Appendix A.5.1.3

Phase 2 Contract 1

N6 Galway City Transport Project Phase 2 Ground Investigation Contract 1,

October 2015 to November 2015

A.5.1.3

Appendix 4

Geophysical Survey Report

(APEX Report AGL15188_02)

AGL15188_02

REPORT ON THE GEOPHYSICAL SURVEY FOR THE N6 GALWAY CITY TRANSPORT PROJECT, PHASE 2, CONTRACT 1

FOR

ARUP CONSULTING ENGINEERS

23RD NOVEMBER 2015

APEX Geoservices Limited
Unit 6 Knockmullen Business Pk.,
Gorey,
Co. Wexford, Ireland

T: 0402 21842
F: 0402 21843
E: info@apexgeoservices.ie
W: www.apexgeoservices.com

PRIVATE AND CONFIDENTIAL

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	AGL15188		
AUTHOR	**CHECKED**	**REPORT STATUS**	**DATE**
EURGEOL YVONNE O'CONNELL P.GEO., M.SC (GEOPHYSICS)	EURGEOL SHANE O'ROURKE P.GEO., M.SC (GEOPHYSICS)	V.01	9TH OCTOBER 2015
EURGEOL YVONNE O'CONNELL P.GEO., M.SC (GEOPHYSICS)	EURGEOL SHANE O'ROURKE P.GEO., M.SC (GEOPHYSICS)	V.02	23RD NOVEMBER 2015

Table of Contents

1. EXECUTIVE SUMMARY

APEX Geoservices Limited was requested IGSL on behalf of ARUP to carry out a geophysical investigation as part of the proposed ground investigation program for the N6 Galway City Transport Project – Phase 2 Ground Investigation Contract 1.

Four rotary core boreholes (RC-2-01 to RC-2-04) were drilled after completion of the geophysical survey and this report has been revised to include their findings.

The objectives of the survey were to: determine the ground conditions, including the thickness of each strata, determine depth to bedrock and to identify any anomalies in the rock formation.

The investigation consisted of 2D Electrical Resistivity Tomography and Seismic Refraction Profiling, carried out along six sections at Galway Racecourse.

The geophysical data predominantly indicated three subsurface layers:

1. A thin (average 1.2m) upper overburden layer comprising of firm to stiff sandy gravelly silt/clay or medium dense to dense silty clayey sand/gravel.

2. An underlying layer (average thickness of 3.6m) of stiff to very stiff sandy gravelly silt/clay or dense to very dense silty clayey sand/gravel. On Section 1 in the west, this layer has been interpreted as wholly comprising moderately weathered limestone. On Section 2, resistivity values suggest that the base of this layer comprises some moderately weathered limestone. On Sections 3, 4, 5 and 6 it is likely that the base of this layer also comprises some moderately weathered limestone as is suggested by rotary cores RC02/03 and RC02/04. The seismic velocities, coupled with the limestone type, suggest that any excavation of the moderately weathered limestone will require very difficult ripping and/or breaking.

3. Slightly weathered to fresh limestone bedrock has been interpreted at an average depth of 4.8m below ground level. The geophysical data indicate predominantly good quality, clean limestone that will require breaking/blasting.

To the southwest of Section 1, a karst feature or palaeo-channel that has been in-filled with very stiff to hard sandy gravelly silt/clay has been observed.

In addition, two zones of low bedrock resistivity have been recorded at depths greater than 27m below ground level on Sections 1 and 2 suggesting possible karstification of limestone.

Additional coring (PBH1 and PBH2) is recommended at the locations indicated on the drawings and listed below to examine specific features indicated by the geophysical survey:

Number	Easting	Northing
PBH1	533066.1	728005.5
PBH2	533327.7	728156.6

The geophysical interpretation and report should be reviewed following completion of the direct investigation.

2. INTRODUCTION

APEX Geoservices Limited was requested IGSL on behalf of ARUP to carry out a geophysical investigation as part of the proposed ground investigation program for the N6 Galway City Transport Project – Phase 2 Ground Investigation Contract 1. The site is located at Galway Racecourse in the east of the city and four rotary core boreholes (RC-2-01 to RC-2-04) have been cored as part of the Ground Investigation Contract 1.

2.1 Survey Objectives

The objectives of the survey were to:

- Determine the ground conditions, including the thickness of each strata;
- Determine depth to bedrock;
- Identify any anomalies in the rock formation.

2.2 Site Background

Surveying was proposed along six sections indicated in Figure 1 and listed below:

Section	Length (m)	Start Coordinates		End Coordinates	
		Easting	Northing	Easting	Northing
1	426	533058.4431	727986.4932	533320.8618	728321.8848
2	416	533610.5172	728110.2223	533202.5153	728176.0736
3	175	533602.6586	728101.9053	533763.4426	728033.1504
4	180	533760.7249	728037.285	533917.5386	727949.7565
5	87	533882.0583	727948.0468	533959.9158	727908.8439
6	114	533953.516	727904.5424	534032.0587	727822.1889

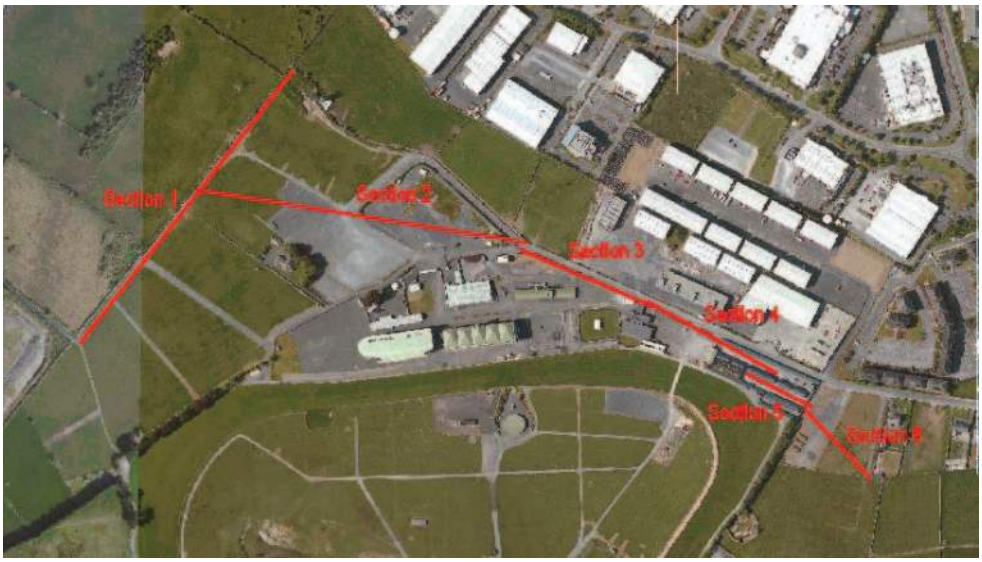


Figure 1: Survey locations indicated by red lines.

The GSI 1:100k Bedrock Geology map for the area indicates that the site is underlain by Visean undifferentiated limestone. This limestone is known to be susceptible to karstification and some nearby karst features are indicated in the GSI open file data. These include two swallow holes and a cave approximately 1.25km southwest of Section 1 and voids recorded in boreholes to the northeast. Karst may be defined as the whole or partial dissolution of limestone bedrock by the action of water and the subsequent whole or partial infill with overburden material. The Teagasc soils map for the area indicates that the subsoils comprise till derived chiefly from limestones.

2.3 Site Investigation

Four rotary cores drilled subsequent to the geophysical survey encountered sandy gravelly clay over fresh to moderately weathered limestone bedrock at depths from 1.5 m to 6 m below ground level. Their locations are indicated on Drawing AGL15228_01.

2.4 Survey Rationale

A geophysical survey was proposed comprising Electrical Resistivity Tomography and Seismic Refraction Profiling:

Electrical Resistivity Tomography (ERT) images the resistivity of the materials in the subsurface along a profile to produce a pseudo-section showing the variation in resistivity to depths dependent on the length of the profile. Each pseudo-section is interpreted to determine the material type along the profile based on the typical resistivities returned for Irish ground materials. Karst zones are indicated by areas of low resistivity indicative of clay infill. Air-filled voids typically have very high resistivities.

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 profiles the depth to the top of the bedrock. Steep changes in bedrock topography can be indicative of karstic topography.

3. RESULTS & INTERPRETATION

The geophysical survey locations are indicated on Drawing AGL15228_01. The methodology for each technique is discussed in detail in Appendix A.

3.1 Electrical Resistivity Tomography

The ERT profiles are presented on Drawings AGL15188_02 to AGL15188_09. Profiling was carried out on Sections 1, 2 and on 6. ERT was attempted on Sections 3 and 4 but, apart from one 40m section, was adversely affected by underground services and/or concrete. ERT was not attempted on Section 5.

The recorded resistivity values have been broadly interpreted on the following basis:

Apparent Resistivity (ohm-m)	Interpretation
100-250	Sandy Gravelly SILT/CLAY
250-550	Silty/clayey SAND/GRAVEL
550-1000	SAND/GRAVEL
550-1000	Weathered Limestone Bedrock
400-3200	Limestone Bedrock

3.2 Seismic Refraction Profiling

The seismic refraction profiles are presented on Drawings AGL15188_02 to AGL15188_09 and the data is tabulated in Appendix C. The seismic data indicates three velocity layers, with the exception of S7 recorded in the southwest of Section 1, which indicated four velocity layers. The seismic velocities have been broadly interpreted on the following basis:

Layer	Seismic Velocity (m/s)	Average Seismic Velocity (m/s)	Average Thickness (m)	Interpretation	Stiffness/ Rock Quality
1	214-1143	541	1.2	Overburden	Firm-stiff/ Medium dense-dense
2	881-2400	1519	3.6	Overburden	Stiff-very stiff/ Dense- very dense
				Weathered/ Fractured Bedrock	Poor-Fair
3	2100-2197	2144		Overburden	Very stiff-Hard
4	2697-5213	3994		Weathered-Fresh Bedrock	Good

3.3 Discussion

Interpreted geophysical sections are presented on Drawings AGL15188_02 to AGL15188_07. The combined interpretation can be summarised as follows:

Layer	Seismic Velocity (m/s)	Average Velocity (m/s)	Apparent Resistivity (ohm-m)	Average Thickness (m)	Interpretation	Estimated Stiffness/ Rock Quality	Excavatability/ Rippability
1	214-1143	541	100-250	1.2	Sandy Gravelly SILT/CLAY	Firm-Stiff	Diggable
			250-550		Silty/clayey SAND/GRAVEL	Medium dense-dense	
2	881-2400	1519	100-250	3.6	Sandy Gravelly SILT/CLAY	Stiff-Very stiff	Diggable
			250-550		Silty/clayey SAND/GRAVEL	Dense- very dense	
			550-2000		Moderately Weathered Limestone Bedrock	Poor-Fair	Very difficult ripping/Break
3	2100-2197	2144	100-250		Sandy Gravelly SILT/CLAY	Very stiff-Hard	Diggable
4	2697-5213	3994	550-8000		Moderately Weathered Limestone Bedrock	Good	Break/Blast

Layer 1: The geophysical data indicate a thin (average 1.2m) upper overburden layer across the site comprising of firm to stiff sandy gravelly silt/clay or medium dense to dense silty clayey sand/gravel.

Layer 2: The underlying layer has an average thickness of 3.6m and has been interpreted as stiff to very stiff sandy gravelly silt/clay or dense to very dense silty clayey sand/gravel.

On Section 1 in the west, high resistivity values suggest that this layer wholly comprises moderately weathered limestone. The seismic velocities, coupled with the limestone type, suggest that excavation of the moderately weathered limestone will require very difficult ripping and/or breaking.

On Section 2, resistivity values suggest that the base of this layer comprises some moderately weathered limestone. On Sections 3, 4, 5 and 6 it is likely that the base of this layer also comprises some moderately weathered limestone as is suggested by rotary cores RC02/03 and RC02/04. The seismic velocities, coupled with the limestone type, suggest that excavation of the moderately weathered limestone will require very difficult ripping and/or breaking.

Layer 3: This layer has only been observed to the southwest of Section 1 and has been interpreted as indicating a karst feature or palaeo-channel that has been in-filled with very stiff to hard sandy gravelly silt/clay.

Layer 4: This layer has been interpreted as indicating slightly weathered to fresh limestone bedrock. With the exception of the southwest of Section 1, the bedrock topography appears only slightly undulating at an average depth of 4.8m below ground level. Both velocity and resistivity values for the limestone are high, indicating good quality limestone in agreement with the rotary cores, that will require breaking/blasting.

Two zones of low bedrock resistivity have been recorded at depths from 27m below ground level on Sections 1 and 2 (Drawings AGL15188_02 and AGL15188_04) suggesting possible karstification of limestone.

4. RECOMMENDATIONS

Additional coring (PBH1 and PBH2) is recommended at the locations indicated on the drawings and listed below to examine specific features indicated by the geophysical survey:

Number	Easting	Northing
PBH1	533066.1	728005.5
PBH2	533327.7	728156.6

The geophysical interpretation and report should be reviewed following completion of any further 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.

Hagedoorn, J.G., 1959;

'The plus - minus method of interpreting seismic refraction sections', Geophysical Prospecting, 7, 158 - 182.

Palmer, D., 1980;

'The Generalized Reciprocal Method of seismic refraction interpretation', SEG.

Redpath, B.B., 1973;

'Seismic refraction exploration for engineering site investigations', NTIS, U.S. Dept. of Commerce

Soske, J.L., 1959;

'The blind zone problem in engineering geophysics', Geophysics, 24, pp 359-365.

6. APPENDIX A: DETAILED METHODOLOGY

6.1 Electrical Resistivity Tomography

Principles

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

Data Collection

Profiles were recorded using an ABEM meter, imaging software, three 32 takeout multicore cables and 96 stainless steel electrodes with a 3m or 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 29th and 30th September 2015.

Data Processing

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.

Relocation

All data were referenced using a differential GPS system with c.20mm accuracy.

6.2 Seismic Refraction Profiling

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.

Data Collection

Nineteen seismic spreads were recorded on the 24th and 25th September 2015 using a Geode high-resolution 24 channel digital seismograph with geophone spacing of 2m and 3m. The source of the seismic waves was a sledgehammer.

Data Processing

The recorded data was interpreted using the ray-tracing and intercept time methods, to acquire depths to layer boundaries and the P-wave velocities of these layers, using the FIRSTPIX and GREMIX programs.

GREMIX interprets seismic refraction data as a laterally varying layered earth structure. It incorporates the slope-intercept method, parts of the Plus-Minus Method of Hagedoorn (1959), Time-Delay Method, and features the Generalized Reciprocal Method (GRM) of Palmer (1980). Up to four layers can be mapped, one deduced from direct arrivals and three deduced from refractions. Phantoming of all possible travel time pairs can be carried out by adjusting reciprocal times of off shots.

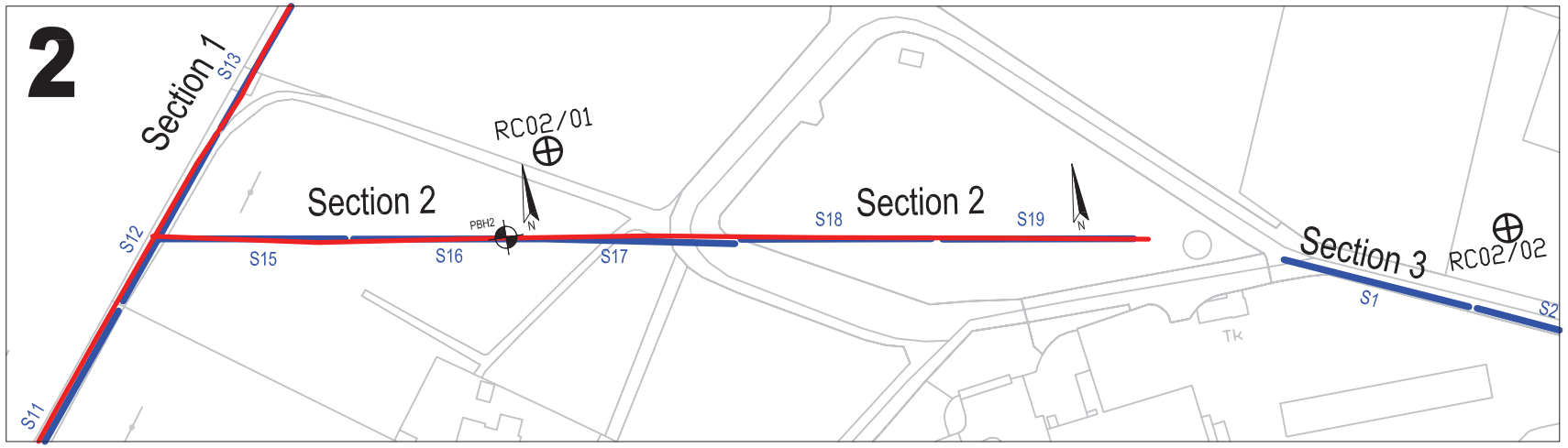
Relocation

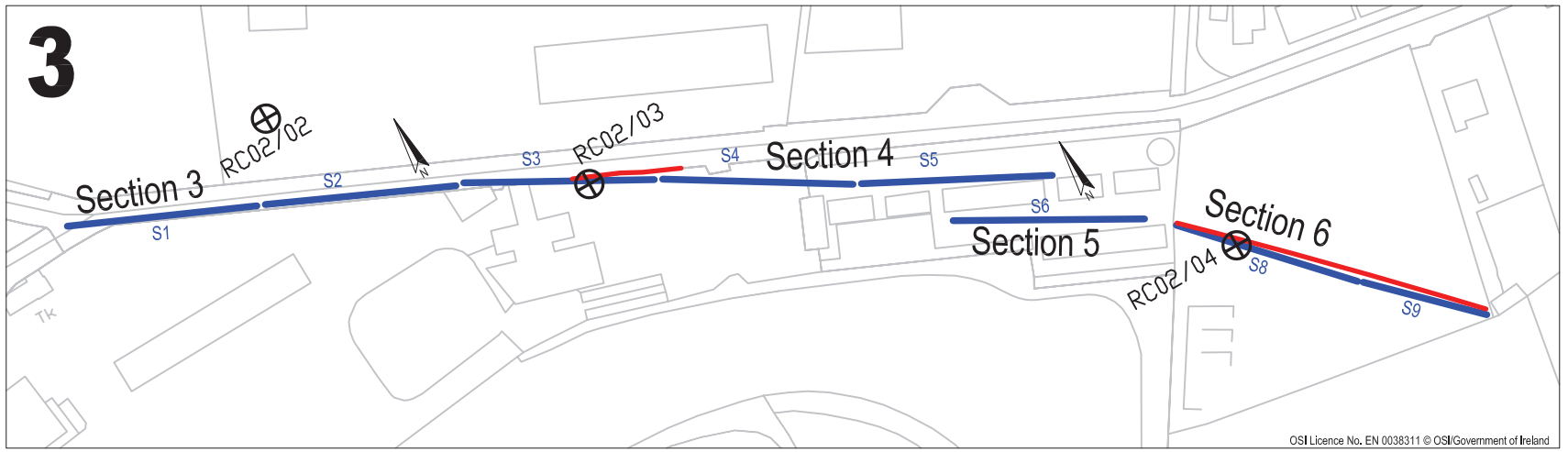
All data were referenced using a differential GPS system with c.20mm accuracy.

