



Job No: 615478.6240
18 February 2015

Clough and Associates
321 Forest Hill Road
Waiatarua
Auckland 0612

Attention: Rod Clough

Dear Rod,

Quarry Road Site Report – Ground Penetrating Radar Survey

Introduction

Geotechnics was engaged to complete a Ground Penetrating Radar (GPR) survey of the lava deposits on Quarry Road in Mangere (see site plan), searching for potential underground voids or anomalies at the above mentioned location and provide an interpretation of the acquired survey data.

Date of Investigation

19/02/2015.

Test Location Plan

A plan with annotated GPR survey plans and encountered anomalies is attached. The plan provides indicative locations only and is not to scale. All other information we provide regarding location should be referenced to the asset owner.

Customer's Instructions

Complete a GPR survey over the area as shown in the site plan, to identify any underground voids or anomalies. Provide interpretation of the GPR survey data.

Test Method

Geotechnics in-house Standard Operating Procedure for GPR.

Test Results

The GPR operator's survey interpretations are attached.

The operator has listed details such as location, estimated size and depth of anomalies and the estimated starting position.

General Remarks

Further geotechnical testing and investigation may be required to verify and determine the size and extent of any anomalies identified by the GPR survey. We can provide additional testing where required, but it may need to be under the direction of a registered geotechnical engineer.

These further investigations can include field tests such as (but not limited to):

- Coring through the concrete to expose the underlying layer and any voids present.
- Field density testing in accordance with NZS 4402.6.5.2:1988. 'Hand method using a dynamic cone penetrometer' (Scala).
- Hand auger boreholes (field soil classification in accordance with 'Guideline for the Field Classification of Soil and Rock for Engineering Purposes' by New Zealand Geotechnical Society (December 2005).

The inherent uncertainties of site investigation work, mean the nature and continuity of subsoil away from the GPR survey could vary from the data logged.

We provide the logs and results for your interpretation and inference.

This work was conducted under the terms of the attached Underground Service Location Disclaimer.

Please reproduce this report in full when transmitting to others or including in internal reports.

If we can be of any further assistance, feel free to get in touch at our contact details at the bottom of the letterhead page.

GEOTECHNICS LTD

Report prepared by:



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Field Technician

Authorised for Geotechnics by:

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Regional Manager

This report consists of 13 pages.

Underground Service Location Disclaimer

To minimise your risk of striking underground services while digging, drilling or probing into the ground, Geotechnics use -

- relevant service plans;
- digital service locators (radio frequency and electromagnetic); and
- Ground penetrating radar (GPR).

We believe that using these three tools in conjunction, significantly reduces the risk of striking underground services which can cause injury to staff, damage to machinery, significant costs and delays in project completion.

Service Plans

Service plans can only be used as a guide to where services actually are, especially for private properties.

Digital Service Locator

We use some of the best technology available in the market for utility location, but still this does not detect all buried utilities. A buried line or pipe must conduct an electronic signal, transmitted by our equipment, to be accurately detected with cable locators.

Geotechnics are not responsible for -

- Non-conductive lines (non-metallic, PVC, water lines, etc.);
- conductive lines with no accessible connection point; and
- Lines that do not appear on blueprints, maps, or as-builts provided by the customer.

Ground Penetrating Radar

Because depth of exploration is dependent on the electrical properties of material(s) inspected and interpretations are opinions based on judgments made from those acquired radar signals and/or data, Geotechnics does not guarantee the accuracy or correctness of interpretations. Geotechnics will not accept liability or responsibility for any loss, damage or expense that may be incurred or sustained by any services as a result of interpretations performed by us.

It is possible that a strong conductor may mask the presence of other services that are poor conductors, e.g. a high voltage cable will likely make it difficult to detect other lower voltage cables, pipes, etc. These may only be detected by using a connection point or self-cancelling induction methods (reversed coils sitting directly over the “offending” cable)

Quarry Road GPR Survey

Output provided:

Site plan

Site plan with voids/anomalies highlighted

GPS data

Examples of voids detected

Photos (annotated)

