

Appendix 7-4 Geophysical Reports - Greenfield Area 2025
(Apex, 20218a, 2018b, 2025)

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AGL18010_01 _PHASE I

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**REPORT
ON THE
GEOPHYSICAL INVESTIGATION
AT
BENNETTSBRIDGE QUARRY EXTENSION
PHASE I
FOR
BENNETTSBRIDGE LIMESTONE
QUARRIES LIMITED**



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THE FINDINGS OF THIS REPORT ARE THE RESULT OF A GEOPHYSICAL SURVEY USING NON-INVASIVE SURVEY TECHNIQUES CARRIED OUT AT THE GROUND SURFACE. INTERPRETATIONS CONTAINED IN THIS REPORT ARE DERIVED FROM A KNOWLEDGE OF THE GROUND CONDITIONS, THE GEOPHYSICAL RESPONSES OF GROUND MATERIALS AND THE EXPERIENCE OF THE AUTHOR. APEX GEOSERVICES LTD. HAS PREPARED THIS REPORT IN LINE WITH BEST CURRENT PRACTICE AND WITH ALL REASONABLE SKILL, CARE AND DILIGENCE IN CONSIDERATION OF THE LIMITS IMPOSED BY THE SURVEY TECHNIQUES USED AND THE RESOURCES DEVOTED TO IT BY AGREEMENT WITH THE CLIENT. THE INTERPRETATIVE BASIS OF THE CONCLUSIONS CONTAINED IN THIS REPORT SHOULD BE TAKEN INTO ACCOUNT IN ANY FUTURE USE OF THIS REPORT.

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AUTHOR	CHECKED	REPORT STATUS	DATE
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1. EXECUTIVE SUMMARY

APEX Geoservices Limited was requested by Bennettsbridge Limestone Quarries Limited to carry out a geophysical and outline drilling investigation to determine the potential for an extension to the Bennettsbridge Limestone Quarry, Kilree, Bennettsbridge, Co Kilkenny, into lands lying immediately west and south-west of the quarry. The area of interest has been divided into two sub-areas designated Phase 1 and Phase 2. Phase 1 is situated to the south of Phase 2.

This report covers the work carried out under this investigation on the Phase 1 area.

The investigation consisted of 2D electrical resistivity tomography (ERT) and rotary percussive drilling.

Bennettsbridge Limestone Quarry is located 1.3 km north-west of Bennettsbridge, County Kilkenny. The survey area is approximately 6 Ha.

The objectives of the investigation were to provide information on the type, thickness and variation of the soils, provide information on the depth to bedrock, type of bedrock, extent of weathering, fissures and clays, and to calculate a potential limestone rock resource across the site.

The results indicate soil material comprises generally sandy/gravelly clay varying in thickness from 1.0 – 1.5 m in the north and 1.0-2.0 m in the central part of the site increasing in the south to >5m.

Bedrock is interpreted as limestone with zones of weathering, fracturing and clay-filled fissures underlying the site.

The extent of the resource is approximately 5.4 Ha for Bench 1 and 4.1 Ha for Bench 2.

A total of 4 million tonnes* of limestone rock has been estimated as follows:

- 2.1 million tonnes* in Bench 1 (top of rock down to 46 m OD, approximately 14.5 m in height);
- 1.9 million tonnes* in Bench 2 (46 – 28 m OD, 18 m in height).

Note: No allowance has been made in this resource estimation for boundary stand offs or waste.

Four rotary core boreholes have been proposed to confirm the geophysical and rotary percussive drilling results.

The investigation should be reviewed following any further intrusive investigations.

* Figures rounded off

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2. INTRODUCTION

APEX Geoservices Limited was requested by Bennettsbridge Limestone Quarries Limited to carry out a geophysical and drilling investigation to determine the potential for an extension to their quarry at Kilree, Bennettsbridge, Co Kilkenny into lands to the west of the existing quarry. The area of proposed extension of quarrying is situated immediately to the west and south-west of the existing quarry, and has been divided into two sub-areas designated Phase 1 and Phase 2. Phase 1 is situated to the south of Phase 2.

This report covers the work carried out under this investigation on the Phase 1 area.

The investigation consisted of 2D electrical resistivity tomography (ERT) and rotary percussive drilling.

2.1 Survey Objectives

The objectives of the survey were to:

1. Provide information on the type, thickness and variation of the overburden;
2. Provide information on the depth to and type of bedrock;
3. Calculate a limestone rock resource.

2.2 Site Background

Bennettsbridge Limestone Quarry is located approximately 1.3km north-west of the village of Bennettsbridge. The Phase 1 portion of the site covered in this report lies immediately to the west and south-west of the existing quarry and its south-eastern boundary is located approximately 50m to the north-west of the M9 Dublin-Waterford motorway.

The site under investigation (Phase 1) is 6 Ha in area. Ground elevations across the site range from approx. to 59 – 69 mOD. The northern part of this site consists of a forestry plantation while the remainder is open agricultural land.

Data from the previous geophysical survey in this area, which was carried out in 2006, has been incorporated into interpretation of the present survey results.

2.3 Bedrock and soils

The GSI bedrock geology map for the area shows the area under investigation is underlain by limestone of the Ballyadams Formation, which is described as crinoidal wackestone / packstone.

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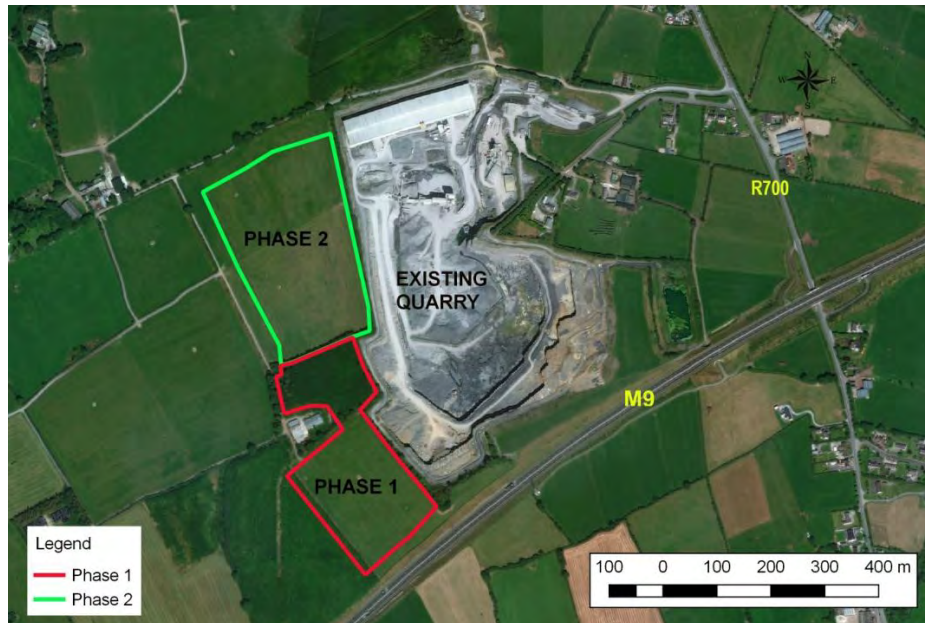


Fig. 2.1. Site location.

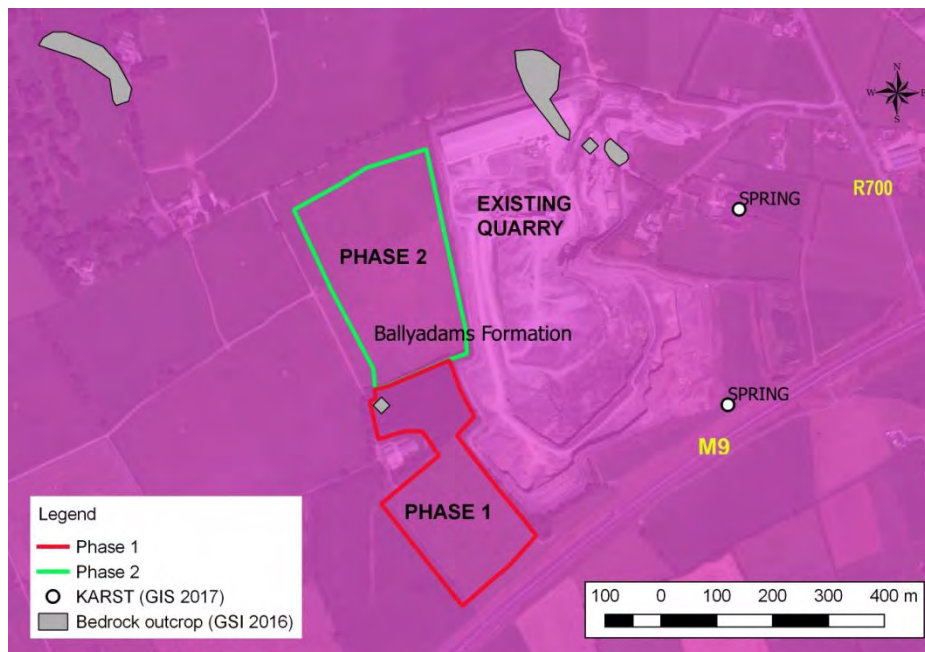


Fig.2.2. Bedrock geology of the survey area.

The GSI subsoil map indicates that the site is located within an area of gravels derived from limestones (see Fig. 2.3).

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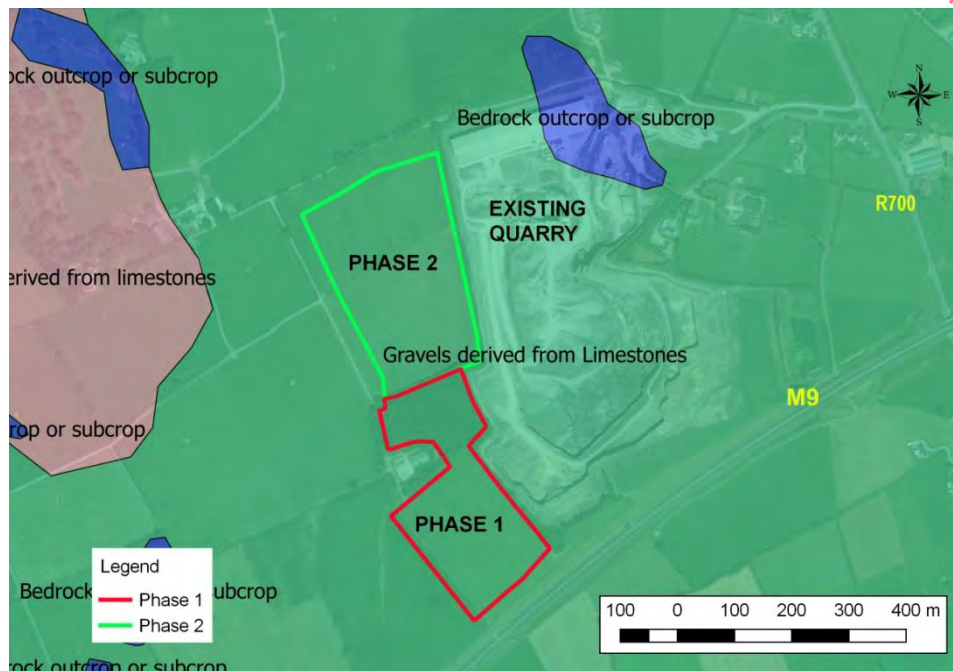


Fig.2.3. Subsoils of the survey area (GSI).

2.4 Groundwater aquifer and vulnerability

The GSI database indicates bedrock within the site as “Locally Important Aquifer – Karstified” and the GSI vulnerability dataset shows the site lying within an area of high vulnerability.

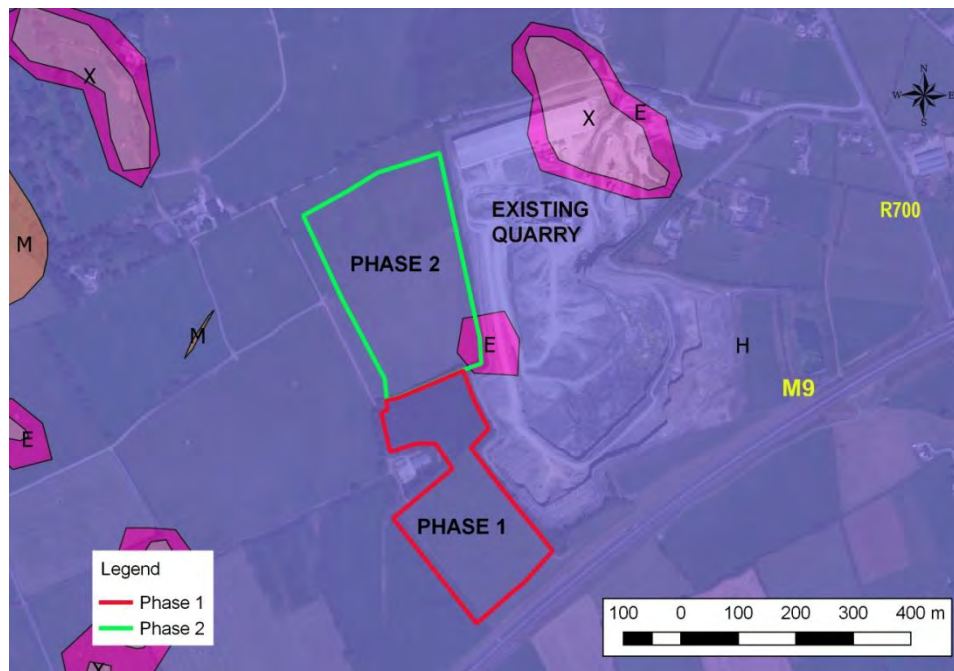


Fig.2.4. Groundwater vulnerability of the survey area.

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2.5 Historical Sheet

The 6" Geological Sheet (Fig.2.5) indicates possible rock outcrops in or close to the north-east corner of the site.

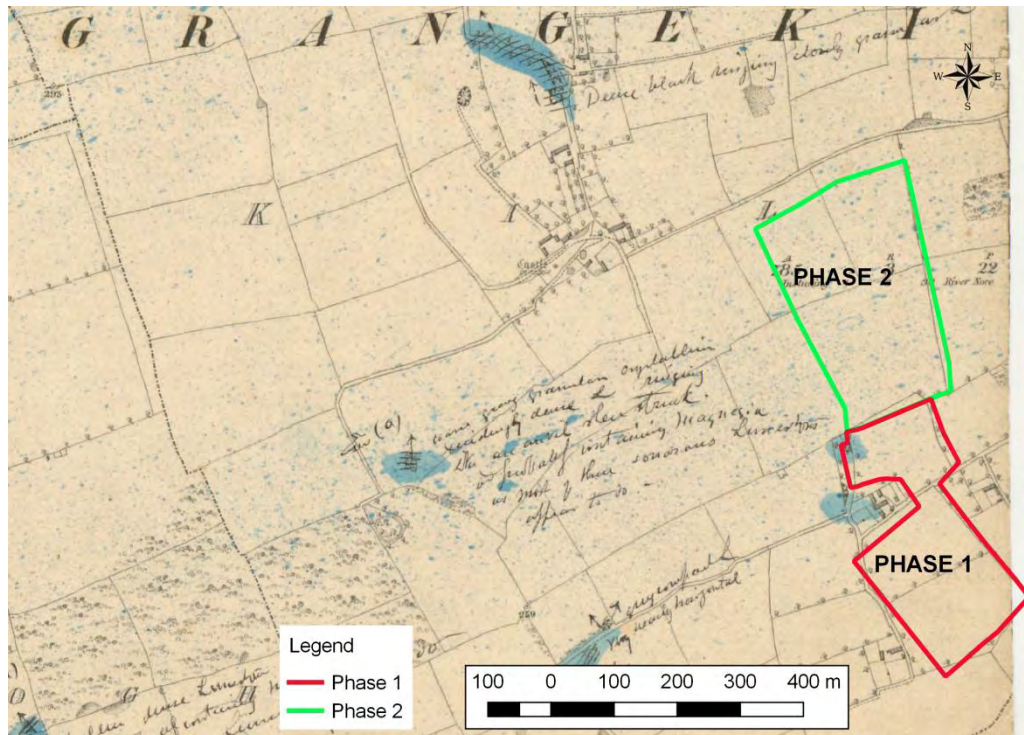


Fig.2.5. GSI 6inch: 1 mile map sheet of the survey area.

2.6 Survey Rationale

Electrical Resistivity Tomography (ERT) soundings will image the resistivity of the materials in the subsurface along a profile to produce a pseudo-section showing the variation in resistivity to a depth which is dependent on the length of the profile. Each pseudo-section will be interpreted to determine the material type along the profile at increasing depth, based on the typical resistivities returned for Irish ground materials. Zones of increased bedrock weathering can be expected to have a lower bedrock resistivity.

Rotary Percussive Drilling provides a relatively inexpensive and fast method to investigate overburden type and thickness, rock type and amount of weathering and fracturing. As no core or samples of intact, undisturbed material can be recovered interpretation is dependent on recovery of fines/cuttings and penetration rate.

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3. RESULTS & INTERPRETATION

3.1 2D Electrical Resistivity Tomography (ERT)

ERT Profiles ERT3 - ERT9 were recorded across the Phase 1 survey area (Drawing AGL18010_01). ERT Profiles RK3 and RK4 recorded in 2006 (Project 6097) across the survey area, together with ERT Profile RK5 recorded in 2006 off site to the south-west, are also presented in this report, and are included in the interpretation.

The profiles have been interpreted on the following general basis:

Resistivity (Ohm-m)	Interpretation
50 - 150	OVERBURDEN/Sandy gravelly CLAY
150 - 400	HIGHLY WEATHERED/ FRACTURED LIMESTONE with clay filled fissures
400 - 1600	MODERATELY WEATHERED/ ARGILLACEOUS LIMESTONE with some clay filled fissures
1600 - 9500	Clean LIMESTONE with few clay filled fissures

3.2 Rotary Percussive Drilling

37 rotary percussive boreholes were drilled across the Phase 1 area (see Drawing No. AGL18010_02). All the boreholes in Phase 1 reached planned depth of 35m below ground level. Overburden thickness recorded from these boreholes ranged from 0.5 to 6.0 m. The borehole logs can be found in Section 7, Appendix B of this report.

3.3 Discussion

The interpreted ERT profiles ERT3 - ERT9 along with previous profiles RK3 - RK5 are presented on Drawings AGL18010_ERT03 – 12. The borehole logs are also presented in summary as stick logs on the profiles and the resistivity and seismic data has been interpreted to take account of the borehole data.

3.3.1 Overburden

Material with resistivity values of 50 - 150 ohm-m has been interpreted as comprising generally sandy/gravelly clay overburden. The overburden has been interpreted as generally varying in thickness from 1.0 – 1.5m in the north (southern parts of Profiles ERT3, ERT4 and RK4) and 1.0-2.0m in the central part of the site increasing in the south to >5m (Profiles ERT5-ERT9).

3.3.2 Bedrock

Material with a resistivity of 150 - 400 ohm-m has been interpreted as highly weathered/ fractured limestone with clay filled fissures. This rock type is limited in extent and is present only in the western corner of the site (ERT7 – 9) and in the north-centre (southern part of ERT4 and middle

part of RK4), generally at some depth (between approx. 10 and 35m below ground level), see Dwg. No. AGL18010_02.

Material with a resistivity of 400 – 1600 ohm-m has been interpreted as moderately weathered/ argillaceous limestone with some clay filled fractures. This material underlies most of the site.

Material with a resistivity of 1600 - 9500 ohm-m has been interpreted as clean limestone with few clay filled fissures. This is frequently present underlying the moderately weathered/ argillaceous limestone.

The potential limestone resource detailed below underlies the entire Phase 1 site and is situated immediately west and south-west of the existing quarry.

3.3.3 Potential Resource

A potential limestone resource consisting of moderately weathered/ argillaceous limestone with some clay filled fractures and clean limestone with few clay filled fissures has been estimated, and is detailed in the table below (see also Drawing AGL18010_02).

Calculation of Resource

Zone		Area	Bottom	Height	Overburden	Rock	Rock
					volume	volume	
		(sq.m.)	(mOD)	(m)	(cu.m)	(cu.m)	(tonnes)
							(@2.6t/cu.m.)
	Overburden	59,358	varies	2.4*	146,176		
	Bench 1	53,680	46	14.5*		790,846	2,056,200
	Bench 2	41,340	28	18		744,120	1,934,712
Total							3,990,912

* Average value

The overburden thickness has been calculated across the resource from ground surface elevation data and top of rock elevations acquired during the geophysical survey and drilling. Bench levels of 46 mOD and 28 mOD have been used. No allowance has been made in this resource estimation for boundary stand offs or waste.

A total of 3,990,912 tonnes of limestone rock has been estimated, comprising 2,056,200 tonnes in Bench 1 (rock head down to 46 m OD, approximately 14.5 m in height) and 1,934,712 tonnes in Bench 2 (46 – 28 m OD, 18 m in height).

4. RECOMMENDATIONS

Rotary core drilling is recommended to confirm the findings of the geophysical and percussion drilling investigations. Proposed locations are as follows:

No.	ITM Easting	ITM Northing	Depth (m bgl)	Target
PBH1	654084	649615	35	Nature, depth to and thickness of moderately weathered/argillaceous limestone with some clay filled fissures and underlying clean limestone
PBH2	653966	649607	35	Nature and depth to highly weathered/fractured limestone with clay filled fissures
PBH3	654032	649740	35	Nature and depth to highly weathered/fractured limestone with clay filled fissures
PBH4	654008	649789	35	Nature, depth to and thickness of moderately weathered/argillaceous limestone with some clay filled fissures and underlying clean limestone

Sampling and testing of the rock types should be carried out and should include appropriate physical, mechanical and geochemical analysis of the aggregate contained in this possible resource to establish its suitability for use as a crushed aggregate.

This report should be reviewed after the completion of any direct investigation.

5. REFERENCES

Bell F.G., 1993; 'Engineering Geology', Blackwell Scientific Press.

Campus Geophysical Instruments, 2000; 'RES2DINV ver. 3.4 Users Manual', Birmingham, England.

Geotomo Software, 2006;
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GSI, 2017;
Bedrock Geology 1:100,000 Shapefile. <http://www.gsi.ie/Mapping.htm>

GSI, 2017;
GSI/Teagasc Subsoils Shapefile. <http://www.gsi.ie/Mapping.htm>

Soske, J.L., 1959; 'The blind zone problem in engineering geophysics', Geophysics, 24, pp 359-365.

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6. APPENDIX A: DETAILED METHODOLOGY

6.1 Electrical Resistivity Tomography (ERT)

6.1.1 Principles

This surveying technique makes use of the Wenner resistivity array. The 2D-resistivity profiling method records a large number of resistivity readings in order to map lateral and vertical changes in material types. The 2D-resistivity profiling method involves the use of 1-64 electrodes connected to a resistivity meter, using computer software to control the process of data collection and storage.

6.1.2 Data Collection

Profiles ERT3-ERT9 were recorded using a Tigre resistivity meter, imaging software, two 32 takeout multicore cables and up to 64 stainless steel electrodes with a 5m electrode spacing. Saline solution was used at the electrode\ground interface in order to gain a good electrical contact required for the technique to work effectively. The recorded data were processed and viewed immediately after the survey. The data was acquired on 11-12th April 2018.

6.1.3 Data Processing

The field readings were stored in computer files and inverted using the RES2DINV package (Campus Geophysical Instruments, 1997) with up to 5 iterations of the measured data carried out for each profile to obtain a 2D-Depth model of the resistivities.

The inverted 2D-Resistivity models and corresponding interpreted geology are displayed on the accompanying drawings. Distance is indicated along the horizontal axis of the profiles. Profiles have been contoured using the same contour intervals and colour codes.

