MALA GPR Australia
26/10-18 Orchard Road
Brookvale, NSW 2100

Tank Investigation

COMPANY	Dad & Dave's Brewing
COMPANY CONTACT	Dave Dumay
PROJECT SITE	45 Mitchell Rd Brookvale NSW, 2100.
ONSITE CONTACT	Dave Dumay
JOB ID	GNX20248
SURVEY DATES	3rd of April 2020
REPORT DATE	4th of April 2020

COMPILED BY

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Geophysicist

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1.0 Introduction

1.2 Scope of Works

MALA GPR Australia was contracted by Dad & Dave's Brewing (DDB) to assist with identifying the potential of an underground storage tank beneath their car park at 45 Mitchell Rd, Brookvale.

1.3 Survey Area

The survey area was determined by DDB defined by a red polygon over Google maps in Figure 1. DDB supplied a Warringah Shire Council permission application dated 1976, this gave an approximate location of the tank within the survey area (Figure 2). Figure 3 illustrates the survey area at ground level with the tanks depicted location and survey area outlined. The 2D GPR coverage over this area was acquired via RTK GPS. The area had sufficient satellite coverage to yield accurate relocation (Figure 4).

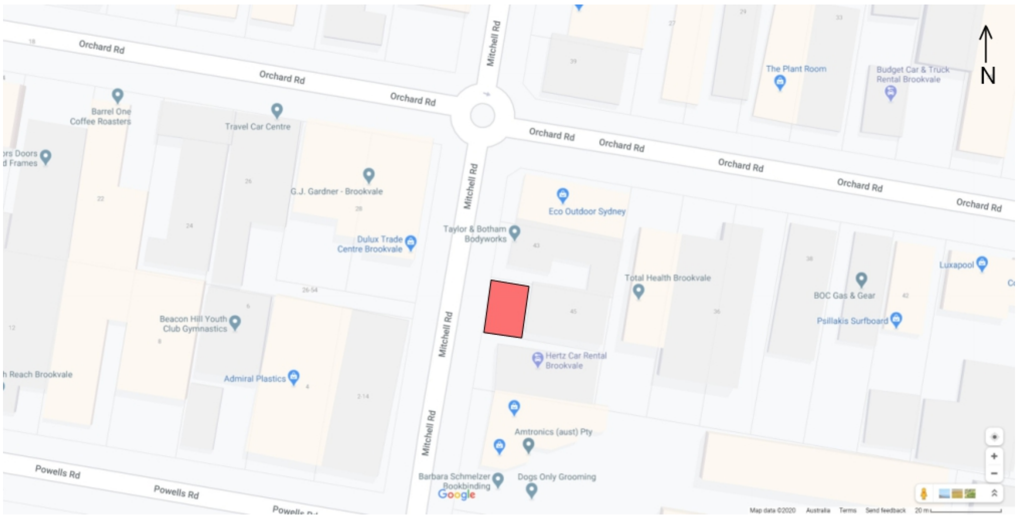

Figure 1 - Polygon over Google Maps of survey area (45 Mitchell Rd, Brookvale, 2100).

