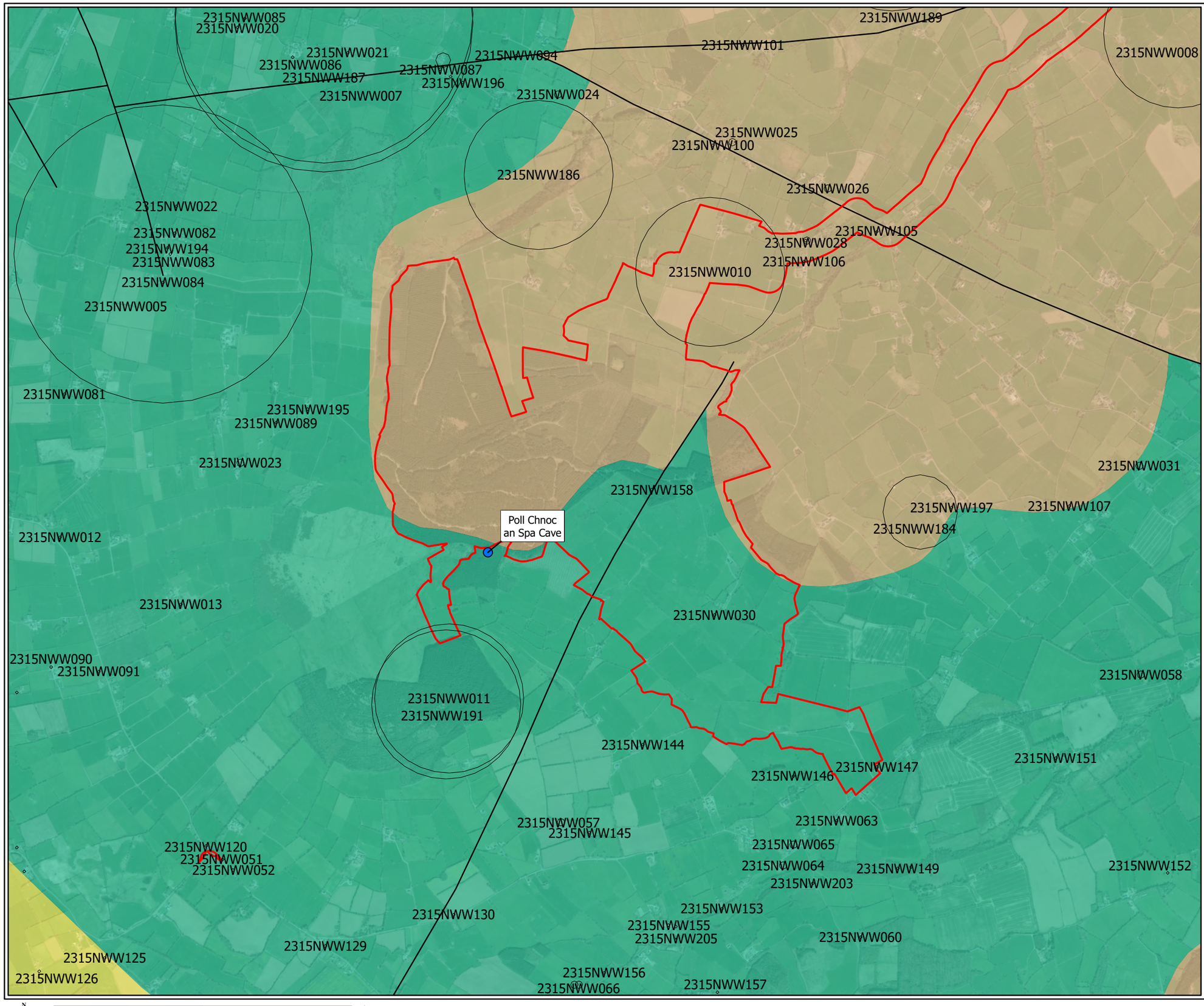
FEHILY TIMONEY
Cork | Dublin | Carlow
www.fehilytimoney.ie

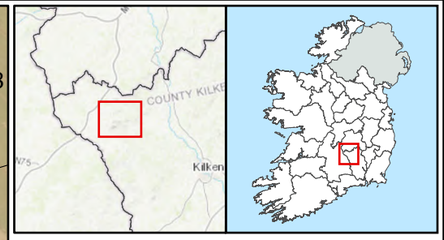
N W E S

0 0.5 1 2 Kilometers

Geological Survey Ireland
Microsoft, Vantor
Esri, HERE, Garmin, FAO, USGS, NGA
Creative and Commons Attribution 4.0 International (CC BY 4.0) licence https://creativecommons.org/licenses/by/4.0/
Mapping Reproduced Under Licence from the Ordnance Survey Ireland
Licence No. CYAL50368274 © Government of Ireland

Path: R:\Map Production\2026\P26-112\Workspaces\P26_112_Figures\P26_112_Figures.aprx





Legend

- Site Boundary
- Groundwater Wells and Springs - circle size is location accuracy
- Regionally important gravel aquifer
- Locally important gravel aquifer

GSI Bedrock Aquifers

- Rkd - Regionally Important Aquifer - Karstified (diffuse)
- Ll - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
- Pl - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones
- GSI Aquifer Geological Lines
- Poll Cnoc an Spa Cave