6.1.4 Relocation

All the geophysical investigation locations were acquired using Trimble Geo 7X high-accuracy GNSS handheld using the settings listed below. This system allows collecting GPS data with sub-meter accuracy.

Coordinate zone:	ITM (Republic of Ireland)
Datum:	Ordnance
Coordinate units:	Metres
Altitude units:	Metres
Survey altitude reference:	MSL
Geoid model:	Republic of Ireland

7. APPENDIX B: ROTARY PERCUSSIVE BOREHOLE LOGS

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Hole ID	Depth		Description	Sample No.	Sample Depth (m)	Elevation mOD
	From	To				
BE-RP-001	0	4	Overburden	51585	5	63.946
	4	6	Dark grey, fine slight yellowish brown oxidation - coarse cuttings of grey, fresh, strong limestone - Steady penetration	51586	10	
	6	13	Grey fines, fine grained cuttings of grey, fresh, strong limestone. Steady penetration	51587	15	
	13	30	Light grey fines, fine / medium grained, tabulate cuttings of grey, strong, fresh limestone - Steady penetration	51588	20	
	30	31	Grey fines, fine grained cuttings of grey, fresh, strong limestone. Steady penetration	51589	25	
	31	33	Pale grey fines - Steady penetration	51590	30	
	33	35	Grey fines, . Steady penetration	51591	35	
BE-RP-002	0	3	Overburden	51578	5	63.363
	3	6	Dark grey, fine slight brown oxidation - Steady penetration	51579	10	
	6	8	Grey fines, fine grained cuttings of grey, fresh, strong limestone. Steady penetration	51580	15	
	8	16	Light grey fines, fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	51581	20	
	16	18	Grey fines, fine grained cuttings of grey, fresh, strong limestone. Steady penetration	51582	25	
	18	35	Light grey fines, fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	51583	30	
				51584	35	
BE-RP-003	0	6	Overburden	51585	5	64.931
	6	8	Dark grey, fine slight yellowish brown oxidation - coarse cuttings of grey, fresh, strong limestone - Steady penetration	51586	10	
	8	12	Grey / light fines, fine grained cuttings of grey, fresh, strong limestone. Steady penetration	51587	15	
	12	18	Grey fines, fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	51588	20	
	18	35	Pale grey fines, fine / medium grained, angular cuttings of grey, strong, fresh limestone and minor white calcite - Steady penetration	51589	25	
				51590	30	
				51591	35	
BE-RP-004	0	4	Overburden	51571	5	62.521
	4	6	Dark grey, fine slight brown oxidation - Steady penetration	51572	10	
	6	11	Grey fines, fine grained cuttings of grey, fresh, strong limestone. Steady penetration	51573	15	
	11	35	Pale grey fines, fine / medium grained cuttings of grey, strong, fresh limestone - Steady penetration	51574	20	
				51575	25	
				51576	30	
				51577	35	

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BE-RP-005	0	4	Overburden	51557	5	62.674
	4	6	Dark grey , fine - Steady penetration	51558	10	
	6	13	Grey / dark grey, fines, fine grained cuttings of grey, fresh, strong limestone. Steady penetration	51559	15	
	13	17	Pale grey fines, fine / medium grained cuttings of grey, strong, fresh limestone - Steady penetration	51560	20	
	17	35	Pale grey fines, fine / medium grained cuttings of grey, strong, fresh limestone. Steady penetration	51561	25	
				51562	30	
				51563	35	
BE-RP-006	0	4	Overburden - yellowish brown sandy	56005	5	62.767
	4	6	Dark grey, fine slight yellowish tinge - coarse cuttings of grey , fresh, strong limestone - Steady penetration	56006	10	
	6	7	Grey fines - Steady penetration	56007	15	
	7	35	Pale grey fines, fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56008	20	
				56009	25	
				56010	30	
				56011	35	
BE-RP-007	0	4	Overburden - yellowish brown sandy	51598	5	63.997
	4	10	Pale grey, fine slight yellowish tinge - coarse cuttings of pale grey , almost bleached, strong limestone - Steady penetration with the driller reporting a softer zone between 7.0 - 8.0m	51599	10	
	10	27	Pale grey fines, fine grained cuttings of grey, fresh, strong limestone with minor white calcite. Steady penetration	51600	15	
	27	35	Grey / light grey fines, fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	51601	20	
				51602	25	
				51603	30	
				51604	35	
BE-RP-008	0.0	2.0	Overburden	51029	5	62.269
	2.0	8.0	Grey / dark grey, fines, fine grained cuttings of grey, fresh, strong limestone. Coarse cuttings coated with fines, slightly increased moisture content, Steady drilling	51030	10	
	8.0	18.0	Pale fines, fine / medium grained cutting of grey, strong, fresh limestone. Locally developed tabulate coarser cuttings.	51031	15	
	18.0	20.0	Jerky progress, pale grey cuttings, no sign of oxidation	51032	20	
	20.0	27.0	Pale fines, fine / medium grained cutting of grey, strong, fresh limestone. Locally developed tabulate coarser cuttings.	51033	25	
	27.0	35.0	Medium grey fines, fine grained cuttings of grey, strong, fresh limestone, Steady drilling.	51034	30	
				51035	35	

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BE-RP-009	0.0	1.0	Overburden	51022	5	62.648
	1.0	11.0	Medium grey fines, fine grained cuttings of grey, strong, fresh limestone Steady drilling.	51023	10	
	11.0	11.5	Rapid penetration, drill head dropped - cavity	51024	15	
	11.5	21.0	Pale grey fines, fine grained cuttings of grey, strong, fresh limestone Steady penetration	51025	20	
	21.0	21.2	slight oxidation, grey / light brown cuttings, driller reports "bad" ground, slightly cavernous	51026	25	
	21.2	28.0	Pale grey fines, fine grained cuttings of grey, strong, fresh limestone, Steady penetration	51027	30	
	28.0	30.0	Darker grey fines, coarser cuttings contain small dark grey tabulate fragments - very minor water struck at 30m.	51028	35	
	30.0	35.0	Medium grey fines, fine grained cuttings of grey, strong, fresh, limestone Steady drilling.			
BE-RP-010	0.0	3.0	Overburden	51036	5	62.074
	3.0	8.0	Medium grey fines, fine grained cuttings of grey, strong, fresh limestone, Steady drilling.	51037	10	
	8.0	35.0	Pale grey fines, fine grained cuttings of grey, strong, fresh limestone Steady penetration	51038	15	
				51039	20	
				51040	25	
				51041	30	
				51042	35	
BE-RP-011	0	3.0	Overburden	51557	5	61.451
	3	8.0	Grey / dark grey, fines, fine grained cuttings of grey, fresh, strong limestone. Steady penetration	51558	10	
	8	16.0	Grey / light grey fines, fine / medium grained cutting of grey, strong, fresh limestone. Steady penetration	51559	15	
	16	19.0	Pale grey fines, fine / medium grained tabulate cuttings of grey, strong, fresh limestone. Steady penetration	51560	20	
	19	22.0	Pale grey fines, fine / medium grained cuttings of grey, strong, fresh limestone. Steady penetration	51561	25	
	22	28.0	Pale grey fines, fine / medium grained tabulate cuttings of grey, strong, fresh limestone. Steady penetration	51562	30	
	28	35.0	Pale grey fines, fine / medium grained cuttings of grey, strong, fresh limestone. Steady penetration	51563	35	
BE-RP-012	0	3.0	Overburden - Brown sandy	56012	5	62.513
	3	5.0	Dark grey / grey - Steady penetration	56013	10	
	5	10.0	Grey fines - Steady penetration	56014	15	
	10	11.0	Grey fines with a slight yellowish tinge. Coarse cuttings are unoxidised - Steady penetration	56015	20	
	11	14.0	Pale grey fines - Steady penetration	56016	25	
	14	15.0	Grey fines with a slight yellowish tinge. Coarse cuttings are unoxidised - Steady penetration	56017	30	
	15	27.0	Pale grey fines, fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56018	35	
	27	30.0	Slightly darker grey fines, fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration			
	30	35.0	Pale grey fines, fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration			

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BE-RP-013	0	1.5	Overburden - Brown, sandy	56054	5	62.416
	1.5	12.0	Grey fines fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56055	10	
	12	14.0	Grey fines / slight brown discolouration - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56056	15	
	14	35.0	Light grey fines, fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56057	20	
				56058	25	
				56059	30	
				56060	35	
BE-RP-014	0	2.5	Overburden Orange brown, sandy / gravelly	56047	5	62.062
	2.5	10.0	Grey fines fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56048	10	
	10	22.0	Light grey fines fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56049	15	
	22	35.0	Pale grey fines, fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56050	20	
				56051	25	
				56052	30	
				56053	35	
BE-RP-015	0	3.0	Overburden - brown sandy soil	56026	5	62.077
	3	10.5	Grey fines, fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56027	10	
	10.5	10.7	Cavity grey yellow cuttings, very jerky action	56028	15	
	10.7	15.5	Pale grey fines, fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56029	20	
	15.5	15.7	Cavity grey cuttings, very jerky action on oxidised returns noted	56030	25	
	15.7	35.0	Pale grey fines, fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56031	30	
				56032	35	
BE-RP-016	0	3.0	Overburden	56019	5	62.37
	3	5.0	Light grey / grey very faint yellowish tinge- Steady penetration	56020	10	
	5	12.0	Light grey fines - Steady penetration	56021	15	
	12	13.0	Light brown / grey yellow fines Steady penetration	56022	20	
	13	14.0	Dark grey fines - Steady penetration	56023	25	
	14	16.0	Grey fines - Steady penetration	56024	30	
	16	18.0	Light brown / grey oxidised	56025	35	
	18	28.0	Pale grey fines, fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration			
	28	35.0	Grey fines, fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration			

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BE-RP-017	0	1.5	Overburden - brown grey sandy	56033	5	62.459
	1.5	3.0	Dark grey / with zones of yellowish grey tinge- Steady penetration	56034	10	
	3	8.0	Grey fines fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56034	15	
	8	35.0	Pale grey fines, fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56034	20	
				56034	25	
				56034	30	
				56034	35	
BE-RP-018	0	1.5	Overburden	56040	5	62.591
	1.5	4.0	Grey / yellowish grey tinge- Steady penetration	56041	10	
	4	8.0	Grey fines fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56042	15	
	8	27.0	Light grey fines, fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56043	20	
	27.0	35.0	Grey fines, fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56044	25	
				56045	30	
				56046	35	
BE-RP-019A			54062E / 49699N			62.471
	0	2.0	Overburden Brown / grey sandy / gravelly	56124	5	
	2	4.0	Dark grey with slight yellowish tinge / slightly oxidised fines, unaided cuttings of grey, fresh, strong limestone - Steady penetration	56125	10	
	4	12.0	Grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56126	15	
	12	16.0	Grey fines, fine grained, angular cuttings of pale grey, strong, limestone - Steady penetration	56127	20	
	16	35.0	Light Grey / grey fines, fine grained, angular cuttings of pale grey, strong, limestone - Steady penetration	56128	25	
				56129	30	
				56130	35	
BE-RP-020A			54015E / 49715N			64.335
	0	2.0	Overburden - Orange brown sandy	56138	5	
	2	4.0	Dark grey / brown slight yellowish tinge / slightly oxidised fines, unoxides cuttings of grey, fresh, strong limestone - Steady penetration	56139	10	
	4	6.0	Light grey, slight brownish tinge fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56140	15	
	6	12.0	Grey fines, fine grained, angular cuttings of pale grey, strong, limestone - Steady penetration	56141	20	
	12	35.0	Light Grey / grey fines, fine grained, angular cuttings of pale grey, strong, limestone - Steady penetration	56142	25	
				56143	30	
				56144	35	

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BE-RP-045	0	2	Overburden	51043	5	61.246
	2	8	Grey / dark grey, fines, fine grained cuttings of grey, fresh, strong limestone. Steady penetration	51044	10	
	8	12	Pale grey fines, fine / medium grained cutting of grey, strong, fresh limestone. Steady penetration	51045	15	
	12	18	Pale grey fines, fine / medium grained tabulate cuttings of grey, strong, fresh limestone. Steady penetration	51046	20	
	18	27	Pale fines, fine / medium grained cuttings of grey, strong, fresh limestone, Steady penetration	51047	25	
	27	28	Pale grey fines, fine / medium grained tabulate cuttings of grey, strong, fresh limestone. Steady penetration	51048	30	
	28	35	Pale fines, fine / medium grained cuttings of grey, strong, fresh limestone. Steady penetration	51049	35	
BE-RP-046	0	3	Overburden	51050	5	61.608
	3	8	Grey / dark grey, fines, fine grained cuttings of grey, fresh, strong limestone. Steady penetration	51551	10	
	8	14	grey / light grey fines, fine / medium grained cutting of grey, strong, fresh limestone. Steady penetration	51552	15	
	14	22	Pale grey fines, fine / medium grained tabulate cuttings of grey, strong, fresh limestone. Steady penetration	51553	20	
	22	28	Pale fines, fine / medium grained cuttings of grey, strong, fresh limestone. Steady penetration	51554	25	
	28	35	Pale grey fines, fine / medium grained tabulate cuttings of grey, strong, fresh limestone. Steady penetration	51555	30	
				51556	35	
BE-RP-047			53971E / 49659N			
	0	2.0	Overburden - Grey / brown, sandy	56061	5	63.069
	2	7.0	Grey / dark grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56062	10	
	7	22.0	Grey / light grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56063	15	
	22	26.0	Brownish grey oxidised cuttings, penetration jerky and difficult, hammer blocking and refusing.	56064	20	
	26	29.0	medium brown clay - slow progress	56065	25	
	29	32.0	Grey brown sandy clay - slow progress Clay is slightly damp and sticky - minor water strike	56066	30	
	32	35.0	Light grey fines, fine grained, angular cuttings of pale grey, strong, limestone - Steady penetration	56067	35	
BE-RP-048			54013E / 49576N			63.093
	0	2.5	Overburden	56068	5	
	2.5	11.0	Grey / dark grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56069	10	
	11	18.0	light grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56070	15	
	18	35.0	Pale grey fines, fine grained, angular cuttings of pale grey, strong, limestone - Steady penetration	56071	20	
				56072	25	
				56073	30	
				56074	35	

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BE-RP-049			53965E / 49528N			
	0	1.5	Overburden Brown / grey sandy	56075	5	
	1.5	8.0	Grey / dark grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56076	10	
	8	27.0	light grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration (24.5m jerky drilling for 0.1m - small cavity)	56077	15	
	27	35.0	Light Grey / grey fines, fine grained, angular cuttings of pale grey, strong, limestone - Steady penetration	56078	20	
				56079	25	
				56080	30	
				56081	35	
BE-RP-050			53964E / 49538N			
	0	1.5	Overburden Brown / grey sandy	56082	5	
	1.5	14.0	Grey / dark grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56083	10	
	14	35.0	light grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration (24.5m jerky drilling for 0.1m - small cavity)	56084	15	
				56085	20	
				56086	25	
				56087	30	
				56088	35	
BE-RP-051			53968E / 49555N			
	0	2.0	Overburden Brown / grey sandy	56089	5	
	2	8.0	Grey / dark grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56090	10	
	8	13.0	Grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration (24.5m jerky drilling for 0.1m - small cavity)	56091	15	
	13	35.0	Light Grey / grey fines, fine grained, angular cuttings of pale grey, strong, limestone - Steady penetration	56092	20	
				56093	25	
				56094	30	
				56095	35	
BE-RP-052			53967E / 49566N			
	0	1.5	Overburden Brown / grey sandy	56096	5	
	1.5	8.0	Grey / dark grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56097	10	
	8	18.0	Grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration (24.5m jerky drilling for 0.1m - small cavity)	56098	15	
	18	35.0	Light Grey / grey fines, fine grained, angular cuttings of pale grey, strong, limestone - Steady penetration	56099	20	
				56100	25	
				56101	30	
				56102	35	

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BE-RP-053			53970E / 49583N			
	0	0.5	Overburden Brown / grey sandy	56103	5	
	0.5	4.0	Grey brown slightly oxidised fines, unoxides cuttings of grey, fresh, strong limestone - Steady penetration	56104	10	
	4	13.0	Grey / dark grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56105	15	
	13	35.0	Light Grey / grey fines, fine grained, angular cuttings of pale grey, strong, limestone - Steady penetration	56106	20	
				56107	25	
				56108	30	
				56109	35	
BE-RP-054			53976E / 49598N			
	0	2.0	Overburden Brown / grey sandy	56110	5	63.91
	2	7.0	Grey brown slight yellowish tinge / slightly oxidised fines, unoxidised cuttings of grey, fresh, strong limestone - Steady penetration	56111	10	
	7	9.0	Grey / dark grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56112	15	
	9	35.0	Light Grey / grey fines, fine grained, angular cuttings of pale grey, strong, limestone - Steady penetration	56113	20	
				56114	25	
				56115	30	
				56116	35	
BE-RP-055			53989E / 49611N			
	0	3.0	Overburden Brown / grey sandy	56117	5	63.634
	3	7.0	Grey brown slight yellowish tinge / slightly oxidised fines, unoxides cuttings of grey, fresh, strong limestone - Steady penetration	56118	10	
	7	9.0	Grey / dark grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56119	15	
	9	12.0	Grey fines, fine grained, angular cuttings of pale grey, strong, limestone - Steady penetration	56120	20	
	12	13.0	Grey with a slight yellowish tinge fines, fine grained, angular cuttings of pale grey, strong, limestone - Steady penetration	56121	25	
	13	35.0	Light Grey / grey fines, fine grained, angular cuttings of pale grey, strong, limestone - Steady penetration	56122	30	
				56123	35	
BE-RP-056			54036E / 49717N			61.922
	0	2.5	Overburden	56145	5	
	2.5	8.0	Grey fines, unoxidised cuttings of grey, fresh, strong limestone - Steady penetration	56146	10	
	8	35.0	Light grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56147	15	
				56148	20	
				56149	25	
				56150	30	
				56151	35	

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BE-RP-057			54003E / 49706N			64.335
	0	2.5	Overburden	56131	5	
	2.5	6.0	Grey with a slight brownish tinge fines, unoxidised cuttings of grey, fresh, strong limestone - Steady penetration	56132	10	
	6	14.0	Grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56133	15	
	14	35.0	Light grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56134	20	
				56135	25	
				56136	30	
				56137	35	
BE-RP-058			54036E / 49539N			62.841
	0	2.0	Overburden - brown / grey sandy / gravelly	56152	5	
	2	6.0	Dark grey / Grey fines, unoxidised cuttings of grey, fresh, strong limestone - Steady penetration	56153	10	
	6	8.0	Grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56154	15	
	8	35.0	Light grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56155	20	
				56156	25	
				56157	30	
				56158	35	
BE-RP-059			53969E / 49712N - tree cover, coordinates not accurate			
	0	1.5	Overburden	56159	5	
	1.5	22.0	Grey / dark grey fines, unoxidised cuttings of grey, fresh, strong limestone - Steady penetration	56160	10	
	22	35.0	Light grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56161	15	
				56162	20	
				56163	25	
				56164	30	
				56165	35	
BE-RP-060			53967E / 49741N - tree cover, coordinates not accurate			
	0	1.3	Overburden	56166	5	
	1.3	9.0	Grey / dark grey fines, unoxidised cuttings of grey, fresh, strong limestone - Steady penetration	56167	10	
	9	16.0	Grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56168	15	
	16	35.0	Light grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56169	20	
				56170	25	
				56171	30	
				56172	35	

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BE-RP-061			53955E / 49770N - tree cover, coordinates not accurate			
	0	1.0	Overburden	56173	5	
	1	8.0	Grey / dark grey with slight brownish tinge fines, unoxidised cuttings of grey, fresh, strong limestone - Steady penetration	56174	10	
	8	20.0	Grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56175	15	
	20	35.0	Light grey fines - fine / medium grained, angular cuttings of grey, strong, fresh limestone - Steady penetration	56176	20	
				56177	25	
				56178	30	
				56179	35	

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8. APPENDIX C: DRAWINGS

The information derived from the geophysical and drilling investigation is presented in the following drawings:

AGL18010_01	Site outline & survey locations map	1:4000 @ A4
AGL18010_02	Boreholes & ERT locations	1:2500 @ A3
AGL18010_03	Fig. 3 Profile ERT3 with interpretation	1:1000 @ A3
AGL18010_04	Fig. 4 Profile ERT4 with interpretation	1:1000 @ A3
AGL18010_05	Fig. 5 Profile ERT5 with interpretation	1:500 @ A3
AGL18010_06	Fig. 6 Profile ERT6 with interpretation	1:1000 @ A3
AGL18010_07	Fig. 7 Profile ERT7 with interpretation	1:1000 @ A3
AGL18010_08	Fig. 8 Profile ERT8 with interpretation	1:1000 @ A3
AGL18010_09	Fig. 9 Profile ERT9 with interpretation	1:1000 @ A3
AGL18010_10	Fig. 10 Profile RK3 with interpretation	1:500 @ A3
AGL18010_11	Fig. 11 Profile RK4 with interpretation	1:1000 @ A3
AGL18010_12	Fig. 12 Profile RK5 with interpretation	1:500 @ A3

FIGURE 1: SITE OUTLINE & SURVEY LOCATIONS

SCALE 1:4000



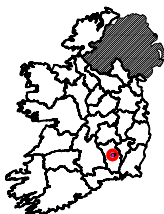
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INDEX MAP:



LEGEND:



Phase 1 Site outline

Phase 2 Site outline

ERT 2006

Completed ERT 2018

Rotary percussive borehole

PROJECT: BENNETTSBRIDGE QUARRY EXTENSION
PHASE 1 & PHASE 2

DRAWING No.: AGL18010_01

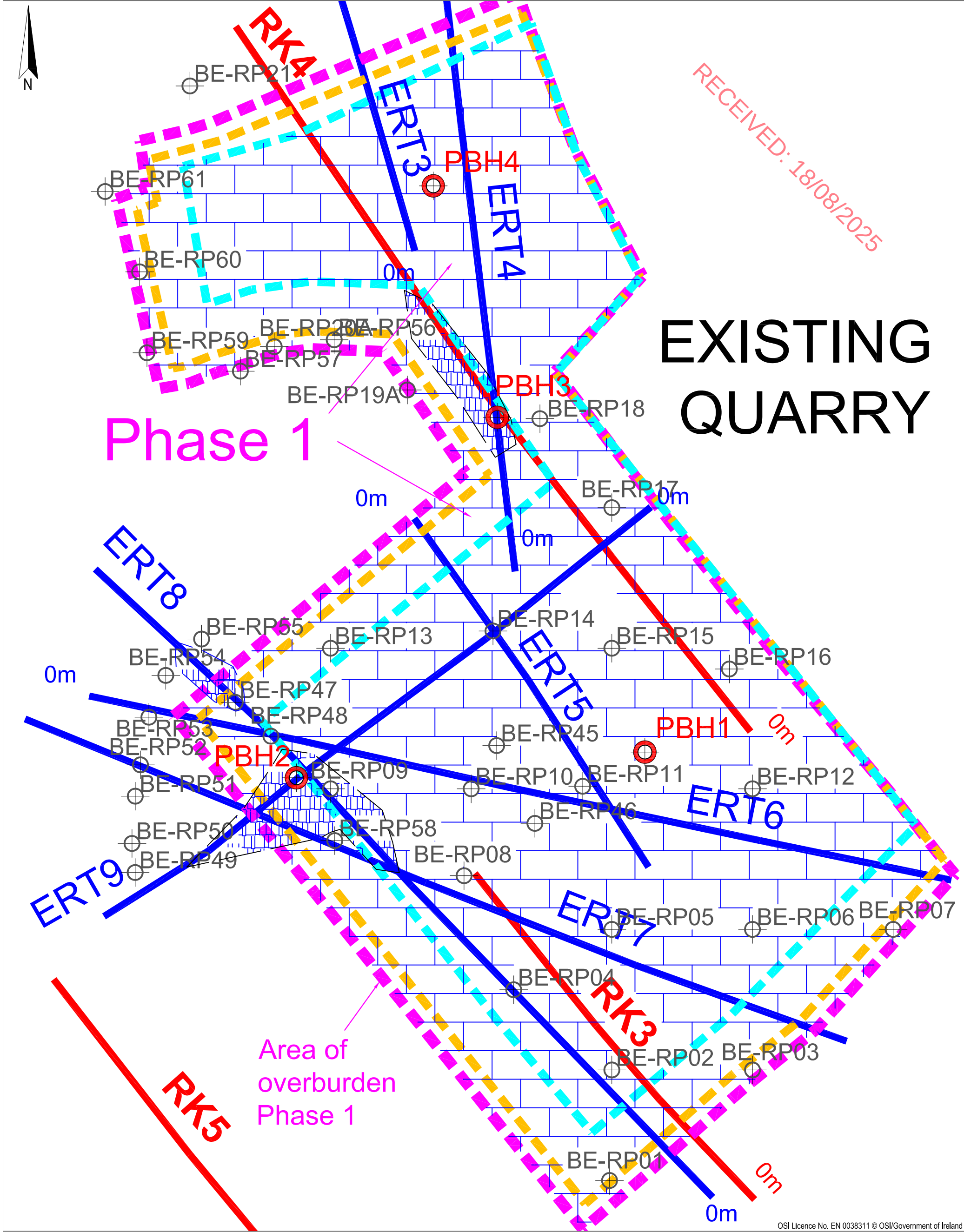
DATE: 09-05-2018

CLIENT: BENNETTSBRIDGE LIMESTONE LIMITED

SCALE: AS INDICATED @ A4

Version:	Date:	Drawn By:	Checked:
001	13-04-2018	KG	KG
002	23-04-2018	KG	POC
003	09-05-2018	KG	POC
004	25-05-2018	MF	KG