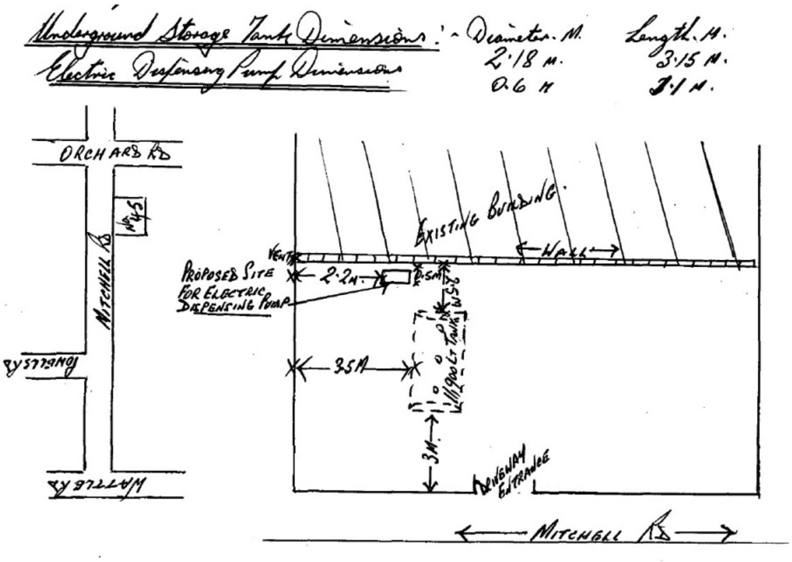

Figure 2–Warringah Shire council application document (1976) showing the tanks apparent location within the survey area.

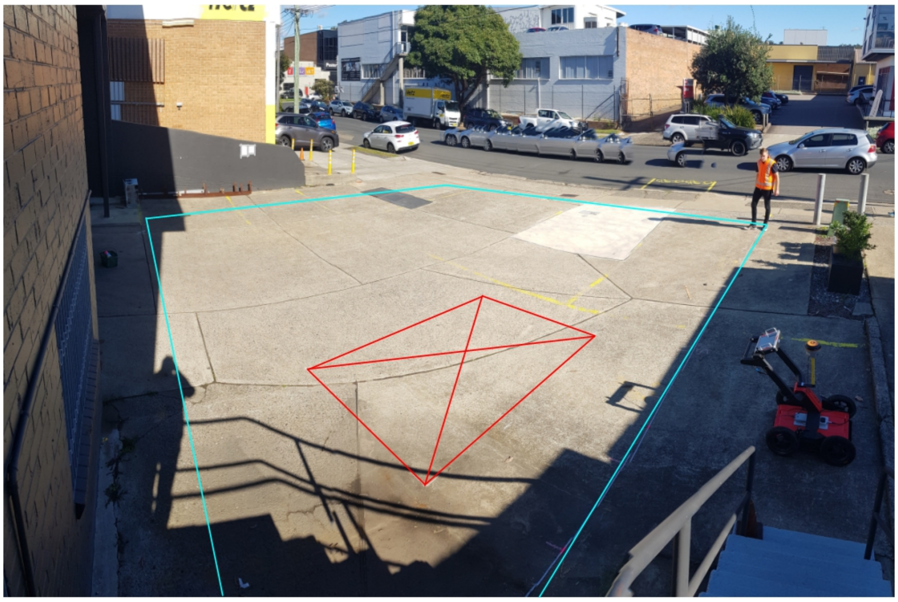

Figure 3 – Total survey Area defined by blue box, red box outlines apparent tank location.

Figure 4 - 2D Survey coverage, x and y axis grid.

The Council document states the diameter of the tank to be 2.5m and 3.5m in length. Tank capacity is claimed to be 11,900 litres buried at a maximum depth to 3.4m. Taking the total depth and diameter into account the top of the tank should be approximately 1m below the surface. The tank also had an associated bowser at one point in time mounted against the building. A valve/pipe is visible at the surface under the stair case suspected to be relating to the tank/bowser (Figure 5).

Figure 5 - Valve/pipe believed to be associated with the tank/bowser, located under the stairs in the car park.

2.0 Geophysical Techniques

2.1 Ground Penetrating Radar

Ground Penetrating Radar (GPR) is a geophysical method that uses radar pulses to image the subsurface. GPR uses transmitting and receiving antennas in which the transmitting antenna radiates short pulses of high-frequency radio waves into the ground/material. When the wave hits a subsurface object or a boundary with differing dielectric permeabilities, the receiving antenna records variations in the reflected return signal (Figure 6).

The depth range of a certain frequency GPR is limited by the electrical conductivity of the ground. As ground conductivity increases, the signal penetration depth decreases. This is caused when the electromagnetic pulse emitted by a GPR transmitter is attenuated and more quickly dissipated into heat, causing a loss in signal strength at depth.