N W E S

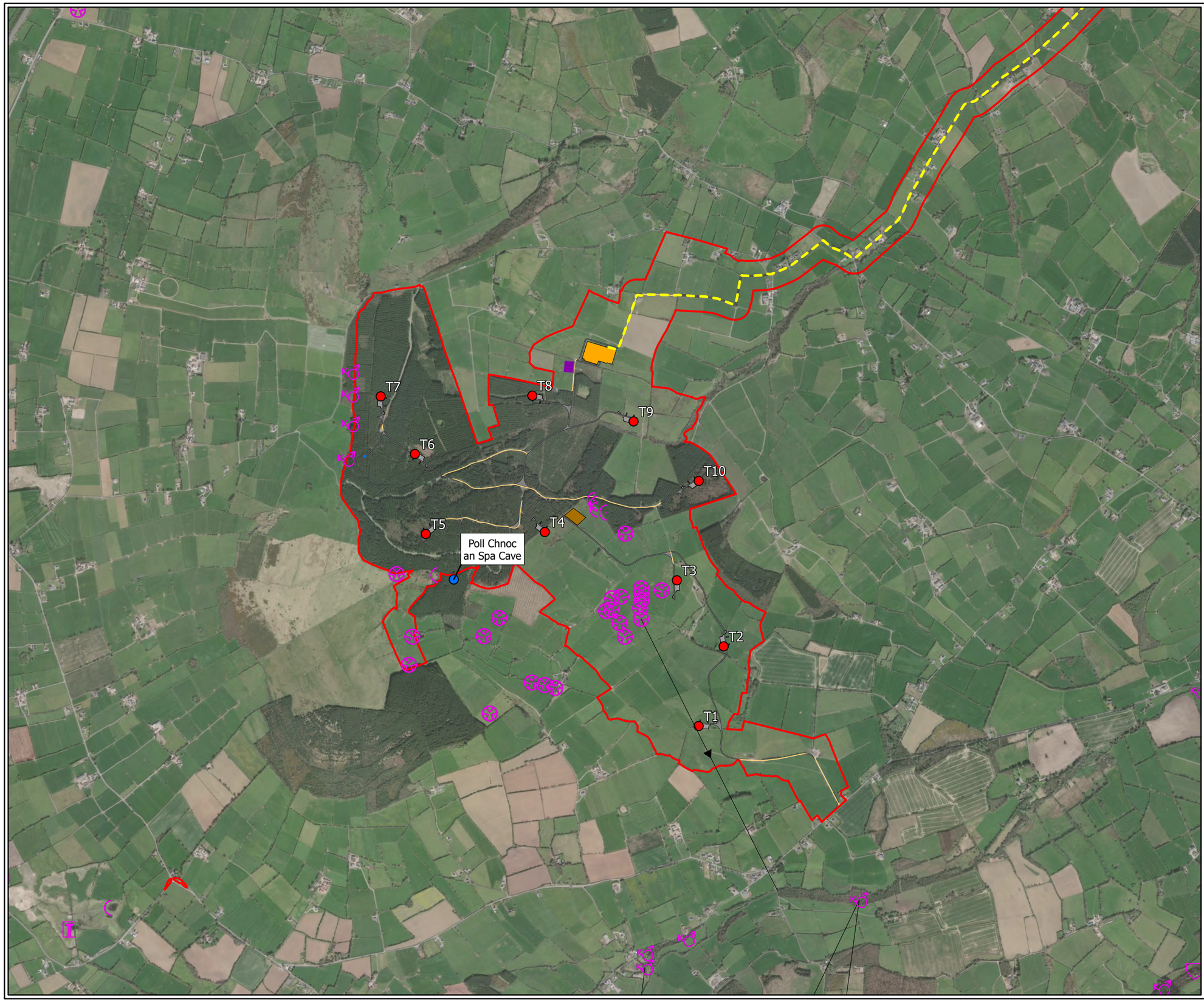
0 0.5 1 2 Kilometers

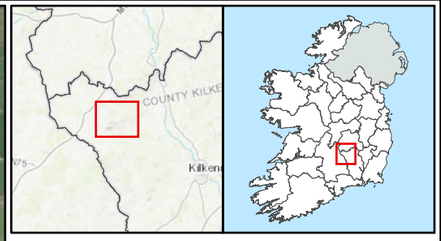
TITLE:	Aquifer Classification		
PROJECT:	Killoshulan Wind Farm		
FIGURE NO:	5		
CLIENT:	MKO		
SCALE:	1:25,000	**REVISION:**	0
DATE:	21/10/2026	**PAGE SIZE:**	A3

FEHILY TIMONEY
Cork | Dublin | Carlow
www.fehilytimoney.ie

Geological Survey Ireland
Microsoft, Vantor
Esri, HERE, Garmin, FAO, USGS, NGA
Creative and Commons Attribution 4.0 International (CC BY 4.0) licence https://creativecommons.org/licenses/by/4.0/
Mapping Reproduced Under Licence from the Ordnance Survey Ireland
Licence No. CYAL50368274 © Government of Ireland

Path: R:\Map Production\2026\P26-112\Workspaces\P26_112_Figures\P26_112_Figures.aprx





Legend

- Site Boundary
- Hardstandings
- Proposed New Access Tracks
- Existing Tracks to be Upgraded
- Spoil Management Area
- Proposed 110kV Substation Compound
- Met Mast Area
- Construction Compound
- Grid Connection Route
- Traced Underground Connections
- Cave
- Enclosed Depression
- Spring
- Swallow Hole
- Turlough
- Poll Cnoc an Spa Cave
- Turbine Location