FIGURE 2: BOREHOLE & ERT LOCATIONS WITH SUMMARY INTERPRETATION
SCALE 1:1250



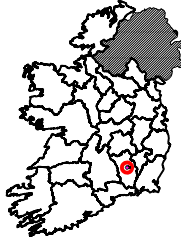
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INDEX MAP:



LEGEND:

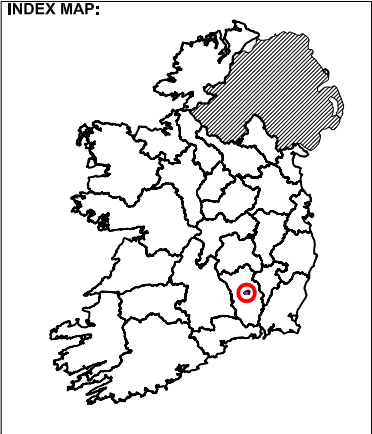
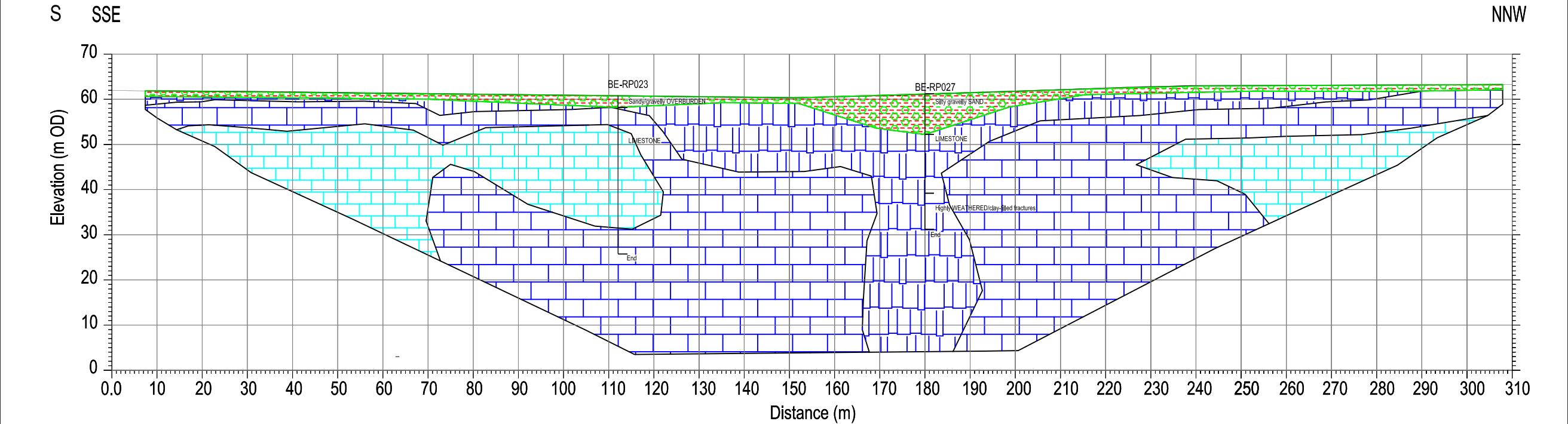
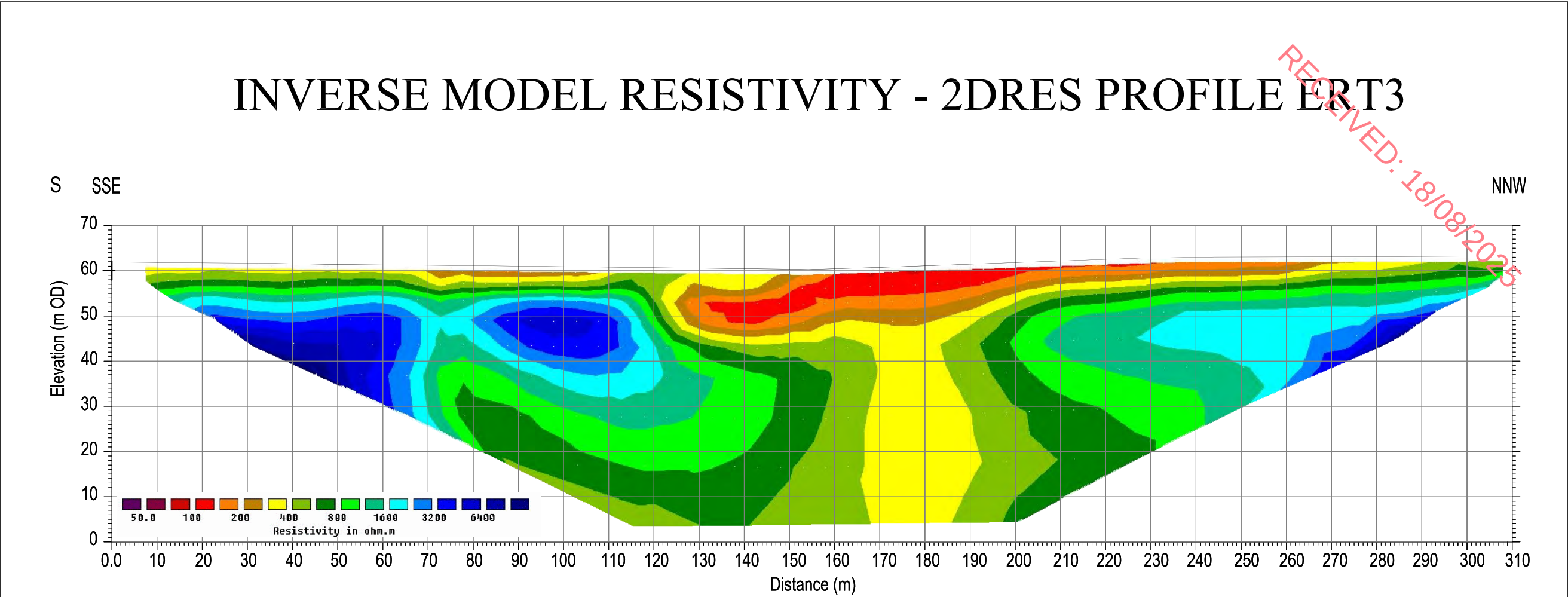
- ERT 2006
- Completed ERT 2018
- Area of overburden, Phase 1
- Area of Bench 1, Phase 1
- Area of Bench 2, Phase 1
- Rotary percussive borehole
- Moderately weathered/ argillaceous limestone with some clay-filled fissures
- Highly weathered/ fractured limestone with clay-filled fissures

LEGEND:

- Proposed quarry extension faces
- Proposed rotary core borehole

PROJECT:	BENNETTSBRIDGE QUARRY EXTENSION		
	GEOPHYSICAL & DRILLING: PHASE 1		
CLIENT:	BENNETTSBRIDGE QUARRIES LIMITED		
DRAWING NO:	AGL18010_02		
SCALE:	AS INDICATED @ A3		
DATE:	20/04/2018		
Version:	Date:	Drawn By:	Checked:
1	20/04/18	KG	POC
2	25/05/18	MF	KG
3	30/05/18	MF	TL

FIGURE 3: ERT PROFILE
SCALE 1:1000



- LEGEND:
- Gravelly Clay Overburden
 - Highly weathered/Fractured Limestone with clay filled fissures
 - Moderately weathered/argillaceous Limestone with some clay filled fissures
 - Clean Limestone with few clay filled fissures
 - Rotary percussive borehole (2018)



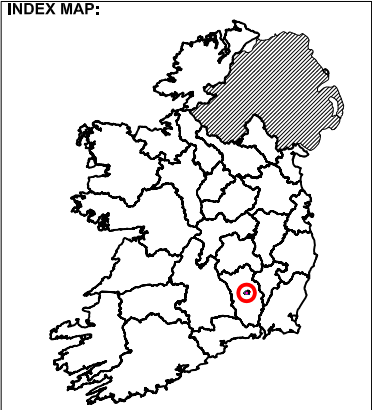
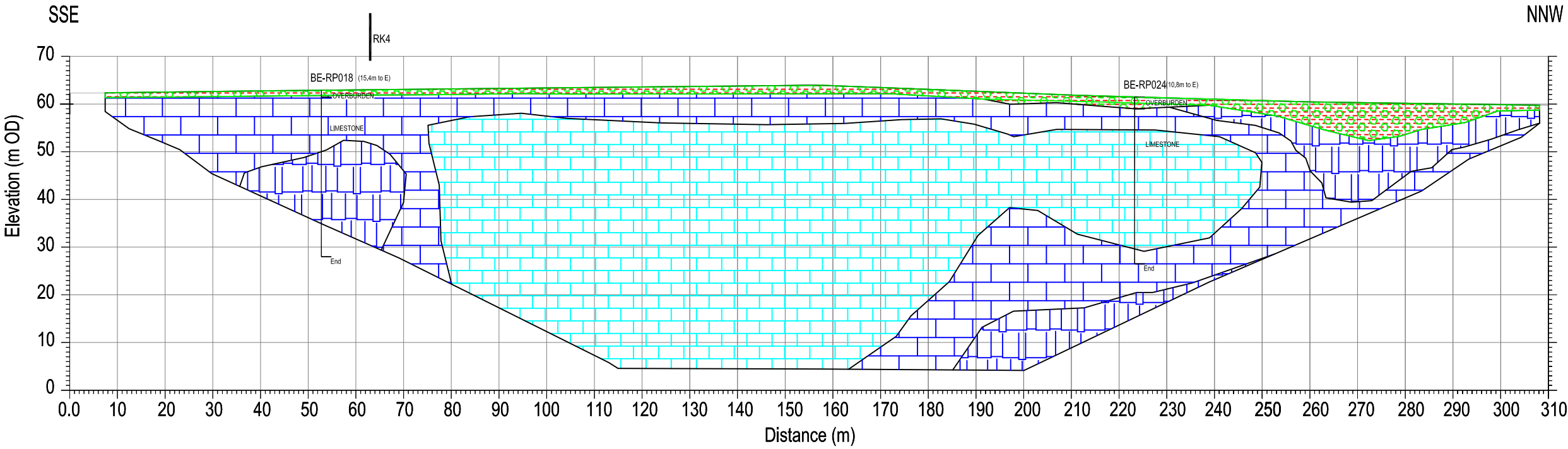
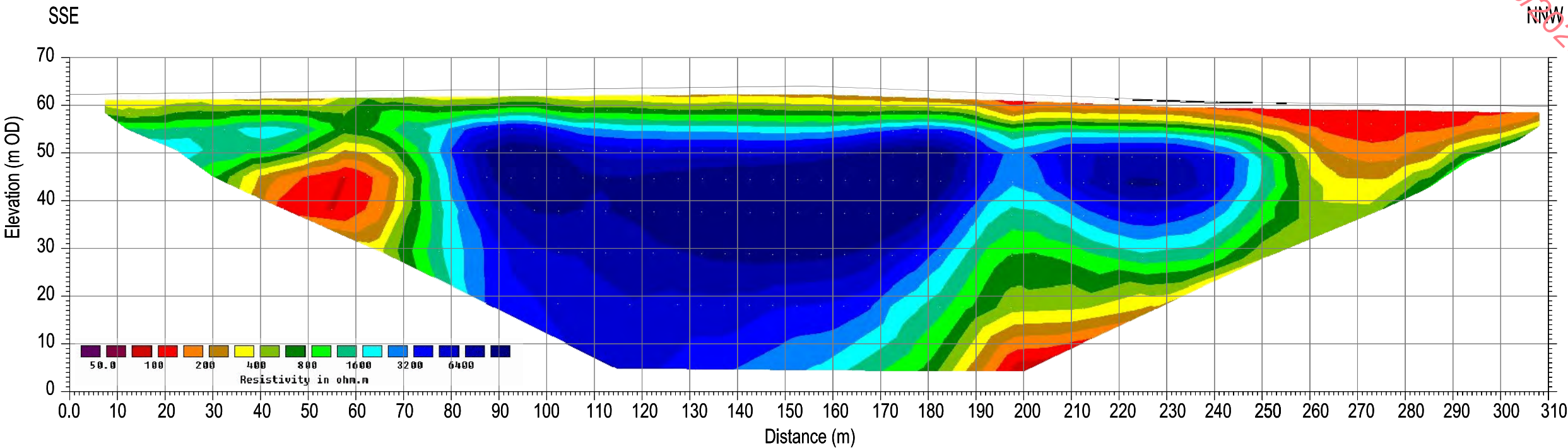
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PROJECT:	BENNETTSBRIDGE QUARRY EXTENSION GEOPHYSICAL SURVEY		
CLIENT:	BENNETTSBRIDGE QUARRIES LIMITED		
DRAWING NO:	AGL18010_ERT03		
SCALE:	AS INDICATED @ A3		
DATE:	20/04/2018		
Version:	Date:	Drawn By:	Checked:
1	20/04/18	KG	KG
2	25/05/18	MF	KG
3	30/05/18	MF	TL

FIGURE 4: ERT PROFILE
SCALE 1:1000

INVERSE MODEL RESISTIVITY - 2DRES PROFILE ERT4



- LEGEND:
- Gravelly Clay Overburden
 - Highly weathered/Fractured Limestone with clay filled fissures
 - Moderately weathered/argillaceous Limestone with some clay filled fissures
 - Clean Limestone with few clay filled fissures
 - Rotary percussive borehole (2018)

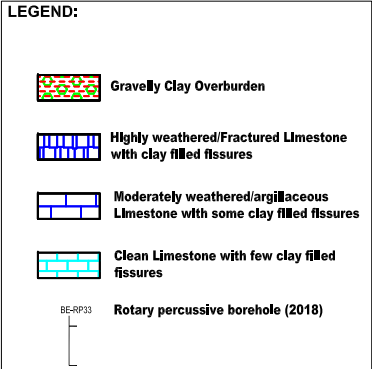
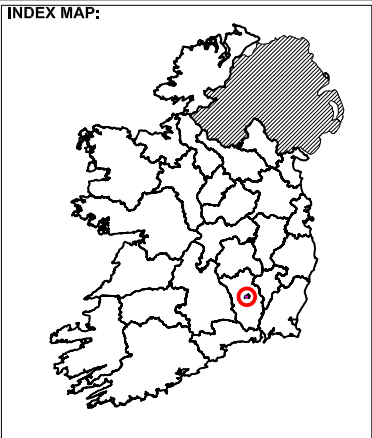
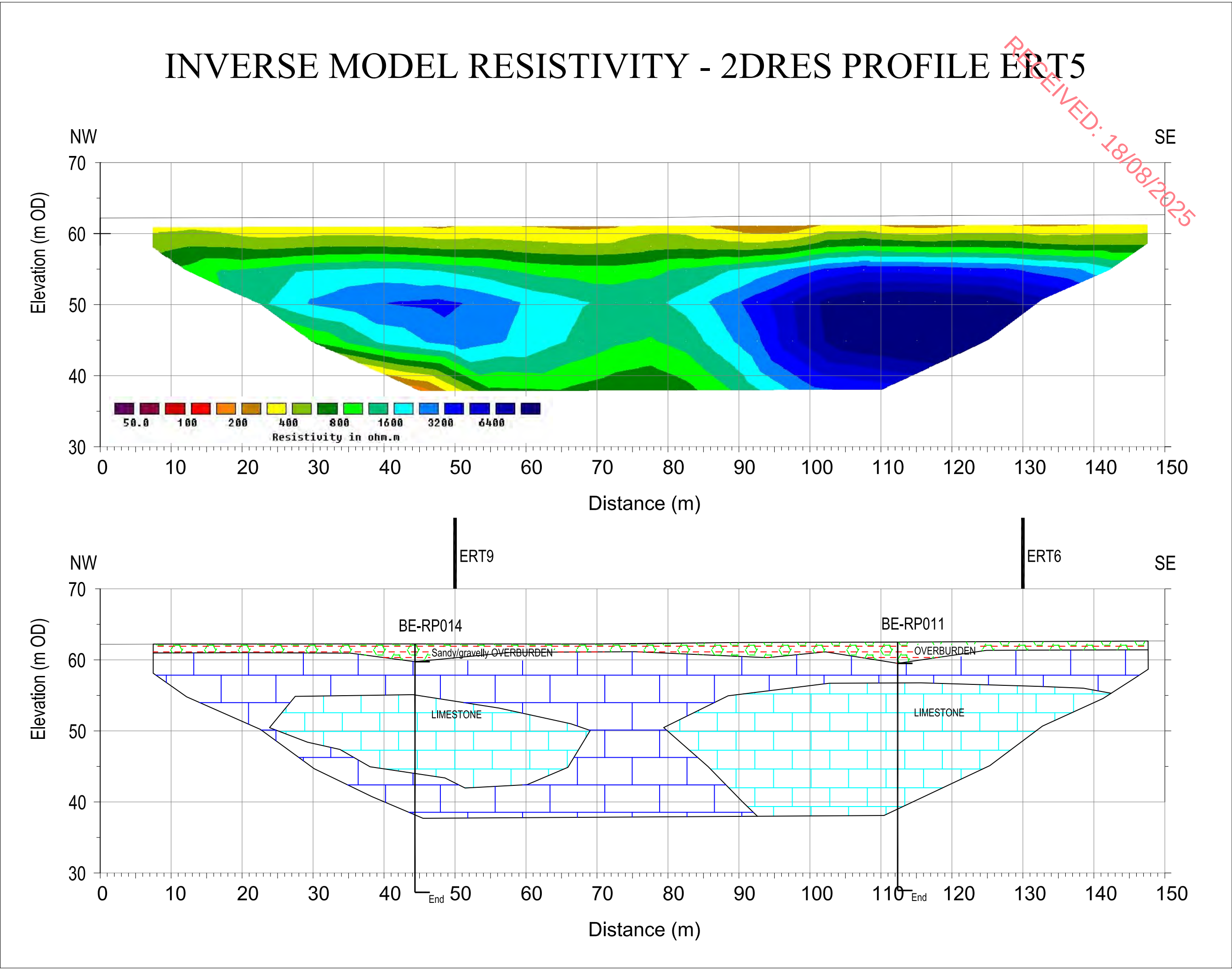


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PROJECT:	BENNETTSBRIDGE QUARRY EXTENSION GEOPHYSICAL SURVEY		
CLIENT:	BENNETTSBRIDGE QUARRIES LIMITED		
DRAWING NO:	AGL18010_ERT04		
SCALE:	AS INDICATED @ A3		
DATE:	20/04/2018		
Version:	Date:	Drawn By:	Checked:
1	20/04/18	KG	KG
2	25/05/18	MF	KG
3	30/05/18	MF	TL

FIGURE 5: ERT PROFILE
SCALE 1:500



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PROJECT: BENNETTSBRIDGE QUARRY EXTENSION
GEOPHYSICAL SURVEY

CLIENT: BENNETTSBRIDGE QUARRIES LIMITED

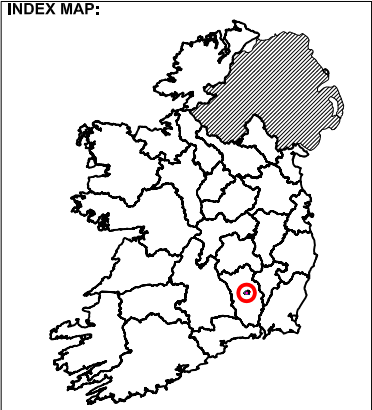
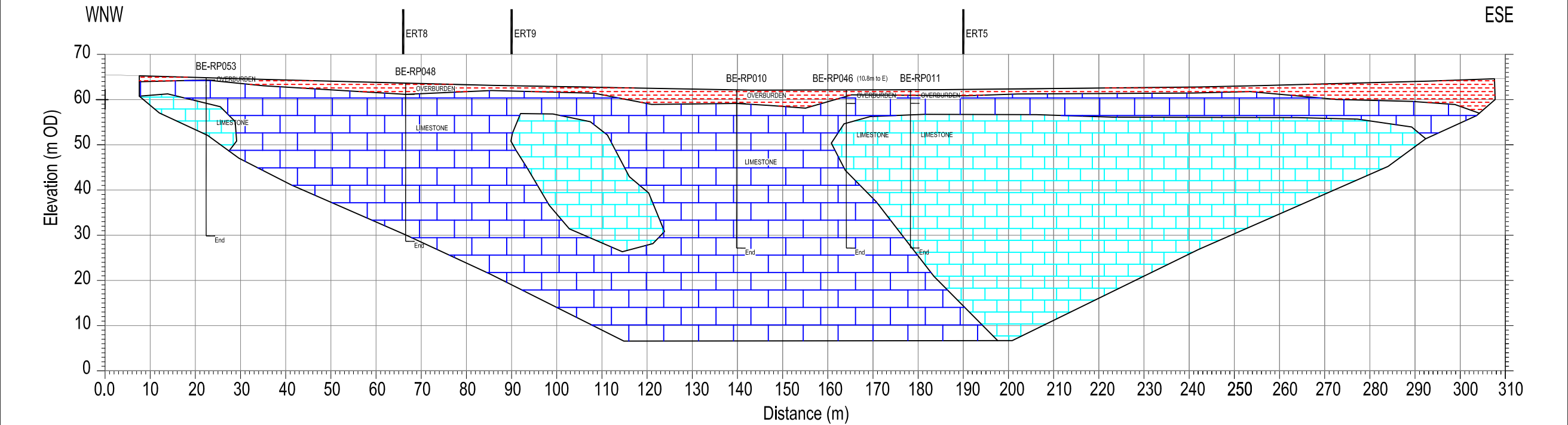
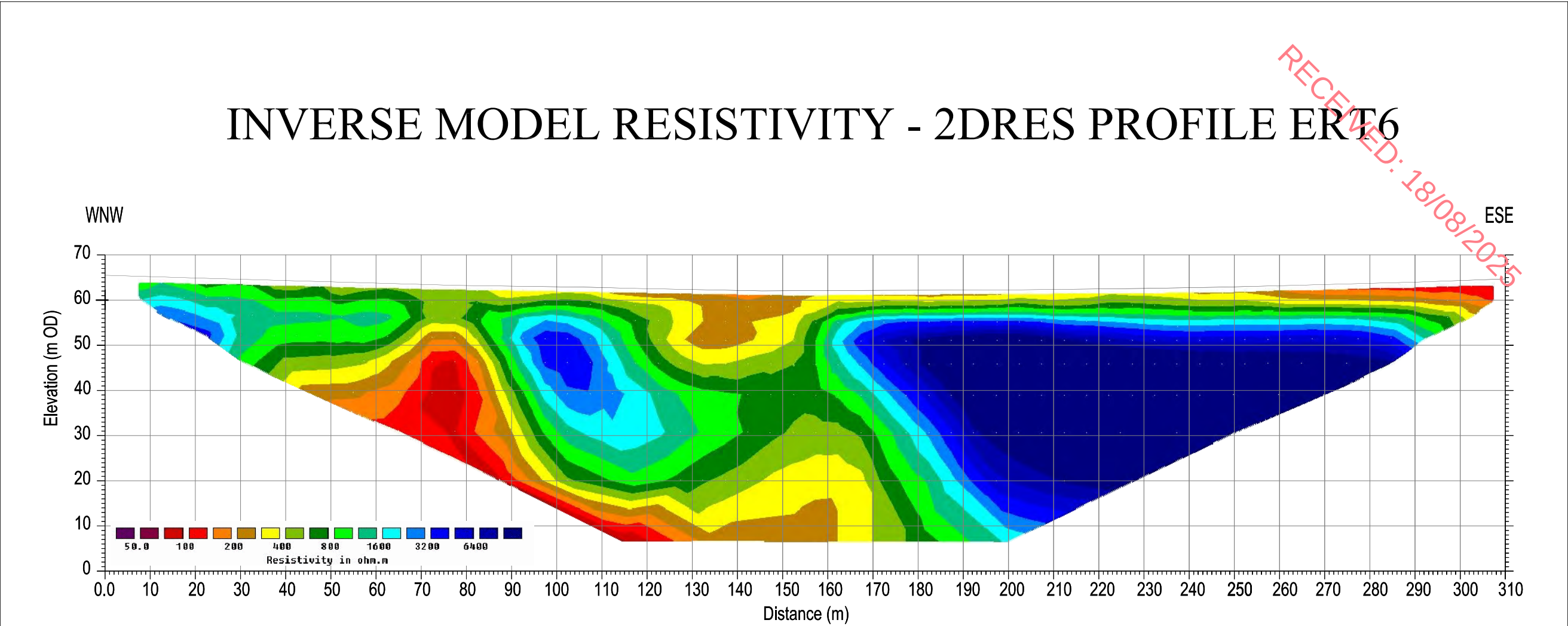
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SCALE: AS INDICATED @ A3