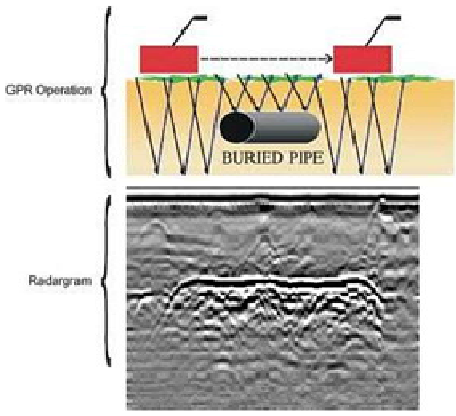

Figure 6: GPR radargram 2D cross section displaying anomaly along (parallel to) a buried pipe.

3.0 Data Acquisition

3.1 Staffing

Data was acquired on site by Geophysicist William Barber(B.Sci) of MALA GPR Australia. Data processing and geophysical report compilation was performed offsite by William Barber and reviewed by senior Geophysicist Mads Toft (M. Geo).

3.2 Survey Methodology

The area under investigation was surveyed in both X and Y orientations with 2D GPR and full coverage via 3D GPR. A grid pattern was used for the 2D acquisition to attempt to delineate the tank in both possible orientations. Full site coverage was acquired in 3D with the MIRA system.

3.3 Instrumentation Used

The area was surveyed using the following systems

- MALA 400Mhz 3D MIRA system - 16 Channel400Mhz (Figure 7)
- MALA Easy Locator HDR WideRange 670/160MHz (Figure 8)

MALA GPR Imaging Radar Array (MIRA) is the most technically advanced GPR system on the market. It is the only system of its kind that integrates acquisition, processing, QA/QC, positioning data, interpretation and export of ground penetrating radar data (Figure 7).

The MIRA instrument has the ability to quickly and easily gather full 3D data in broad paths, called "swats" using 16 channels. This allows for data collection in one pass (i.e. a swat needs to be covered only once, in singular direction) as opposed to single channel systems which require multiple passes in multiple directions. The MIRA system is an efficient and effective solution for large scale ground penetrating radar mapping and subsurface object identification. Results are processed in 3D depth slices and are displayed and interpreted through a dedicated software package (rSlicer) and then exported into suitable GIS or CAD data formats (.dxf) if required.

Figure 7 - MALA MIRA 400Mhz 16 Channel 3D GPR System.

MALA Easy Locator Wide Range HDR GPR; represents one of the highest levels of 2D GPR surveying. This dual frequency system (670Mhz/160Mhz) is portable and easily integrated into a range of configurations for manoeuvring which will allow for a time efficient and cost-effective solution for large scale ground penetrating radar mapping and subsurface object identification. The GPR system was manoeuvred by hand in a pushcart solution for this investigation.

Figure 8 - MALA Easy Locator Wide Range in Rough Terrain Cart

3.5 Positioning

Positioning for the GPR survey was tracked by an external Hemisphere RTK GPS rover antenna, mounted above both 2D and 3D instruments. Horizontal accuracy is approximately 100-300mm when a fix is obtained from GLONASS satellites. Horizontal chainage for GPR profiling was measured using an optical distance encoder triggered by the instruments left rear wheel. Figure 4 represents the GPR profiles acquired.

4.0 Data Processing and Interpretation

4.1 Survey Parameters

Data collected using the MALA MIRA 400Mhz antenna array Data sampling was triggered with an encoder wheel connected to the John Deere rear wheel. The table below outlines the collection parameters used for the survey.

Collection Parameters	400Mhz MIRA Array
Samples per trace	408
Trace Sampling Frequency	4096.55 MHz
Frequency Steps	116
Distance Interval	0.066 m
Antennas	400MHz Shielded
Antenna Separation	0.28 m
Time Window	99.59 ns
Stacks	4

Data collected using the Easy Locator Wide Range HDR was triggered with an encoder wheel on the WideRange road cart. The table below outlines the collection parameters used for the survey.

Collection Parameters	Easy Locator WideRange HDR
Distance Interval	0.025 m
Antenna Frequency	670MHz / 160MHz Shielded
Time Window	200 ns

4.2 Processing Software

The collected GPR data was reviewed in post processing software packages, rSlicer and ObjectMapper 2018.