TITLE:	GSI Karst Distribution		
PROJECT:	Killoshulan Wind Farm		
FIGURE NO:	6		
CLIENT:	MKO		
SCALE:	1:25,000	**REVISION:**	0
DATE:	21/10/2026	**PAGE SIZE:**	A3

FEHILY TIMONEY
Cork | Dublin | Carlow
www.fehilytimoney.ie

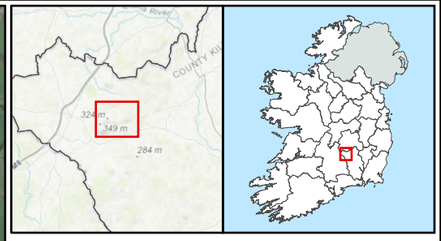
N W E S

0 0.5 1 2 Kilometers

Path: R:\Map Production\2026\P26-112\Workspaces\P26_112_Figures\P26_112_Figures.aprx

Microsoft, Vantor
Esri, HERE, Garmin, FAO, USGS
Creative and Commons Attribution 4.0 International (CC BY 4.0) licence https://creativecommons.org/licenses/by/4.0/
Mapping Reproduced Under Licence from the Ordnance Survey Ireland
Licence No. CYAL50368274 © Government of Ireland





Legend

- Site Boundary
- Borehole
- Trial Pit

N
W E
S

0 0.25 0.5 1 Kilometers

TITLE:	Intrusive Ground Investigation Locations		
PROJECT:	Killoshulan Wind Farm		
FIGURE NO:	7		
CLIENT:	MKO		
SCALE:	1:15,000	**REVISION:**	0
DATE:	07/10/2026	**PAGE SIZE:**	A3

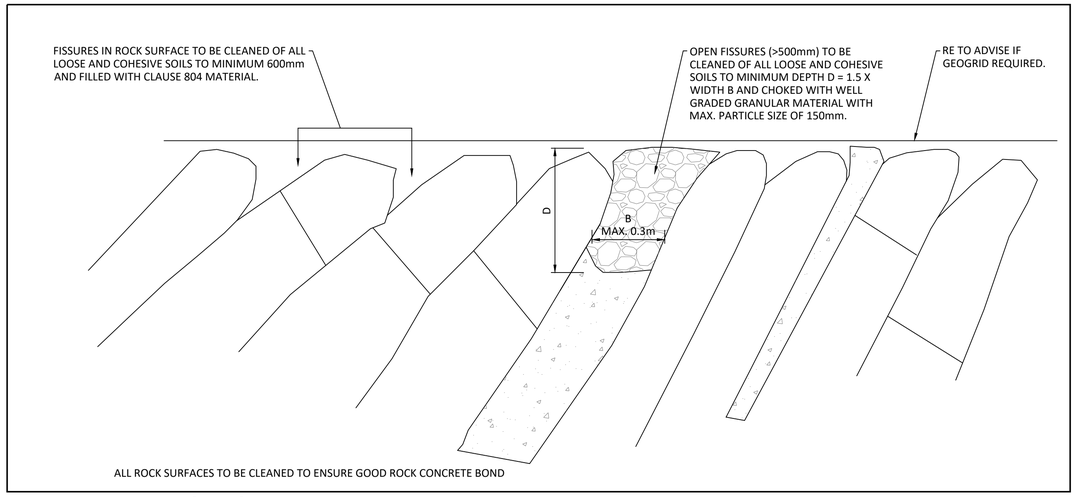
FEHILY TIMONEY
Cork | Dublin | Carlow
www.fehilytimoney.ie

FEHILY TIMONEY

DESIGNING AND DELIVERING
A SUSTAINABLE FUTURE

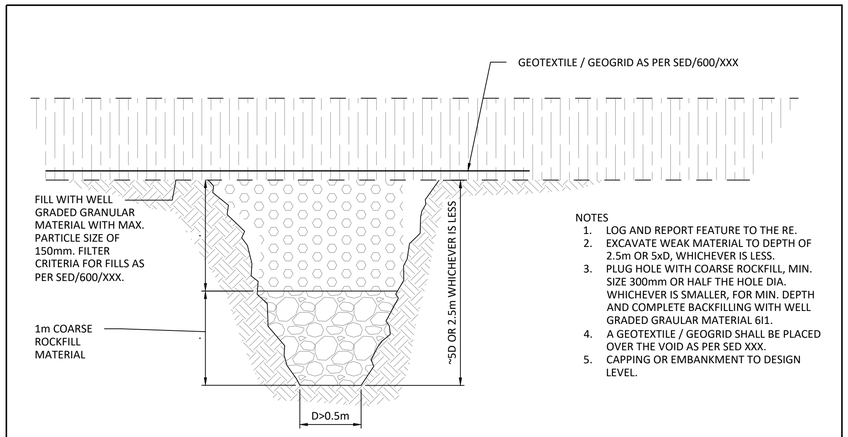
APPENDIX B

Drawings



SED/601/701: TYPICAL DETAIL FOR FOMATION AT ROCK LEVEL IN KARST AREA

Scale N.T.S.



SED/601/702: TYPICAL DETAIL FOR SMALL SINKHOLE - (D < 1.0m DIA.)

Scale N.T.S.