DATE: 20/04/2018

Version:	Date:	Drawn By:	Checked:
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2	25/05/18	MF	KG
3	30/05/18	MF	TL

FIGURE 6: ERT PROFILE
SCALE 1:1000



- LEGEND:
- Gravelly Clay Overburden
 - Highly weathered/Fractured Limestone with clay filled fissures
 - Moderately weathered/argillaceous Limestone with some clay filled fissures
 - Clean Limestone with few clay filled fissures
 - Rotary percussive borehole (2018)

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GEOPHYSICAL SURVEY

CLIENT: BENNETTSBRIDGE QUARRIES LIMITED

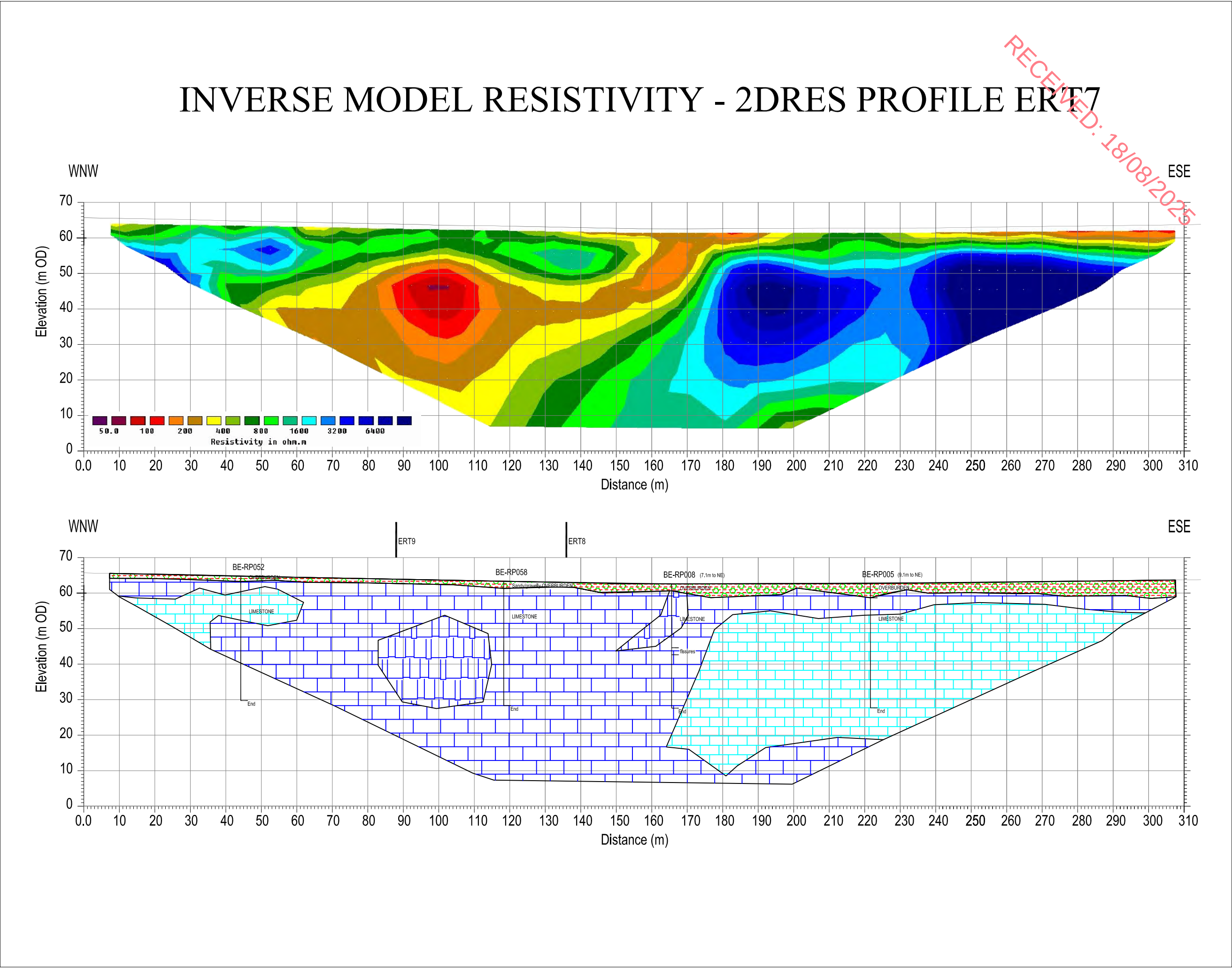
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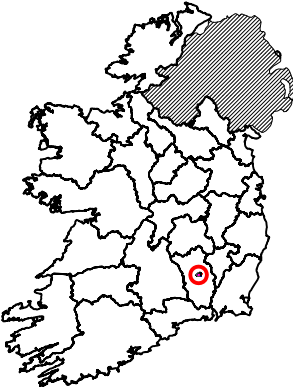
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2	25/05/18	MF	KG
3	30/05/18	MF	TL

FIGURE 7: ERT PROFILE
SCALE 1:1000



INDEX MAP:



LEGEND:

- Gravelly Clay Overburden
- Highly weathered/Fractured Limestone with clay filled fissures
- Moderately weathered/argillaceous Limestone with some clay filled fissures
- Clean Limestone with few clay filled fissures
- Rotary percussive borehole (2018)

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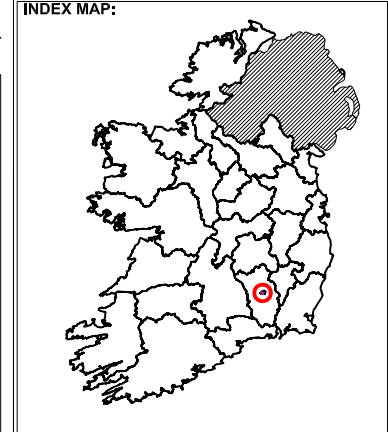
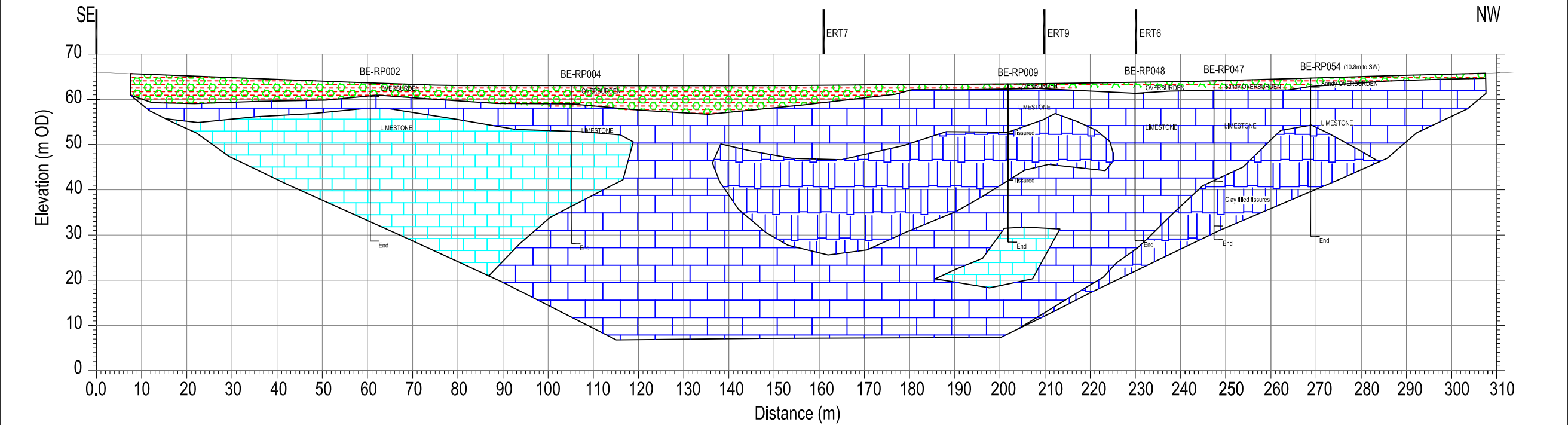
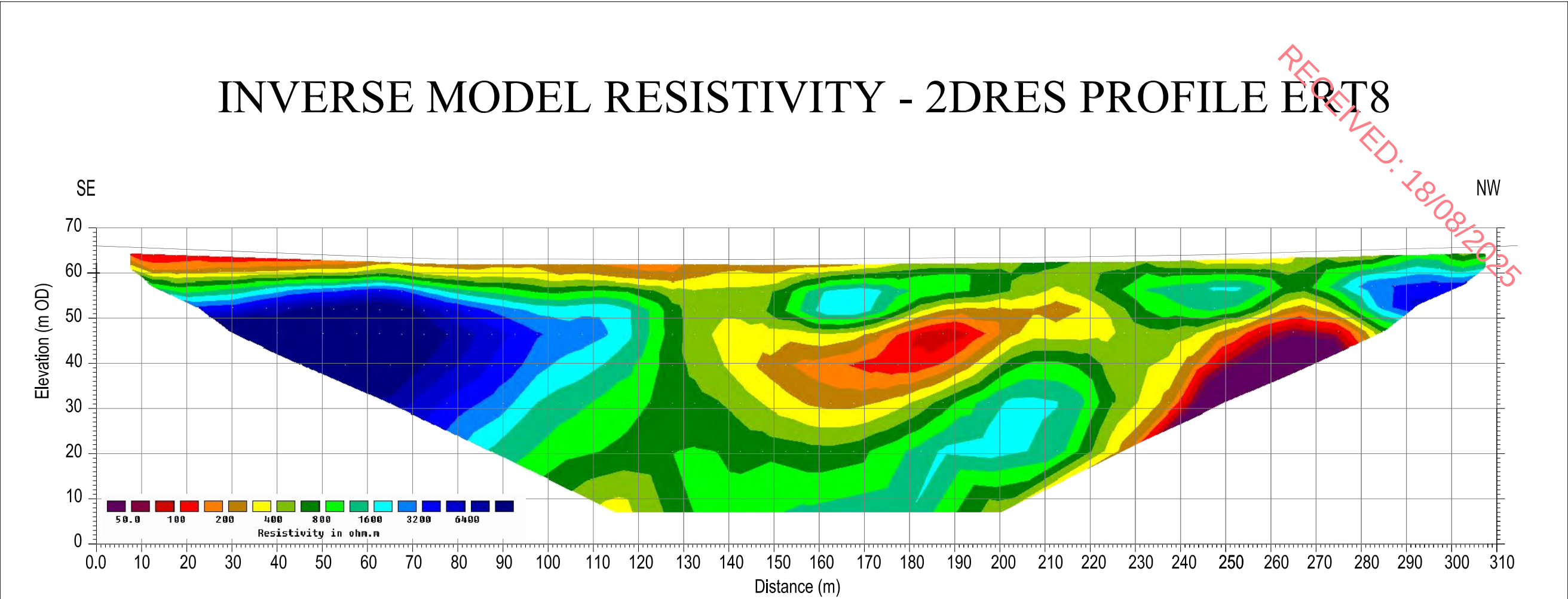
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Version:	Date:	Drawn By:	Checked:
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2	25/05/18	MF	KG
3	30/05/18	MF	TL

FIGURE 8: ERT PROFILE
SCALE 1:1000



- LEGEND:
- Gravelly Clay Overburden
 - Highly weathered/Fractured Limestone with clay filled fissures
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 - Clean Limestone with few clay filled fissures
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DRAWING NO: AGL18010_ERT08

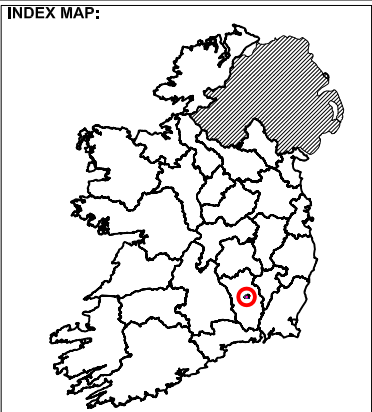
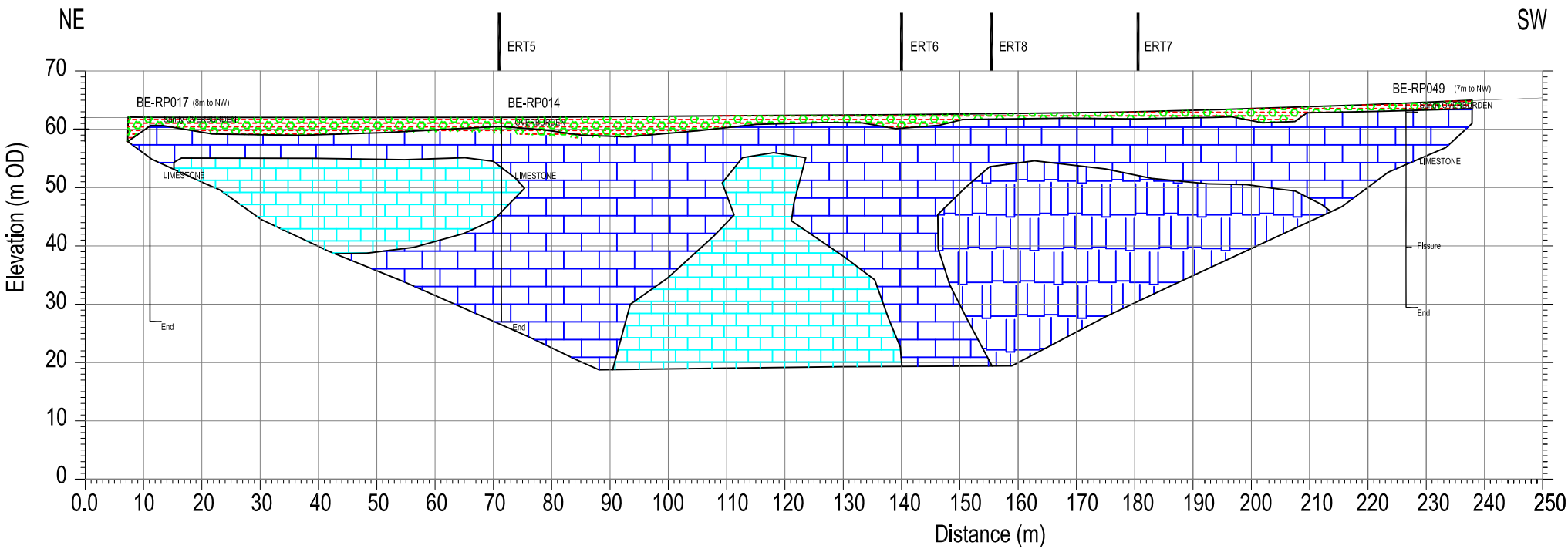
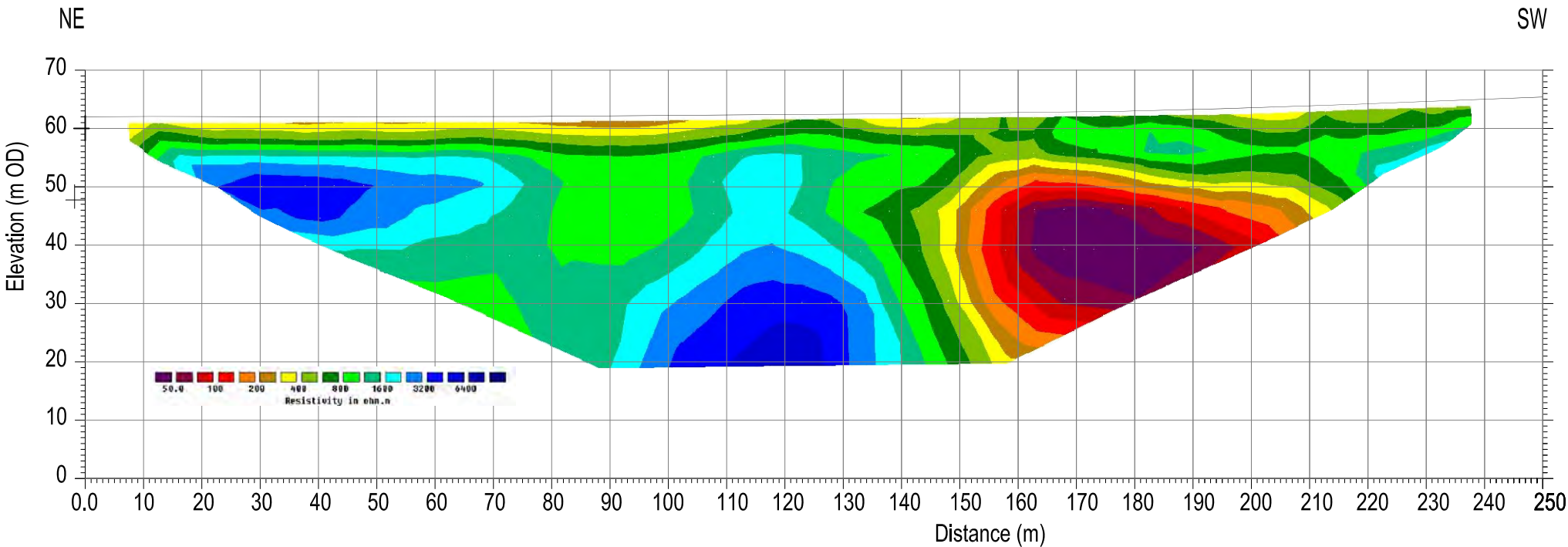
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DATE: 20/04/2018

Version:	Date:	Drawn By:	Checked:
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2	25/05/18	MF	KG
3	30/05/18	MF	TL

FIGURE 9: ERT PROFILE
SCALE 1:1000

INVERSE MODEL RESISTIVITY - 2DRES PROFILE ERT9



- LEGEND:
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 - Clean Limestone with few clay filled fissures
 - Rotary percussive borehole (2018)

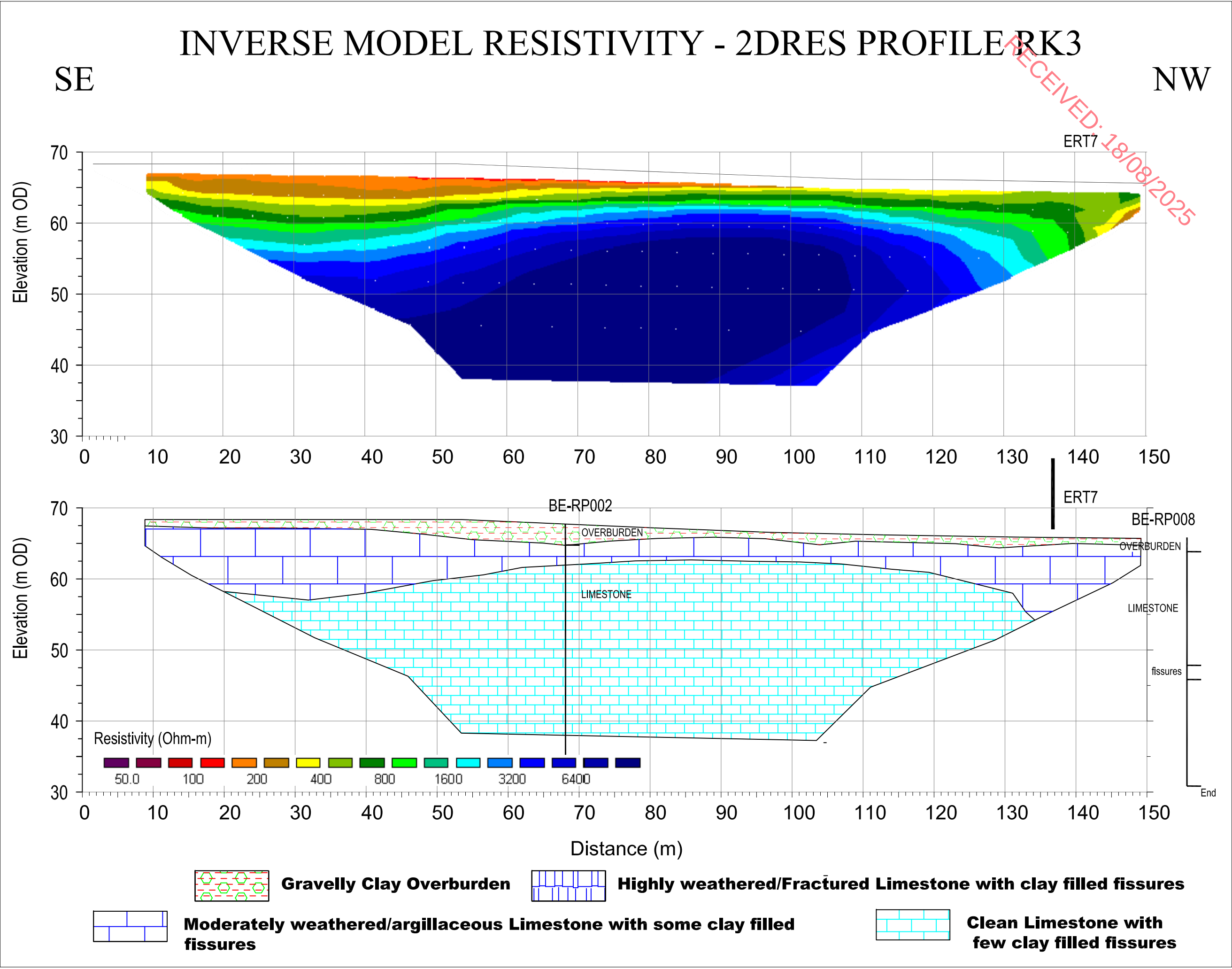


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CLIENT:	BENNETTSBRIDGE QUARRIES LIMITED		
DRAWING NO:	AGL18010_ERT09		
SCALE:	AS INDICATED @ A3		
DATE:	20/04/2018		
Version:	Date:	Drawn By:	Checked:
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2	25/05/18	MF	KG
3	30/05/18	MF	TL