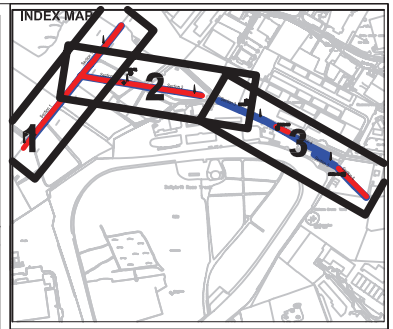
7. APPENDIX B: DRAWINGS

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

AGL15188_01	Overview Location Map	1:2500 @ A4
AGL15188_02	Section 1 (Part 1)	1:1250 @ A4
AGL15188_03	Section 1 (Part 2)	1:1250 @ A4
AGL15188_04	Section 2 (Part 1)	1:1250 @ A4
AGL15188_05	Section 2 (Part 2)	1:1250 @ A4
AGL15188_06	Section 3	1:1250 @ A4
AGL15188_07	Section 4	1:1250 @ A4
AGL15188_08	Section 5	1:1250 @ A4
AGL15188_09	Section 6	1:1250 @ A4







LEGEND:

- R1 — Electrical Resistivity Tomography
- S1 — Seismic refraction profile
- RC02/01 — Rotary Cored Boreholes
- PBH1 — APEX Proposed borehole

apex geoservices

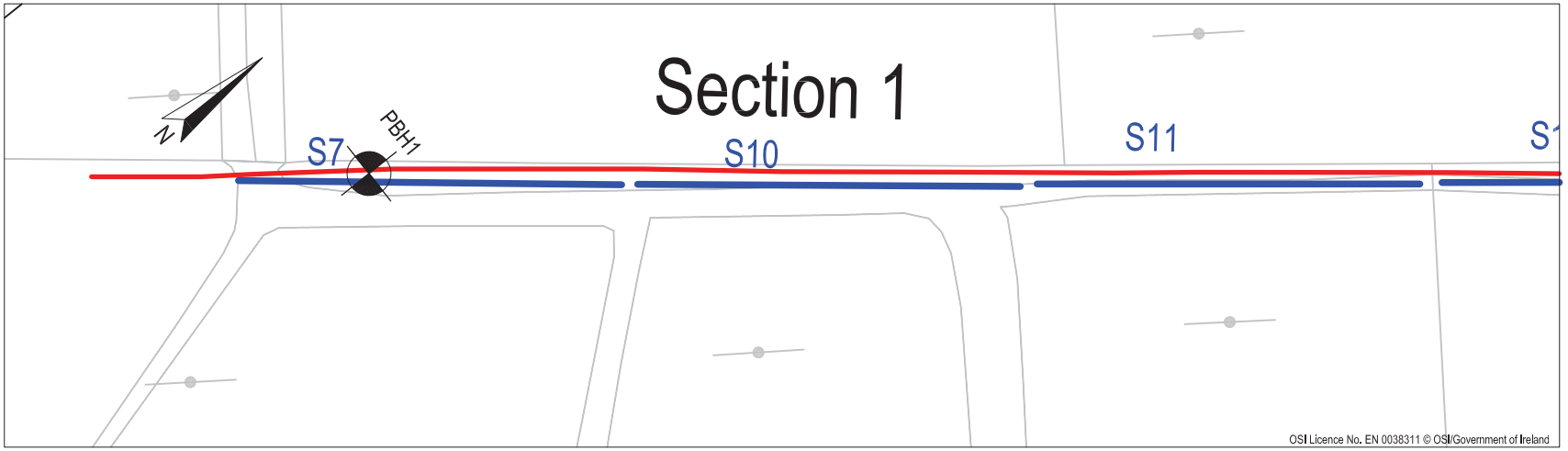
6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland,
T +353 (0)402-21842
F +353 (0)402-21843
E info@apexgeoservices.ie
www.apexgeoservices.ie

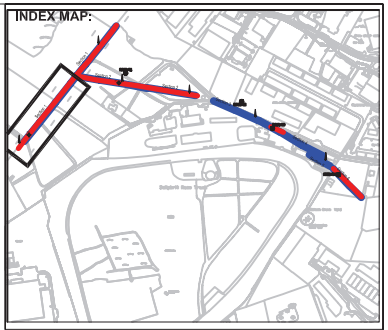
Regus House, Herald Way
Pegasus Business Park
Castle Donington
Derby DE74 2TZ
UK
T +44 (0)844 8700 692
E info@apexgeoservices.co.uk
www.apexgeoservices.co.uk

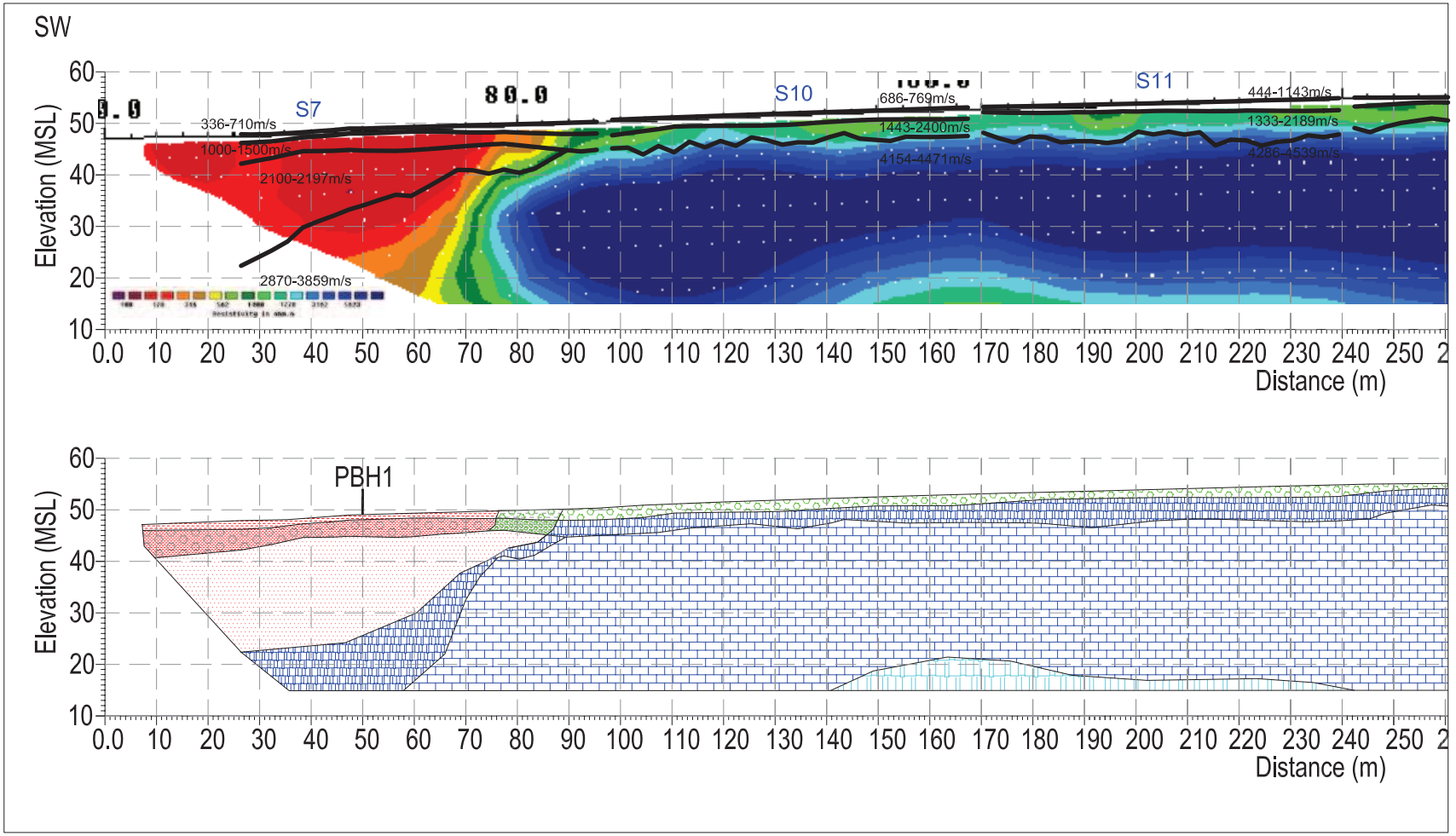
PROJECT:	N6 Galway City Transport Project, Phase 2 Geophysical Survey
DRAWING No.:	AGL15188_01
DATE:	09-10-2015
CLIENT:	ARUP
SCALE:	1:2500 @ A4

Version:	Date:	Drawn By:	Checked:
01	09-10-15	YOC	
02	23-11-15	YOC	

Section 1







LEGEND:

- R1 — Electrical Resistivity Tomography
- S1 — Seismic refraction profile
- RC02/01 — Rotary Cored Boreholes
- PBH1 — APEX Proposed borehole
- Firm-stiff sandy gravelly SILT/CLAY
- Stiff-very stiff sandy gravelly SILT/CLAY
- Very stiff-Hard sandy gravelly SILT/CLAY
- Medium dense-dense silty clayey SAND/GRAVEL
- Dense- very dense silty clayey SAND/GRAVEL
- Medium dense-dense SAND/GRAVEL
- Moderately weathered LIMESTONE
- Slightly Weathered to fresh LIMESTONE
- possible karstified LIMESTONE

apex geoservices

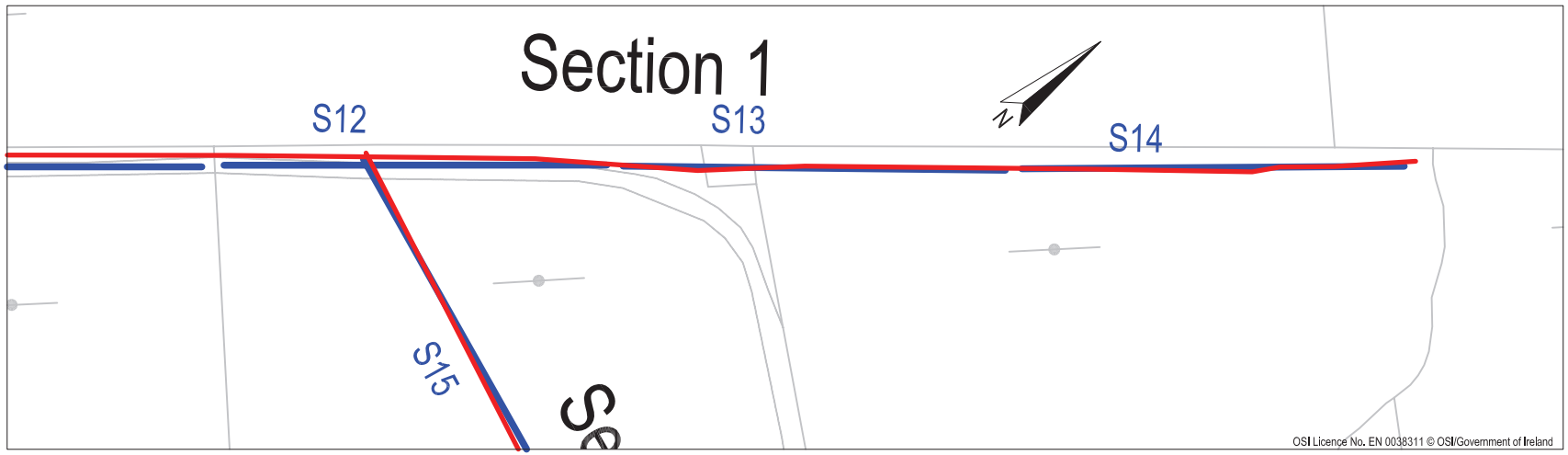
6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland.
T +353 (0)402-21842
F +353 (0)402-21843
E info@apexgeoservices.ie
www.apexgeoservices.ie

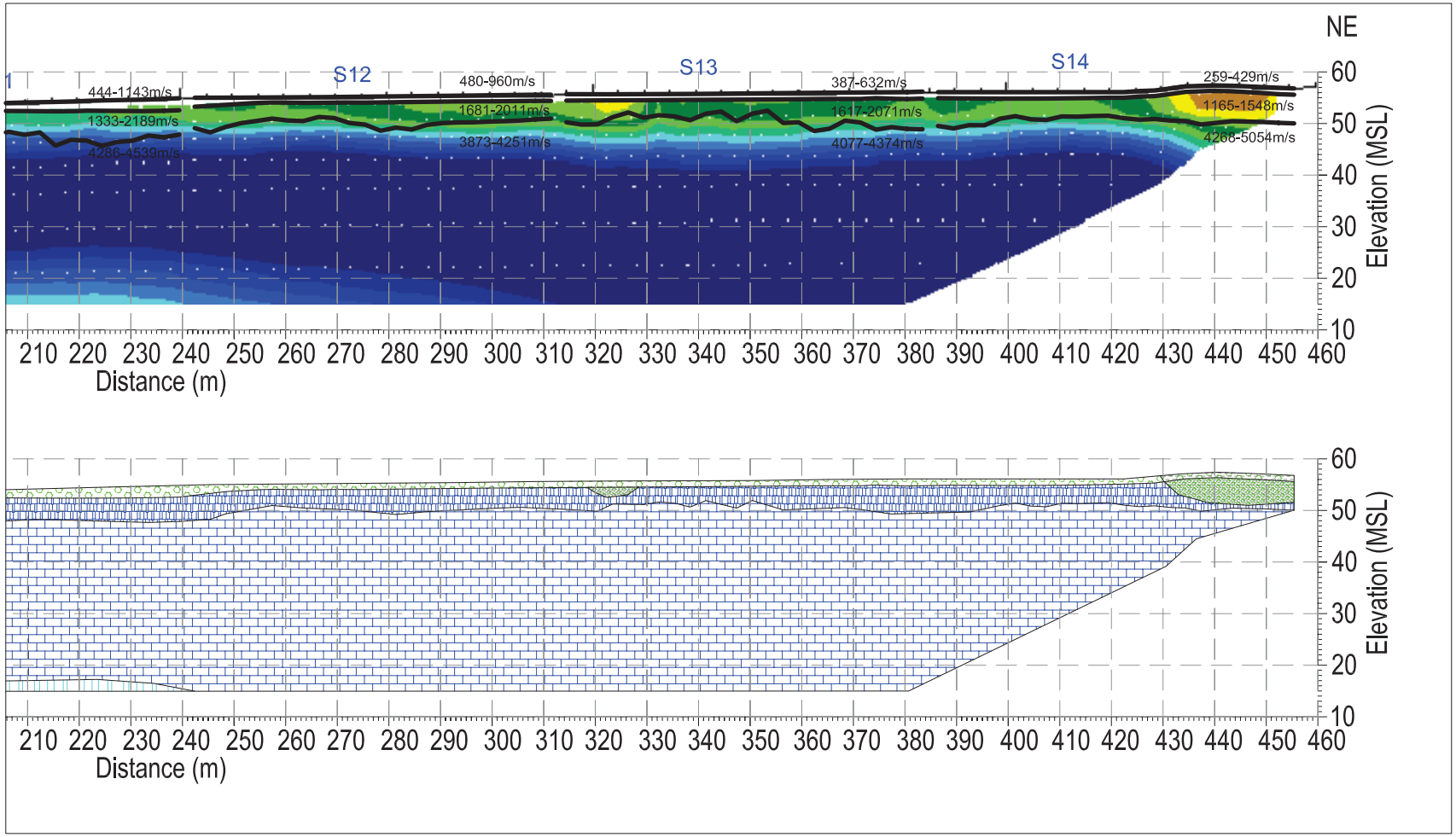
Regus House, Herald Way
Pegasus Business Park
Castle Donington
Derby DE74 2TZ
UK
T +44 (0)844 8700 692
E info@apexgeoservices.co.uk
www.apexgeoservices.co.uk

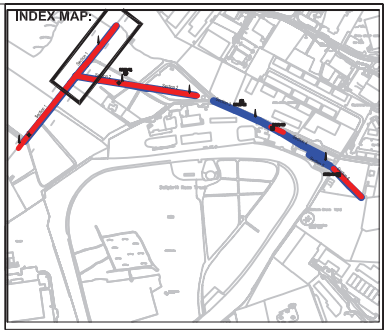
PROJECT:	N6 Galway City Transport Project, Phase 2 Geophysical Survey
DRAWING No.:	AGL15188_02
DATE:	09-10-2015
CLIENT:	ARUP
SCALE:	1:1250 @ A4

Version:	Date:	Drawn By:	Checked:
01	09-10-15	YOC	
02	23-11-15	YOC	

Section 1







LEGEND:

- R1 — Electrical Resistivity Tomography
- S1 — Seismic refraction profile
- RC02/01 — Rotary Cored Boreholes
- PBH1 — APEX Proposed borehole
- Firm-stiff sandy gravelly SILT/CLAY
- Stiff-very stiff sandy gravelly SILT/CLAY
- Very stiff-Hard sandy gravelly SILT/CLAY
- Medium dense-dense silty clayey SAND/GRAVEL
- Dense- very dense silty clayey SAND/GRAVEL
- Medium dense-dense SAND/GRAVEL
- Moderately weathered LIMESTONE
- Slightly Weathered to fresh LIMESTONE
- possible karstified LIMESTONE