If Applicable : Tailte Éireann Licence No. CYAL50368274 © Ordnance Survey Ireland and Government of Ireland

FEHILY TIMONEY

Cork | Dublin | Carlow

www.fehilytimoney.ie

No part of this document may be reproduced or transmitted in any form or stored in any retrieval system of any nature without the written permission of Fehily Timoney & Company as copyright holder except as agreed for use on the project for which the document was originally issued. Do not scale. Use figured dimensions only. If in doubt - Ask!

Rev.	Description	App By	Date
P01	FOR INFORMATION	BDH	14.10.26

PROJECT	KILLOSHULAN WIND FARM
CLIENT	MKO
SHEET	KARST STANDARD DETAILS SHEET 1 OF 3
Date	14.10.26
Project number	P26-112
Scale (@ A1)	As Shown
Drawn by	POR
Drawing Number	P26112-FT-XX-XX-SD-GE-0001
Rev	P01
Checked by	IH

O:\ACAD\2026\P26-112\P26112-FT-XX-XX-SD-CE-0001

14 October 2026

PLAN OF ONE-WAY GEOTEXTILE REINFORCEMENT OVER SUBSIDENCE SINKHOLES (DEPTH TO ROCK > 5M)

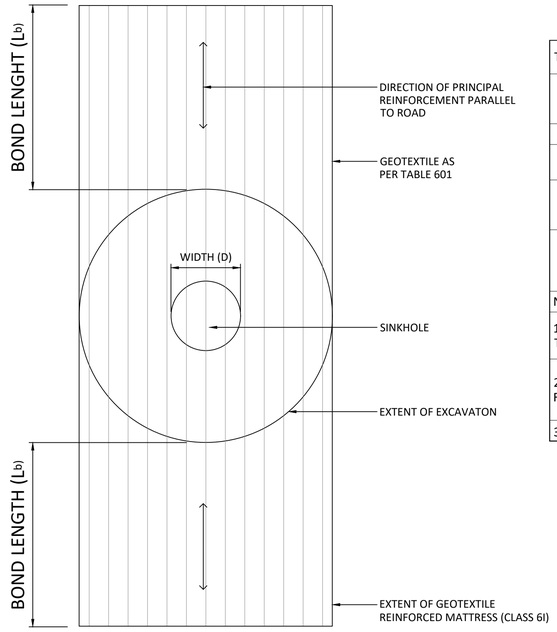


TABLE 601 - GEOTEXTILE TYPE - STABILENKA OR APPROVED EQUIVALENT

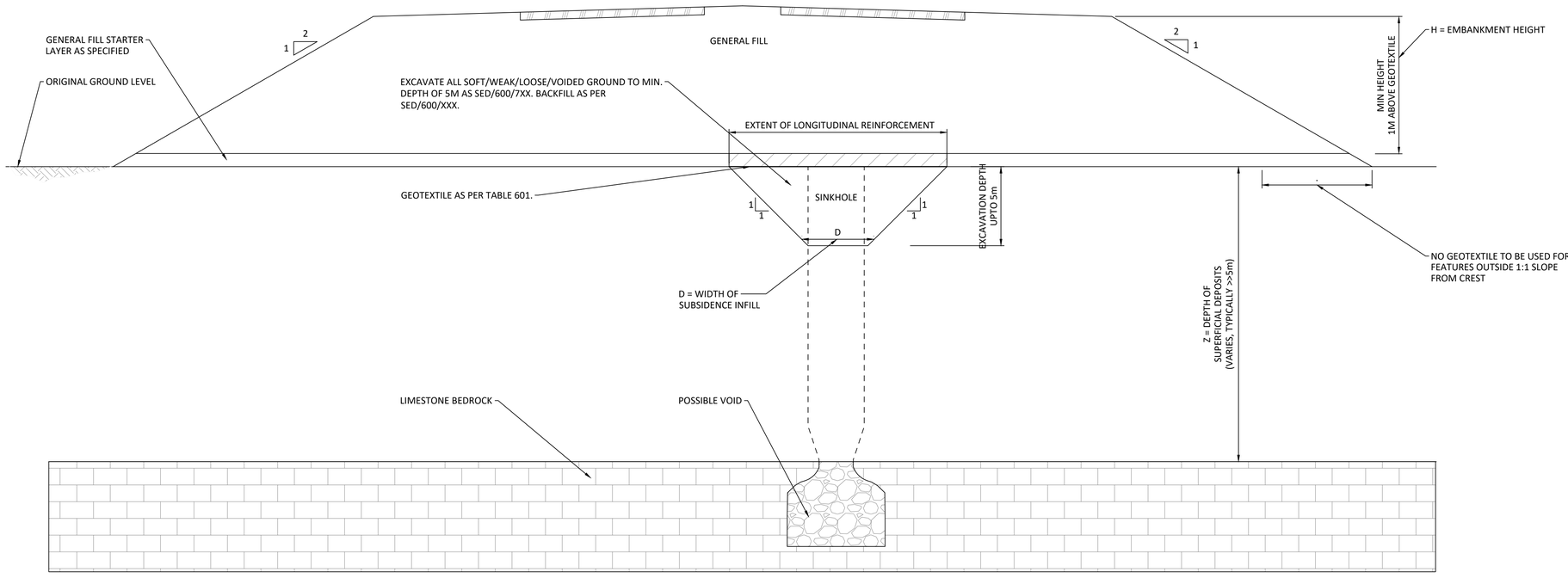
SINKHOLE DIAMETER D (m)	HEIGHT OF FILL H (m) (BOND LENGTH SHOWN IN BRACKETS)				
	≥ 1	≥ 2	≥ 3	≥ 4	≥ 5
1	PET 200 (3.2m)	PET 200 (2.6m)	PET 200 (2.1m)	PET 200 (1.9m)	PET 200 (1.8m)
3	NOTE 3	PET 800 (7.5m)	PET 800 (6.5m)	PET 1000 (5.7m)	PET 1200 (5.5m)
>3	VOIDS LARGER THAN 3m OR VOIDS THAT COULD POTENTIALLY COLLAPSE TO FORM A VOID LARGER THAN 3m SHALL BE REVIEWED ON A CASE BY CASE BASIS BY THE DESIGNER.				