4.3 Results,Discussion and Conclusion

3D Data –Initial observations made from the data were those regarding data quality and depth penetration. The MIRA survey achieved 100% coverage of the open survey area. Data quality appeared satisfactorywith known features/ anomalies distinctin the data (grease trap and drainage channel at front of property). Depth penetration reached a maximum depth of ~ 2200mm (considering a soil velocity of 8.5cm/μs). With the 400MHz frequency antenna used this depth penetration achieved is indicative of an acceptable subsurface material for GPR technology.

Below are a range of depth slices taken from the 3D data at 500mm intervals to a total depth of 2 meters. The red box has been placed over the area the tank is suggest to have been buried in the council document. The green box outlines the grease trap, a known visible surface anomaly.

No depth sliceshows strong evidence to suggest a subsurface tank is present in the data. However, evidence is apparent of disturbed soils profiles.

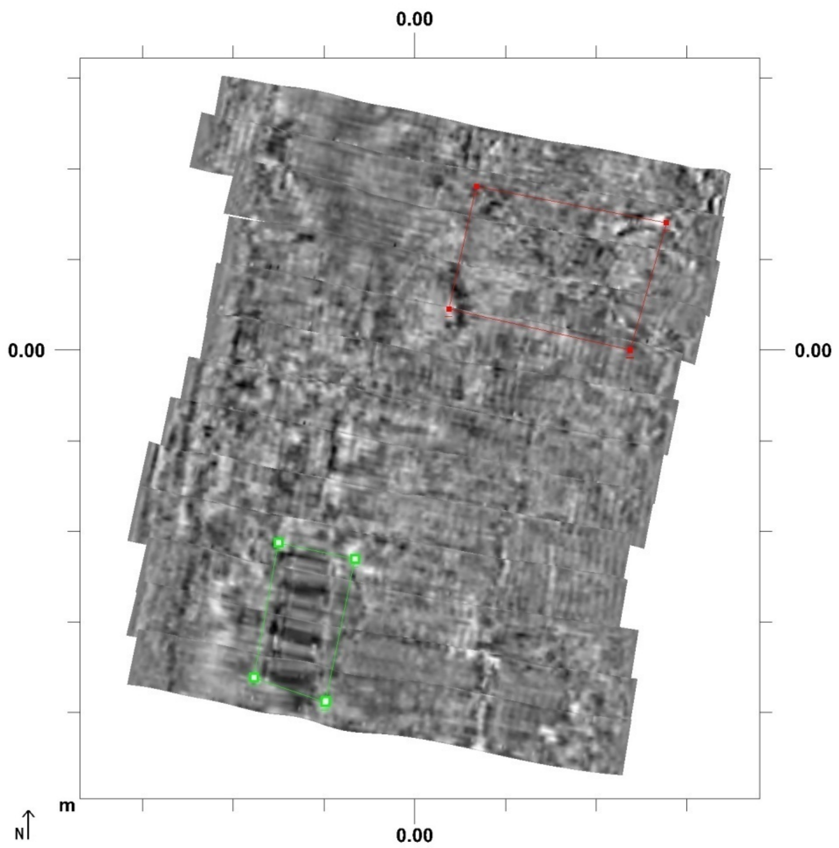

Figure 9 - MIRA data 0.5m depth slice.