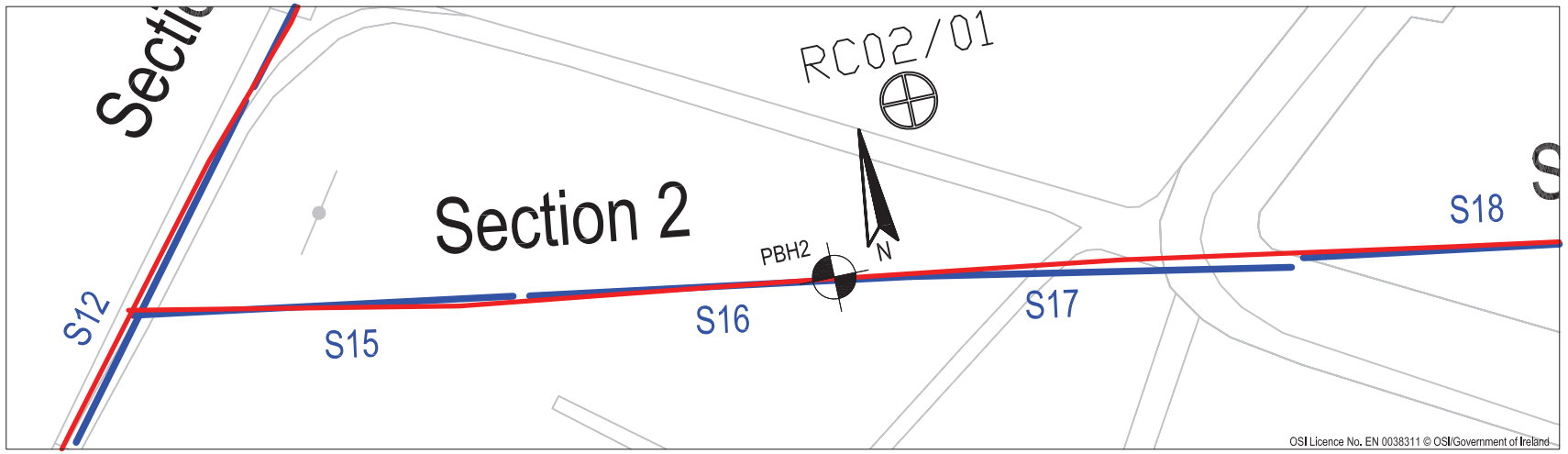
apex geoservices

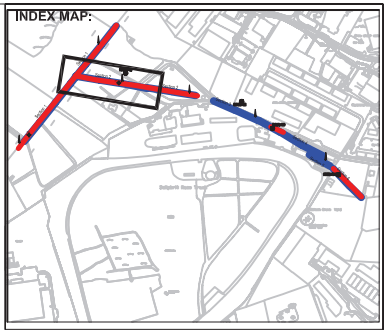
6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland.
T +353 (0)402-21842
F +353 (0)402-21843
E info@apexgeoservices.ie
www.apexgeoservices.ie

Regus House, Herald Way
Pegasus Business Park
Castle Donington
Derby DE74 2TZ
UK
T +44 (0)844 8700 692
E info@apexgeoservices.co.uk
www.apexgeoservices.co.uk

PROJECT:	N6 Galway City Transport Project, Phase 2 Geophysical Survey
DRAWING No.:	AGL15188_03
DATE:	09-10-2015
CLIENT:	ARUP
SCALE:	1:1250 @ A4

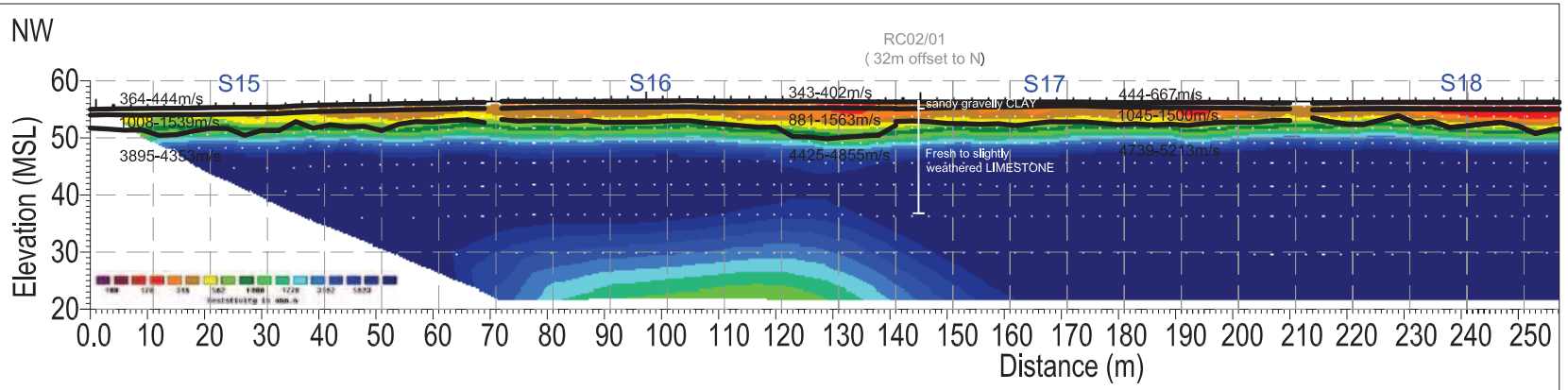
Version:	Date:	Drawn By:	Checked:
01	09-10-15	YOC	
02	23-11-15	YOC	

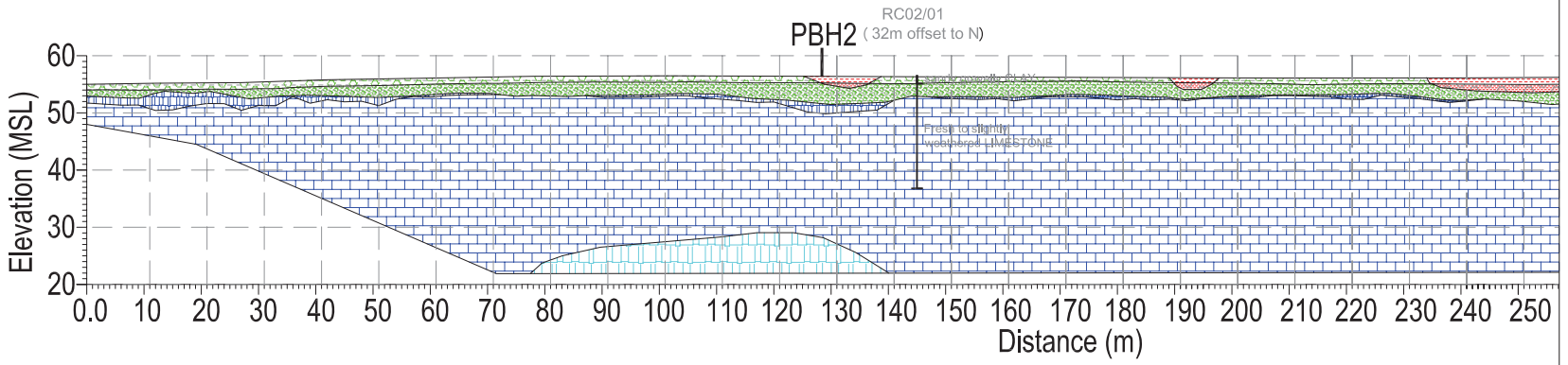




LEGEND:

- R1 — Electrical Resistivity Tomography
- S1 — Seismic refraction profile
- RC02/01 — Rotary Cored Boreholes
- PBH1 — APEX Proposed borehole
- Firm-stiff sandy gravelly SILT/CLAY
- Stiff-very stiff sandy gravelly SILT/CLAY
- Very stiff-Hard sandy gravelly SILT/CLAY
- Medium dense-dense silty clayey SAND/GRAVEL
- Dense- very dense silty clayey SAND/GRAVEL
- Medium dense-dense SAND/GRAVEL
- Moderately weathered LIMESTONE
- Slightly Weathered to fresh LIMESTONE
- possible karstified LIMESTONE





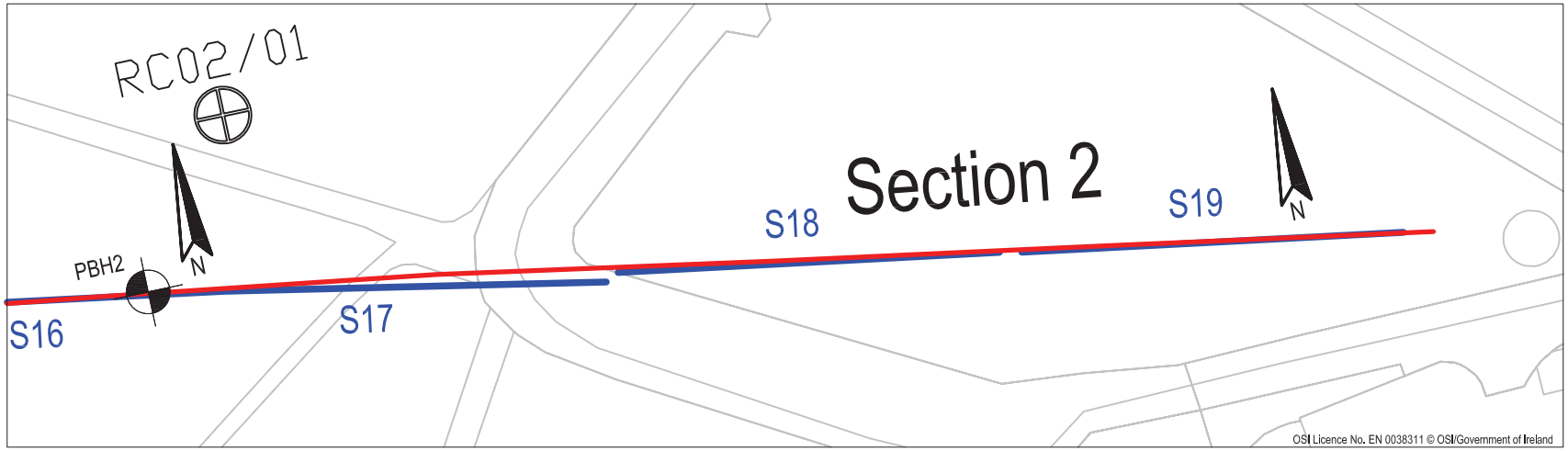
apex geoservices

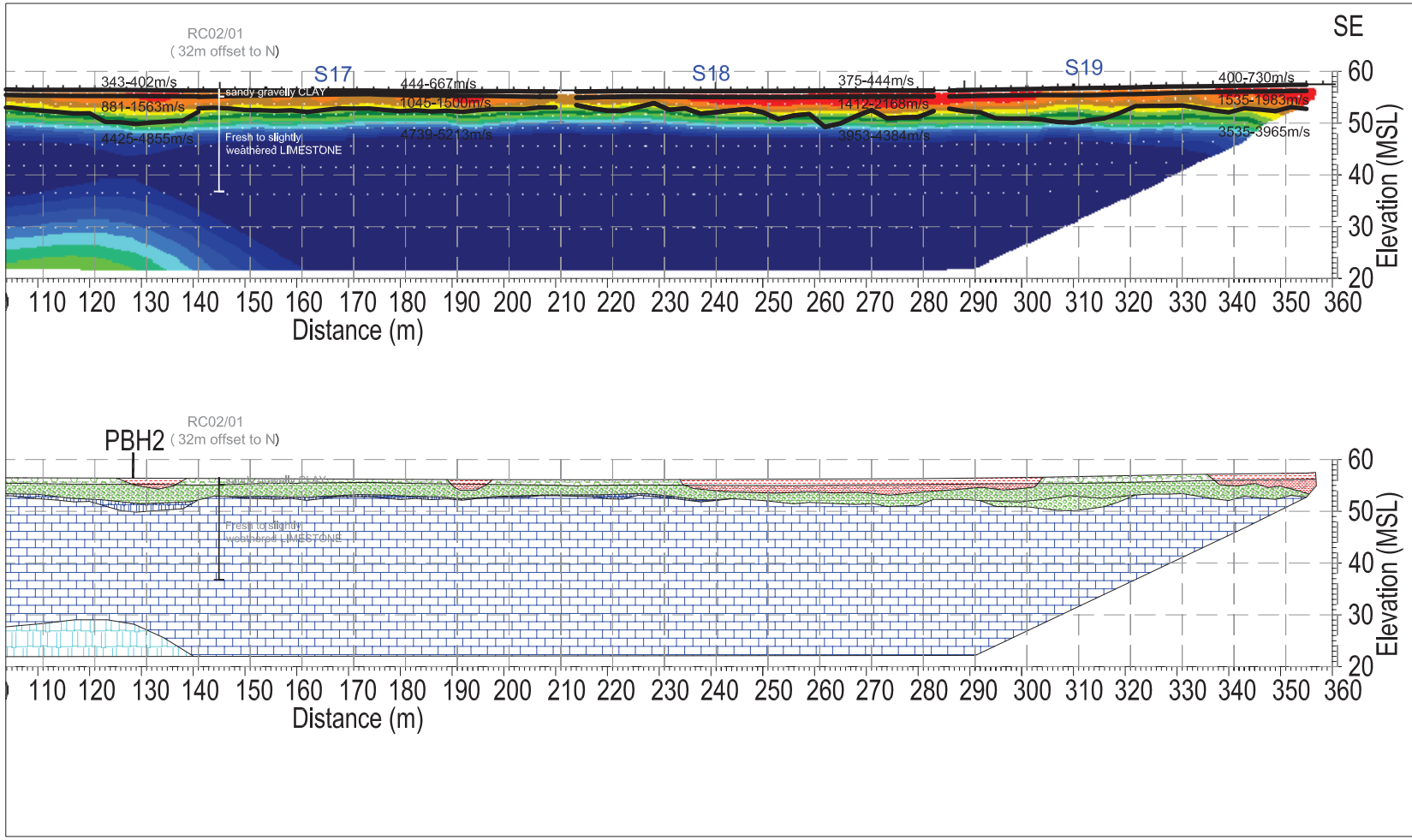
6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland.
T +353 (0)402-21842
F +353 (0)402-21843
E info@apexgeoservices.ie
www.apexgeoservices.ie

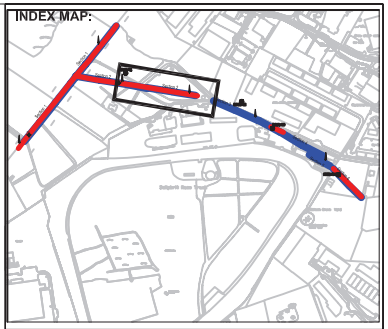
Regus House, Herald Way
Pegasus Business Park
Castle Donington
Derby DE74 2TZ
UK
T +44 (0)844 8700 692
E info@apexgeoservices.co.uk
www.apexgeoservices.co.uk

PROJECT:	N6 Galway City Transport Project, Phase 2 Geophysical Survey
DRAWING No.:	AGL15188_04
DATE:	09-10-2015
CLIENT:	ARUP
SCALE:	1:1250 @ A4

Version:	Date:	Drawn By:	Checked:
01	09-10-15	YOC	
02	23-11-15	YOC	







LEGEND:

- Electrical Resistivity Tomography (R1)
- Seismic refraction profile (S1)
- RC02/01 Rotary Cored Boreholes
- PBH1 APEX Proposed borehole
- Firm-stiff sandy gravelly SILT/CLAY
- Stiff-very stiff sandy gravelly SILT/CLAY
- Very stiff-Hard sandy gravelly SILT/CLAY
- Medium dense-dense silty clayey SAND/GRAVEL
- Dense- very dense silty clayey SAND/GRAVEL
- Medium dense-dense SAND/GRAVEL
- Moderately weathered LIMESTONE
- Slightly Weathered to fresh LIMESTONE
- possible karstified LIMESTONE

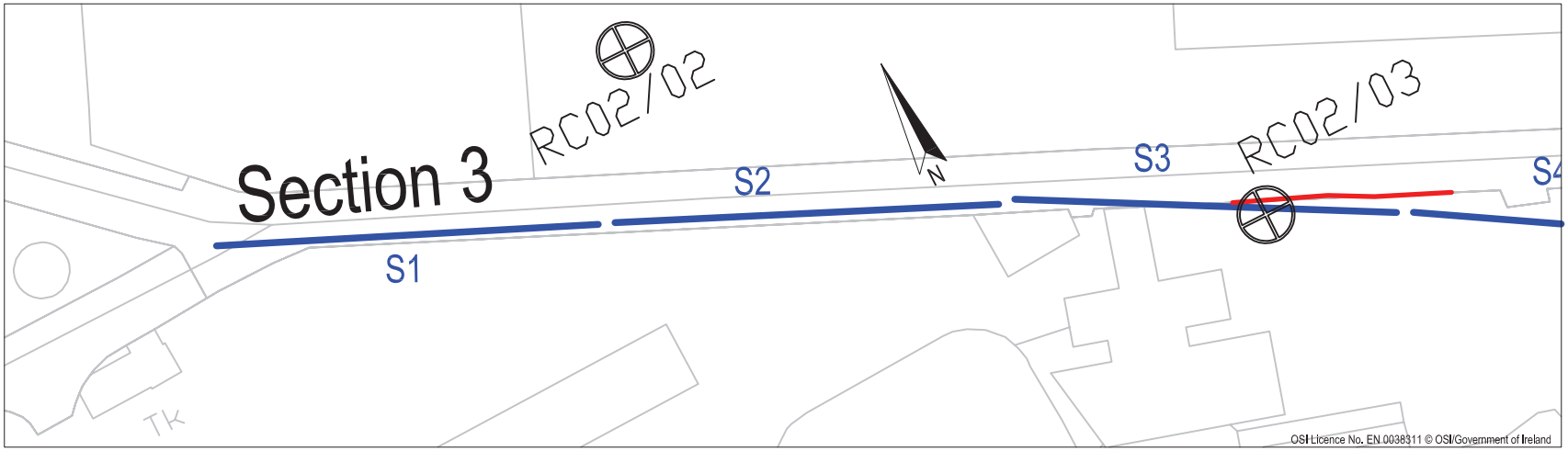
apex geoservices

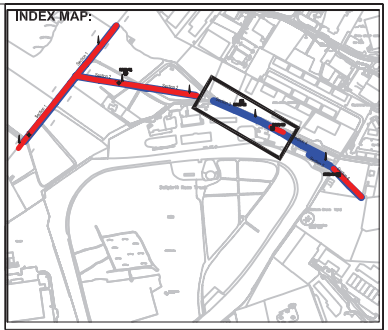
6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland.
T +353 (0)402-21842
F +353 (0)402-21843
E info@apexgeoservices.ie
www.apexgeoservices.ie