FIGURE 10: ERT PROFILE
SCALE 1:500



INDEX MAP:

LEGEND:

- Gravelly Clay Overburden
- Highly weathered/Fractured Limestone with clay filled fissures
- Moderately weathered/argillaceous Limestone with some clay filled fissures
- Clean Limestone with few clay filled fissures
- Rotary percussive borehole (2018)

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GEOPHYSICAL SURVEY

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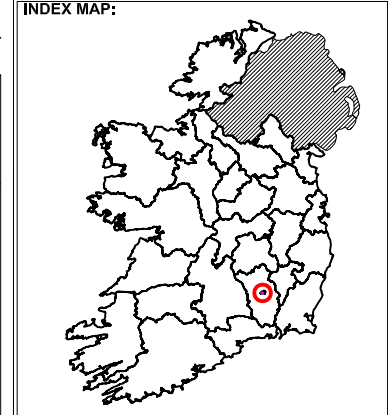
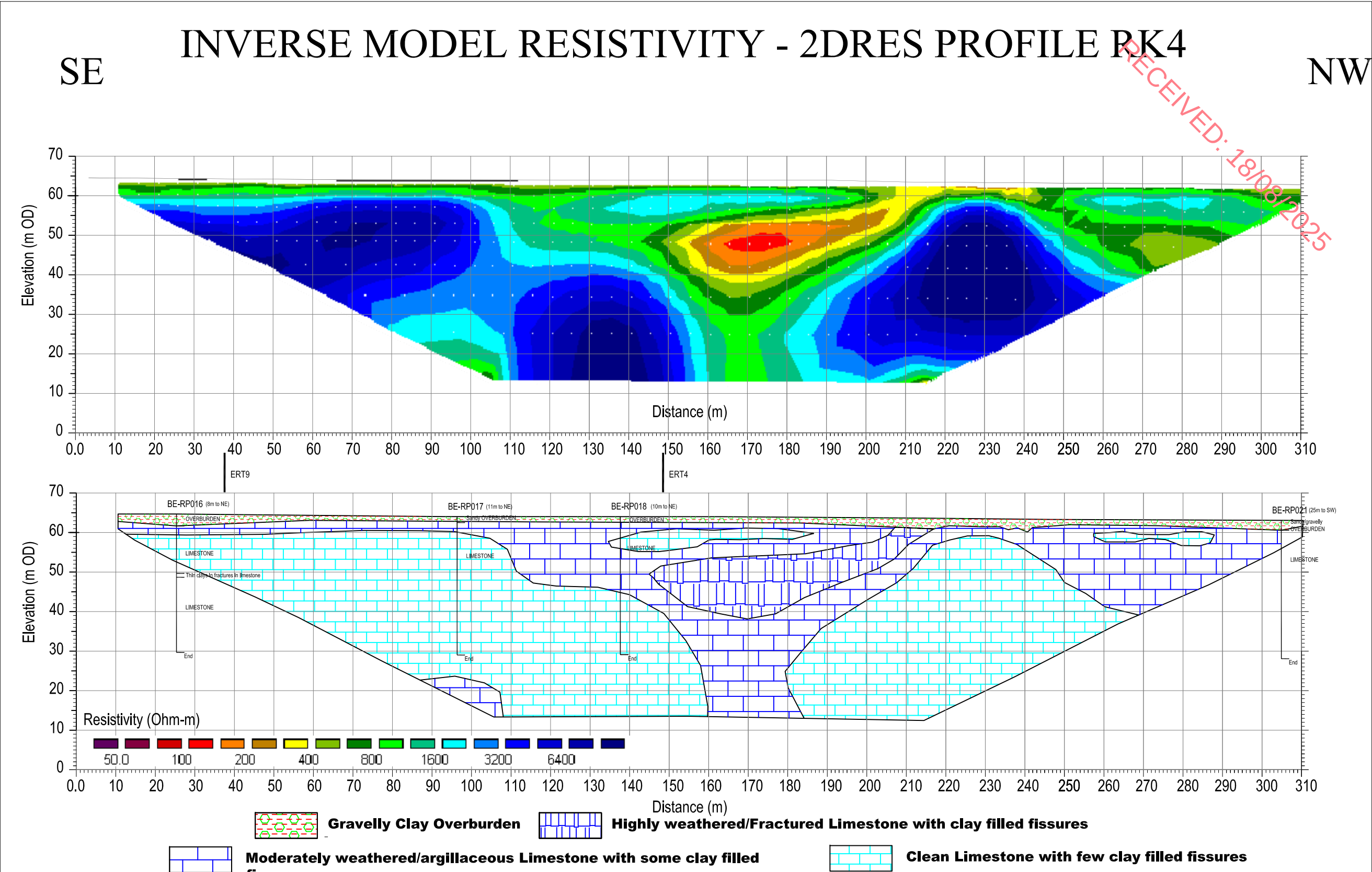
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SCALE: AS INDICATED @ A3

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2	25/05/18	MF	KG
3	30/05/18	MF	TL

FIGURE 11: ERT PROFILE
SCALE 1:1000



- LEGEND:
- Gravelly Clay Overburden
 - Highly weathered/Fractured Limestone with clay filled fissures
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 - Clean Limestone with few clay filled fissures
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CLIENT: BENNETTSBRIDGE QUARRIES LIMITED

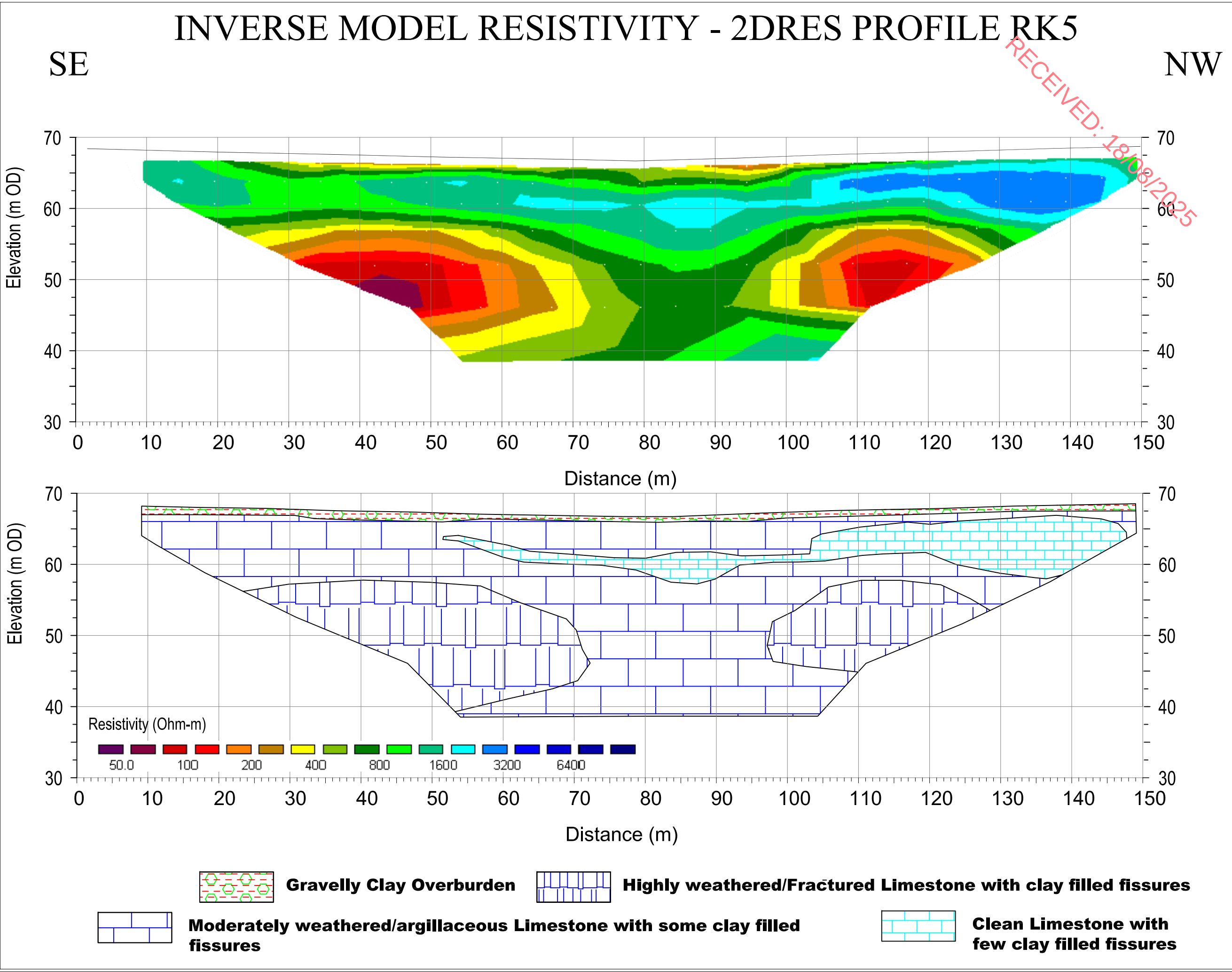
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SCALE: AS INDICATED @ A3

DATE: 20/04/2018

Version:	Date:	Drawn By:	Checked:
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2	25/05/18	MF	KG
3	30/05/18	MF	TL

FIGURE 12: ERT PROFILE
SCALE 1:500



INDEX MAP:

LEGEND:

- Gravelly Clay Overburden
- Highly weathered/Fractured Limestone with clay filled fissures
- Moderately weathered/argillaceous Limestone with some clay filled fissures
- Clean Limestone with few clay filled fissures
- Rotary percussive borehole (2018)

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GEOPHYSICAL SURVEY

CLIENT: BENNETTSBRIDGE QUARRIES LIMITED

DRAWING NO: AGL18010_12

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AGL18010_01_PHASE 2

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**REPORT
ON THE
GEOPHYSICAL INVESTIGATION
AT
BENNETTSBRIDGE QUARRY EXTENSION
PHASE 2
FOR
BENNETTSBRIDGE LIMESTONE
QUARRIES LIMITED**

05TH JUNE 2018



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THE FINDINGS OF THIS REPORT ARE THE RESULT OF A GEOPHYSICAL SURVEY USING NON-INVASIVE SURVEY TECHNIQUES CARRIED OUT AT THE GROUND SURFACE. INTERPRETATIONS CONTAINED IN THIS REPORT ARE DERIVED FROM A KNOWLEDGE OF THE GROUND CONDITIONS, THE GEOPHYSICAL RESPONSES OF GROUND MATERIALS AND THE EXPERIENCE OF THE AUTHOR. APEX GEOSERVICES LTD. HAS PREPARED THIS REPORT IN LINE WITH BEST CURRENT PRACTICE AND WITH ALL REASONABLE SKILL, CARE AND DILIGENCE IN CONSIDERATION OF THE LIMITS IMPOSED BY THE SURVEY TECHNIQUES USED AND THE RESOURCES DEVOTED TO IT BY AGREEMENT WITH THE CLIENT. THE INTERPRETATIVE BASIS OF THE CONCLUSIONS CONTAINED IN THIS REPORT SHOULD BE TAKEN INTO ACCOUNT IN ANY FUTURE USE OF THIS REPORT.

PROJECT NUMBER	AGL18010_01_PHASE 2		
AUTHOR	CHECKED	REPORT STATUS	DATE
MALCOLM FITZELL BA (HONS), PGEO, EURGEOL	TONY LOMBARD, MSc (GEOPHYSICS)	V.01	05 TH JUNE 2018

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1. EXECUTIVE SUMMARY

APEX Geoservices Limited was requested by Bennettsbridge Limestone Quarries Limited to carry out a geophysical and outline drilling investigation to determine the potential for an extension to the Bennettsbridge Limestone Quarry, Kilree, Bennettsbridge, Co Kilkenny, into lands lying immediately west of the quarry. The area of interest has been divided into two sub-areas designated Phase 1 and Phase 2. Phase 2 is situated to the north of Phase 1.

This report covers the work carried out under this investigation on the Phase 2 area.

The investigation consisted of 2D electrical resistivity tomography (ERT), seismic refraction profiling and rotary percussive drilling.

Bennettsbridge Limestone Quarry is located 1.3 km north-west of Bennettsbridge, County Kilkenny. The survey area is approximately 8.2 Ha.

The objectives of the investigation were to provide information on the type, thickness and variation of the soils, provide information on the depth to bedrock, type of bedrock, extent of weathering, fissures and clays, and to calculate a potential limestone rock resource across the site.

The results indicate soil material comprises generally sandy/gravelly clay 1.0 – 2.0m in thickness in the northern part of the site increasing to 12 m in the central part of the site where a zone of underlying highly weathered/ fractured limestone with clay filled fissures is indicated by the resistivity and drilling. South of this zone the overburden is relatively thin again (generally 1-2 m).

Bedrock has been interpreted as moderately weathered/ argillaceous limestone with some clay filled fractures and clean limestone with few clay filled fissures. This is traversed by the zone of highly weathered/fractured limestone with clay filled fissures mentioned above (apparently a continuation of the “Clay Zone” in the existing quarry).

The extent of the resource is approximately 7.9 Ha for Bench 1 and 7.1 Ha for Bench 2. This includes 1.53 Ha for Bench 1 and 1.4 Ha for Bench 2 in the highly weathered/fractured zone.

A total of 4.3 million tonnes* of limestone rock has been estimated, comprising:

- 2.0 million tonnes in Bench 1 (top of rock down to 46m OD) in the northern zone and 492,801 tonnes in Bench 1 in the southern zone;
- 2.1 million tonnes in Bench 2 (46 – 28 m OD) in the northern zone and 591,365 tonnes in the southern zone;
- 0.2 million tonnes in Bench 1 and 328,372 tonnes in Bench 2 in the Centre (Clay Zone).

The resource estimation takes account of boundary standoffs from adjoining lands to the north and west. An allowance for waste of 50% has been included in the resource tonnage calculation in the central zone (‘Clay Zone’).

Four rotary core boreholes have been proposed to confirm the geophysical and rotary percussive drilling results. The investigation should be reviewed following any further intrusive investigations.

* Figures rounded off.

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2. INTRODUCTION

APEX Geoservices Limited was requested by Bennettsbridge Limestone Quarries Limited to carry out a geophysical and drilling investigation to determine the potential for an extension to the quarry at Kilree, Bennettsbridge, Co Kilkenny into lands to the west of the existing quarry. The area of proposed extension of quarrying is situated immediately to the west and south-west of the existing quarry, and has been divided into two sub-areas designated Phase 1 and Phase 2. Phase 1 is situated to the south of Phase 2.

This report covers the work carried out under this investigation on the Phase 2 area.

The investigation consisted of 2D electrical resistivity tomography (ERT), seismic refraction profiling and rotary percussive drilling.

2.1 Survey Objectives

The objectives of the survey were to:

1. Provide information on the type, thickness and variation of the overburden.
2. Provide information on the depth to and type of bedrock.
3. Calculate a potential aggregate resource.

2.2 Site Background

Bennettsbridge Limestone Quarry is located approximately 1.3km northwest of the village of Bennettsbridge. The Phase 2 portion of the site covered in this report lies immediately to the west of the existing quarry to the north of the Phase 1 area.

The site under investigation (Phase 2) is 8.2 Ha in area. Ground elevations across the site range from approx. 59 to 69 mOD. The site consists of open agricultural land.

Data from the previous geophysical survey in this area, which had been carried out in 2006, has been incorporated into interpretation of the present survey results.

2.3 Bedrock and soils

The GSI bedrock geology map for the area shows the area under investigation is underlain by limestones of the Ballyadams Formation, which is described as crinoidal wackestone / packstone.

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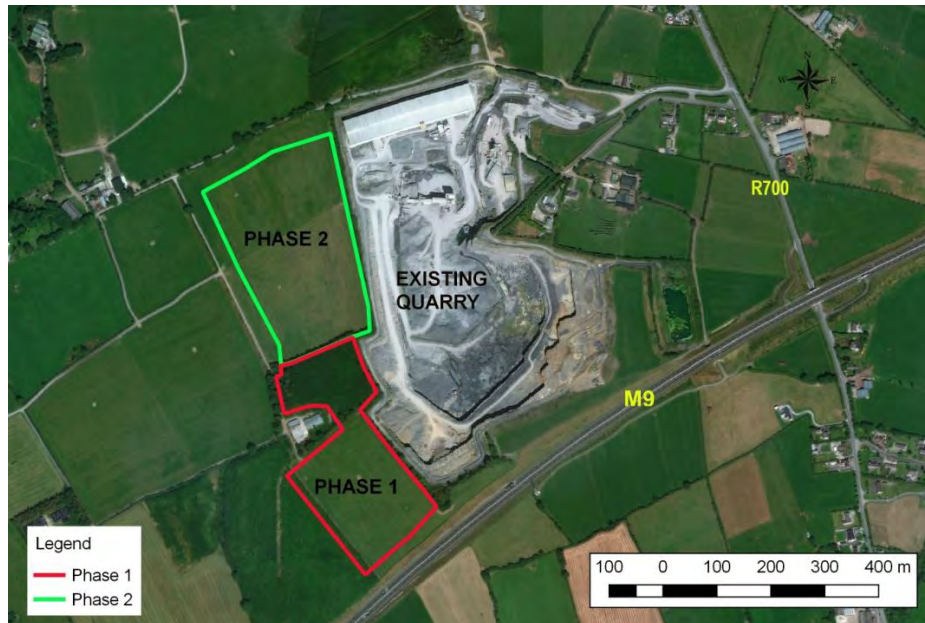


Fig. 2.1. Site location.

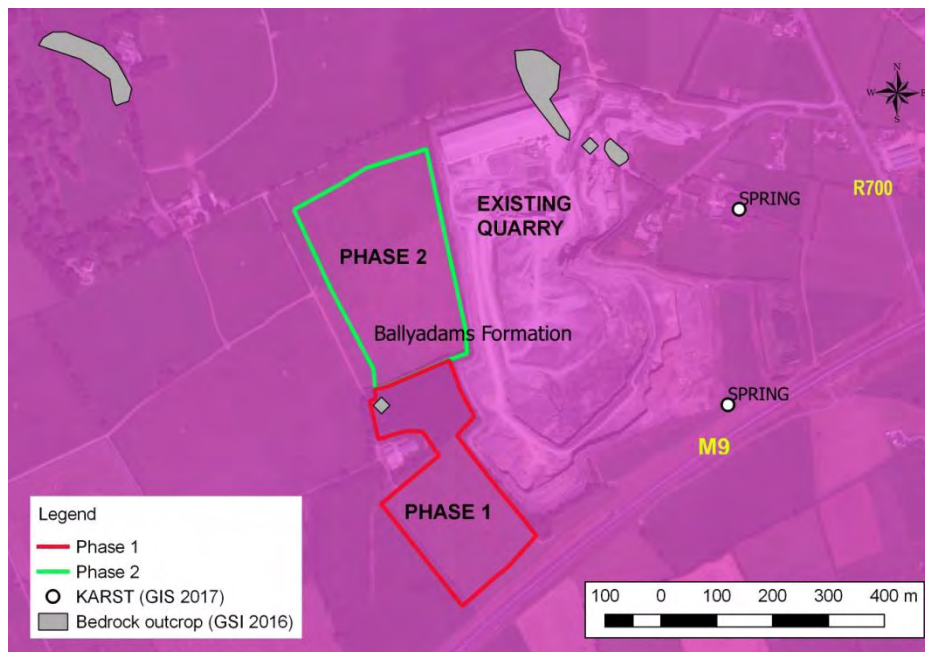


Fig.2.2. Bedrock geology of the survey area.

The GSI subsoil map indicates that the site is located within an area of gravels derived from limestones (see Fig. 2.3).

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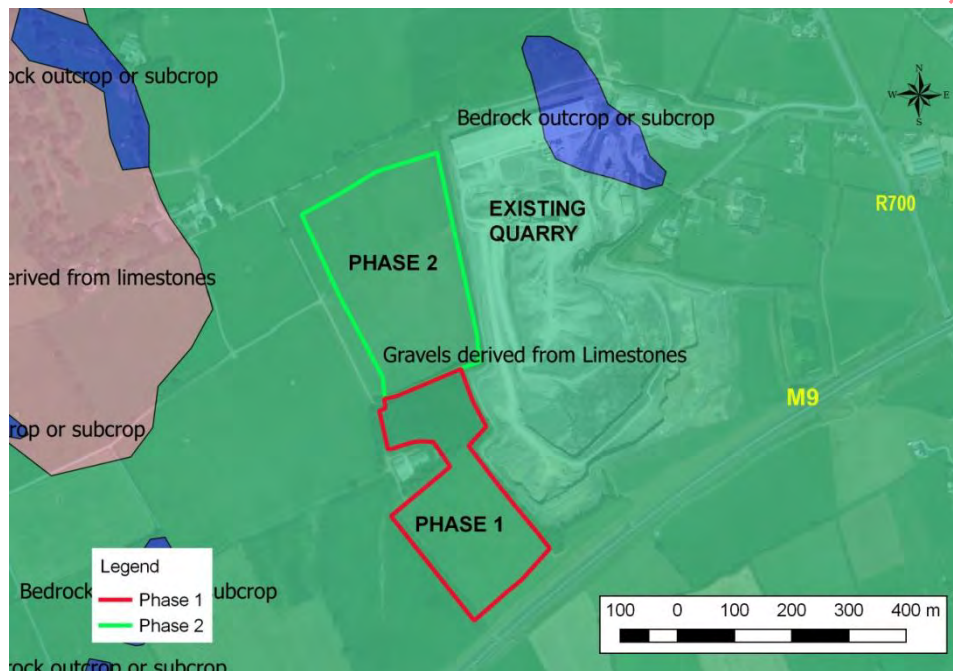


Fig.2.3. Subsoils of the survey area (GSI).

2.4 Groundwater aquifer and vulnerability

The GSI database indicates bedrock within the site as “Locally Important Aquifer – Karstified” and the GSI vulnerability dataset shows the site lying within an area of high vulnerability.