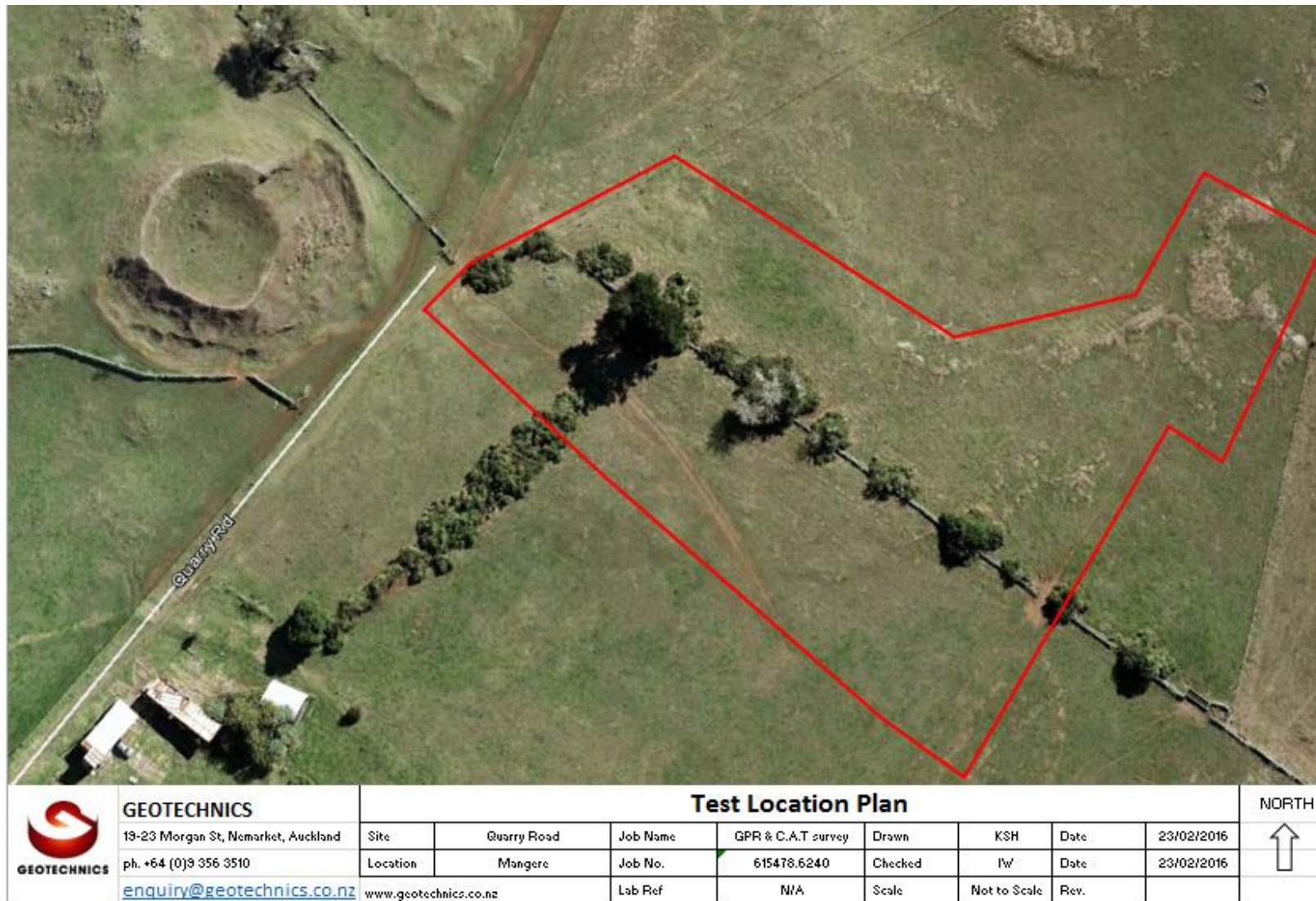
Notes on survey and interpretation

The 'voids' identified in this survey are indicated by a dramatic change in density, which shows up as an anomaly or reflections that differ from the surrounding material. Examples of this are shown in the screenshots of the radar data below.