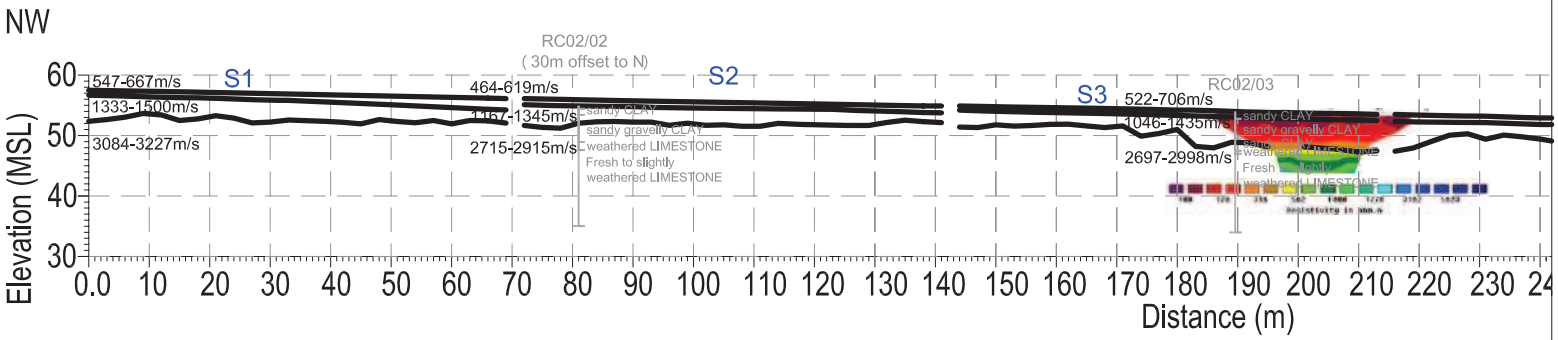
Regus House, Herald Way
Pegasus Business Park
Castle Donington
Derby DE74 2TZ
UK
T +44 (0)844 8700 692
E info@apexgeoservices.co.uk
www.apexgeoservices.co.uk

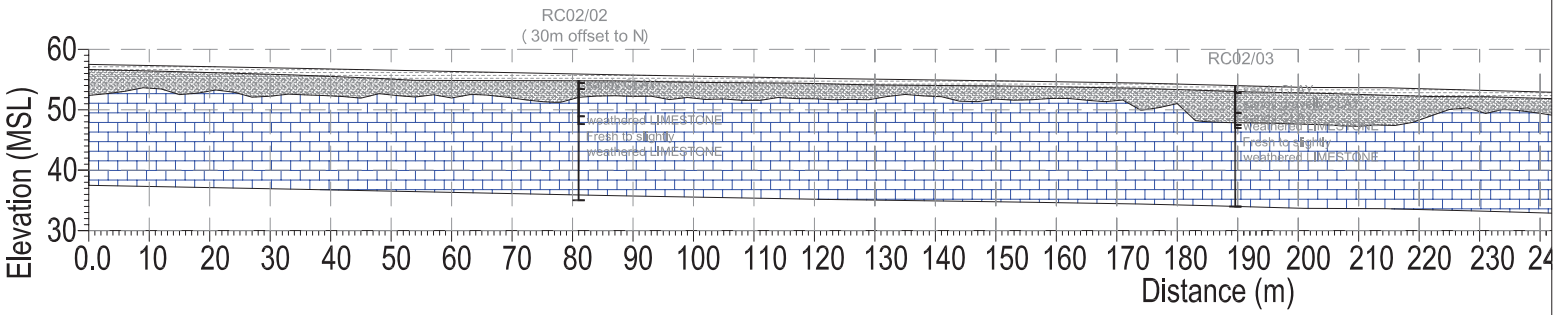
PROJECT:	N6 Galway City Transport Project, Phase 2 Geophysical Survey
DRAWING No.:	AGL15188_05
DATE:	09-10-2015
CLIENT:	ARUP
SCALE:	1:1250 @ A4

Version:	Date:	Drawn By:	Checked:
01	09-10-15	YOC	
02	23-11-15	YOC	









LEGEND:

- R1 — Electrical Resistivity Tomography
- S1 — Seismic refraction profile
- RC02/01 — Rotary Cored Boreholes
- PBH1 — APEX Proposed borehole
- Firm-stiff or medium dense to dense OVERBURDEN
- Stiff-very stiff or dense to very dense OVERBURDEN or moderately weathered BEDROCK
- Slight weathered to fresh BEDROCK

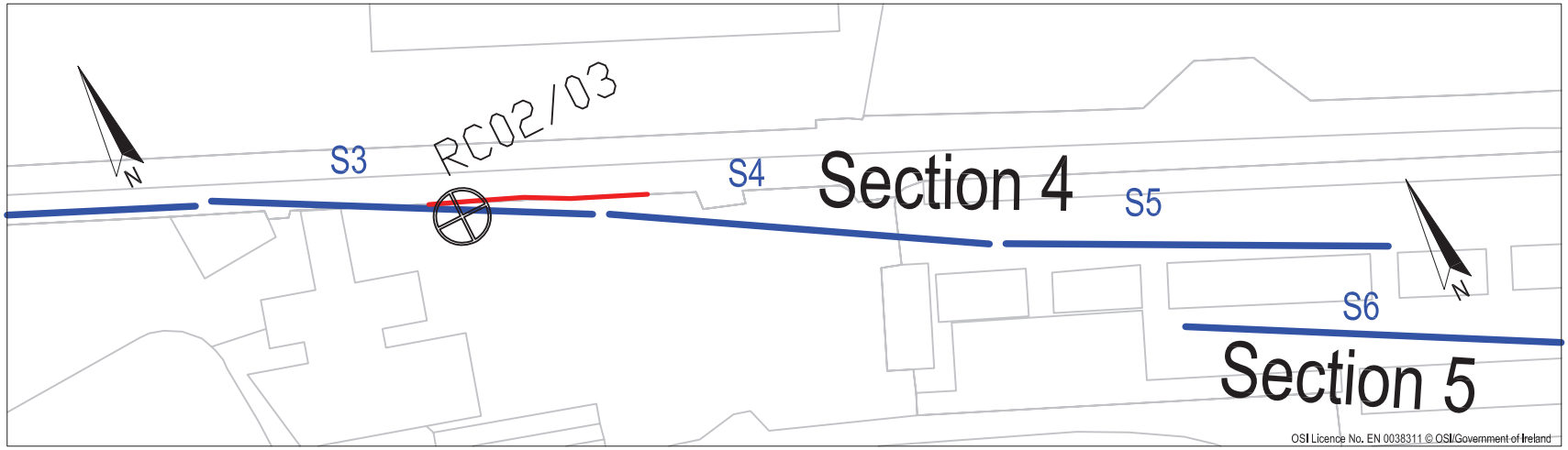
apex geoservices

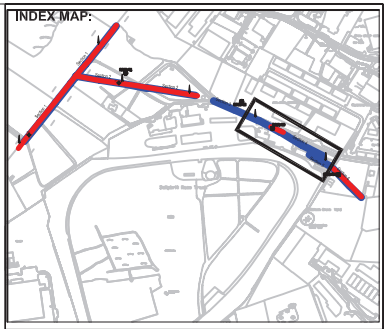
6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland.
T +353 (0)402-21842
F +353 (0)402-21843
E info@apexgeoservices.ie
www.apexgeoservices.ie

Regus House, Herald Way
Pegasus Business Park
Castle Donington
Derby DE74 2TZ
UK
T +44 (0)844 8700 692
E info@apexgeoservices.co.uk
www.apexgeoservices.co.uk

PROJECT:	N6 Galway City Transport Project, Phase 2 Geophysical Survey
DRAWING No.:	AGL15188_06
DATE:	09-10-2015
CLIENT:	ARUP
SCALE:	1:1250 @ A4

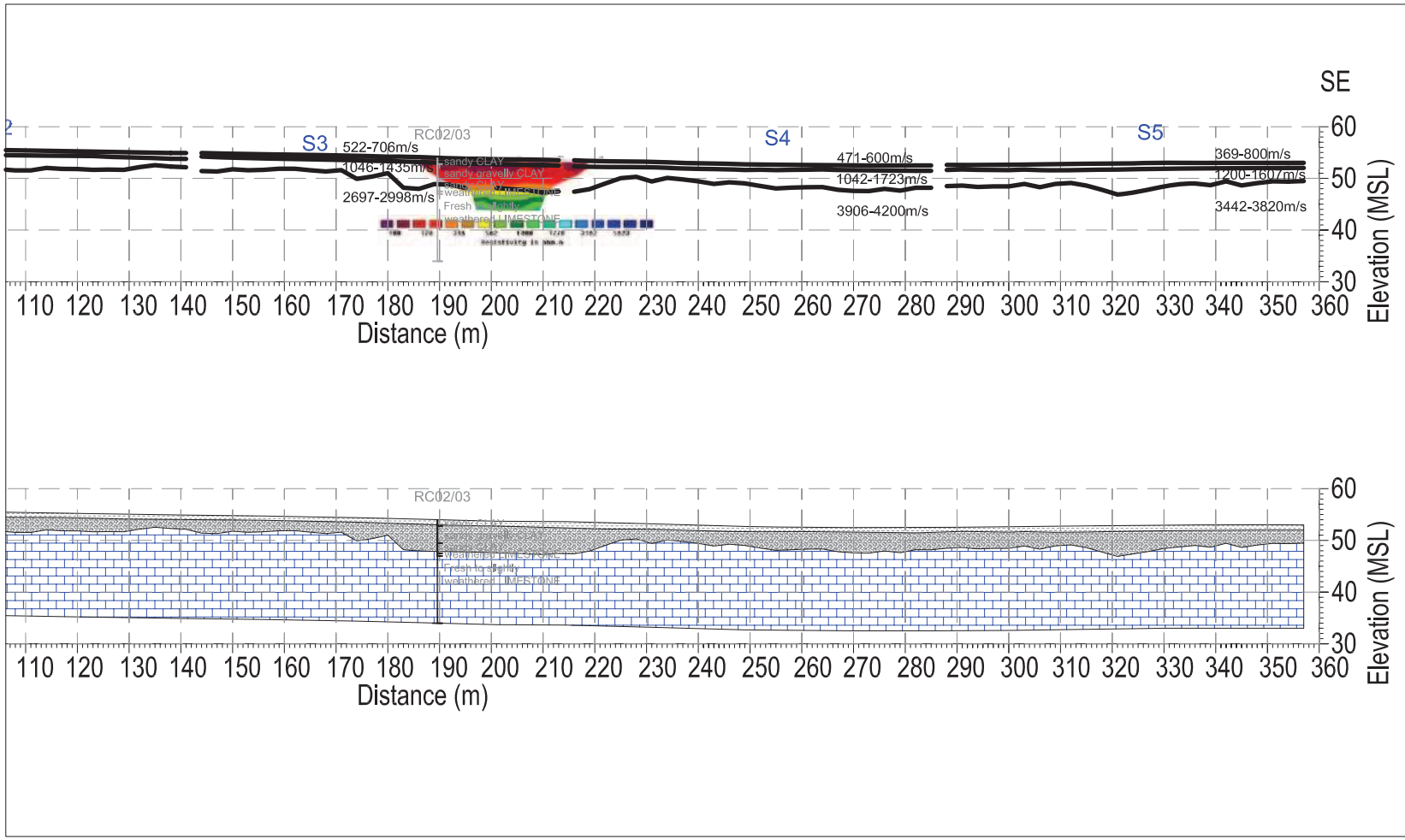
Version:	Date:	Drawn By:	Checked:
01	09-10-15	YOC	
02	23-11-15	YOC	





LEGEND:

- R1 — Electrical Resistivity Tomography
- S1 — Seismic refraction profile
- RC02/01 — Rotary Cored Boreholes
- PBH1 — APEX Proposed borehole
- Firm-stiff or medium dense to dense OVERBURDEN
- Stiff-very stiff or dense to very dense OVERBURDEN or moderately weathered BEDROCK
- Slight weathered to fresh BEDROCK



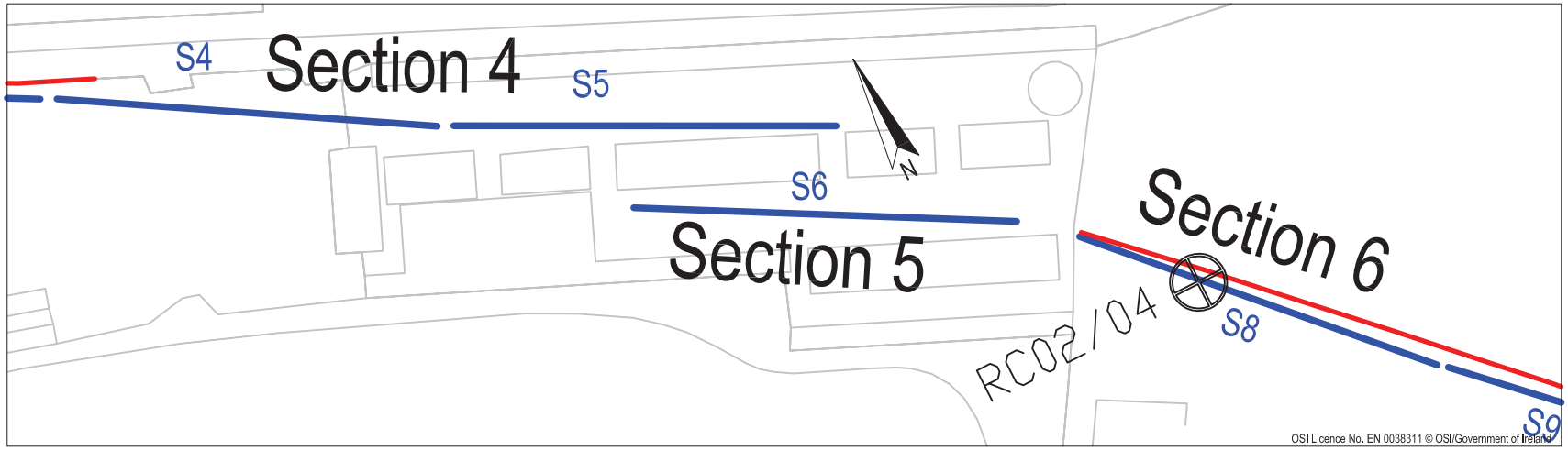
apex geoservices

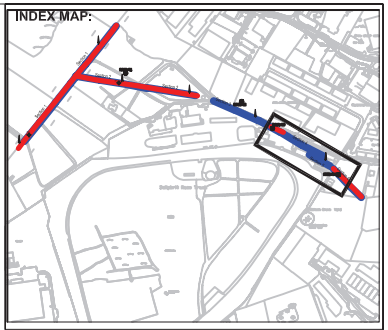
6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland.
T +353 (0)402-21842
F +353 (0)402-21843
E info@apexgeoservices.ie
www.apexgeoservices.ie

Regus House, Herald Way
Pegasus Business Park
Castle Donington
Derby DE74 2TZ
UK
T +44 (0)844 8700 692
E info@apexgeoservices.co.uk
www.apexgeoservices.co.uk

PROJECT:	N6 Galway City Transport Project, Phase 2 Geophysical Survey
DRAWING No.:	AGL15188_07
DATE:	09-10-2015
CLIENT:	ARUP
SCALE:	1:1250 @ A4

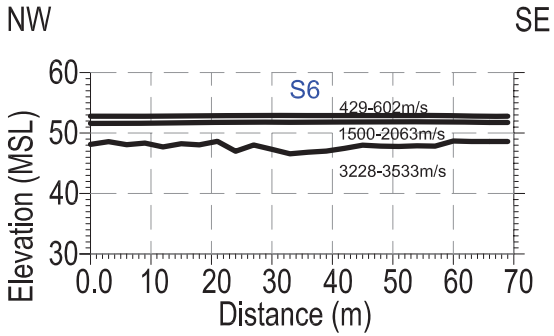
Version:	Date:	Drawn By:	Checked:
01	09-10-15	YOC	
02	23-11-15	YOC	

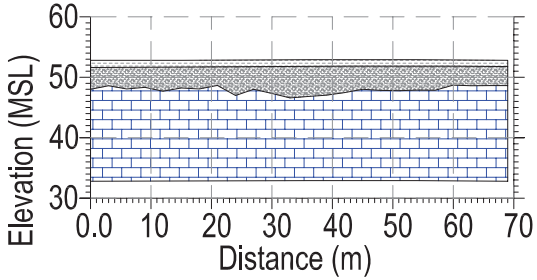




LEGEND:

- R1 — Electrical Resistivity Tomography
- S1 — Seismic refraction profile
- RC02/01 — Rotary Cored Boreholes
- PBH1 — APEX Proposed borehole
- Firm-stiff or medium dense to dense OVERBURDEN
- Stiff-very stiff or dense to very dense OVERBURDEN or moderately weathered BEDROCK
- Slight weathered to fresh BEDROCK