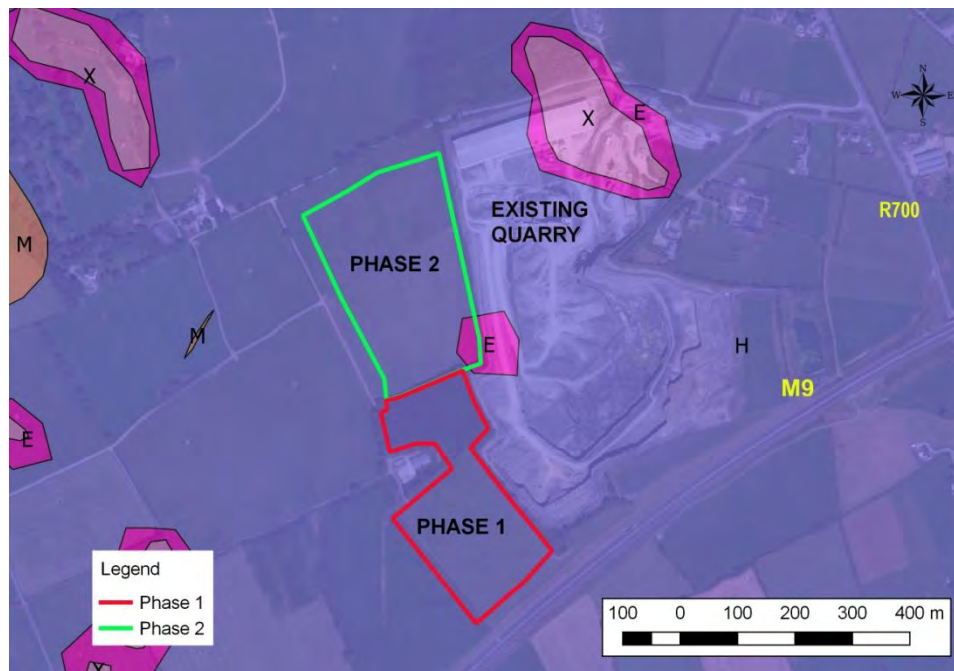


Fig.2.4. Groundwater vulnerability of the survey area.

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2.5 Historical Sheet

The 6" Geological Sheet (Fig.2.5) indicates possible rock outcrops in or close to the north-east corner of the site.

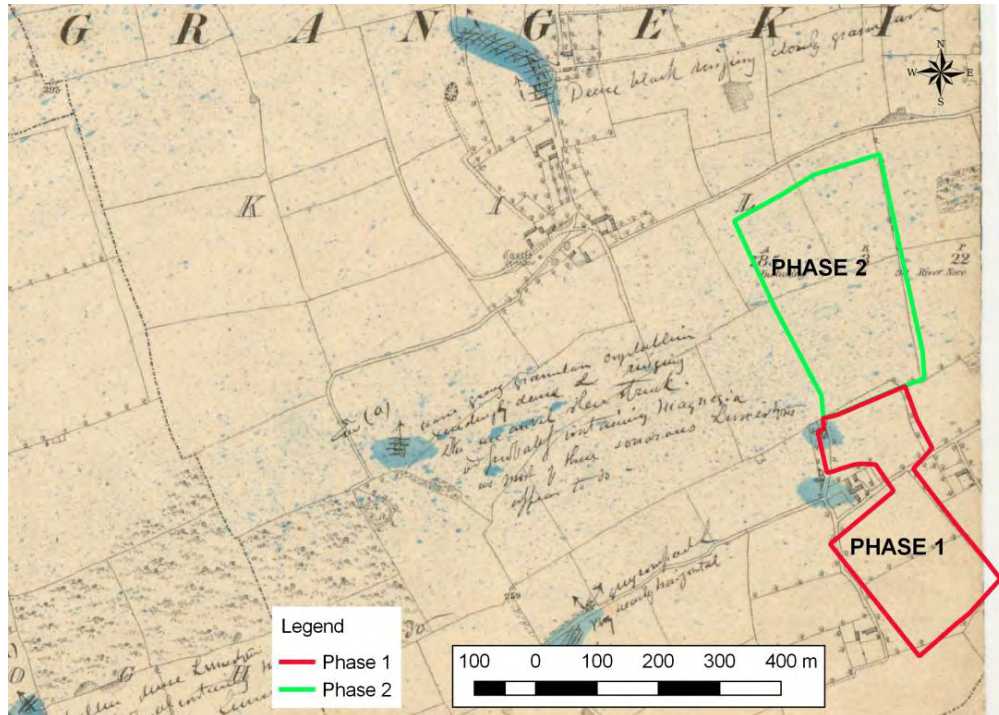


Fig.2.5. GSI 6inch: 1 mile map sheet of the survey area.

2.6 Survey Rationale

Electrical Resistivity Tomography (ERT) soundings will image the resistivity of the materials in the subsurface along a profile to produce a pseudo-section showing the variation in resistivity to a depth which is dependent on the length of the profile. Each pseudo-section will be interpreted to determine the material type along the profile at increasing depth, based on the typical resistivities returned for Irish ground materials. Zones of increased bedrock weathering can be expected to have a lower bedrock resistivity.

Seismic Refraction Profiling measures the velocity of refracted seismic waves through the overburden and rock material and allows an assessment of the thickness and quality of the materials present to be made. Stiffer and stronger materials usually have higher seismic velocities while soft, loose or fractured materials have lower velocities. Readings are taken using geophones connected via multi-core cable to a seismograph. This method will allow us to profile the depth to the top of the bedrock, along profiles across the site.

Rotary Percussive Drilling provides a relatively inexpensive and fast method to investigate overburden type and thickness, rock type and amount of weathering and fracturing. As no core or samples of intact, undisturbed material can be recovered interpretation is dependent on recovery of cuttings and penetration rate.

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3. RESULTS & INTERPRETATION

3.1 2D Electrical Resistivity Tomography (ERT)

ERT Profiles ERT1 – ERT4 were recorded across the Phase 2 survey area (Drawing AGL18010_01). ERT Profiles RK1, RK2 and RK4 recorded in 2006 (Project 6097) across the survey area are also presented in this report. The profiles have been interpreted on the following basis:

Resistivity (Ohm-m)	Interpretation
50 - 150	OVERBURDEN/Sandy gravelly CLAY
150 - 400	HIGHLY WEATHERED/ FRACTURED LIMESTONE with clay filled fissures
400 - 1600	MODERATELY WEATHERED/ ARGILLACEOUS LIMESTONE with some clay filled fissures
1600 - 9500	Clean LIMESTONE with few clay filled fissures

3.2 Seismic Refraction Profiling

One seismic refraction spread (Seis 1) was recorded across the survey area (Drawing AGL18010_01). The seismic refraction plate can be found in Section7, Appendix B. The seismic refraction datasets have been interpreted on the following basis:

Layer	Seismic Velocity (m/s)	Interpretation	Stiffness/Rock Quality
1	461	OVERBURDEN	Soft – firm / Loose – Medium Dense
2	721	HIGHLY WEATHERED/FRACTURED LIMESTONE	Poor - Fair
3	2249	MODERATELY WEATHERED/FRACTURED LIMESTONE	Fair
4	4204	SLIGHTLY WEATHERED-FRESH LIMESTONE	Good

3.3 Rotary Percussive Drilling

10 rotary percussive boreholes were drilled across the Phase 2 area (see Drawing No. AGL18010_13). Eight of the boreholes in Phase 2 reached planned depth of 35m below ground level, while two boreholes (BE-RP 25 and BE_RP27) were terminated at shallower depths (12 and

30 m respectively below ground level) in thick, coarse gravelly overburden and/or highly weathered/ fractured rock. Overburden thickness recorded from the 35m boreholes ranged from 1.0 to 5.5 m. The borehole logs can be found in Section 8, Appendix C of this report.

3.3 Discussion

The interpreted ERT profiles ERT1 – ERT4 along with previous profiles RK1, RK2 and RK4 are presented on Drawings AGL18010_14 – AGL18010_20. The borehole logs are also presented in summary as stick logs on the profiles and the resistivity and seismic data has been interpreted to take account of the borehole data.

3.3.1 Overburden

Material with resistivity values of 50 - 150 Ohm-m has been interpreted as comprising generally sandy/gravelly clay overburden. The overburden has been interpreted as generally varying in thickness from 1.0 – 2.0m in the north (Profiles ERT1, ERT2 and RK1 and the northern part of ERT3) increasing to 12 m in the central part of the site where a zone of underlying highly weathered/ fractured limestone with clay filled fissures is indicated by the resistivity and drilling. South of this zone the overburden is relatively thin again (generally 1-2 m), see Map 18010_13.

3.3.2 Bedrock

Material with a resistivity of 150 - 400 Ohm-m has been interpreted as highly weathered/ fractured limestone with clay filled fissures. As mentioned above, this rock type is prevalent in the central part of the site (Map 18010_13), see Profiles ERT3 and RK2 (central parts) and ERT4 (north), and has been interpreted as persisting to a depth of at least 57m below ground level on ERT3 and to approx. 20m below ground level on ERT4 and RK2. Here it appears to be a continuation to the west of the zone of clay filled fractured/fissured limestone (the “Clay Zone”) which has significantly affected rock quality during extraction in the existing quarry.

Material with a resistivity of 400 – 1600 Ohm-m has been interpreted as moderately weathered/ argillaceous limestone with some clay filled fractures. This material underlies most of the site to the north and south of the central zone of weathered/fractured limestone.

Localised zones of sandy clay may be present within this moderately weathered/ argillaceous limestone as indicated by Rotary Percussive BE-RP37, located just to the SSE of Profile ERT2 in the northern part of the area. This should be further investigated by a rotary core borehole.

Material with a resistivity of 1600 - 9500 Ohm-m has been interpreted as clean limestone with few clay filled fissures. This is frequently present underlying the moderately weathered/ argillaceous limestone.

About two-thirds of the site area has been interpreted as a potential limestone resource with fair to good rock quality with the remainder comprising the central zone of highly weathered/ fractured limestone with clay filled fissures (“Clay Zone”) for which a waste factor would have to be allowed.

3.3.3 Potential Resource

A potential limestone resource consisting of moderately weathered/ argillaceous limestone with some clay filled fractures and clean limestone with few clay filled fissures has been estimated. As

mentioned, this resource is traversed by a zone of poor to fair quality limestone with clay filled fissures. The resource is detailed in the table below (see also Drawing AGL18010_13).

Calculation of Resource - Phase 2

Zone		Area	Bottom	Height	Overburden	Rock	Rock
					volume	volume	
		(sq.m.)	(mOD)	(m)	(cu.m)	(cu.m)	(tonnes)
							(@2.6t/cu.m.)
Phase II	Overburden	81,697	varies	2.75*	206,312		
North	Bench 1	50,352	46	15.8*		787,153	2,046,598
	Bench 2	43,988	28	18		791,784	2,058,638
Centre (Clay Zone)	Bench 1	15,386	46	13.8*		173,848	226,002**
	Bench 2	14,033	28	18		252,594	328,372**
South	Bench 1	13,409	46	12*		189,539	492,801
	Bench 2	12,636	28	18		227,448	591,365
Total						2,422,366	5,743,776

* Average value

** after applying 50% factor for waste

The overburden thickness has been calculated across the resource from ground surface elevation data and top of rock elevations acquired during the geophysical survey and drilling. Bench levels of 46 mOD and 28 mOD have been used. The resource estimation takes account of boundary standoffs from adjoining lands to the north and west. An allowance for waste of 50% has been included in the resource tonnage calculation in the central zone ('Clay Zone') – this waste factor is based on experience of processing similar material in the existing quarry.

A total of 4,332,651 tonnes of limestone rock has been estimated, comprising

- 2,046,598 tonnes in Bench 1 (top of rock down to 46m OD) in the northern zone and 492,801 tonnes in Bench 1 in the southern zone;
- 2,058,638 tonnes in Bench 2 (46 – 28 m OD) in the northern zone and 591,365 tonnes in the southern zone;
- 226,002 tonnes in Bench 1 and 328,372 tonnes in Bench 2 in the Centre (Clay Zone).

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4. RECOMMENDATIONS

Rotary core drilling is recommended to confirm the findings of the geophysical and percussion drilling investigations. Proposed locations are as follows:

No.	ITM Easting	ITM Northing	Depth (m bgl)	Target
PBH1	653922	650102	35	Nature and thickness of moderately weathered/argillaceous limestone. RP drill recovery of sandy clay at 17-22 m bgl, just off the SSE end of Profile ERT2
PBH2	654006	649947	35	Nature and depth to highly weathered/fractured limestone with clay filled fissures
PBH3	653880	649963	35	Thickness of overburden, depth and nature of highly weathered/fractured limestone with clay filled fissures
PBH4	653953	649789	35	Thickness of overburden, depth and nature of highly weathered/fractured limestone with clay filled fissures

Sampling and testing of the rock types should be carried out and should include appropriate physical, mechanical and geochemical analysis of the aggregate contained in this possible resource to establish its suitability for use as a crushed aggregate.

This report should be reviewed after the completion of any direct investigation.

5. REFERENCES

Bell F.G., 1993; 'Engineering Geology', Blackwell Scientific Press.

Campus Geophysical Instruments, 2000; 'RES2DINV ver. 3.4 Users Manual', Birmingham, England.

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'RES2DINV Users Manual', Malaysia.

GSI, 2017;
Bedrock Geology 1:100,000 Shapefile. <http://www.gsi.ie/Mapping.htm>

GSI, 2017;
GSI/Teagasc Subsoils Shapefile. <http://www.gsi.ie/Mapping.htm>

Soske, J.L., 1959; 'The blind zone problem in engineering geophysics', Geophysics, 24, pp 359-365.

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6. APPENDIX A: DETAILED METHODOLOGY

6.1 Electrical Resistivity Tomography (ERT)

6.1.1 Principles

This surveying technique makes use of the Wenner resistivity array. The 2D-resistivity profiling method records a large number of resistivity readings in order to map lateral and vertical changes in material types. The 2D-resistivity profiling method involves the use of 1-64 electrodes connected to a resistivity meter, using computer software to control the process of data collection and storage.

6.1.2 Data Collection

Profiles ERT1-ERT4 were recorded using a Tigre resistivity meter, imaging software, two 32 takeout multicore cables and up to 64 stainless steel electrodes with a 5m electrode spacing. Saline solution was used at the electrode/ground interface in order to gain a good electrical contact required for the technique to work effectively. The recorded data were processed and viewed immediately after the survey. The data was acquired on 12th April 2018.

6.1.3 Data Processing

The field readings were stored in computer files and inverted using the RES2DINV package (Campus Geophysical Instruments, 1997) with up to 5 iterations of the measured data carried out for each profile to obtain a 2D-Depth model of the resistivities.

The inverted 2D-Resistivity models and corresponding interpreted geology are displayed on the accompanying drawings. Distance is indicated along the horizontal axis of the profiles. Profiles have been contoured using the same contour intervals and colour codes.

6.2 Seismic Refraction Profiling

6.2.1 Principles

The seismic refraction profiling method measures the velocity of refracted seismic waves through the overburden and rock material and allows an assessment of the thickness and quality of the materials present to be made. Stiffer and stronger materials usually have higher seismic velocities while soft, loose or fractured materials have lower velocities. Readings are taken using geophones connected via multi-core cable to a seismograph.

6.2.2 Data Collection

One seismic spread was recorded on the 12th April 2018 using a Geode high-resolution 24 channel digital seismograph with a geophone spacing of 2m. The source of the seismic waves was a sledgehammer.

6.2.3 Data Processing

The recorded data was processed and interpreted using the ray-tracing and tomographic inversion methods, to acquire depths to boundaries and the P-wave velocities of these layers, using the SeisImager/2D programme from Geometrics.

SeisImager/2D interprets seismic refraction data as a laterally varying layered earth structure. The programme includes three methods for data analysis, time-term inversion, the reciprocal method and tomography.

The tomography method creates an initial velocity model, then traces rays through the model, comparing the calculated and measured traveltimes. The model is then modified and the process repeated to minimise the difference between the calculated and measured times. The data was processed using this method followed by conversion to a layered model.

Approximate errors for Vp velocities are estimated to be +/- 10%. Errors for the calculated layer thicknesses are of the order of +/-20%. Possible errors due to the "hidden layer" and "velocity inversion" effects may also occur (Soske, 1959).

6.3 Spatial Relocation

All the geophysical investigation locations were acquired using Trimble Geo 7X high-accuracy GNSS handheld using the settings listed below. This system allows collecting GPS data with sub-meter accuracy.

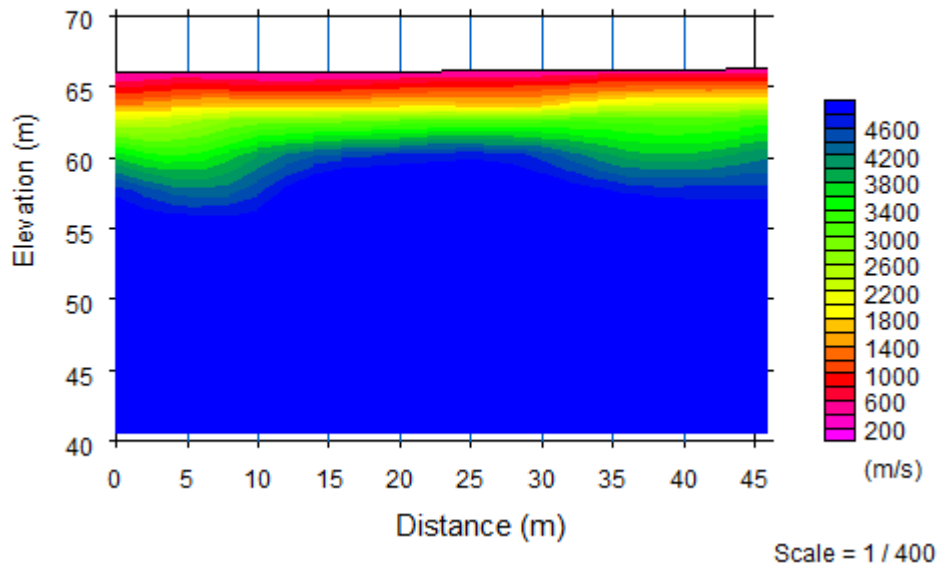
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Datum:	Ordnance
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Altitude units:	Metres
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Geoid model:	Republic of Ireland

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7. APPENDIX B: SIESMIC REFRACTION PLATES

The result of the tomographic inversion of seismic spread Seis 1 is shown below.

SEIS 1



8. APPENDIX C: ROTARY PERCUSSIVE BOREHOLE LOGS

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Hole ID	Depth		Description	Sample No	Sample Depth (m)	Elevation mOD
	From	To				
BE-RP-021	0	2.5	Overburden - Medium brown - sandy / gravelly	56180	5	61.156
	2.5	7.5	Light grey - slight yellowish tinge very slightly oxidised fines, unoxidised cuttings of grey, fresh, strong limestone - steady penetration	56181	10	
	7.5	12	Grey / light grey fines, - fine / medium grained, angular cuttings of grey, strong, fresh limestone - steady penetration	56182	15	
	12	35	Light Grey / grey fines, fine grained, angular cuttings of pale grey, strong, limestone - steady penetration	56183	20	
				56184	25	
				56185	30	
				56186	35	
BE-RP-023	0	2.5	Overburden - Medium brown - sandy / gravelly	56187	5	60.202
	2.5	7	Light grey - fines, unoxidised cuttings of grey, fresh, strong limestone - steady penetration	56188	10	
	7	19	Grey / light grey fines, - fine / medium grained, angular cuttings of grey, strong, fresh limestone - steady penetration	56189	15	
	19	19.25	Bright yellow / brown sandy return, jerky penetration	56190	20	
	19.25	20.5	Light Grey / grey with a slight yellowish tinge fines, fine grained, angular cuttings of grey, strong, limestone - steady penetration	56191	25	
	20.5	30.5	Light grey fines, - fine / medium grained, angular cuttings of grey, strong, fresh limestone - steady penetration	56192	30	
	30.5	32	Grey with a slight yellowish tinge, weakly oxidised - steady progress	56193	35	
	32	35	Light grey fines, - fine / medium grained, angular cuttings of grey, strong, fresh limestone - steady penetration			
BE-RP-024	0	2.5	Overburden	56221	5	62.331
	2.5	14	Pale grey fines, subangular medium grey chips	56222	10	
	14	30	Slightly lighter grey fines, nearly white in colour, very few chips	56223	15	
	30	35	Slower drilling, off white coloured fines, few medium grey chips	56224	20	
				56225	25	
				56226	30	
				56227	35	
BE-RP-025	0	12	Overburden: Brown, clayey, silty sand with medium grey limestone pebbles and cobbles. Refusal at 9.9m, air-flushed and continued to 12m. Refusal again at 12m EOH called.	56242	5	62.082
				56243	9.9	
BE-RP-027	0	9	Overburden: Brown/orange silty sands, minor clay, few dark grey, subrounded limestone pebbles and cobbles	56235	5	60.696
	9	12.5	Pale grey to off-white fines	56236	10	
	12.5	16	Very pale grey fines, minor orange alteration from small weathered zones/joints	56237	15	
	16	18	Brown-orange fines, medium grey subrounded pebbles	56238	16	
	18	22	Pale grey fines, minor oxidation	56239	20	
	22	30	Heavily weathered zone: orange-brown fines, difficult drilling, air-flushing hole for some time, refusal at 30m (EOH)	56240	25	
				56241	30	
BE-RP-032	0	3.5	Overburden: Brown sandy clays	56228	5	60.606
	3.5	8	Pale grey fines, minor weathered zones (possibly along joints) with fine sandy silts	56229	10	
	8	19	Very pale grey to white fines, no chips	56230	15	
	19	24	Brown-grey and light grey fines, some minor silty sandy material. Subangular and subrounded pebbles. Slow drilling.	56231	20	
	24	30	Pale grey fines, few calcite and medium grey limestone chips. Slower drilling from 27m.	56232	25	
	30	33	Slightly darker grey fines	56233	30	
	33	34	Medium grey fines, slow drilling.	56234	35	
	34	35	Brown-grey to pale grey fines, sandy silts			

BE-RP-033	0	5.5	Overburden - Medium brown - sandy / gravelly	56194	10	66.431
	5.5	14.5	Light grey - fines, unoxidised cuttings of grey, fresh, strong limestone - steady penetration	56195	15	
	14.5	14.75	Grey with a brownish tinge fines, - slow penetration - jerky, hammer refusing, driller reports cavity	56196	20	
		16.5	Light Grey / slight brownish tinge to fines, slight oxidation - steady penetration	56197	25	
	16.5	16.75	Brown / grey oxidised returns - cavernous, Hammer refusing, progress slow.	56198	30	
	16.75	35	Light grey fines, - fine / medium grained, angular cuttings of grey, strong, fresh limestone - steady penetration	56199	35	
BE-RP-037	0	1	Overburden	56200	5	62.404
	1	6	Pale grey fines, subangular medium grey chips	56201	10	
	6	17	Pale grey fines, angular medium grey chips	56202	15	
	17	22	Sandy clay	56203	20	
	22	35	Light grey fines, rounded chips	56204	25	
				56205	30	
				56206	35	
BE-RP-041	0	4.5	Overburden: weathered, subrounded pebbles and cobbles, brown sandy clays	56207	5	59.854
	4.5	21	Pale grey fines, subangular medium grey chips	56208	10	
	21	22.5	Brown, sandy clays, subangular pebbles and cobbles	56209	15	
	22.5	26	Pale grey fines, small, subrounded medium grey limestone fragments	56210	20	
	26	35	Slightly darker grey fines, angular medium grey chips	56211	25	
				56212	30	
				56213	35	
BE-RP-042	0	2	Overburden	56214	5	62.524
	2	6	Pale grey fines, subangular fragments coated in fines	56215	10	
	6	13	Light grey fines, subangular chips of medium grey limestone	56216	15	
	13	22.5	Pale grey fines, subangular and subrounded medium grey chips	56217	20	
	22.5	35	Pale grey fines, darker grey chips	56218	25	
				56219	30	
				56220	35	