NOTES

1. A MINIMUM EMBANKMENT HEIGHT OF 1m IS REQUIRED FOR THE DESIGN TO BE VALID.

2. THE BOND LENGTH IS VALID FOR THE FULL HEIGHT OF FILL. FOR INTERMEDIATE FILL HEIGHTS THE LARGEST OF THE BOND LENGHTS SHOULD BE APPLIED.

3. DESIGN TO BE DEVELOPED ON A CASE BY CASE BASIS.



SED/601/703: TYPICAL DETAIL FOR LARGE SINKHOLE (>Ø1.0m < Ø3.0m)

Scale N.T.S.

If Applicable : Tailte Éireann Licence No. CYAL50368274 © Ordnance Survey Ireland and Government of Ireland

FEHILY TIMONEY
Cork | Dublin | Carlow
www.fehilytimoney.ie

No part of this document may be reproduced or transmitted in any form or stored in any retrieval system of any nature without the written permission of Fehily Timoney & Company as copyright holder except as agreed for use on the project for which the document was originally issued. Do not scale. Use figured dimensions only. If in doubt - Ask!

Rev.	Description	App By	Date
P01	FOR INFORMATION	BDH	14.10.26

PROJECT	KILLOSHULAN WIND FARM
CLIENT	MKO
SHEET	KARST STANDARD DETAILS SHEET 2 OF 3
Date	14.10.26
Project number	P26-112
Scale (@ A1)	As Shown
Drawn by	POR
Drawing Number	P26112-FT-XX-XX-SD-GE-0002
Rev	P01
Checked by	IH

O:\ACAD\2026\P26-112\P26112-FT-XX-XX-SD-CE-0002

14 October 2026

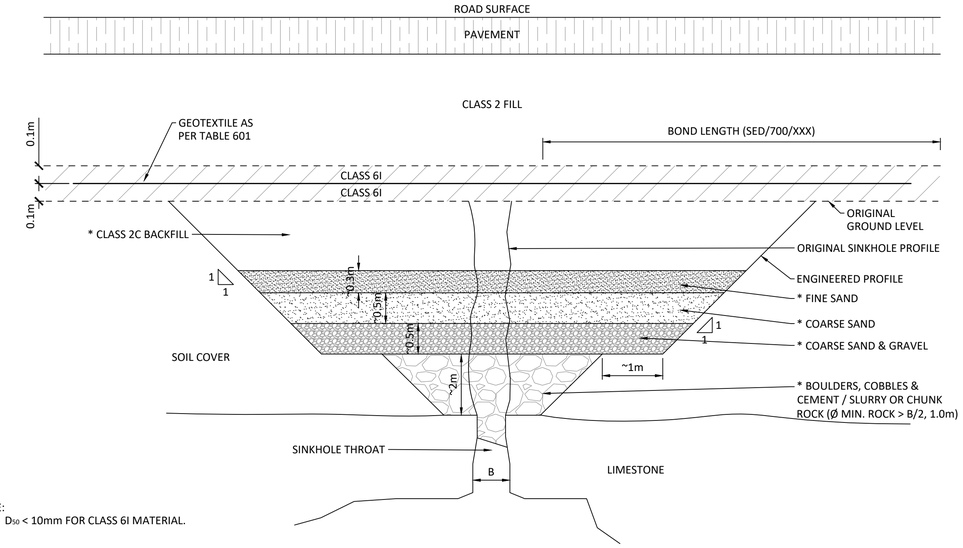
*D15 $_{Filter}$ FINE SAND MUST BE < 5xD85 $_{base\ soil}$ CLASS 2C BACKFILL