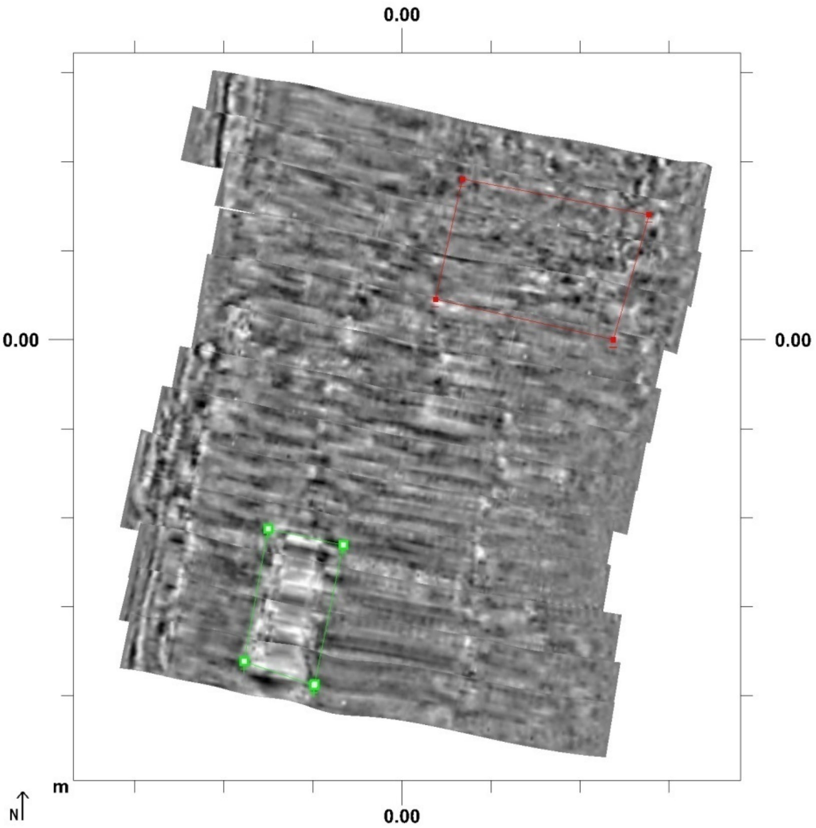

Figure 10 - MIRA data 1m depth slice

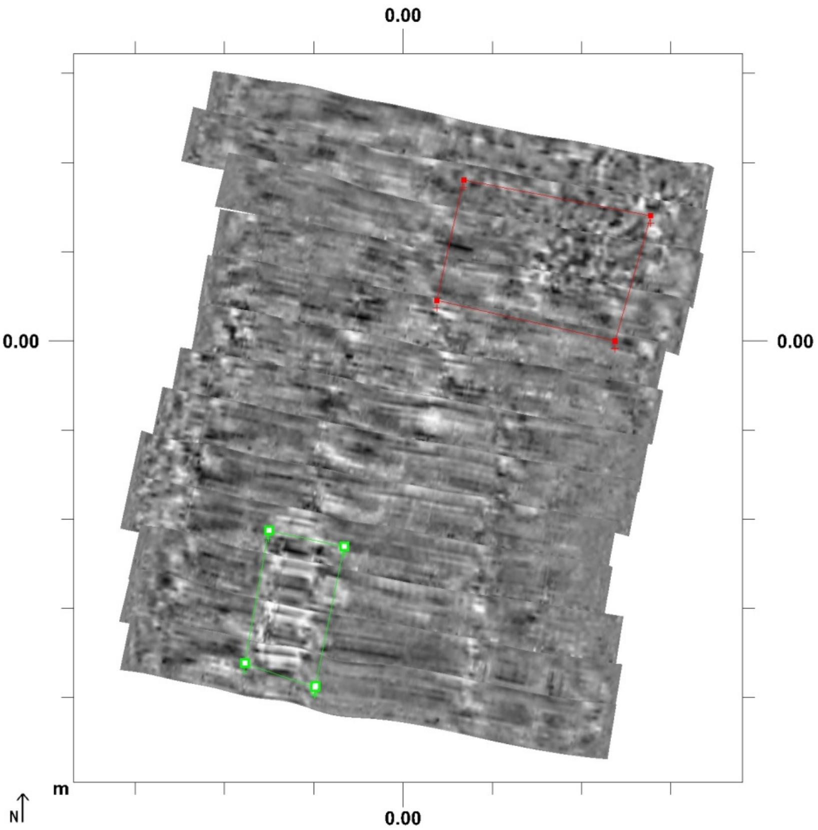

Figure 11 - MIRA Data 1.5m depth slice

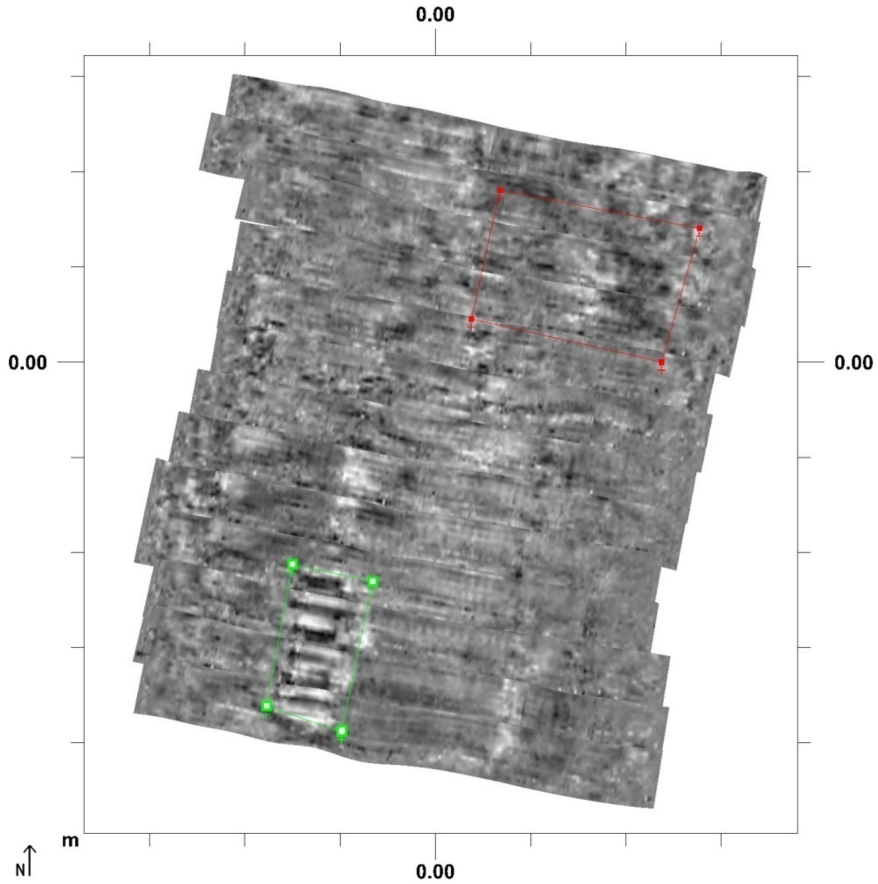

Figure 12 - MIRA Data 2.0m depth slice