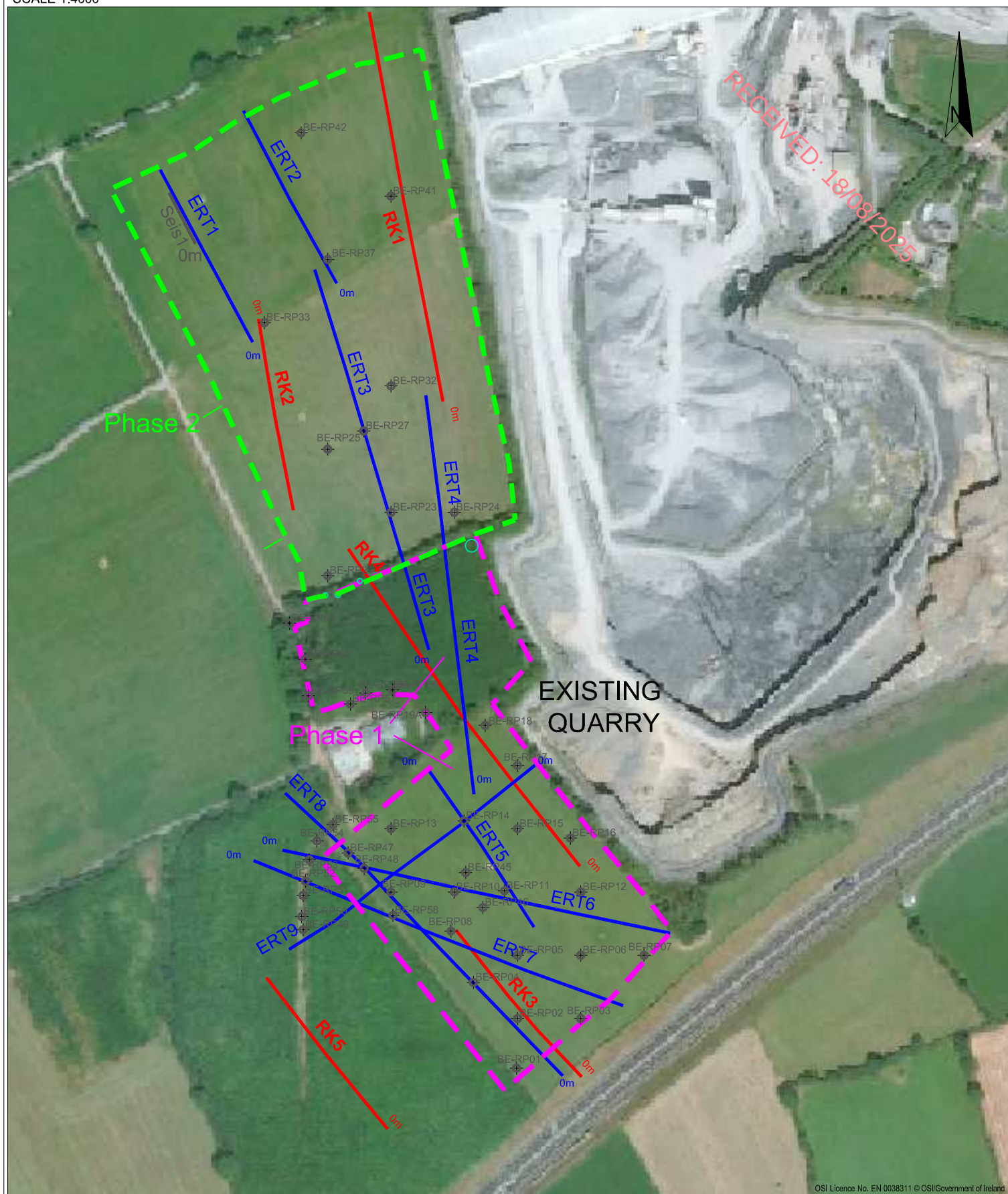
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9. APPENDIX D: DRAWINGS

The information derived from the geophysical and drilling investigation is presented in the following drawings:

AGL18010_01	Site outline & survey locations map	1:4000 @ A4
AGL18010_13	Boreholes & ERT locations	1:1250 @ A3
AGL18010_14	Fig. 3 Profile ERT1 with interpretation	1:500 @ A3
AGL18010_15	Fig. 4 Profile ERT2 with interpretation	1:500 @ A3
AGL18010_16	Fig. 5 Profile ERT3 with interpretation	1:500 @ A3
AGL18010_17	Fig. 6 Profile ERT4 with interpretation	1:1000 @ A3
AGL18010_18	Fig. 7 Profile RK1 with interpretation	1:1000 @ A3
AGL18010_19	Fig. 8 Profile RK2 with interpretation	1:500 @ A3
AGL18010_20	Fig. 9 Profile RK4 with interpretation	1:1000 @ A3

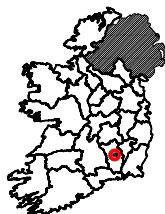
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INDEX MAP:



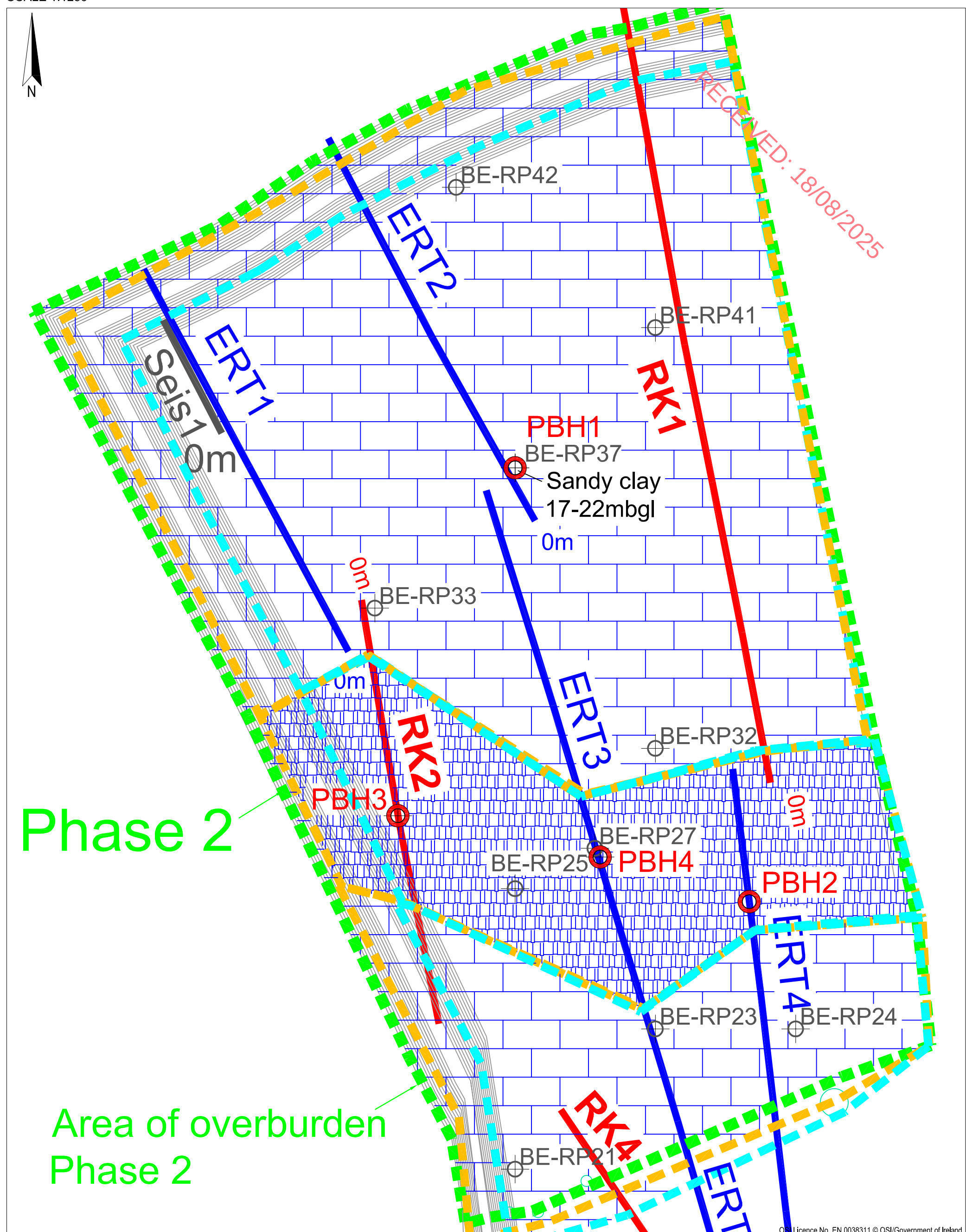
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Rotary percussive borehole

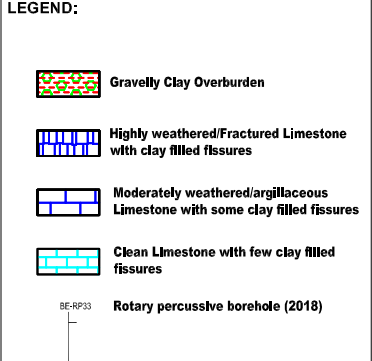
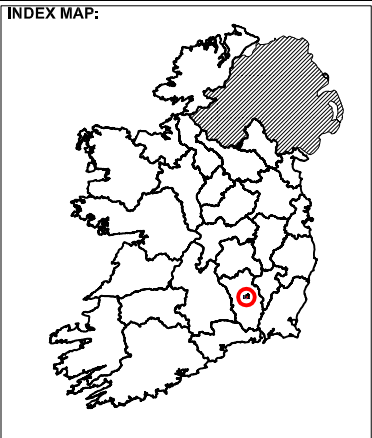
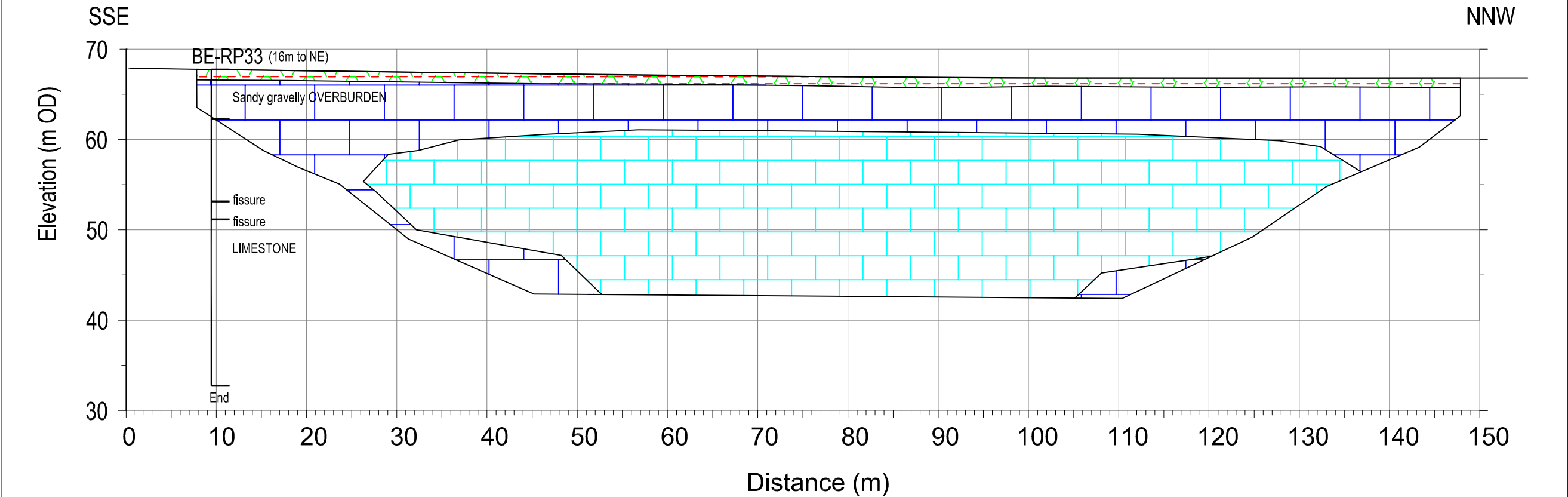
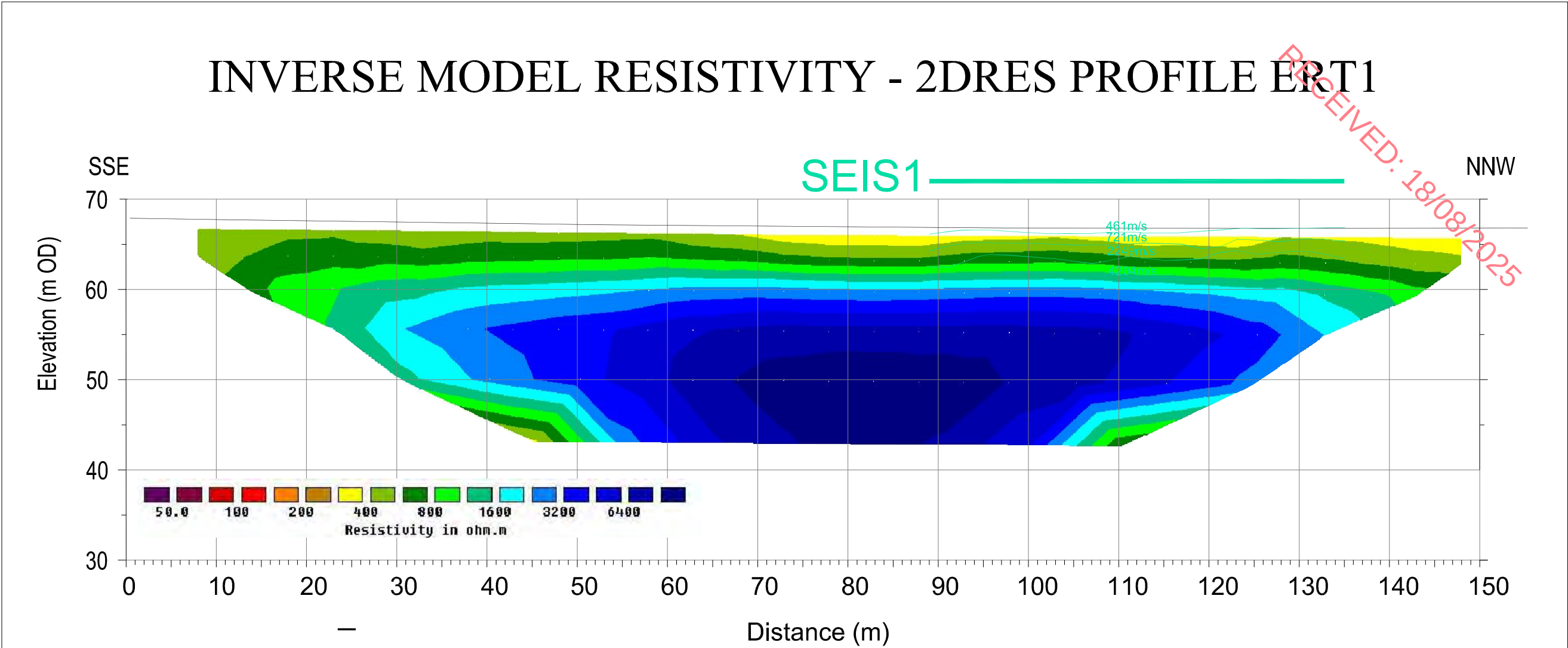
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002	23-04-2018	KG	POC
003	09-05-2018	KG	POC
004	25-05-2018	MF	KG

SCALE 1:1250



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FIGURE 3: ERT PROFILE
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GEOPHYSICAL SURVEY

CLIENT: BENNETTSBRIDGE QUARRIES LIMITED

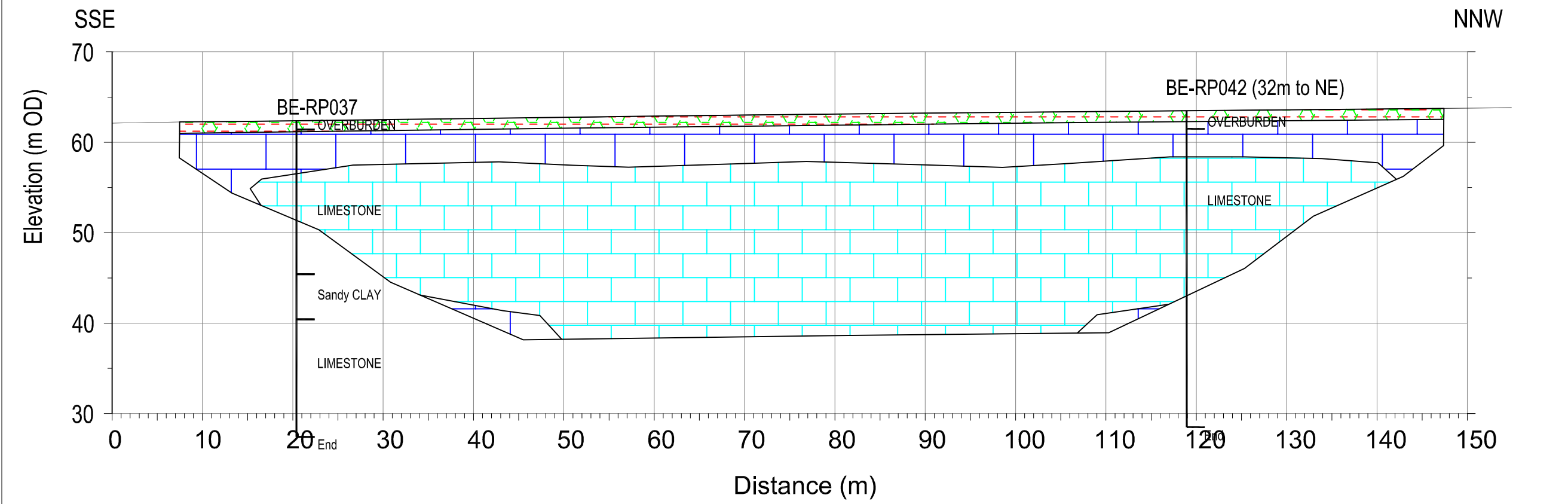
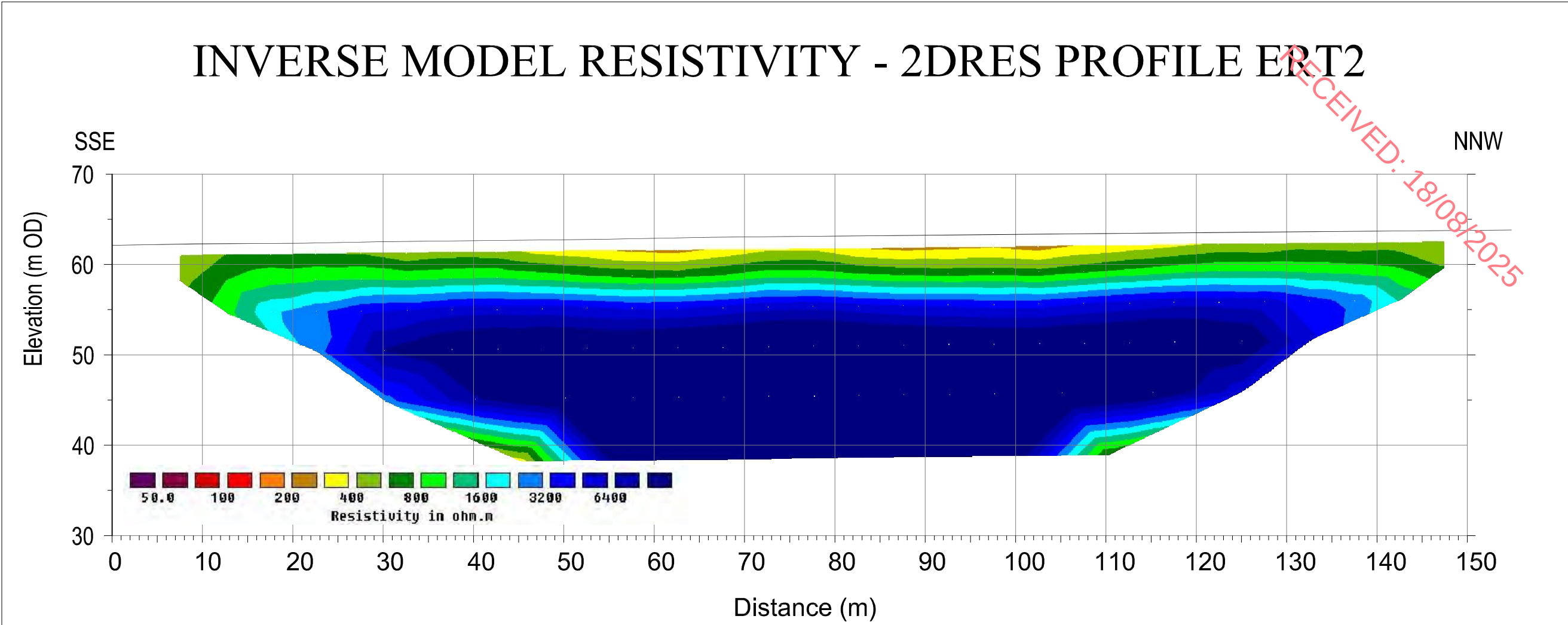
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DATE: 20/04/2018

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3	05/06/18	MF	TL

FIGURE 4: ERT PROFILE
SCALE 1:500



INDEX MAP:

LEGEND:

- Gravelly Clay Overburden
- Highly weathered/Fractured Limestone with clay filled fissures
- Moderately weathered/argillaceous Limestone with some clay filled fissures
- Clean Limestone with few clay filled fissures
- Rotary percussive borehole (2018)

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CLIENT: BENNETTSBRIDGE QUARRIES LIMITED