D15 $_{Filter}$ COARSE SAND MUST BE < 5xD85 $_{base\ soil}$ FINE SAND

D15 $_{Filter}$ COARSE SAND & GRAVEL MUST BE < 5xD85 $_{base\ soil}$ COARSE SAND

D15 $_{Filter}$ BOULDERS ETC. < 5xD85 $_{base\ soil}$ COARSE SAND & GRAVEL

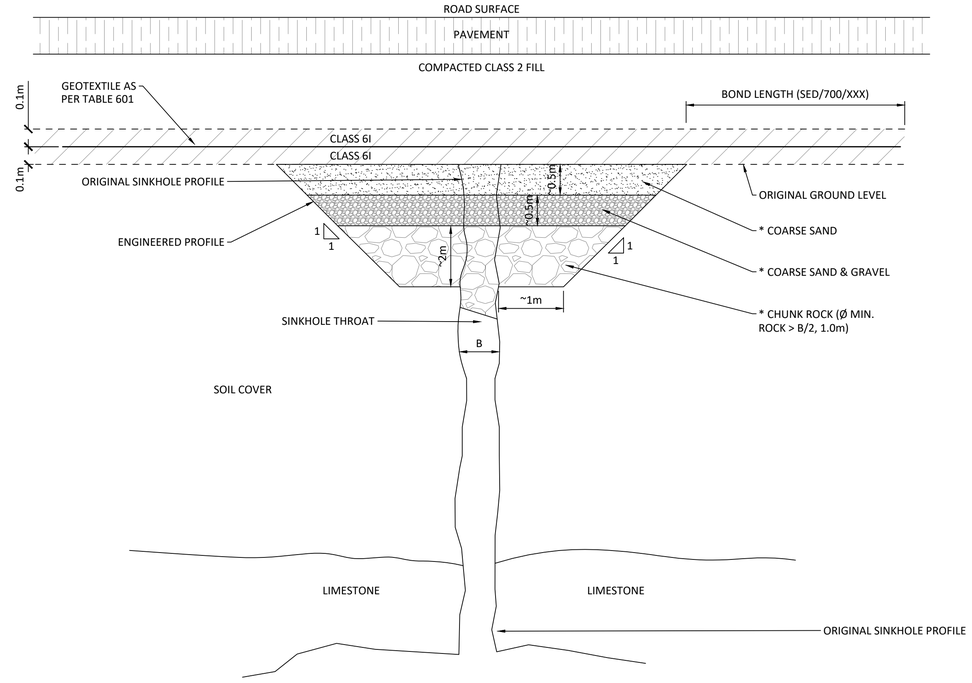
COMPACTION REQUIREMENTS TO BE AGREED WITH THE RE AND SHALL TAKE INTO ACCOUNT THE DIAMETER OF THE VOID, ACCESS TO THE VOID AND HEALTH AND SAFETY ASSESSMENTS AT EACH VOID TO BE TREATED.



NOTE:
1. D_{50} < 10mm FOR CLASS 6I MATERIAL.

SED/601/704: TYPICAL SINKHOLE TREATMENT (DEPTH ROCK <5.0m) DIA < 3M, DIA >1m

Scale N.T.S.



SED/601/705: TYPICAL SINKHOLE TREATMENT (DEPTH ROCK >5.0m) DIA < 3m, DIA >1m

Scale N.T.S.

If Applicable : Tailte Éireann Licence No. CYAL50368274 © Ordnance Survey Ireland and Government of Ireland

FEHILY TIMONEY
Cork | Dublin | Carlow
www.fehilytimoney.ie

No part of this document may be reproduced or transmitted in any form or stored in any retrieval system of any nature without the written permission of Fehily Timoney & Company as copyright holder except as agreed for use on the project for which the document was originally issued. Do not scale. Use figured dimensions only. If in doubt - Ask!

Rev.	Description	App By	Date
P01	FOR INFORMATION	BDH	14.10.26

PROJECT	KILLOSHULAN WIND FARM
CLIENT	MKO
SHEET	KARST STANDARD DETAILS SHEET 3 OF 3
Date	14.10.26
Project number	P26-112
Scale (@ A1)	As Shown
Drawn by	POR
Checked by	IH
Drawing Number	P26112-FT-XX-XX-SD-GE-0003
Rev	P01

O:\ACAD\2026\P26-112\P26112-FT-XX-XX-SD-CE-0003

14 October 2026

FEHILY TIMONEY

DESIGNING AND DELIVERING
A SUSTAINABLE FUTURE

APPENDIX C

Site Photos



Photo 1: View of enclosed depression 200m west of T03



Photo 2: View of sinkhole east of T04



Photo 3: Bedrock exposed at ground level showing evidence of epikarst features, east of T04

FEHILY TIMONEY

DESIGNING AND DELIVERING
A SUSTAINABLE FUTURE

APPENDIX D

Ground Investigation Factual Report

GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

Catherinestown House,
Hazelhatch Road,
Newcastle,
Co. Dublin.
D22 YD52

Tel: 01 601 5175 / 5176
Email: info@gii.ie
Web: www.gii.ie

Ground Investigations Ireland

Killoshulan Wind Farm

MKO

Ground Investigation Report

September 2026

Directors:
Fergal McNamarra, Conor Finnerty, Barry Sexton, Stephen Kealy and Micheal Sutton
Ground Investigations Ireland Limited | Registered in Ireland Company Regsitration No.: 405726

GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

Catherinestown House,
Hazelhatch Road,
Newcastle,
Co. Dublin.
D22 YD52

Tel: 01 601 5175 / 5176
Email: info@gii.ie
Web: www.gii.ie

DOCUMENT CONTROL SHEET

Project Title	Killoshulan Wind Farm Initial
Client	MKO
Project No	15495-04-26
Document Title	Ground Investigation Report

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
C	Final	E Byrne	E Byrne	M Sutton	Dublin	11 September 2026

Ground Investigations Ireland Ltd. present the results of the fieldworks and laboratory testing in accordance with the specification and related documents provided by or on behalf of the client The possibility of variation in the ground and/or groundwater conditions between or below exploratory locations or due to the investigation techniques employed must be taken into account when this report and the appendices inform designs or decisions where such variation may be considered relevant. Ground and/or groundwater conditions may vary due to seasonal, man-made or other activities not apparent during the fieldworks and no responsibility can be taken for such variation. The data presented and the recommendations included in this report and associated appendices are intended for the use of the client and the client's geotechnical representative only and any duty of care to others is excluded unless approved in writing.