2D Data–The 2D data acquired supports evidence of disturbed soil profiles. Figure 13 is a representation of the 2D data acquired.

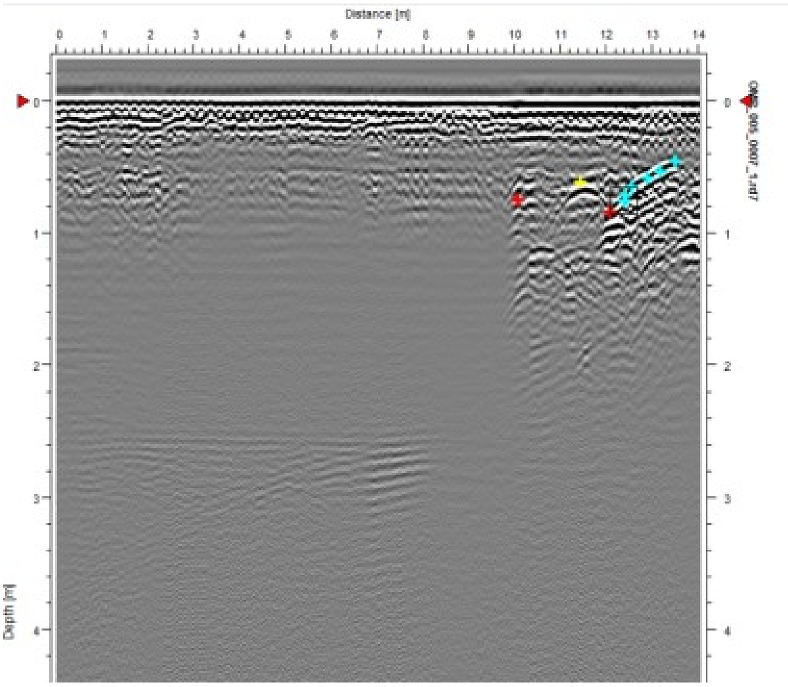

Figure 13 - Example of 2D data acquired (single swath OMP_005_0007_1).