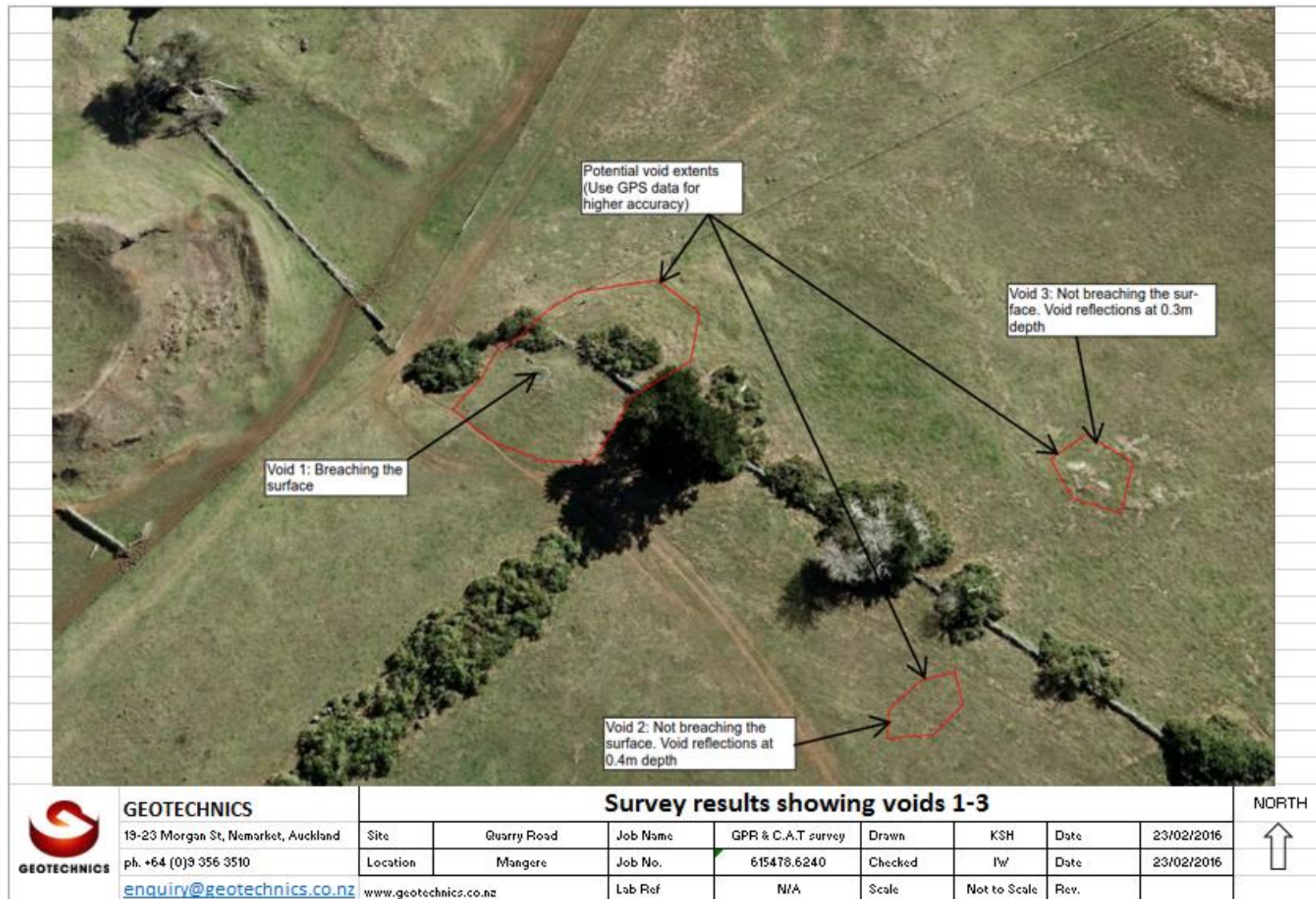
The images below are annotated to better show the location of the identified voids, and the extent of the discovered anomaly. We identified the extent of the main void indicated by your representative on site, however there are limitations to the survey such as survey obstructions i.e vegetation. As well as the depth limitation which in this area was around 3metres at most, however this level of depth penetration should be enough to identify any large voids present in the survey area.

The extent of the flow is visible from the surface, the location and extent of the voids are indicated in this report.