GROUND INVESTIGATIONS IRELAND
Geotechnical & Environmental

Catherinestown House,
Hazelhatch Road,
Newcastle,
Co. Dublin.
D22 YD52

Tel: 01 601 5175 / 5176
Email: info@gii.ie
Web: www.gii.ie

CONTENTS

1.0 Preamble 1
2.0 Overview 1
2.1. Background 1
2.2. Purpose and Scope 1
3.0 Subsurface Exploration 1
3.1. General 1
3.2. Rotary Boreholes 1
3.3. Surveying 2
3.4. Groundwater Monitoring Installations 2
3.5. Electrical Resistivity Tomography (ERT) Survey 2
3.6. Microgravity Survey 3
3.7. Laboratory Testing 3
4.0 Ground Conditions 3
4.1. General 3
4.2. Groundwater 4
4.3. Laboratory Testing 4
4.3.1. Geotechnical Laboratory Testing 4
4.3.2. Chemical Laboratory Testing 4
4.3.3. Rock Laboratory Testing 5

APPENDICES

Appendix 1 Site Location Plan
Appendix 2 Rotary Core Records
Appendix 3 Laboratory Testing
Appendix 4 Geophysics Survey

1.0 Preamble

On the instructions of MKO, a site investigation was carried out by Ground Investigations Ireland Ltd., between May and June 2026 at the site of the proposed wind farm in Killoshulan, Co. Kilkenny.

2.0 Overview

2.1. Background

It is proposed to construct a new Aldi store with associated services, access roads and car parking at the proposed site. The site is currently greenfield and is situated to the east of Urlingford Town. The proposed construction is envisaged to consist of piled foundations and pavement make up with some local excavations for services and plant.

2.2. Purpose and Scope

The purpose of the site investigation was to investigate subsurface conditions utilising a variety of investigative methods in accordance with the project specification. The scope of the work undertaken for this project included the following:

- Visit project site to observe existing conditions
- Carry out 13 No. Rotary Core Boreholes to a maximum depth of 30.50m BGL
- Installation of 3 No. Groundwater monitoring wells
- Carry out 28 No. ERT survey lines
- Carry out 1 No. Microgravity Survey
- Geotechnical & Chemical Laboratory testing
- Factual Report

3.0 Subsurface Exploration

3.1. General

During the ground investigation a programme of intrusive investigation specified by the Consulting Engineer was undertaken to determine the sub surface conditions at the proposed site. Regular sampling and in-situ testing was undertaken in the exploratory holes to facilitate the geotechnical descriptions and to enable laboratory testing to be carried out on the soil samples recovered during excavation and drilling.
The procedures used in this site investigation are in accordance with Eurocode 7 Part 2: Ground Investigation and testing (ISEN 1997 – 2:2007) and B.S. 5930:2015.

3.2. Rotary Boreholes

The rotary coring was carried out by a track mounted T44 Beretta rig at the locations shown on the location plan in Appendix 1. The rotary boreholes were completed from the surface.

The T44 Beretta is equipped with rubber tracks which allow for short travel on pavement surfaces avoiding any damage to the surface. The T44 Beretta utilises a triple tube core barrel system operated using a wireline drilling process. The outer barrel is rotated by the drill rods and at its lower end, carries the coring bit. The inner barrel is mounted on a swivel so that it does not rotate during the process. The third barrel or liner is placed within the second one to retain the core intact and to preserve as much as possible the fabric of the drilling stratum. The core is cut by the coring bit and passes to the inner liner. The core is brought up to the surface within the inner barrel on a small diameter wire rope or line attached to the "overshoot" recovery tool which is then placed into a core box in order of recovery. A drilling fluid, typically air mist or water flush is passed from the surface through hollow drill rods to the drill bit and is used to cool the drill bit. Temporary casing is used in some situations to support unstable ground or to seal off fissures or voids. It should be noted that the rotary coring can only achieve limited recovery in overburden, particularly granular or weakly cemented strata due to the flushing medium washing away the cohesive fraction during coring. The recovery achieved, where required is noted on the borehole logs and core photographs are provided to allow assessment of the core recovered. The rotary borehole logs are provided in Appendix 2 of this Report.

3.3. Surveying

The exploratory hole locations have been recorded using a KQ GEO Technologies KQ-M8 System which records the coordinates and elevation of the locations to ITM as required by the project specification. The coordinates and elevations are provided on the exploratory hole logs in the appendices of this Report.

3.4. Groundwater Monitoring Installations

Groundwater Monitoring Installations were installed upon the completion of selected boreholes to enable sampling and the determination of the equilibrium groundwater level. The typical groundwater monitoring installation consists of a 50mm uPVC/HDPE slotted pipe with a pea gravel response zone and bentonite seal installed to the Engineers specification. Where required the standpipe is sealed with a gas tap and finished with a durable steel cover fixed in place with a concrete surround. The installation details are provided on the exploratory hole logs in the appendices of this Report.

3.5. Electrical Resistivity Tomography (ERT) Survey

Two ERT lines were carried out at the proposed location of each wind turbine. The survey is a non-invasive geophysical method used to determine the distribution of electrical resistivity in the subsurface. It works by injecting an electrical current into the ground through current electrodes and measuring the resulting voltage differences with potential electrodes. These measurements are then processed to generate 2D resistivity maps, which reflect variations in subsurface materials and structures based on their electrical properties. The results of this survey are provided in Appendix 4 of this Report.