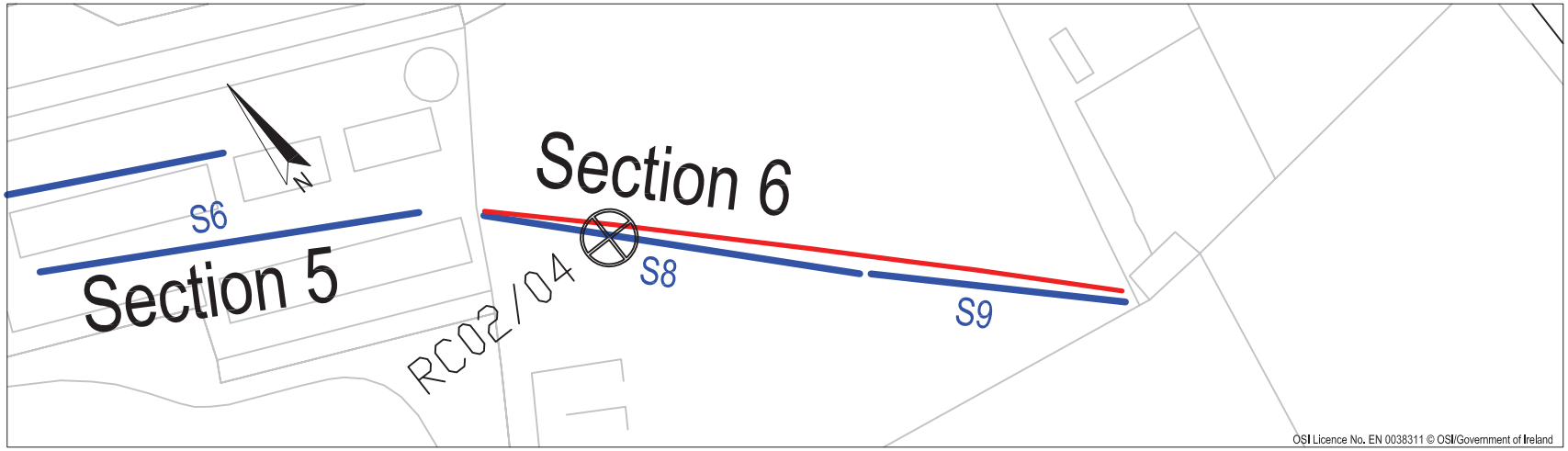
apex geoservices

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland.
T +353 (0)402-21842
F +353 (0)402-21843
E info@apexgeoservices.ie
www.apexgeoservices.ie

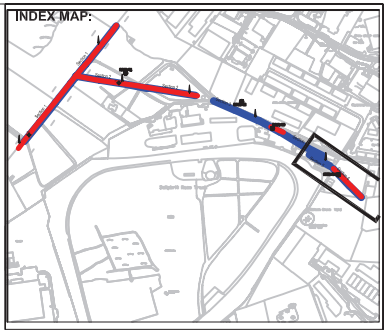
Regus House, Herald Way
Pegasus Business Park
Castle Donington
Derby DE74 2TZ
UK
T +44 (0)844 8700 692
E info@apexgeoservices.co.uk
www.apexgeoservices.co.uk

PROJECT:	N6 Galway City Transport Project, Phase 2 Geophysical Survey
DRAWING No.:	AGL15188_08
DATE:	09-10-2015
CLIENT:	ARUP
SCALE:	1:1250 @ A4

Version:	Date:	Drawn By:	Checked:
01	09-10-15	YOC	
02	23-11-15	YOC	

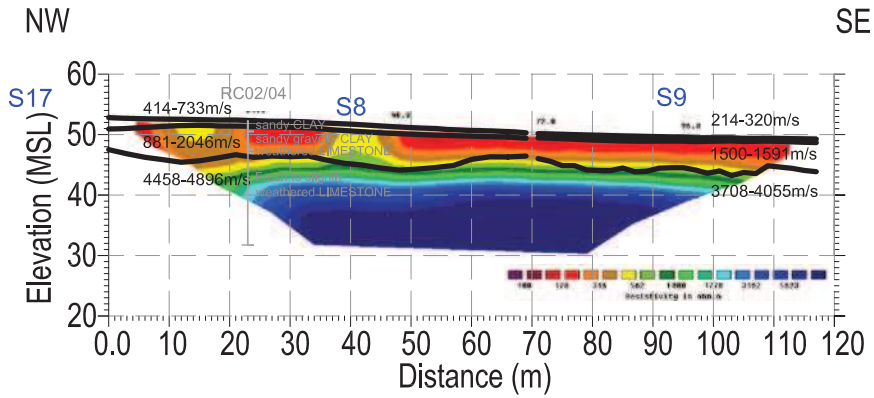


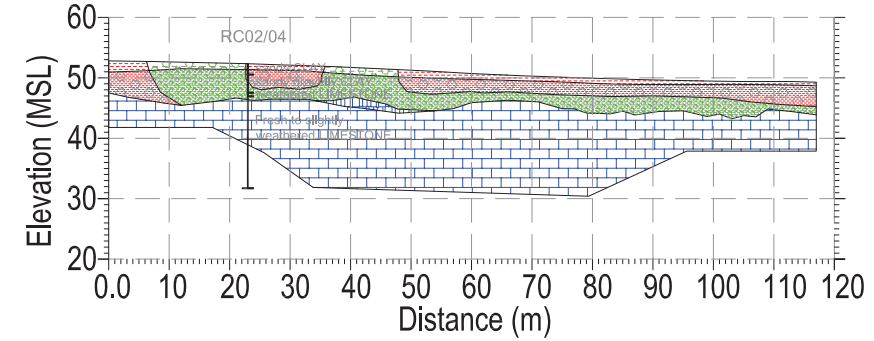
INDEX MAP:



LEGEND:

- Electrical Resistivity Tomography (R1)
- Seismic refraction profile (S1)
- RC02/01 Rotary Cored Boreholes
- PBH1 APEX Proposed borehole
- Firm-stiff sandy gravelly SILT/CLAY
- Stiff-very stiff sandy gravelly SILT/CLAY
- Very stiff-Hard sandy gravelly SILT/CLAY
- Medium dense-dense silty clayey SAND/GRAVEL
- Dense- very dense silty clayey SAND/GRAVEL
- Medium dense-dense SAND/GRAVEL
- Moderately weathered LIMESTONE
- Slightly Weathered to fresh LIMESTONE
- possible karstified LIMESTONE





apex geoservices

6 Knockmullen Business Park
Gorey
Co. Wexford
Ireland.
T +353 (0)402-21842
F +353 (0)402-21843
E info@apexgeoservices.ie
www.apexgeoservices.ie

Regus House, Herald Way
Pegasus Business Park
Castle Donington
Derby DE74 2TZ
UK
T +44 (0)844 8700 692
E info@apexgeoservices.co.uk
www.apexgeoservices.co.uk

PROJECT:	N6 Galway City Transport Project, Phase 2 Geophysical Survey
DRAWING No.:	AGL15188_09
DATE:	09-10-2015
CLIENT:	ARUP
SCALE:	1:1250 @ A4

Version:	Date:	Drawn By:	Checked:
01	09-10-15	YOC	
02	23-11-15	YOC	

8. APPENDIX C: SEISMIC REFRACTION DATA

Seismic Spread	Distance	Velocity Layer 1	Velocity Layer 2	Velocity Layer 3	Velocity Layer 4	Thickness Layer 1	Thickness Layer 2	Thickness Layers 1 +	Elevation	Base Layer 1	Base Layer 2
No.	(m)	(m/s)	(m/s)	(m/s)	(m/s)	(m)	(m)	(m)	(MSL)	(MSL)	(MSL)
1	0	632	1333		3227	0.8	4.3	5.1	57.5	56.66	52.37
1	3	613	1343		3227	0.9	4.0	4.8	57.5	56.63	52.66
1	6	595	1353		3227	0.9	3.5	4.4	57.4	56.51	53.04
1	9	577	1363		3208	0.9	2.7	3.7	57.3	56.39	53.65
1	12	558	1373		3208	0.9	3.0	3.9	57.3	56.37	53.42
1	15	558	1373		3208	0.9	3.8	4.7	57.2	56.27	52.5
1	18	556	1391		3208	1.0	3.5	4.5	57.2	56.24	52.75
1	21	554	1410		3208	1.0	2.8	3.8	57.1	56.11	53.27
1	24	551	1429		3179	1.0	3.2	4.2	57.1	56.09	52.9
1	27	549	1448		3167	1.0	3.9	4.9	57	55.96	52.08
1	30	547	1467		3167	1.1	3.6	4.7	56.9	55.83	52.22
1	33	547	1467		3167	1.1	3.3	4.3	56.9	55.83	52.57
1	36	558	1470		3167	1.1	3.2	4.4	56.8	55.67	52.45
1	39	568	1473		3167	1.2	3.3	4.5	56.8	55.61	52.35
1	42	579	1476		3084	1.3	3.3	4.5	56.7	55.44	52.19
1	45	590	1479		3084	1.3	3.4	4.7	56.6	55.27	51.92
1	48	601	1482		3084	1.4	2.6	4.0	56.6	55.2	52.65
1	51	612	1485		3084	1.5	2.7	4.2	56.5	55.03	52.33
1	54	623	1488		3084	1.5	2.8	4.3	56.4	54.86	52.11
1	57	634	1491		3084	1.6	2.3	3.9	56.4	54.78	52.48
1	60	645	1494		3084	1.7	2.7	4.4	56.3	54.6	51.94
1	63	656	1497		3130	1.8	2.0	3.8	56.3	54.52	52.49
1	66	667	1500		3130	1.9	1.9	3.8	56.2	54.34	52.43
1	69	667	1500		3130	1.9	2.2	4.0	56.1	54.24	52.06
2	0	571	1333		2915	1.0	3.4	4.4	56.1	55.1	51.68
2	3	545	1336		2915	1.0	3.6	4.7	56	54.98	51.35
2	6	518	1339		2915	1.0	3.8	4.8	56	54.98	51.22
2	9	491	1342		2904	1.0	2.8	3.9	55.9	54.87	52.04
2	12	464	1345		2904	1.0	2.6	3.6	55.9	54.88	52.26
2	15	464	1345		2904	1.0	2.5	3.5	55.8	54.78	52.33
2	18	489	1323		2904	1.0	2.6	3.6	55.8	54.78	52.22
2	21	514	1300		2887	1.0	2.5	3.5	55.7	54.68	52.23
2	24	539	1277		2887	1.0	2.9	3.9	55.6	54.58	51.69
2	27	564	1254		2905	1.0	2.6	3.6	55.6	54.59	52.03
2	30	589	1232		2905	1.0	2.8	3.8	55.5	54.51	51.69
2	33	589	1232		2905	1.0	2.7	3.7	55.5	54.51	51.78
2	36	595	1219		2905	1.0	2.9	3.9	55.4	54.43	51.54
2	39	601	1206		2905	0.9	2.9	3.9	55.4	54.46	51.55
2	42	607	1193		2888	0.9	2.4	3.3	55.3	54.38	52.02
2	45	613	1180		2905	0.9	2.6	3.5	55.3	54.41	51.84
2	48	619	1167		2905	0.9	2.5	3.4	55.2	54.33	51.82
2	51	619	1167		2905	0.9	2.7	3.5	55.2	54.33	51.66
2	54	603	1172		2905	0.9	2.5	3.4	55.1	54.18	51.71
2	57	587	1178		2828	1.0	2.5	3.4	55.1	54.12	51.66
2	60	570	1183		2828	1.0	1.8	2.8	55	53.98	52.18
2	63	554	1189		2715	1.1	1.4	2.5	55	53.93	52.54
2	66	538	1194		2801	1.1	1.5	2.6	54.9	53.8	52.29
2	69	522	1200		2888	1.1	1.6	2.8	54.9	53.77	52.15
3	0	706	1091		2736	0.7	2.8	3.5	54.9	54.21	51.41
3	3	673	1080		2736	0.7	2.7	3.5	54.8	54.06	51.32
3	6	639	1069		2697	0.8	2.3	3.0	54.8	54.03	51.76
3	9	606	1057		2697	0.8	2.3	3.1	54.7	53.9	51.57
3	12	573	1046		2726	0.8	2.2	3.0	54.7	53.89	51.66
3	15	573	1046		2726	0.8	1.9	2.7	54.6	53.79	51.86
3	18	570	1069		2726	0.8	1.9	2.7	54.6	53.77	51.87
3	21	567	1092		2779	0.8	2.1	2.9	54.5	53.66	51.57
3	24	564	1115		2779	0.9	2.3	3.2	54.5	53.65	51.32
3	27	561	1138		2779	0.9	2.0	2.8	54.4	53.54	51.59
3	30	558	1161		2779	0.9	3.6	4.5	54.4	53.52	49.9
3	33	555	1183		2748	0.9	3.1	4.0	54.3	53.41	50.35
3	36	552	1206		2748	0.9	2.3	3.2	54.2	53.3	51.01
3	39	549	1229		2748	0.9	5.1	6.0	54.2	53.29	48.19
3	42	546	1252		2748	0.9	5.2	6.1	54.1	53.17	47.96
3	45	543	1275		2825	0.9	4.2	5.1	54	53.06	48.89

Seismic Spread	Distance	Velocity Layer 1	Velocity Layer 2	Velocity Layer 3	Velocity Layer 4	Thickness Layer 1	Thickness Layer 2	Thickness Layers 1 +	Elevation	Base Layer 1	Base Layer 2
No.	(m)	(m/s)	(m/s)	(m/s)	(m/s)	(m)	(m)	(m)	(MSL)	(MSL)	(MSL)
3	48	540	1298		2825	1.0	4.2	5.1	53.9	52.95	48.77
3	51	537	1321		2908	1.0	4.7	5.6	53.8	52.84	48.16
3	54	534	1344		2908	1.0	5.1	6.1	53.8	52.82	47.69
3	57	531	1367		2908	1.0	4.6	5.6	53.7	52.71	48.15
3	60	528	1389		2893	1.0	4.8	5.8	53.7	52.7	47.92
3	63	525	1412		2893	1.0	4.9	5.9	53.6	52.59	47.68
3	66	522	1435		2952	1.0	5.3	6.3	53.6	52.58	47.26
3	69	522	1435		2998	1.0	5.0	6.0	53.5	52.48	47.46
4	0	545	1700		3906	1.2	4.9	6.1	53.5	52.33	47.41
4	3	545	1706		3906	1.1	4.3	5.5	53.4	52.26	47.93
4	6	545	1712		3906	1.1	3.2	4.3	53.3	52.19	49.01
4	9	545	1717		4154	1.1	2.2	3.3	53.3	52.22	50.04
4	12	545	1723		4154	1.1	1.9	2.9	53.2	52.15	50.3
4	15	545	1723		4154	1.1	2.8	3.8	53.2	52.15	49.39
4	18	531	1698		4154	1.1	2.0	3.0	53.1	52.04	50.08
4	21	516	1674		4154	1.1	2.1	3.2	53	51.93	49.8
4	24	501	1649		4122	1.1	2.4	3.5	52.9	51.83	49.42
4	27	486	1625		4162	1.1	2.9	4.0	52.9	51.82	48.93
4	30	471	1600		4162	1.1	2.5	3.6	52.8	51.72	49.25
4	33	471	1600		4162	1.1	2.6	3.7	52.7	51.62	49.02
4	36	473	1488		4162	1.0	3.2	4.2	52.7	51.67	48.52
4	39	474	1377		4041	1.0	3.6	4.5	52.6	51.61	48.06
4	42	476	1265		4041	1.0	3.4	4.4	52.6	51.65	48.21
4	45	478	1153		4058	0.9	3.4	4.3	52.6	51.69	48.3
4	48	480	1042		4125	0.9	3.4	4.3	52.6	51.72	48.32
4	51	480	1042		4125	0.9	3.8	4.7	52.5	51.62	47.8
4	54	504	1133		4125	0.9	4.0	4.9	52.5	51.59	47.59
4	57	528	1225		3993	0.9	4.0	5.0	52.5	51.56	47.54
4	60	552	1317		3993	1.0	3.6	4.5	52.5	51.53	47.96
4	63	576	1408		3913	1.0	3.9	4.9	52.5	51.5	47.62
4	66	600	1500		4057	1.0	3.3	4.3	52.5	51.46	48.19
4	69	600	1500		4200	1.0	3.3	4.3	52.5	51.46	48.18
5	0	800	1412		3442	1.0	3.1	4.1	52.6	51.63	48.5
5	3	743	1440		3442	0.9	3.1	4.0	52.6	51.73	48.62
5	6	686	1468		3442	0.9	3.3	4.2	52.6	51.66	48.36
5	9	629	1496		3480	1.0	3.2	4.1	52.6	51.62	48.46
5	12	571	1524		3545	1.0	3.1	4.1	52.6	51.6	48.46
5	15	571	1524		3545	1.0	2.8	3.8	52.7	51.7	48.93
5	18	531	1540		3545	1.1	3.3	4.4	52.7	51.61	48.3
5	21	491	1557		3579	1.2	2.6	3.8	52.7	51.55	48.94
5	24	450	1574		3579	1.2	2.5	3.7	52.8	51.61	49.12
5	27	410	1590		3579	1.2	3.0	4.2	52.8	51.6	48.6
5	30	369	1607		3679	1.2	3.9	5.1	52.9	51.71	47.79
5	33	369	1607		3679	1.2	4.8	6.0	52.9	51.71	46.9
5	36	394	1569		3679	1.2	4.5	5.7	52.9	51.72	47.25
5	39	418	1531		3588	1.2	4.0	5.2	53	51.84	47.85
5	42	443	1493		3588	1.1	3.4	4.6	53	51.86	48.45
5	45	467	1455		3588	1.1	3.1	4.2	53	51.9	48.84
5	48	492	1417		3607	1.1	2.9	4.0	53	51.95	49.02
5	51	492	1417		3607	1.1	3.3	4.3	53	51.95	48.68
5	54	489	1373		3645	1.0	2.5	3.6	53	51.97	49.44
5	57	487	1330		3645	1.0	3.4	4.4	53	51.98	48.63
5	60	485	1287		3645	1.0	2.9	3.9	53	51.99	49.09
5	63	482	1243		3645	1.0	2.6	3.6	53	52.01	49.43
5	66	480	1200		3820	1.0	2.7	3.6	53	52.02	49.37
5	69	480	1200		3820	1.0	2.6	3.5	53	52.02	49.47
6	0	429	2063		3366	1.2	3.5	4.7	52.8	51.6	48.14
6	3	464	2057		3366	1.2	3.0	4.2	52.8	51.59	48.59
6	6	500	2050		3366	1.2	3.5	4.7	52.8	51.6	48.08
6	9	536	2043		3421	1.2	3.3	4.5	52.8	51.63	48.34
6	12	571	2037		3421	1.1	4.0	5.1	52.8	51.67	47.7
6	15	571	2037		3421	1.1	3.4	4.6	52.8	51.67	48.23
6	18	577	2036		3421	1.1	3.7	4.8	52.9	51.77	48.06
6	21	583	2035		3421	1.1	3.1	4.3	52.9	51.77	48.64