Survey Area



Survey site plan showing voids

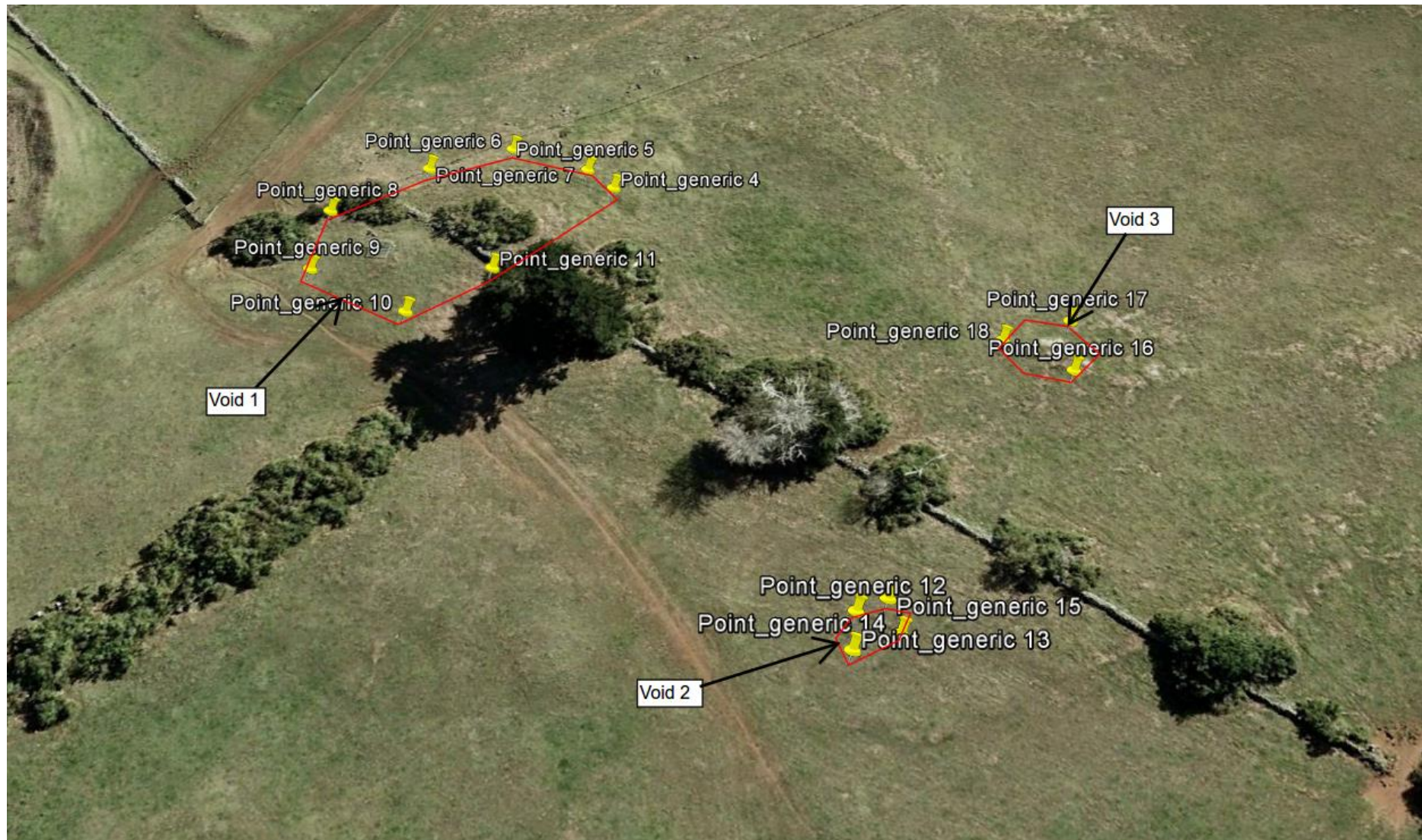


GPS Data

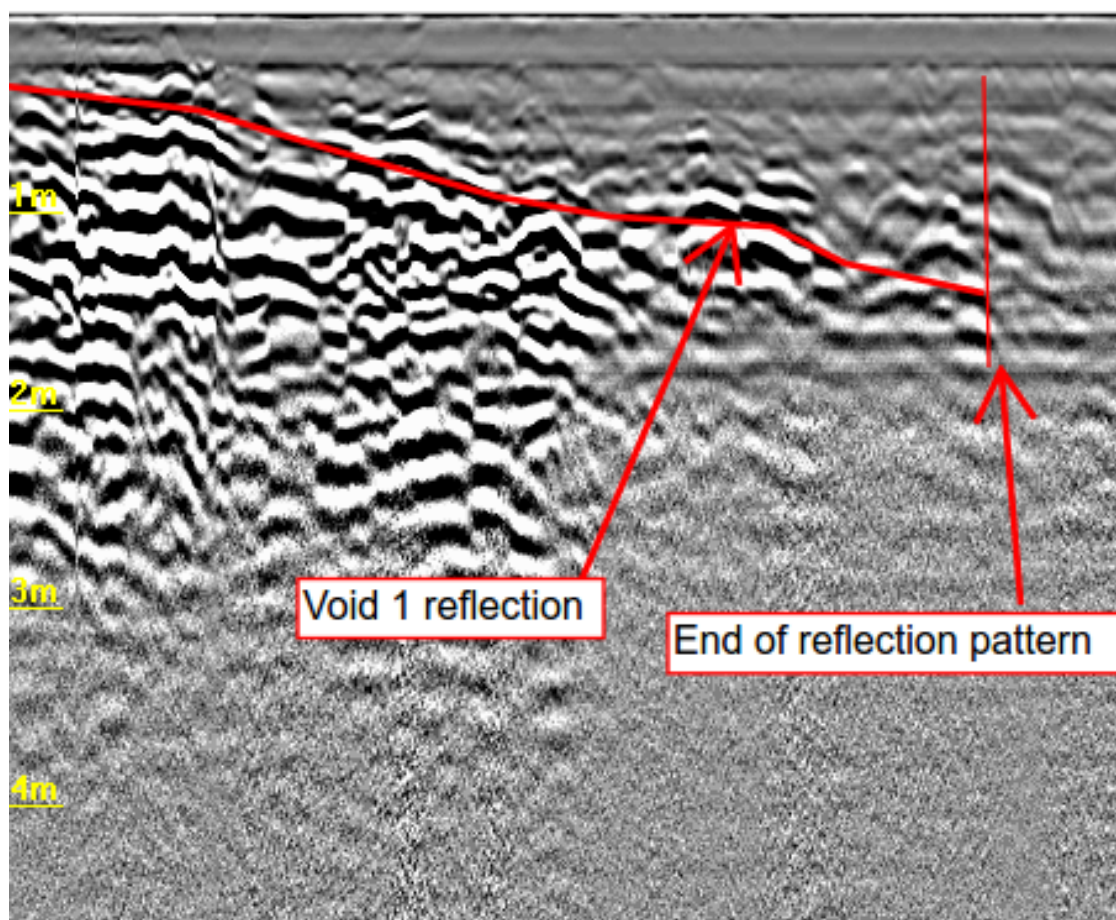
Name	GPSdate	Filename	WGS84	WGS84	WGS84	Auckland 1946 Easting	Northing	Orth.Height
			174 45	36 59				
Void 1\1	19/02/2016	1911QUARRY.cor	30.625664470 E	01.630511440 S	53.491	2666910.759	6467179.224	19.918
			174 45	36 59				
Void 1\2	19/02/2016	1911QUARRY.cor	30.471033690 E	01.522555894 S	54.309	2666907.004	6467182.629	20.736
			174 45	36 59				
Void 1\3	19/02/2016	1911QUARRY.cor	30.032674750 E	01.384598379 S	54.483	2666896.252	6467187.102	20.910
			174 45	36 59				
Void 1\4	19/02/2016	1911QUARRY.cor	29.584658110 E	01.517410401 S	54.477	2666885.092	6467183.235	20.904
			174 45	36 59				
Void 1\5	19/02/2016	1911QUARRY.cor	29.099040610 E	01.792724805 S	55.079	2666872.912	6467174.995	21.507
			174 45	36 59				
Void 1\6	19/02/2016	1911QUARRY.cor	29.079697030 E	02.151667299 S	55.438	2666872.207	6467163.943	21.866
			174 45	36 59				
Void 1\7	19/02/2016	1911QUARRY.cor	29.635100410 E	02.401261206 S	54.439	2666885.783	6467155.970	20.867
			174 45	36 59				