3.6. Microgravity Survey

A microgravity survey was carried out in the vicinity of T4. The survey is a non-invasive geophysical method used to determine the subtle variations in the Earth's gravitational field to map subsurface density differences, revealing voids, faults, and other underground features.

3.7. Laboratory Testing

Samples were selected from the exploratory holes for a range of geotechnical and environmental testing to assist in the classification of soils and to provide information for the proposed design.
Chemical testing as required by the specification, including pH and sulphate testing was carried out by Element Materials Technology Laboratory in the UK.
Geotechnical testing consisting of moisture content, Atterberg limits, Particle Size Distribution (PSD) and hydrometer tests were carried out in NMTL's Geotechnical Laboratory in Carlow.
Rock strength testing including Point Load (Is_{50}) and Unconfined Compressive Strength (UCS) testing was carried out in Prosoil's Geotechnical Laboratory
The results of the laboratory testing are included in Appendix 3 of this Report.

4.0 Ground Conditions

4.1. General

The ground conditions encountered during the investigation are summarised below with reference to insitu and laboratory test results. The full details of the strata encountered during the ground investigation are provided in the exploratory hole logs included in the appendices of this report.

The sequence of strata encountered were variable across the site and generally comprised;

- Topsoil
- Granular Deposits
- Cohesive Deposits
- Bedrock

TOPSOIL: Topsoil was encountered in most of the exploratory holes and was present to a maximum depth of 0.25m BGL.

COHESIVE DEPOSITS: Cohesive deposits were encountered beneath the Topsoil and were described typically as *brown sandy gravelly CLAY with low boulder content*. The secondary sand and gravel constituents varied across the site and with depth, with granular lenses occasionally present in the cohesive matrix. The strength of the cohesive deposits typically increased with depth and was firm to stiff or stiff below 2.50m BGL in the majority of the exploratory holes. These deposits had low (<5%), medium (5%-20%) or high (20%-50%) cobble and boulder content, where noted on the exploratory hole logs.

GRANULAR DEPOSITS: Granular deposits were encountered below the base of the cohesive deposits and were typically described as *grey clayey sandy sub rounded to angular fine to coarse GRAVEL with low cobble content.* The secondary sand/gravel and silt/clay constituents varied across the site with cohesive or coarse lenses occasionally present in the granular matrix. These deposits had low (<5%), medium (5%-20%) or high (20%-50%) cobble and boulder content, where noted on the exploratory hole logs.

BEDROCK: The rotary core boreholes recovered Medium strong to very strong grey fine to medium grained massive/thinly bedded LIMESTONE. This is typical of the Waulsortian Formation, which is noted on the geological mapping below the proposed site. Karstification is associated with this formation and dolines can be seen on the surface of the site in places. Extensive infilled cavities were logged in BH04 from 9.90m BGL to 24.10m BGL and BH-T4-NW from 7.00m BGL to 15.80m BGL. Namurian Siltstones and Mudstones were also present on the site.
The depth to rock varies from surface in BH07 and BH08 in the western portion of the site to a maximum of 11.50m BGL in BH06 in the central portion of the site. The total core recovery is good, typically 100% with some of the uppermost runs dropping to 80 or 90%. The SCR and RQD both are relatively poor in the upper weathered zone, often recovered as non-intact, however both indices show an increase with depth in each of the boreholes.

4.2. Groundwater

No groundwater was noted during the investigation however we would point out that these exploratory holes did not remain open for sufficiently long periods of time to establish the hydrogeological regime and groundwater levels would be expected to vary with the time of year, rainfall, nearby construction and other factors. For this reason, standpipes were installed in BH01 and BH04A to allow the equilibrium groundwater level to be determined.

4.3. Laboratory Testing

4.3.1. Geotechnical Laboratory Testing

The geotechnical testing carried out on soil samples recovered generally confirm the descriptions on the logs with the primary constituent of the cohesive deposits found to be a CLAY of intermediate to high plasticity. The Particle Size Distribution tests confirm that generally the cohesive deposits are well-graded with percentages of sands and gravels ranging between 13.50% and 49.00% generally with fines contents of 36.00 to 57.60%.
The CBR testing on remoulded samples gave results ranging between 11.3% and 50.0% for the cohesive deposits.

4.3.2. Chemical Laboratory Testing

The chemical testing completed as part of the scope of works, pH and sulphate testing indicate that the pH results are near neutral and that the water soluble sulphate results are low when compared to the guideline values in Table C1 (Greenfield) of the from BRE Special Digest 1:2005. The samples tested are below the threshold for Design Sulphate Class of DS-1.

4.3.3. Rock Laboratory Testing

The rock testing carried out on samples recovered from the boreholes reported Unconfined Compressive Strength (UCS) values ranging between 85.3 and 124 MPa while the point load testing gave Is50 values ranging between 0.28 to 4.80 MPa. The Is_{50} results correlate to the UCS values using a factor of approximately 20, giving values of 5.6 MPa and 96 MPa. These results correlate to the strength descriptions ranging between of Weak to Very Strong and confirming the variability of this stratum and the descriptions on the logs.

The results from the completed laboratory testing are included in Appendix 3 of this report.

APPENDIX 1 - Site Location Plan