Seismic Spread	Distance	Velocity Layer 1	Velocity Layer 2	Velocity Layer 3	Velocity Layer 4	Thickness Layer 1	Thickness Layer 2	Thickness Layers 1 +	Elevation	Base Layer 1	Base Layer 2
No.	(m)	(m/s)	(m/s)	(m/s)	(m/s)	(m)	(m)	(m)	(MSL)	(MSL)	(MSL)
6	24	589	2034		3343	1.1	4.8	5.9	52.9	51.78	46.99
6	27	595	2033		3338	1.1	3.8	4.9	52.9	51.78	48.02
6	30	602	2032		3338	1.1	4.5	5.6	52.9	51.78	47.32
6	33	602	2032		3338	1.1	5.2	6.3	52.9	51.78	46.57
6	36	586	1926		3338	1.1	5.0	6.1	52.9	51.8	46.82
6	39	570	1819		3338	1.1	4.8	5.9	52.9	51.81	47.03
6	42	554	1713		3228	1.1	4.4	5.4	52.9	51.83	47.47
6	45	538	1606		3228	1.1	3.8	4.9	52.9	51.84	48
6	48	522	1500		3239	1.0	4.0	5.1	52.9	51.86	47.83
6	51	522	1500		3239	1.0	4.1	5.1	52.9	51.86	47.78
6	54	532	1543		3239	1.0	4.0	5.0	52.9	51.86	47.89
6	57	542	1586		3239	1.0	4.0	5.1	52.9	51.86	47.85
6	60	552	1629		3239	1.0	3.2	4.2	52.9	51.86	48.69
6	63	561	1671		3386	1.0	3.2	4.2	52.8	51.76	48.6
6	66	571	1714		3533	1.0	3.2	4.2	52.8	51.76	48.61
6	69	571	1714		3533	1.0	3.2	4.2	52.8	51.76	48.61
7	0	686	1500	2197		1.7	4.0	5.7	47.9	46.2	
7	3	611	1375	2197		1.5	3.6	5.1	47.9	46.36	
7	6	536	1250	2197		1.4	3.2	4.6	47.9	46.52	
7	9	461	1125	2197		1.2	2.9	4.1	48.1	46.9	
7	12	386	1000	2106		1.0	2.7	3.7	48.3	47.28	
7	15	386	1000	2106		1.0	2.8	3.9	48.5	47.48	
7	18	376	1000	2106		1.0	3.0	4.0	48.7	47.7	
7	21	366	1000	2106		1.0	3.2	4.1	49	48.02	
7	24	356	1000	2106		1.0	3.3	4.3	49	48.04	
7	27	346	1000	2106		0.9	3.5	4.4	49.1	48.16	
7	30	336	1000	2117		0.9	3.6	4.6	49.2	48.28	
7	33	336	1000	2128		0.9	3.6	4.5	49.3	48.38	
7	36	345	1000	2139		1.0	3.4	4.4	49.4	48.39	
7	39	353	1000	2150		1.1	3.1	4.2	49.5	48.38	
7	42	361	1000	2161		1.2	2.8	4.1	49.5	48.27	
7	45	370	1000	2172		1.3	2.6	3.9	49.6	48.26	
7	48	378	1000	2183		1.5	2.3	3.8	49.7	48.24	
7	51	378	1000	2183		1.5	2.3	3.8	49.8	48.34	
7	54	445	1053	2169		1.7	2.5	4.1	49.9	48.24	
7	57	511	1105	2155		1.8	2.7	4.5	49.9	48.06	
7	60	577	1158	2142		2.0	2.9	4.9	50	48	
7	63	644	1211	2128		2.1	3.1	5.3	50.1	47.96	
7	66	710	1263	2114		2.3	3.4	5.6	50.2	47.95	
7	69	710	1263	2100		2.3	3.2	5.4	50.3	48.05	
8	0	600	2046		4727	1.9	3.4	5.3	52.8	50.94	47.51
8	3	612	1963		4679	1.7	4.2	5.9	52.7	51.04	46.82
8	6	625	1880		4631	1.5	4.9	6.4	52.6	51.15	46.23
8	9	637	1797		4582	1.2	5.5	6.8	52.6	51.37	45.84
8	12	649	1714		4534	1.0	6.1	7.1	52.5	51.51	45.43
8	15	649	1714		4534	1.0	5.8	6.8	52.5	51.51	45.67
8	18	666	1611		4534	1.0	5.3	6.3	52.4	51.42	46.15
8	21	683	1509		4534	1.0	4.8	5.7	52.4	51.43	46.66
8	24	700	1406		4584	1.0	5.1	6.0	52.3	51.34	46.26
8	27	716	1303		4742	1.0	4.8	5.7	52.2	51.24	46.46
8	30	733	1200		4742	1.0	4.9	5.9	52.2	51.23	46.34
8	33	733	1200		4742	1.0	4.7	5.7	52.1	51.13	46.44
8	36	674	1335		4742	1.0	5.1	6.1	51.9	50.86	45.79
8	39	615	1469		4742	1.1	5.5	6.6	51.8	50.7	45.25
8	42	556	1604		4896	1.1	5.5	6.7	51.6	50.47	44.95
8	45	497	1739		4896	1.1	5.8	6.9	51.4	50.26	44.47
8	48	497	1739		4896	1.1	6.0	7.2	51.3	50.16	44.14
8	51	483	1596		4896	1.1	5.7	6.8	51.1	50.01	44.27
8	54	469	1453		4896	1.1	5.4	6.5	51	49.95	44.55
8	57	456	1310		4458	1.0	4.9	5.9	50.8	49.8	44.9
8	60	442	1167		4458	1.0	3.9	4.8	50.7	49.74	45.89
8	63	428	1024		4458	0.9	3.3	4.3	50.6	49.67	46.34
8	66	414	881		4667	0.9	3.3	4.2	50.5	49.6	46.29
8	69	414	881		4667	0.9	3.0	3.9	50.3	49.4	46.44

Seismic Spread	Distance	Velocity Layer 1	Velocity Layer 2	Velocity Layer 3	Velocity Layer 4	Thickness Layer 1	Thickness Layer 2	Thickness Layers 1 +	Elevation	Base Layer 1	Base Layer 2
No.	(m)	(m/s)	(m/s)	(m/s)	(m/s)	(m)	(m)	(m)	(MSL)	(MSL)	(MSL)
9	0	320	1500		3901	0.6	4.8	5.4	49.4	48.8	44
9	2	293	1521		3946	0.6	4.6	5.2	49.4	48.83	44.21
9	4	267	1543		3990	0.5	4.4	5.0	49.5	48.97	44.54
9	6	240	1564		4035	0.5	4.2	4.7	49.5	49	44.77
9	8	214	1586		4035	0.5	4.1	4.5	49.5	49.05	44.96
9	10	214	1586		4035	0.5	5.4	5.8	49.5	49.03	43.67
9	12	220	1587		4035	0.5	5.1	5.6	49.5	49	43.86
9	14	227	1588		4035	0.5	5.7	6.3	49.6	49.07	43.35
9	16	233	1589		4035	0.6	4.9	5.5	49.6	49.04	44.13
9	18	240	1590		3910	0.6	5.3	5.9	49.6	49.01	43.72
9	20	246	1591		3910	0.6	4.7	5.3	49.6	48.97	44.28
9	22	246	1591		3910	0.6	4.4	5.0	49.7	49.06	44.66
9	24	255	1586		3910	0.7	4.4	5.1	49.7	49.02	44.65
9	26	263	1581		3910	0.7	4.5	5.2	49.8	49.07	44.56
9	28	272	1576		4055	0.8	5.0	5.7	49.8	49.03	44.08
9	30	280	1571		3971	0.8	5.1	5.9	49.9	49.09	43.97
9	32	289	1566		3971	0.9	4.4	5.3	49.9	49.04	44.6
9	34	289	1566		3971	0.9	5.0	5.8	50	49.14	44.17
9	36	276	1555		3971	0.8	5.0	5.8	50	49.17	44.21
9	38	262	1544		3971	0.8	5.0	5.8	50.1	49.31	44.29
9	40	249	1533		3971	0.8	4.4	5.1	50.1	49.34	44.99
9	42	236	1522		3730	0.7	4.5	5.2	50.2	49.48	45.01
9	44	222	1511		3708	0.7	3.8	4.5	50.2	49.51	45.72
9	46	222	1500		3708	0.7	3.5	4.1	50.3	49.61	46.16
10	0	769	2000		4225	3.0	2.5	5.6	50.7	47.68	45.15
10	3	756	1894		4225	2.7	2.8	5.5	50.8	48.09	45.29
10	6	743	1788		4225	2.4	4.5	6.9	50.9	48.49	43.99
10	9	730	1682		4225	2.1	3.3	5.4	51	48.88	45.61
10	12	717	1576		4171	1.8	5.0	6.8	51.2	49.37	44.39
10	15	717	1576		4171	1.8	3.0	4.9	51.3	49.47	46.44
10	18	721	1675		4171	1.9	4.1	6.0	51.4	49.5	45.36
10	21	726	1775		4171	2.0	2.9	4.9	51.5	49.52	46.6
10	24	731	1875		4471	2.1	3.9	6.0	51.6	49.55	45.64
10	27	735	1974		4471	2.1	2.3	4.4	51.7	49.57	47.29
10	30	740	2074		4471	2.2	2.8	5.1	51.8	49.58	46.74
10	33	740	2074		4471	2.2	3.8	6.0	51.9	49.68	45.87
10	36	731	1948		4471	2.1	3.6	5.7	52	49.88	46.32
10	39	723	1822		4471	2.0	3.8	5.8	52.1	50.08	46.28
10	42	714	1695		4471	1.9	3.0	4.9	52.2	50.27	47.3
10	45	706	1569		4428	1.9	2.3	4.2	52.3	50.45	48.12
10	48	697	1443		4154	1.8	3.6	5.3	52.4	50.63	47.06
10	51	697	1443		4154	1.8	3.9	5.7	52.5	50.73	46.82
10	54	695	1635		4154	1.8	4.2	6.0	52.6	50.76	46.6
10	57	692	1826		4154	1.9	3.4	5.3	52.7	50.78	47.42
10	60	690	2017		4196	2.0	3.4	5.5	52.8	50.79	47.35
10	63	688	2209		4239	2.1	3.4	5.5	52.9	50.79	47.36
10	66	686	2400		4281	2.2	3.4	5.6	53	50.79	47.44
10	69	686	2400		4281	2.2	3.4	5.6	53.1	50.89	47.54
11	0	444	1333		4314	1.0	4.0	5.0	53.2	52.16	48.17
11	3	491	1431		4314	1.1	4.9	6.1	53.2	52.06	47.13
11	6	538	1528		4314	1.2	5.8	7.0	53.3	52.07	46.3
11	9	584	1626		4535	1.3	4.6	5.9	53.4	52.08	47.46
11	12	631	1723		4535	1.4	4.7	6.1	53.4	51.99	47.31
11	15	631	1723		4535	1.4	5.8	7.2	53.5	52.09	46.34
11	18	653	1745		4535	1.4	5.6	7.1	53.6	52.17	46.53
11	21	676	1767		4484	1.4	5.6	7.1	53.6	52.16	46.54
11	24	699	1789		4484	1.5	6.0	7.5	53.7	52.24	46.2
11	27	722	1810		4323	1.5	5.7	7.2	53.8	52.33	46.6
11	30	744	1832		4323	1.5	3.9	5.4	53.8	52.32	48.38
11	33	744	1832		4323	1.5	4.6	6.1	53.9	52.42	47.85
11	36	756	1903		4323	1.6	4.1	5.6	54	52.44	48.38
11	39	768	1975		4323	1.7	4.6	6.3	54.1	52.45	47.82
11	42	780	2046		4323	1.7	4.1	5.8	54.1	52.36	48.28
11	45	792	2117		4539	1.8	6.7	8.5	54.2	52.38	45.71

Seismic Spread	Distance	Velocity Layer 1	Velocity Layer 2	Velocity Layer 3	Velocity Layer 4	Thickness Layer 1	Thickness Layer 2	Thickness Layers 1 +	Elevation	Base Layer 1	Base Layer 2
No.	(m)	(m/s)	(m/s)	(m/s)	(m/s)	(m)	(m)	(m)	(MSL)	(MSL)	(MSL)
11	48	804	2189		4389	1.9	5.5	7.5	54.3	52.38	46.84
11	51	804	2189		4389	1.9	5.8	7.7	54.4	52.48	46.7
11	54	871	2158		4286	2.0	6.8	8.8	54.5	52.49	45.67
11	57	939	2128		4286	2.1	6.0	8.1	54.5	52.4	46.43
11	60	1007	2097		4286	2.2	5.7	7.9	54.6	52.42	46.68
11	63	1075	2067		4286	2.3	4.8	7.0	54.7	52.45	47.68
11	66	1143	2036		4286	2.3	5.1	7.5	54.8	52.48	47.35
11	69	1143	2036		4286	2.3	4.7	7.1	54.9	52.58	47.85
12	0	960	2003		3873	1.7	4.2	5.9	55	53.26	49.11
12	3	874	1923		3873	1.5	5.2	6.7	55	53.46	48.28
12	6	788	1842		3873	1.4	4.3	5.7	55	53.64	49.33
12	9	702	1762		4025	1.2	3.7	4.9	55	53.82	50.09
12	12	616	1681		4134	1.0	3.5	4.5	55	53.99	50.52
12	15	616	1681		4134	1.0	3.1	4.1	55.1	54.09	50.96
12	18	595	1712		4134	1.1	3.5	4.5	55.1	54.05	50.58
12	21	575	1743		4047	1.1	3.6	4.6	55.1	54.02	50.47
12	24	555	1774		4050	1.1	2.7	3.8	55.1	53.99	51.27
12	27	535	1805		4050	1.1	3.0	4.1	55.2	54.07	51.06
12	30	514	1836		4127	1.2	3.9	5.1	55.2	54.05	50.12
12	33	514	1836		4127	1.2	4.3	5.4	55.2	54.05	49.78
12	36	509	1805		4127	1.1	5.5	6.6	55.2	54.06	48.61
12	39	505	1774		4032	1.1	5.0	6.1	55.3	54.17	49.21
12	42	500	1744		4032	1.1	5.3	6.5	55.3	54.18	48.84
12	45	495	1713		4020	1.1	4.5	5.6	55.3	54.19	49.74
12	48	490	1682		4020	1.1	4.2	5.3	55.4	54.3	50.09
12	51	490	1682		4020	1.1	4.1	5.2	55.4	54.3	50.22
12	54	488	1748		4020	1.1	4.0	5.2	55.4	54.28	50.25
12	57	486	1813		4020	1.1	4.0	5.1	55.5	54.36	50.39
12	60	484	1879		4020	1.2	3.9	5.1	55.5	54.34	50.45
12	63	482	1945		4251	1.2	3.7	4.9	55.5	54.31	50.6
12	66	480	2011		4251	1.2	3.6	4.8	55.6	54.39	50.8
12	69	480	2011		4251	1.2	3.4	4.6	55.6	54.39	50.97
13	72	387	2048		4319	1.2	4.2	5.5	55.7	54.46	50.25
13	75	406	1961		4319	1.2	4.7	5.9	55.7	54.47	49.8
13	78	425	1875		4318	1.2	4.6	5.9	55.7	54.48	49.85
13	81	443	1789		4318	1.2	3.3	4.5	55.7	54.5	51.24
13	84	462	1703		4268	1.2	2.4	3.6	55.7	54.52	52.14
13	87	481	1617		4268	1.2	3.4	4.6	55.7	54.55	51.12
13	90	481	1617		4268	1.2	2.9	4.1	55.7	54.55	51.63
13	93	467	1631		4268	1.2	3.2	4.3	55.7	54.54	51.38
13	96	453	1645		4238	1.2	3.9	5.1	55.7	54.54	50.65
13	99	438	1659		4223	1.2	2.7	3.9	55.8	54.64	51.91
13	102	424	1673		4223	1.2	2.3	3.5	55.8	54.64	52.33
13	105	424	1673		4223	1.2	4.2	5.4	55.8	54.64	50.45
13	108	427	1753		4223	1.2	2.7	3.9	55.8	54.62	51.91
13	111	429	1832		4223	1.2	2.2	3.4	55.9	54.71	52.5
13	114	432	1912		4077	1.2	4.6	5.8	55.9	54.69	50.1
13	117	434	1992		4077	1.2	4.4	5.7	55.9	54.67	50.23
13	120	437	2071		4121	1.2	6.2	7.4	56	54.76	48.56
13	123	437	2071		4121	1.2	5.8	7.0	56	54.76	49.01
13	126	476	2010		4121	1.2	4.2	5.4	56	54.76	50.56
13	129	515	1949		4160	1.2	4.6	5.8	56	54.78	50.19
13	132	554	1887		4160	1.2	6.1	7.3	56.1	54.92	48.81
13	135	593	1826		4374	1.1	6.0	7.1	56.1	54.97	48.96
13	138	632	1765		4374	1.1	6.7	7.8	56.1	55.05	48.34
13	141	632	1765		4374	1.1	6.9	7.9	56.2	55.15	48.27
14	216	429	1548		4450	1.2	5.4	6.6	56.1	54.92	49.54
14	219	424	1522		4478	1.2	5.8	7.0	56.1	54.9	49.06
14	222	420	1496		4478	1.2	5.2	6.4	56.1	54.88	49.68
14	225	416	1469		4478	1.2	5.2	6.5	56.1	54.86	49.65
14	228	411	1443		4478	1.3	3.9	5.2	56.1	54.84	50.94
14	231	407	1417		4478	1.3	3.4	4.7	56.1	54.82	51.42
14	234	407	1417		4832	1.3	4.0	5.3	56.1	54.82	50.83
14	237	389	1373		4832	1.3	4.2	5.4	56.1	54.85	50.7