Void 1\8	19/02/2016	1911QUARRY.cor	30.041174720 E	02.145005386 S	54.508	2666895.984	6467163.663	20.936
			174 45	36 59				
Void 2\1	19/02/2016	1911QUARRY.cor	31.949851290 E	03.856749141 S	48.985	2666942.098	6467109.943	15.414
			174 45	36 59				
Void 2\2	19/02/2016	1911QUARRY.cor	31.931856810 E	04.020318314 S	48.722	2666941.550	6467104.911	15.151
			174 45	36 59				
Void 2\3	19/02/2016	1911QUARRY.cor	32.147287340 E	03.952352585 S	48.550	2666946.919	6467106.897	14.979
			174 45	36 59				
Void 2\4	19/02/2016	1911QUARRY.cor	32.094175750 E	03.802147071 S	48.791	2666945.701	6467111.553	15.220
			174 45	36 59				
Void 3\1	19/02/2016	1911QUARRY.cor	33.059475640 E	02.698222938 S	48.098	2666970.262	6467145.088	14.525
			174 45	36 59				
Void 3\2	19/02/2016	1911QUARRY.cor	33.072256820 E	02.423751795 S	47.989	2666970.751	6467153.541	14.416
			174 45	36 59				
Void 3\3	19/02/2016	1911QUARRY.cor	32.713770500 E	02.531201051 S	48.805	2666961.820	6467150.410	15.232

Note: accuracy of Easting and Northing are to within 0.4m. Elevation is to within 1m

GPS Google Earth overlay



Example of void 1 reflection



Annotated Images

Void 1



Void 2



Void 3