There is a linear feature crossing multiple neighbouring profiles becoming shallower towards the old bowser location (yellow markers, believed to be slightly skewed due to GPS inaccuracies closer to the building). This maybe the subsurface section of pipevisibly terminated under the stairs. Red markers indicate the start of the difference in data surrounding where the tank is believed to be. Blue markings highlight a sharp dipping or cutting in horizons, this could be the sides of previous excavation or potentially running parallel along a subsurface linear feature. Figure 14 shows a plan view of the markings inserted in the 2D profiles.

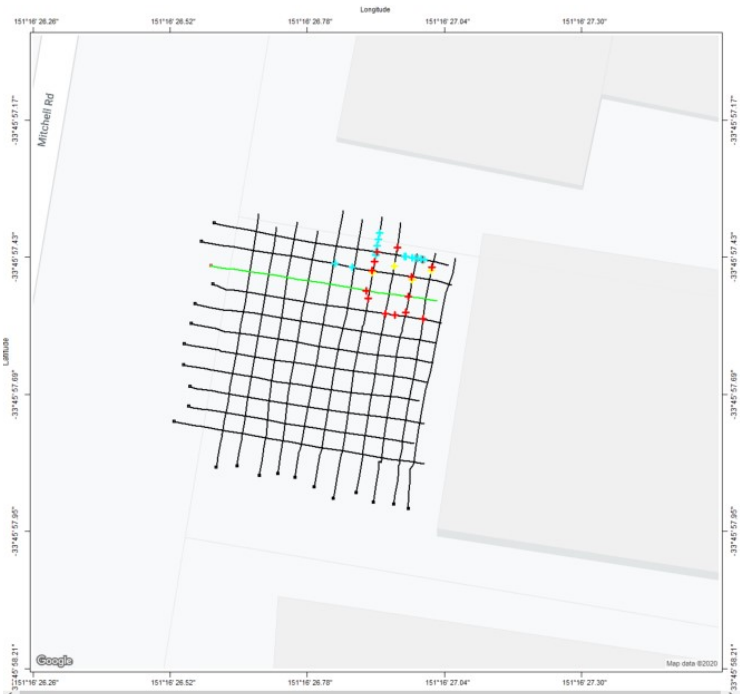

Figure 14 - Plan view of site map of all 2D profile markings.

The 2D data observed does not suggest a subsurface tank is present in the data. There is however evidence of disturbed soil profiles in the area where the tank is believed to be.

6.0 Disclaimer

It should be noted that the attached results are the result of an interpretation of the collected data. Whilst state-of-the-art instrumentation and qualified personnel have been utilised for this survey there are circumstances under which the interpreted result can differ from the actual sub surface strata.

The author accepts no responsibility for actions or decisions made on the basis of the presented result. The results are presented for the clients' review only and should not form the sole basis of any decision or action made in relation to this project.

This report has been prepared for the use of the client as listed on page 1 in accordance with general accepted consulting practice. No other warranty, expressed or implied, is made as to the professional advice included in this report.

This report was prepared on completion of the fieldwork/processing and is based on conditions encountered and reviewed at the time of preparation. MALA GPR Australia disclaims responsibility for any changes that might have occurred after this time.

This report should be read in full, no responsibility for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Only qualified legal practitioners can give legal advice.

Whilst to the best of our knowledge, information contained in this report is accurate at the date of issue; conditions on the site can change in a limited time. This should be borne in mind if the report is used after a protracted delay. As with any form of non-destructive testing, our opinions of results do not apply, we rely solely on date collection and criteria conformance.

If it is found that the actual results differ from the interpreted result the author should be contacted immediately.