Seismic Spread	Distance	Velocity Layer 1	Velocity Layer 2	Velocity Layer 3	Velocity Layer 4	Thickness Layer 1	Thickness Layer 2	Thickness Layers 1 +	Elevation	Base Layer 1	Base Layer 2
No.	(m)	(m/s)	(m/s)	(m/s)	(m/s)	(m)	(m)	(m)	(MSL)	(MSL)	(MSL)
14	240	371	1329		4832	1.2	3.5	4.7	56.1	54.89	51.39
14	243	353	1285		4832	1.2	3.6	4.8	56.1	54.93	51.32
14	246	335	1242		4832	1.1	3.5	4.6	56.1	54.97	51.47
14	249	317	1198		5054	1.1	3.5	4.6	56.1	55.01	51.5
14	252	317	1198		4593	1.1	4.0	5.1	56.1	55.01	51.03
14	255	305	1195		4593	1.1	4.5	5.6	56.3	55.21	50.75
14	258	294	1191		4593	1.1	4.4	5.5	56.4	55.32	50.89
14	261	282	1188		4614	1.1	5.2	6.2	56.8	55.73	50.58
14	264	270	1185		4268	1.1	5.7	6.7	57.2	56.14	50.46
14	267	259	1182		4566	1.0	6.4	7.5	57.3	56.26	49.83
14	270	259	1178		4566	1.0	6.2	7.3	57.4	56.36	50.14
14	273	266	1175		4566	1.1	5.8	6.9	57.3	56.22	50.45
14	276	272	1172		4549	1.1	5.7	6.8	57.2	56.08	50.38
14	279	279	1168		4533	1.2	5.6	6.8	57.1	55.94	50.31
14	282	286	1165		4516	1.2	5.6	6.8	56.9	55.7	50.14
14	285	286	1165		4500	1.2	5.6	6.8	56.8	55.6	50.04
15	0	444	1008		4353	1.0	2.3	3.3	55	54	51.72
15	3	424	1141		4325	1.0	2.5	3.5	55.1	54.06	51.56
15	6	404	1273		4296	1.1	2.7	3.8	55.1	54.02	51.34
15	9	384	1406		4296	1.1	2.6	3.7	55.1	53.99	51.39
15	12	364	1539		4296	1.1	3.6	4.8	55.2	54.06	50.44
15	15	364	1539		4296	1.1	3.5	4.7	55.2	54.06	50.54
15	18	367	1531		4296	1.1	2.9	4.0	55.2	54.06	51.19
15	21	371	1523		4099	1.2	2.5	3.7	55.3	54.15	51.65
15	24	374	1515		4099	1.2	2.5	3.7	55.3	54.15	51.63
15	27	378	1508		4099	1.2	3.7	4.9	55.3	54.15	50.45
15	30	381	1500		4186	1.2	2.9	4.1	55.4	54.24	51.3
15	33	381	1500		4186	1.2	3.0	4.1	55.4	54.24	51.26
15	36	380	1459		4186	1.2	1.6	2.7	55.6	54.45	52.86
15	39	379	1418		3895	1.1	2.9	4.0	55.7	54.57	51.69
15	42	377	1377		3895	1.1	2.4	3.5	55.8	54.68	52.3
15	45	376	1336		3895	1.1	2.7	3.9	55.8	54.69	51.95
15	48	375	1295		4116	1.1	2.8	3.9	55.9	54.8	52.04
15	51	375	1295		4116	1.1	3.5	4.6	55.9	54.8	51.27
15	54	377	1255		4116	1.1	2.5	3.6	56	54.91	52.39
15	57	380	1214		3895	1.1	2.1	3.2	56	54.93	52.85
15	60	382	1173		3895	1.1	2.3	3.3	56.1	55.04	52.79
15	63	385	1132		3895	1.1	2.0	3.1	56.1	55.05	53.05
15	66	387	1091		4088	1.0	2.0	3.0	56.2	55.16	53.17
15	69	387	1091		4088	1.0	2.5	3.5	56.2	55.16	52.67
16	72	343	1333		4425	1.2	1.9	3.2	56.4	55.16	53.22
16	75	345	1220		4426	1.2	2.3	3.5	56.4	55.23	52.92
16	78	348	1107		4426	1.1	2.3	3.4	56.4	55.29	53.04
16	81	351	994		4709	1.0	2.4	3.4	56.4	55.36	52.99
16	84	353	881		4855	1.0	2.6	3.5	56.4	55.42	52.87
16	87	353	881		4855	1.0	2.4	3.4	56.4	55.42	53.03
16	90	353	914		4855	1.0	2.7	3.7	56.4	55.4	52.73
16	93	353	947		4655	1.0	2.7	3.7	56.4	55.39	52.74
16	96	353	979		4655	1.0	2.6	3.7	56.4	55.38	52.75
16	99	353	1012		4655	1.0	2.5	3.6	56.4	55.36	52.83
16	102	353	1045		4846	1.1	2.4	3.5	56.5	55.44	53.01
16	105	353	1045		4846	1.1	2.4	3.5	56.5	55.44	53
16	108	363	1149		4846	1.1	2.7	3.8	56.4	55.32	52.59
16	111	373	1252		4666	1.1	2.9	4.0	56.4	55.3	52.36
16	114	382	1356		4636	1.1	3.1	4.3	56.4	55.28	52.15
16	117	392	1460		4636	1.1	3.4	4.6	56.4	55.26	51.84
16	120	402	1563		4636	1.2	3.3	4.5	56.4	55.24	51.91
16	123	402	1563		4636	1.2	5.0	6.2	56.4	55.24	50.22
16	126	394	1558		4636	1.2	5.1	6.3	56.4	55.24	50.15
16	129	387	1552		4636	1.2	5.4	6.6	56.4	55.24	49.85
16	132	379	1547		4636	1.2	5.1	6.3	56.4	55.24	50.1
16	135	371	1541		4476	1.2	4.8	6.0	56.3	55.15	50.31
16	138	364	1536		4476	1.2	4.7	5.8	56.3	55.15	50.48
16	141	364	1500		4500	1.2	3.0	4.1	56.3	55.15	52.2

Seismic Spread	Distance	Velocity Layer 1	Velocity Layer 2	Velocity Layer 3	Velocity Layer 4	Thickness Layer 1	Thickness Layer 2	Thickness Layers 1 +	Elevation	Base Layer 1	Base Layer 2
No.	(m)	(m/s)	(m/s)	(m/s)	(m/s)	(m)	(m)	(m)	(MSL)	(MSL)	(MSL)
17	0	444	1500		4739	1.2	2.2	3.4	56.3	55.08	52.86
17	3	476	1442		4739	1.2	2.2	3.4	56.3	55.13	52.95
17	6	508	1383		4907	1.1	2.4	3.5	56.3	55.19	52.83
17	9	540	1325		4907	1.0	2.8	3.8	56.3	55.28	52.53
17	12	571	1267		5035	0.9	2.9	3.8	56.3	55.38	52.48
17	15	571	1267		5035	0.9	3.0	3.9	56.3	55.38	52.38
17	18	590	1222		5035	0.9	2.9	3.8	56.3	55.41	52.49
17	21	610	1178		5016	0.9	3.3	4.2	56.3	55.45	52.13
17	24	629	1134		5016	0.8	3.0	3.8	56.3	55.5	52.51
17	27	648	1090		5016	0.8	2.7	3.5	56.3	55.55	52.84
17	30	667	1045		5213	0.7	2.8	3.5	56.3	55.6	52.81
17	33	667	1045		5213	0.7	2.8	3.5	56.3	55.6	52.83
17	36	664	1106		5213	0.7	2.9	3.7	56.2	55.46	52.52
17	39	661	1167		5132	0.8	3.1	3.9	56.2	55.41	52.3
17	42	658	1228		5132	0.8	2.9	3.7	56.2	55.37	52.48
17	45	656	1289		5188	0.9	3.1	4.0	56.2	55.33	52.25
17	48	653	1350		5188	0.9	2.9	3.8	56.2	55.28	52.42
17	51	653	1350		5188	0.9	3.1	4.1	56.2	55.28	52.15
17	54	631	1380		5188	1.0	2.8	3.7	56.2	55.25	52.5
17	57	610	1410		5188	1.0	2.5	3.5	56.2	55.23	52.73
17	60	588	1440		5188	1.0	2.5	3.5	56.2	55.21	52.75
17	63	567	1470		5188	1.0	2.4	3.4	56.1	55.09	52.72
17	66	545	1500		5109	1.0	2.1	3.1	56.1	55.08	53.03
17	69	545	1500		5109	1.0	2.1	3.1	56.1	55.08	53.03
18	0	400	1714		4284	1.2	1.4	2.6	56.1	54.92	53.48
18	3	411	1639		4334	1.2	2.1	3.3	56.1	54.94	52.85
18	6	422	1563		4384	1.1	2.7	3.8	56.2	55.06	52.41
18	9	433	1487		4384	1.1	2.7	3.8	56.2	55.09	52.38
18	12	444	1412		4384	1.1	2.0	3.1	56.2	55.12	53.11
18	15	444	1412		4384	1.1	1.3	2.3	56.2	55.12	53.86
18	18	431	1451		4384	1.1	2.5	3.6	56.2	55.09	52.57
18	21	417	1490		4297	1.1	2.2	3.4	56.2	55.07	52.85
18	24	403	1529		4297	1.2	3.2	4.4	56.2	55.05	51.82
18	27	389	1568		4297	1.2	2.9	4.1	56.2	55.03	52.11
18	30	375	1607		4297	1.2	2.6	3.8	56.2	55.02	52.44
18	33	375	1607		4297	1.2	2.3	3.5	56.2	55.02	52.73
18	36	386	1719		4297	1.2	2.9	4.1	56.2	55.01	52.1
18	39	398	1831		4091	1.2	4.3	5.5	56.2	55	50.75
18	42	409	1944		4091	1.2	3.5	4.7	56.2	54.99	51.47
18	45	420	2056		4091	1.2	3.3	4.6	56.3	55.08	51.74
18	48	431	2168		4148	1.2	5.8	7.1	56.3	55.08	49.24
18	51	431	2168		4148	1.2	5.2	6.4	56.3	55.08	49.93
18	54	425	2054		4148	1.2	3.8	5.0	56.3	55.1	51.34
18	57	418	1941		4148	1.2	2.6	3.8	56.3	55.11	52.5
18	60	412	1827		4148	1.2	4.2	5.4	56.3	55.13	50.93
18	63	406	1714		3953	1.2	4.1	5.2	56.3	55.15	51.09
18	66	400	1600		3953	1.1	4.0	5.1	56.3	55.16	51.16
18	69	400	1600		3953	1.1	2.9	4.0	56.3	55.16	52.31
19	72	400	1535		3822	1.2	2.3	3.5	56.3	55.13	52.81
19	75	400	1605		3822	1.2	2.9	4.1	56.4	55.23	52.29
19	78	401	1675		3822	1.2	3.1	4.3	56.4	55.23	52.09
19	81	401	1745		3869	1.2	4.4	5.6	56.5	55.32	50.94
19	84	401	1816		3917	1.2	4.5	5.6	56.5	55.32	50.86
19	87	402	1886		3965	1.2	4.5	5.7	56.6	55.41	50.89
19	90	402	1886		3965	1.2	4.8	5.9	56.6	55.41	50.66
19	93	467	1833		3965	1.3	5.2	6.5	56.7	55.43	50.2
19	96	533	1781		3965	1.3	5.3	6.6	56.7	55.37	50.08
19	99	598	1729		3848	1.4	4.9	6.3	56.8	55.45	50.54
19	102	664	1676		3731	1.4	4.5	5.9	56.8	55.45	50.92
19	105	730	1624		3731	1.3	3.6	4.9	56.9	55.58	51.97
19	108	730	1624		3731	1.3	2.3	3.6	56.9	55.58	53.26
19	111	687	1696		3731	1.3	2.4	3.7	57	55.72	53.34
19	114	645	1768		3711	1.3	2.4	3.7	57	55.75	53.32
19	117	602	1840		3711	1.2	2.5	3.7	57.1	55.89	53.42

Seismic Spread	Distance	Velocity Layer 1	Velocity Layer 2	Velocity Layer 3	Velocity Layer 4	Thickness Layer 1	Thickness Layer 2	Thickness Layers 1 +	Elevation	Base Layer 1	Base Layer 2
No.	(m)	(m/s)	(m/s)	(m/s)	(m/s)	(m)	(m)	(m)	(MSL)	(MSL)	(MSL)
19	120	559	1911		3711	1.2	3.0	4.2	57.1	55.93	52.95
19	123	517	1983		3711	1.1	3.5	4.7	57.1	55.98	52.45
19	126	517	1983		3711	1.1	4.0	5.1	57.2	56.08	52.09
19	129	514	1949		3711	1.1	3.2	4.3	57.2	56.06	52.86
19	132	510	1915		3632	1.2	3.5	4.7	57.3	56.14	52.61
19	135	507	1880		3535	1.2	3.8	5.0	57.3	56.12	52.31
19	138	503	1846		3535	1.2	3.1	4.3	57.4	56.2	53.08
19	141	500	1846		3535	1.2	3.5	4.7	57.4	56.21	52.75

Appendix 5

Rock Test Records

POINT LOAD STRENGTH INDEX TEST DATA

Contract: N6 Galway Transport Project (Phase 2)
Date of test: 18/11/15

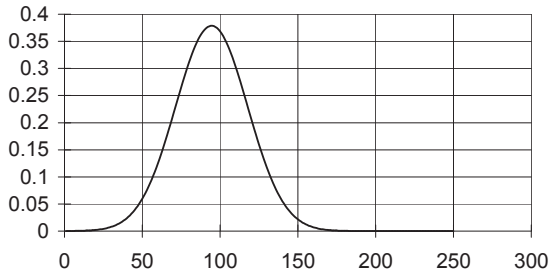
Sample Type: Core
Contract no. 18746

RC No.	Depth m	D (Diameter) mm	P (failure load) kN	F	Is (index strength) Mpa	Is(50) (index strength) Mpa	*UCS MPa	Type	Orienation
RC02/01	3.3	78	22.0	1.222	3.62	4.42	88	PL	90°
	6.2	78	10.0	1.222	1.64	2.01	40	PL	90°
	6.6	78	24.0	1.222	3.94	4.82	96	PL	90°
	13.1	78	29.0	1.222	4.77	5.82	116	PL	90°
	13.4	78	21.0	1.222	3.45	4.22	84	PL	90°
	16.8	78	22.0	1.222	3.62	4.42	88	PL	90°
RC02/02	7.9	78	24.0	1.222	3.94	4.82	96	PL	90°
	15.3	78	19.0	1.222	3.12	3.81	76	PL	90°
	15.7	78	27.0	1.222	4.44	5.42	108	PL	90°
	19.2	78	29.0	1.222	4.77	5.82	116	PL	90°
RC02/03	7.4	78	27.0	1.222	4.44	5.42	108	PL	90°
	7.8	78	27.0	1.222	4.44	5.42	108	PL	90°
	9.4	78	24.0	1.222	3.94	4.82	96	PL	90°
	13.0	78	26.0	1.222	4.27	5.22	104	PL	90°
	17.3	78	29.0	1.222	4.77	5.82	116	PL	90°
	17.7	78	28.0	1.222	4.60	5.62	112	PL	90°
	19.5	78	27.0	1.222	4.44	5.42	108	PL	90°
RC02/04	5.6	78	32.0	1.222	5.26	6.42	128	PL	90°
	10.5	78	27.0	1.222	4.44	5.42	108	PL	90°
	13.3	78	15.0	1.222	2.47	3.01	60	PL	90°
	13.7	78	14.0	1.222	2.30	2.81	56	PL	90°
	14.4	78	15.0	1.222	2.47	3.01	60	PL	90°

Statistical Summary Data	Is(50)	UCS*
Number of Samples Tested	22	22
Minimum	2.01	40
Average	4.73	95
Maximum	6.42	128
Standard Dev.	1.16	23
Upper 95% Confidence Limit	7.00	139.97
Lower 95% Confidence Limit	2.46	49.13

Comments:
*UCS taken as k x Point Load Is(50): k= 20

*UCS Normal Distribution Curve



Abbreviations	
i	irregular
a	axial
b	block
d	diametral

approx. orientation to planes of weakness/bedding

U	unknown
P	perpendicular
//	parallel

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	N6 Galway Transport Project (Phase 2)
Job Number:	18746
Hole No:	RC02/01
Depth (m):	6.3m

Sample Description

Colour:	Pale Grey
Grain size:	Fine grained
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

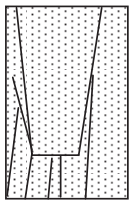
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	201	
Diameter (Ø)	78.1	mm

Sketch of Failure Surfaces



Testing

Load Rate	3.3	kN/min
Load at Failure (P)	322	kN

Strength Calculations

$$\text{Uniaxial Compressive Strength} = \frac{322000}{4788.19385}$$

$$= \frac{1000 \times P}{\prod \times (Ø/2)^2}$$

$$= 67.21 \text{ (Mpa)}$$

$$\text{Bulk Density} = 2.67 \text{ (Mg/m}^3\text{)}$$

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	N6 Galway Transport Project (Phase 2)
Job Number:	18746
Hole No:	RC02/01
Depth (m):	13.0m

Sample Description

Colour:	Pale Grey
Grain size:	Fine grained
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

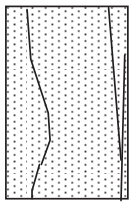
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	198	
Diameter (Ø)	78	mm

Sketch of Failure Surfaces



Testing

Load Rate	3.3	kN/min
Load at Failure (P)	249	kN

Strength Calculations

Uniaxial Compressive Strength $= \dfrac{249000}{4775.94}$

$= \dfrac{1000 \times P}{\prod \times (Ø/2)^2}$

$=$ 52.11 (Mpa)

Bulk Density $=$ 2.65 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	N6 Galway Transport Project (Phase 2)
Job Number:	18746
Hole No:	RC02/02
Depth (m):	15.5m

Sample Description

Colour:	Pale Grey
Grain size:	Fine grained
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

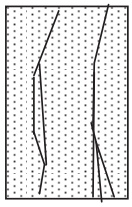
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	199	
Diameter (Ø)	78	mm

Sketch of Failure Surfaces



Testing

Load Rate	3.3	kN/min
Load at Failure (P)	368	kN

Strength Calculations

$$\text{Uniaxial Compressive Strength} = \frac{368000}{4775.94}$$

$$= \frac{1000 \times P}{\prod \times (Ø/2)^2}$$

$$= 77.01 \text{ (Mpa)}$$

$$\text{Bulk Density} = 2.67 \text{ (Mg/m}^3\text{)}$$

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	N6 Galway Transport Project (Phase 2)
Job Number:	18746
Hole No:	RC02/03
Depth (m):	7.6m

Sample Description

Colour:	Pale Grey
Grain size:	Fine grained
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

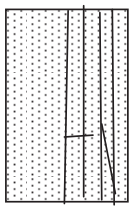
Weathering Grade Criteria

I. Fresh: Unchanged from original state
II. Slightly weathered: Slight discolouration, slight weakening
III. Moderately weathered: Considerable weakening, penetrative discolouration
IV. Highly weathered: Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	196	
Diameter (Ø)	77.9	mm

Sketch of Failure Surfaces



Testing

Load Rate	3.3	kN/min
Load at Failure (P)	255	kN

Strength Calculations

Uniaxial Compressive Strength = $\frac{255000}{4763.70185}$

$= \frac{1000 \times P}{\prod \times (Ø/2)^2}$

= 53.50 (Mpa)

Bulk Density = 2.65 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	N6 Galway Transport Project (Phase 2)
Job Number:	18746
Hole No:	RC02/03
Depth (m):	17.4m

Sample Description

Colour:	Pale Grey
Grain size:	Fine grained
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

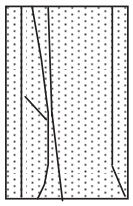
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	198	
Diameter (Ø)	78	mm

Sketch of Failure Surfaces



Testing

Load Rate	3.3	kN/min
Load at Failure (P)	238	kN

Strength Calculations

Uniaxial Compressive Strength $= \dfrac{238000}{4775.94}$

$= \dfrac{1000 \times P}{\prod \times (Ø/2)^2}$

$=$ 49.81 (Mpa)

Bulk Density $=$ 2.62 (Mg/m^3)

Notes:

Uniaxial Compression Test Report Sheet

I.G.S.L.