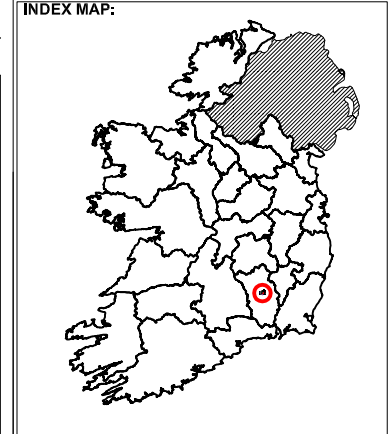
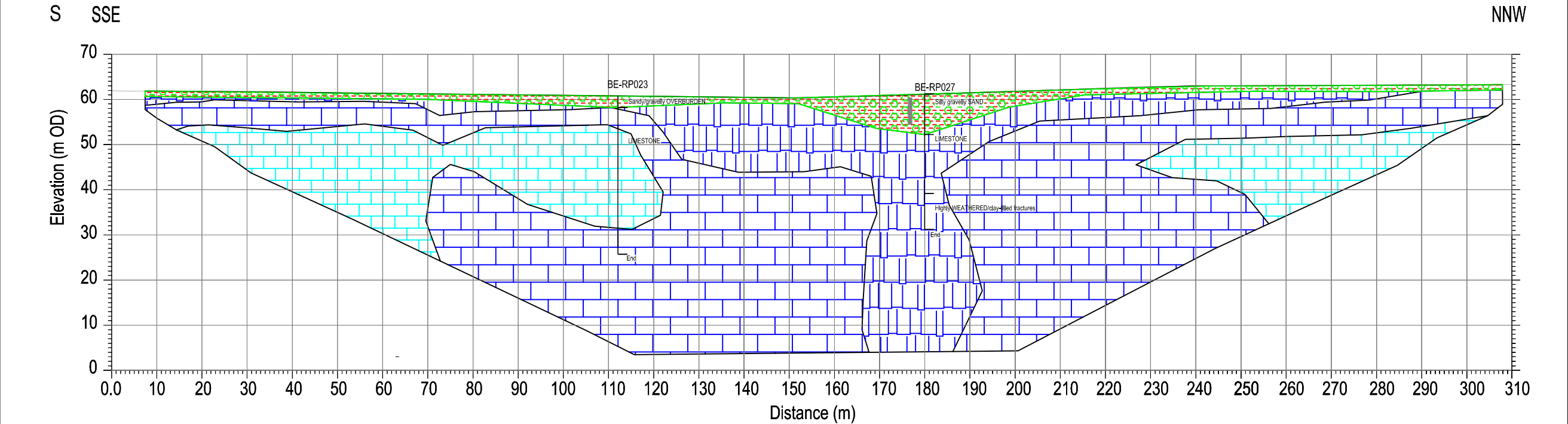
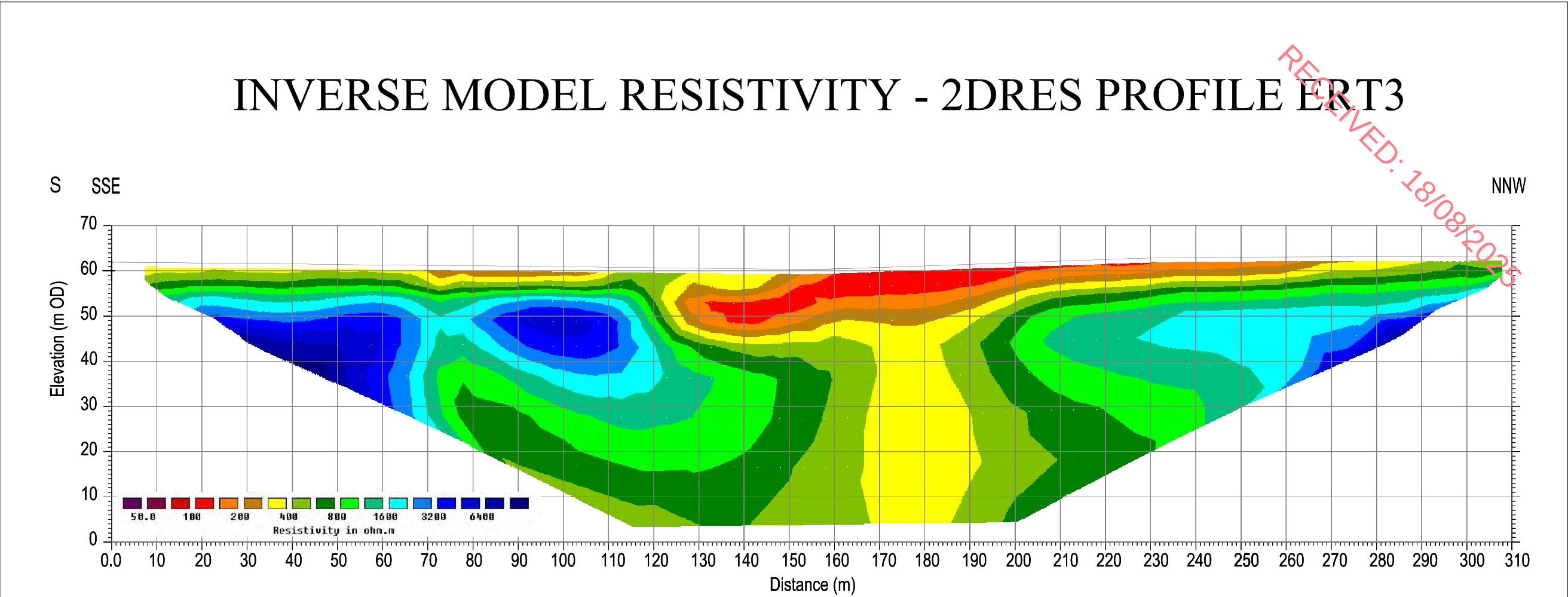
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2	25/05/18	MF	KG
3	05/06/18	MF	TL

FIGURE 5: ERT PROFILE
SCALE 1:1000



- LEGEND:
- Gravelly Clay Overburden
 - Highly weathered/Fractured Limestone with clay filled fissures
 - Moderately weathered/argillaceous Limestone with some clay filled fissures
 - Clean Limestone with few clay filled fissures
 - Rotary percussive borehole (2018)

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GEOPHYSICAL SURVEY

CLIENT: BENNETTSBRIDGE QUARRIES LIMITED

DRAWING NO: AGL18010_16

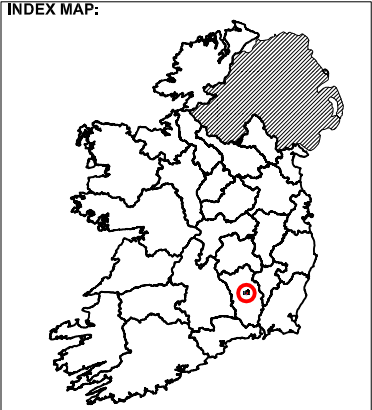
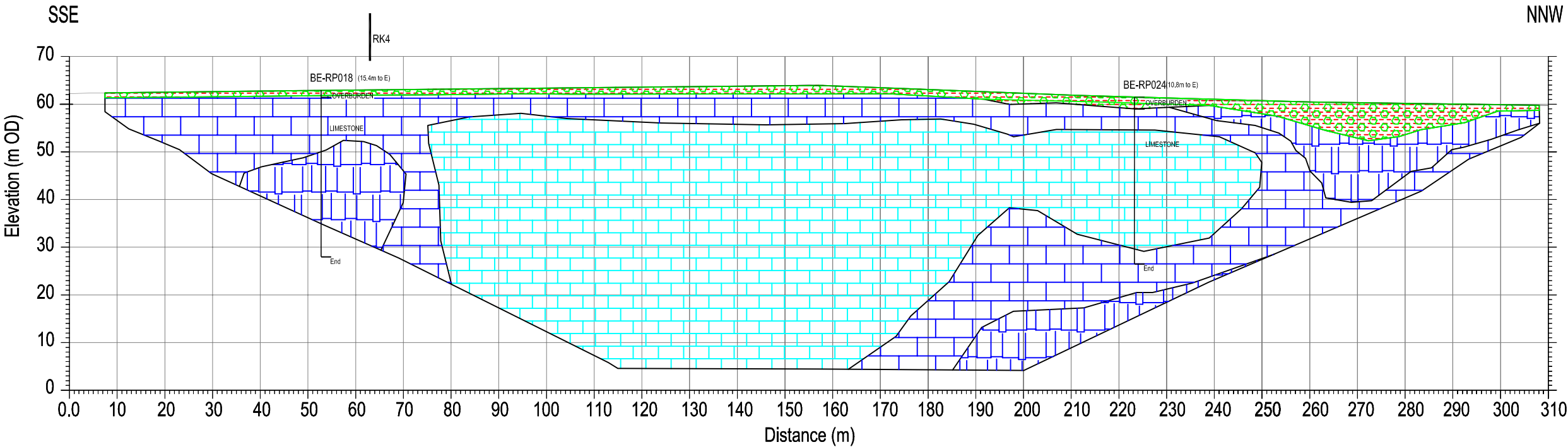
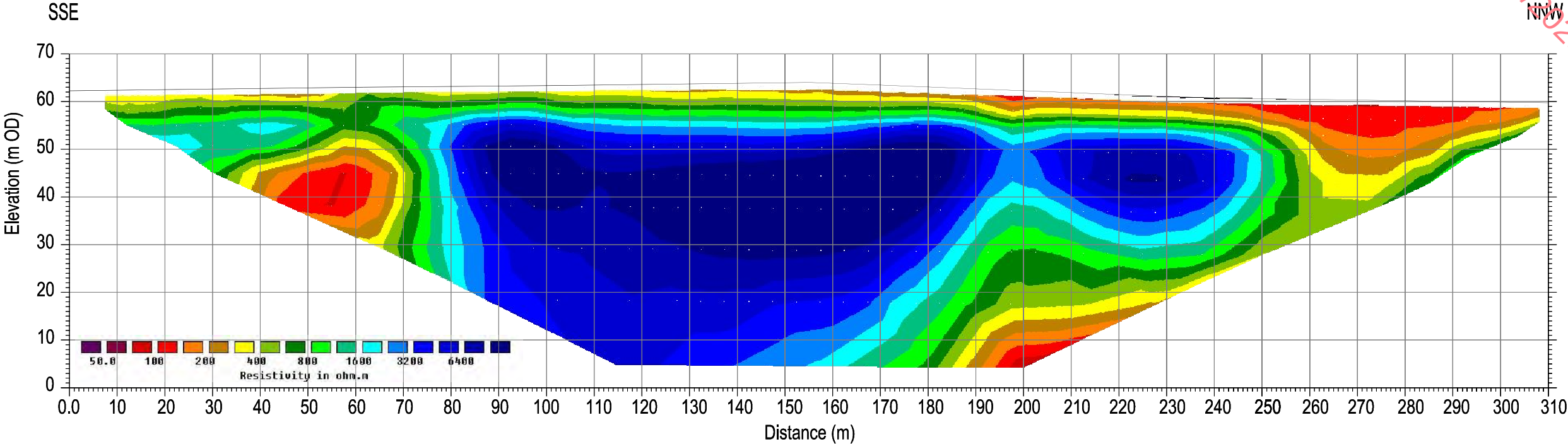
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DATE: 20/04/2018

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2	25/05/18	MF	KG
3	05/06/18	MF	TL

FIGURE 6: ERT PROFILE
SCALE 1:1000

INVERSE MODEL RESISTIVITY - 2DRES PROFILE ERT4



- LEGEND:
- Gravelly Clay Overburden
 - Highly weathered/Fractured Limestone with clay filled fissures
 - Moderately weathered/argillaceous Limestone with some clay filled fissures
 - Clean Limestone with few clay filled fissures
 - Rotary percussive borehole (2018)

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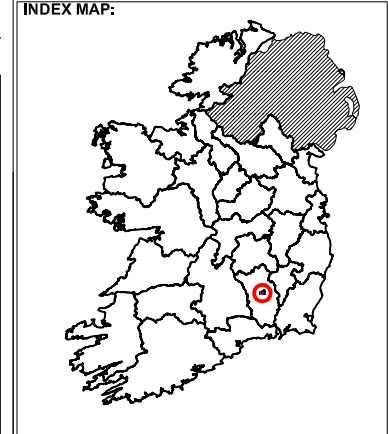
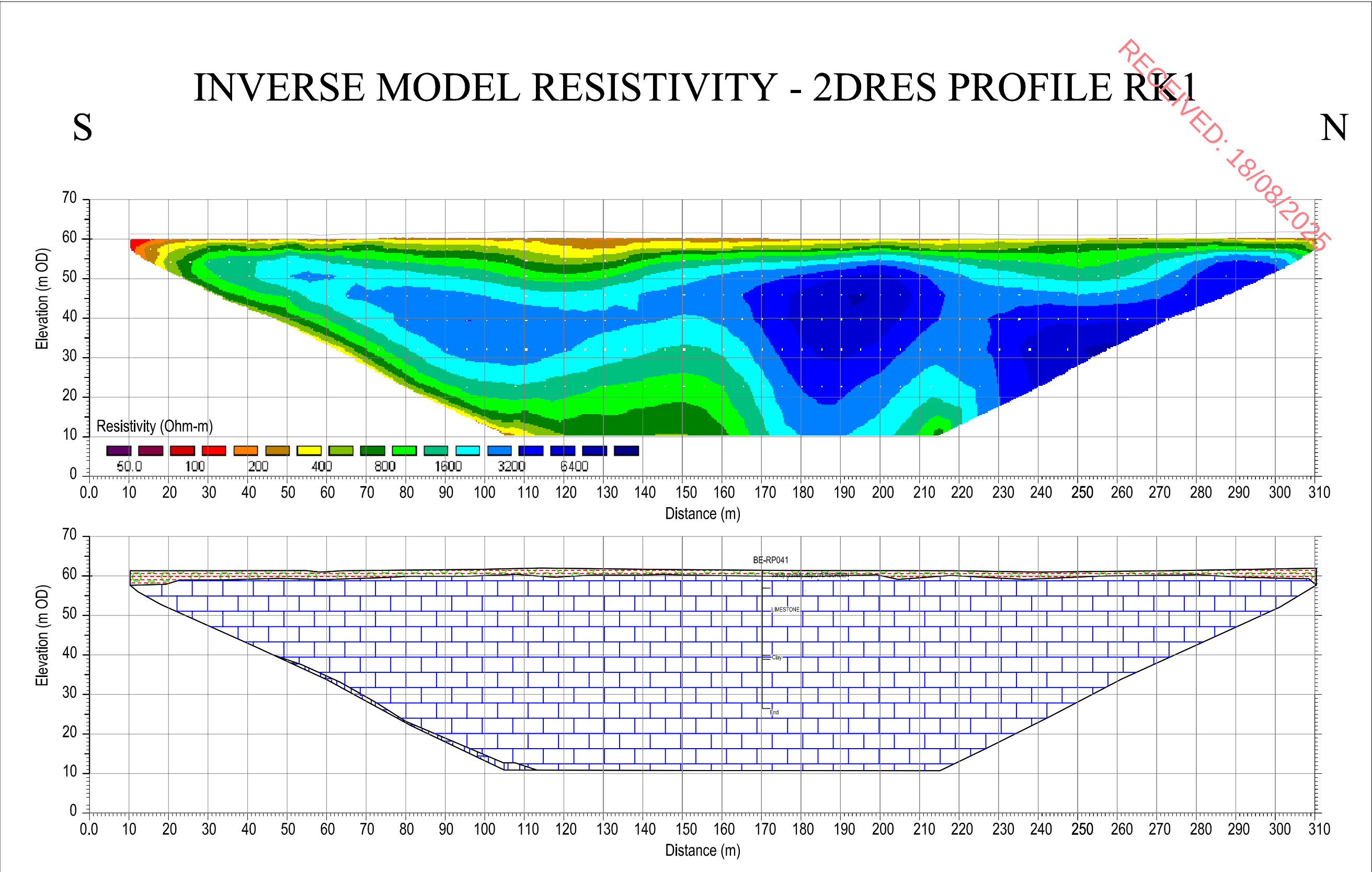
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CLIENT: BENNETTSBRIDGE QUARRIES LIMITED
DRAWING NO: AGL18010_17
SCALE: AS INDICATED @ A3
DATE: 20/04/2018

Version:	Date:	Drawn By:	Checked:
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2	25/05/18	MF	KG
3	05/06/18	MF	TL

FIGURE 7: ERT PROFILE
SCALE 1:1000



LEGEND:

- Gravelly Clay Overburden
- Highly weathered/Fractured Limestone with clay filled fissures
- Moderately weathered/argillaceous Limestone with some clay filled fissures
- Clean Limestone with few clay filled fissures
- Rotary percussive borehole (2018)

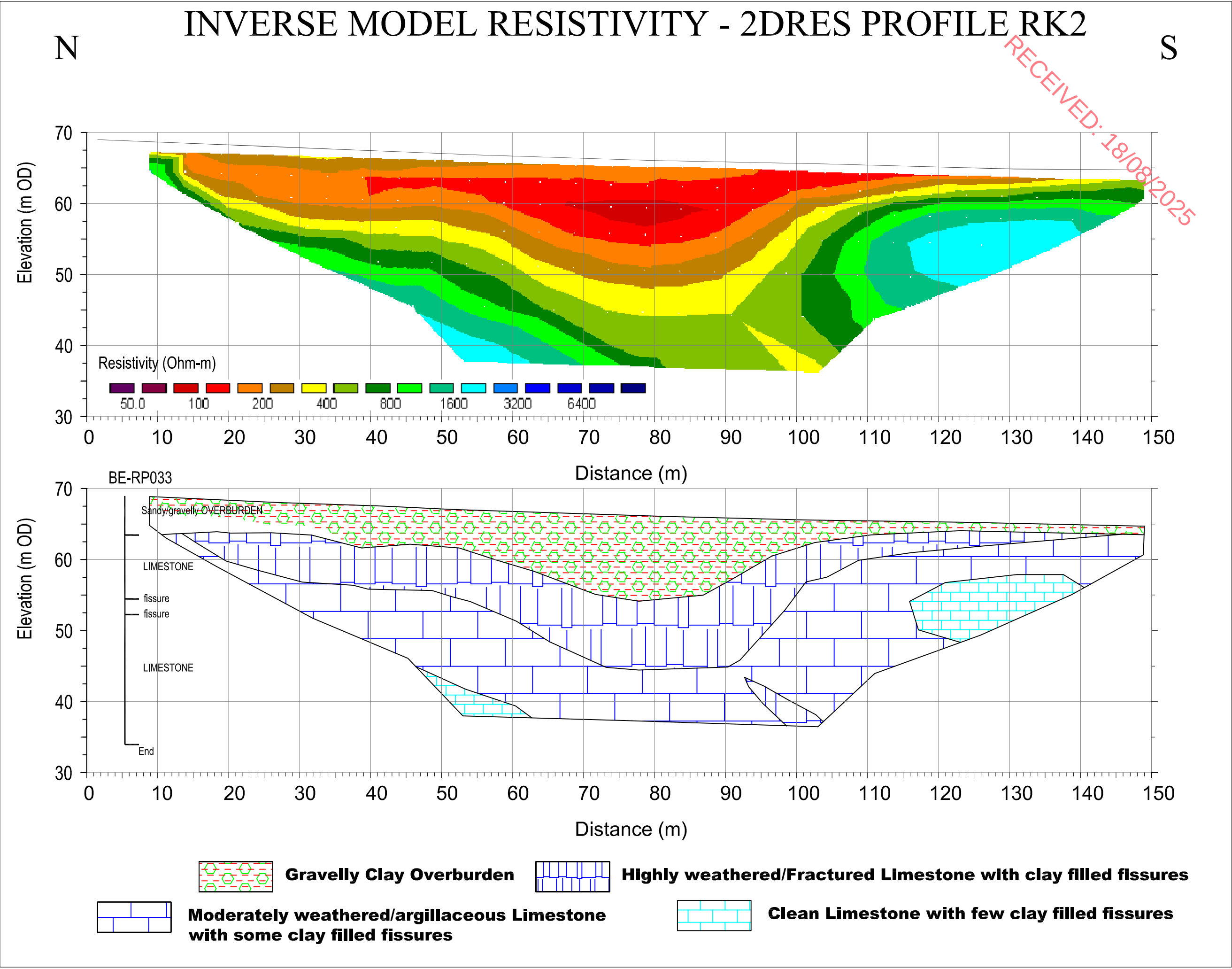
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PROJECT: BENNETTSBRIDGE QUARRY EXTENSION GEOPHYSICAL SURVEY			
CLIENT: BENNETTSBRIDGE QUARRIES LIMITED			
DRAWING NO: AGL18010_18			
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DATE: 20/04/2018			
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3	05/06/18	MF	TL

FIGURE 8: ERT PROFILE
SCALE 1:500



INDEX MAP:

LEGEND:

- Gravelly Clay Overburden
- Highly weathered/Fractured Limestone with clay filled fissures
- Moderately weathered/argillaceous Limestone with some clay filled fissures
- Clean Limestone with few clay filled fissures
- Rotary percussive borehole (2018)

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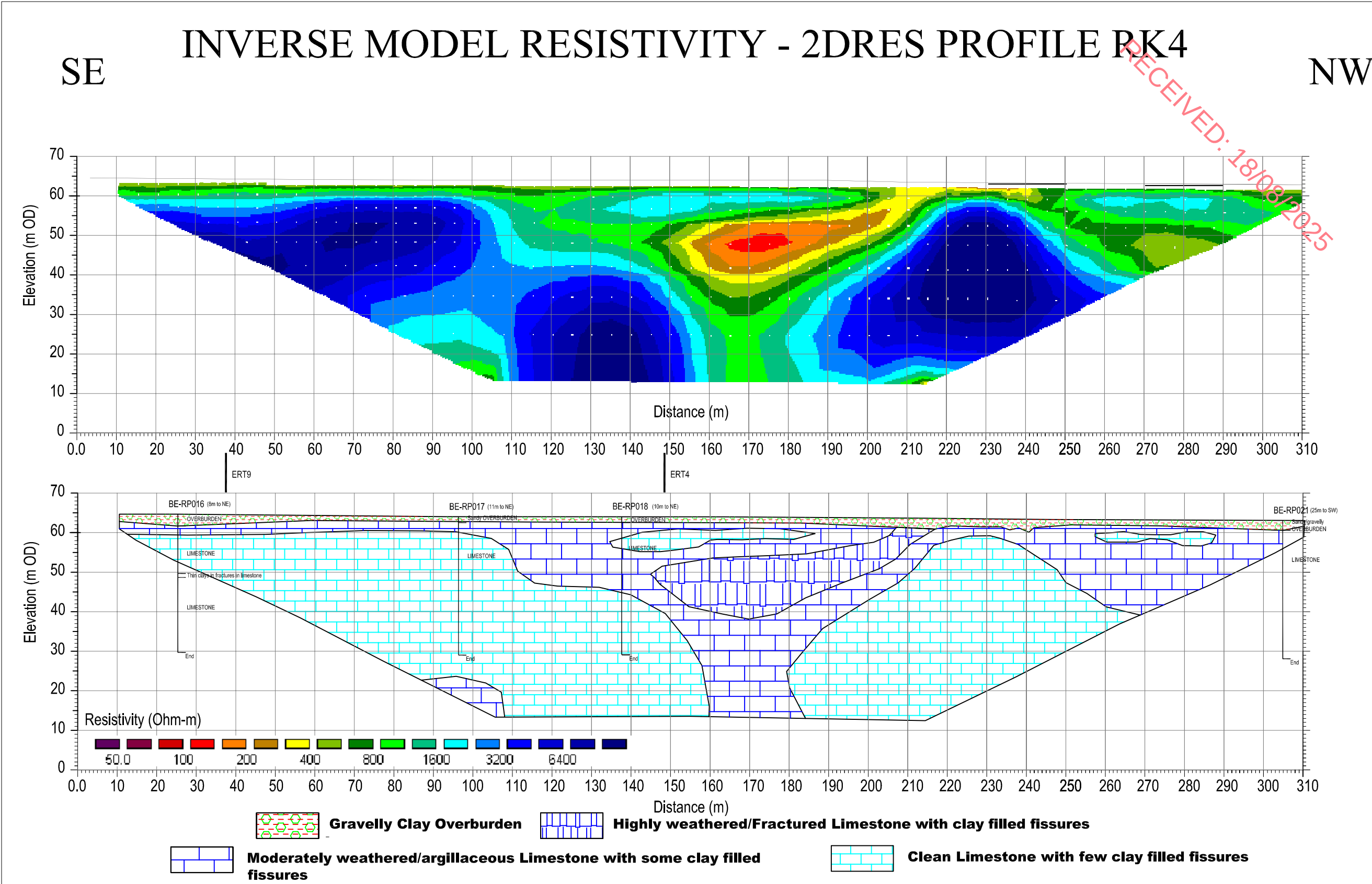
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PROJECT: BENNETTSBRIDGE QUARRY EXTENSION
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DRAWING NO.: AGL18010_19
SCALE: AS INDICATED @ A3
DATE: 20/04/2018

Version:	Date:	Drawn By:	Checked:
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FIGURE 9: ERT PROFILE
SCALE 1:1000



INDEX MAP:

LEGEND:

- Gravelly Clay Overburden
- Highly weathered/Fractured Limestone with clay filled fissures
- Moderately weathered/argillaceous Limestone with some clay filled fissures
- Clean Limestone with few clay filled fissures
- Rotary percussive borehole (2018)

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PROJECT: BENNETTSBRIDGE QUARRY EXTENSION
GEOPHYSICAL SURVEY

CLIENT: BENNETTSBRIDGE QUARRIES LIMITED

DRAWING NO: AGL18010_20

SCALE: AS INDICATED @ A3

DATE: 20/04/2018

Version:	Date:	Drawn By:	Checked:
1	20/04/18	KG	KG
2	25/05/18	MF	KG
3	05/06/18	MF	TL