Sample Identification

Contract Name:	N6 Galway Transport Project (Phase 2)
Job Number:	18746
Hole No:	RC02/04
Depth (m):	13.5m

Sample Description

Colour:	Pale Grey
Grain size:	Fine grained
Weathering Grade:	Fresh
Rock Type:	LIMESTONE

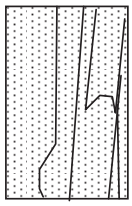
Weathering Grade Criteria

I. Fresh:	Unchanged from original state
II. Slightly weathered:	Slight discolouration, slight weakening
III. Moderately weathered:	Considerable weakening, penetrative discolouration
IV. Highly weathered:	Considerable weakening, penetrative discolouration, breaks in hand

Sample Measurements

Length	197	
Diameter (Ø)	78	mm

Sketch of Failure Surfaces



Testing

Load Rate	3.3	kN/min
Load at Failure (P)	166	kN

Strength Calculations

Uniaxial Compressive Strength = $\frac{166000}{4775.94}$

$= \frac{1000 \times P}{\prod \times (Ø/2)^2}$

= 34.74 (Mpa)

Bulk Density = 2.67 (Mg/m^3)

Notes:

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18746

CONTRACT N6 Galway Transport Project (Phase 2)

DRILLHOLE NO **RP-2-01**
SHEET Sheet 1 of 4

CO-ORDINATES

GROUND LEVEL (mOD)

RIG TYPE Mack Truck
FLUSH Air Percussive
INCLINATION (deg) -90
CORE DIAMETER (mm)

DATE DRILLED 22/09/2015
DATE LOGGED 22/09/2015

CLIENT Galway County Council
ENGINEER ARUP

DRILLED BY Mulcair Drilling
LOGGED BY JL

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								Driller reports overburden				
1												
2												
3									3.00			
								Driller reports LIMESTONE				
4												
5												
6												
7												
8												
9												

REMARKS

Rotary percussive methods to 35m depth bgl. 50mm diameter well installed in rotary percussive hole following completion of drilling.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
22-09-15	35.00	1.00	35.00	50mm SP

IGSL_RC FI 10M 18746.GPJ IGSL.GDT 9/11/15

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18746

CONTRACT N6 Galway Transport Project (Phase 2)

DRILLHOLE NO **RP-2-01**
SHEET Sheet 2 of 4

CO-ORDINATES

GROUND LEVEL (mOD)

RIG TYPE Mack Truck
FLUSH Air Percussive
INCLINATION (deg) -90
CORE DIAMETER (mm)

DATE DRILLED 22/09/2015
DATE LOGGED 22/09/2015

CLIENT Galway County Council
ENGINEER ARUP

DRILLED BY Mulcair Drilling
LOGGED BY JL

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10								Driller reports LIMESTONE *(continued)*				
11												
12												
13												
14												
15												
16												
17												
18												
19												

REMARKS

Rotary percussive methods to 35m depth bgl. 50mm diameter well installed in rotary percussive hole following completion of drilling.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
22-09-15	35.00	1.00	35.00	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL_RC FI 10M 18746.GPJ IGSL.GDT 9/11/15

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18746

CONTRACT N6 Galway Transport Project (Phase 2)

DRILLHOLE NO **RP-2-01**
SHEET Sheet 3 of 4

CO-ORDINATES

GROUND LEVEL (mOD)

RIG TYPE Mack Truck
FLUSH Air Percussive
INCLINATION (deg) -90
CORE DIAMETER (mm)

DATE DRILLED 22/09/2015
DATE LOGGED 22/09/2015

CLIENT Galway County Council
ENGINEER ARUP

DRILLED BY Mulcair Drilling
LOGGED BY JL

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
20								Driller reports LIMESTONE *(continued)*				
21												
22												
23												
24												
25												
26												
27												
28												
29												

REMARKS

Rotary percussive methods to 35m depth bgl. 50mm diameter well installed in rotary percussive hole following completion of drilling.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
22-09-15	35.00	1.00	35.00	50mm SP

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18746

CONTRACT N6 Galway Transport Project (Phase 2)

DRILLHOLE NO **RP-2-01**
SHEET Sheet 4 of 4

CO-ORDINATES

GROUND LEVEL (mOD)

DATE DRILLED 22/09/2015
DATE LOGGED 22/09/2015

RIG TYPE Mack Truck
FLUSH Air Percussive
INCLINATION (deg) -90
CORE DIAMETER (mm)

CLIENT Galway County Council
ENGINEER ARUP

DRILLED BY Mulcair Drilling
LOGGED BY JL

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
30								Driller reports LIMESTONE *(continued)*				
31												
32												
33												
34												
35									35.00			
								End of Borehole at 35.00 m				
36												
37												
38												
39												

REMARKS

Rotary percussive methods to 35m depth bgl. 50mm diameter well installed in rotary percussive hole following completion of drilling.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
22-09-15	35.00	1.00	35.00	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL RC FI 10M 18746.GPJ IGSL.GDT 9/11/15

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18746

CONTRACT	N6 Galway Transport Project (Phase 2)
DRILLHOLE NO	**RP-2-03**
SHEET	Sheet 1 of 4
CO-ORDINATES	
GROUND LEVEL (mOD)	
DATE DRILLED	21/09/2015
DATE LOGGED	21/09/2015
RIG TYPE	Mack Truck
FLUSH	Air Percussive
CLIENT	Galway County Council
INCLINATION (deg)	-90
DRILLED BY	Mulcair Drilling
ENGINEER	ARUP
CORE DIAMETER (mm)	
LOGGED BY	JL

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								Driller reports overburden				
1												
2												
3									3.00			
								Driller reports LIMESTONE				
4												
5												
6												
7												
8												
9												

REMARKS

Rotary percussive methods to 35m depth bgl. 50mm diameter well installed in rotary percussive hole following completion of drilling.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
21-09-15	35.00	1.00	35.00	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL RC FI 10M 18746.GPJ IGSL.GDT 9/11/15

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18746

CONTRACT	N6 Galway Transport Project (Phase 2)
DRILLHOLE NO	**RP-2-03**
SHEET	Sheet 2 of 4
CO-ORDINATES	
GROUND LEVEL (mOD)	
DATE DRILLED	21/09/2015
DATE LOGGED	21/09/2015
RIG TYPE	Mack Truck
FLUSH	Air Percussive
INCLINATION (deg)	-90
CORE DIAMETER (mm)	
CLIENT	Galway County Council
ENGINEER	ARUP
DRILLED BY	Mulcair Drilling
LOGGED BY	JL

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10								Driller reports LIMESTONE *(continued)*				
11												
12												
13												
14												
15												
16												
17												
18												
19												

REMARKS

Rotary percussive methods to 35m depth bgl. 50mm diameter well installed in rotary percussive hole following completion of drilling.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
21-09-15	35.00	1.00	35.00	50mm SP

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18746

CONTRACT N6 Galway Transport Project (Phase 2)

DRILLHOLE NO **RP-2-03**
SHEET Sheet 3 of 4

CO-ORDINATES

GROUND LEVEL (mOD)

RIG TYPE Mack Truck
FLUSH Air Percussive
INCLINATION (deg) -90
CORE DIAMETER (mm)

DATE DRILLED 21/09/2015
DATE LOGGED 21/09/2015

CLIENT Galway County Council
ENGINEER ARUP

DRILLED BY Mulcair Drilling
LOGGED BY JL

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
20								Driller reports LIMESTONE *(continued)*				
21												
22												
23												
24												
25												
26												
27												
28												
29												

REMARKS

Rotary percussive methods to 35m depth bgl. 50mm diameter well installed in rotary percussive hole following completion of drilling.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
21-09-15	35.00	1.00	35.00	50mm SP

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18746

CONTRACT N6 Galway Transport Project (Phase 2)

DRILLHOLE NO **RP-2-03**
SHEET Sheet 4 of 4

CO-ORDINATES

GROUND LEVEL (mOD)

DATE DRILLED 21/09/2015
DATE LOGGED 21/09/2015

RIG TYPE Mack Truck
FLUSH Air Percussive
INCLINATION (deg) -90
CORE DIAMETER (mm)

CLIENT Galway County Council
ENGINEER ARUP

DRILLED BY Mulcair Drilling
LOGGED BY JL

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
30								Driller reports LIMESTONE *(continued)*				
31												
32												
33												
34												
35									35.00			
								End of Borehole at 35.00 m				
36												
37												
38												
39												

REMARKS

Rotary percussive methods to 35m depth bgl. 50mm diameter well installed in rotary percussive hole following completion of drilling.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
21-09-15	35.00	1.00	35.00	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL RC FI 10M 18746.GPJ IGSL.GDT 9/11/15

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18746

CONTRACT	N6 Galway Transport Project (Phase 2)	**DRILLHOLE NO**	**RP-2-04**
		SHEET	Sheet 1 of 1
CO-ORDINATES		**DATE DRILLED**	23/09/2015
GROUND LEVEL (mOD)		**DATE LOGGED**	23/09/2015
RIG TYPE	Mack Truck		
FLUSH	Air Percussive		
CLIENT	Galway County Council	**INCLINATION (deg)**	-90
ENGINEER	ARUP	**CORE DIAMETER (mm)**	
		DRILLED BY	Mulcair Drilling
		LOGGED BY	JL

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								Driller reports peaty overburden				
1												
									2.00			
2								Driller reports MARL				
3												
									4.00			
4								Driller reports coarse grained gravelly SAND				
5												
6												
7												
									7.50			
8								End of Borehole at 7.50 m				
9												

REMARKS

Rotary percussive methods to 7.50m depth bgl. Percussive drilling suspended after observing minor sinkholes developing in proximity to the rig. Presumed initiated by compressed air-supported drilling. Borehole backfilled with arisings.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18746

CONTRACT N6 Galway Transport Project (Phase 2)

DRILLHOLE NO **RP-2-05**
SHEET Sheet 1 of 5

CO-ORDINATES

GROUND LEVEL (mOD)

RIG TYPE Mack Truck
FLUSH Air Percussive
INCLINATION (deg) -90
CORE DIAMETER (mm)

DATE DRILLED 23/09/2015
DATE LOGGED 23/09/2015

CLIENT Galway County Council
ENGINEER ARUP

DRILLED BY Mulcair Drilling
LOGGED BY JL

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								Driller reports overburden				
1									1.50			
								Driller reports LIMESTONE				
2												
3												
4												
5												
6												
7												
8												
9												

REMARKS

Rotary percussive methods to 45m depth bgl. 50mm diameter well installed in rotary percussive hole following completion of drilling.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
23-09-15	45.00	1.00	35.00	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL RC FI 10M 18746.GPJ IGSL.GDT 9/11/15

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18746

CONTRACT	N6 Galway Transport Project (Phase 2)	**DRILLHOLE NO**	**RP-2-05**
		SHEET	Sheet 2 of 5
CO-ORDINATES		**DATE DRILLED**	23/09/2015
GROUND LEVEL (mOD)		**DATE LOGGED**	23/09/2015
RIG TYPE	Mack Truck		
FLUSH	Air Percussive		
CLIENT	Galway County Council	**INCLINATION (deg)**	-90
ENGINEER	ARUP	**CORE DIAMETER (mm)**	
		DRILLED BY	Mulcair Drilling
		LOGGED BY	JL

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10								Driller reports LIMESTONE *(continued)*				
11												
12												
13												
14												
15												
16												
17												
18												
19												

REMARKS

Rotary percussive methods to 45m depth bgl. 50mm diameter well installed in rotary percussive hole following completion of drilling.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
23-09-15	45.00	1.00	35.00	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL_RC FI 10M 18746.GPJ IGSL.GDT 9/11/15

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18746

CONTRACT N6 Galway Transport Project (Phase 2)

DRILLHOLE NO **RP-2-05**
SHEET Sheet 3 of 5

CO-ORDINATES

GROUND LEVEL (mOD)

RIG TYPE Mack Truck
FLUSH Air Percussive
INCLINATION (deg) -90
CORE DIAMETER (mm)

DATE DRILLED 23/09/2015
DATE LOGGED 23/09/2015

CLIENT Galway County Council
ENGINEER ARUP

DRILLED BY Mulcair Drilling
LOGGED BY JL

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
20								Driller reports LIMESTONE *(continued)*				
21												
22												
23												
24												
25												
26												
27												
28												
29												

REMARKS

Rotary percussive methods to 45m depth bgl. 50mm diameter well installed in rotary percussive hole following completion of drilling.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
23-09-15	45.00	1.00	35.00	50mm SP

IGSL_RC FI 10M 18746.GPJ IGSL.GDT 9/11/15

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18746

CONTRACT N6 Galway Transport Project (Phase 2)

DRILLHOLE NO **RP-2-05**
SHEET Sheet 4 of 5

CO-ORDINATES

GROUND LEVEL (mOD)

RIG TYPE Mack Truck
FLUSH Air Percussive
INCLINATION (deg) -90
CORE DIAMETER (mm)

DATE DRILLED 23/09/2015
DATE LOGGED 23/09/2015

CLIENT Galway County Council
ENGINEER ARUP

DRILLED BY Mulcair Drilling
LOGGED BY JL

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
30								Driller reports LIMESTONE *(continued)*				
31												
32												
33												
34												
35												
36												
37												
38												
39												

REMARKS

Rotary percussive methods to 45m depth bgl. 50mm diameter well installed in rotary percussive hole following completion of drilling.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
23-09-15	45.00	1.00	35.00	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL_RC FI 10M 18746.GPJ IGSL.GDT 9/11/15

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18746

CONTRACT N6 Galway Transport Project (Phase 2)

DRILLHOLE NO **RP-2-05**
SHEET Sheet 5 of 5

CO-ORDINATES

GROUND LEVEL (mOD)

DATE DRILLED 23/09/2015
DATE LOGGED 23/09/2015

RIG TYPE Mack Truck
FLUSH Air Percussive
INCLINATION (deg) -90
CORE DIAMETER (mm)

CLIENT Galway County Council
ENGINEER ARUP

DRILLED BY Mulcair Drilling
LOGGED BY JL

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
40								Driller reports LIMESTONE *(continued)*				
41												
42												
43												
44												
45									45.00			
								End of Borehole at 45.00 m				
46												
47												
48												
49												

REMARKS

Rotary percussive methods to 45m depth bgl. 50mm diameter well installed in rotary percussive hole following completion of drilling.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
23-09-15	45.00	1.00	35.00	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL RC FI 10M 18746.GPJ IGSL.GDT 9/11/15

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18746

CONTRACT N6 Galway Transport Project (Phase 2)

DRILLHOLE NO **RP-2-05A**
SHEET Sheet 1 of 2

CO-ORDINATES

GROUND LEVEL (mOD)

RIG TYPE Mack Truck
FLUSH Air Percussive
INCLINATION (deg) -90
CORE DIAMETER (mm)

DATE DRILLED 23/09/2015
DATE LOGGED 23/09/2015

CLIENT Galway County Council
ENGINEER ARUP

DRILLED BY Mulcair Drilling
LOGGED BY JL

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								Driller reports overburden				
1									1.50			
2								Driller reports LIMESTONE				
3												
4												
5												
6												
7												
8												
9												

REMARKS

Rotary percussive methods to 12m depth bgl. 50mm diameter well installed in rotary percussive hole following completion of drilling.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
23-09-15	12.00	1.00	12.00	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL RC FI 10M 18746.GPJ IGSL.GDT 9/11/15

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18746

CONTRACT	N6 Galway Transport Project (Phase 2)
DRILLHOLE NO	**RP-2-05A**
SHEET	Sheet 2 of 2
CO-ORDINATES	
GROUND LEVEL (mOD)	
DATE DRILLED	23/09/2015
DATE LOGGED	23/09/2015
RIG TYPE	Mack Truck
FLUSH	Air Percussive
CLIENT	Galway County Council
INCLINATION (deg)	-90
DRILLED BY	Mulcair Drilling
ENGINEER	ARUP
CORE DIAMETER (mm)	
LOGGED BY	JL

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10								Driller reports LIMESTONE *(continued)*				
11												
									12.00			
12								End of Borehole at 12.00 m				
13												
14												
15												
16												
17												
18												
19												

REMARKS

Rotary percussive methods to 12m depth bgl. 50mm diameter well installed in rotary percussive hole following completion of drilling.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
23-09-15	12.00	1.00	12.00	50mm SP

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL RC FI 10M 18746.GPJ IGSL.GDT 9/11/15