INNOVATION, SUSTAINABILITY + DIGITAL IN PRACTICE

ISDIP

ISDIP 066	3D Ground Penetrating Radar
Date	August 2024
Business Unit	Engineering Services
Project & Region	National
ISC Themes	• Management and Governance • Using Resources • People and Place • Innovation

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What Happened?

Buried service strikes are estimated to cost millions of dollars each year across the construction industry and pose a critical safety risk. The engineering services team was tasked with undertaking an innovation sprint to investigate the causes and investigate suitable solutions. Following an analysis of investigations into hundreds of strikes across the Fletcher businesses, three primary causes were identified.

- Poor quality data
- Poor data management
- Operator overconfidence

The team implemented a design-thinking approach to problem solving facilitated through the FB Innovation and sustainability team. Focusing on the team at the Eastern Busway Alliance, the sprint team trialled multiple platforms and equipment to devise a workflow enabling full machine lockout of buried services detected with ground penetrating radar (GPR) equipment. The image below shows an excavator stopped unable to move closer to a lock-out zone around a live water main detected using GPR equipment available through engineering services. The buried services sprint demonstrated how the data can be collected using 3D GPR hosted and visualised by any project, and machine control lock-out implemented through our survey team.

What Are We Doing Differently?

Service locating has become increasingly more important as the construction space grows. Due to a lack in historical evidence and as-built plans, our underground service system is outdated. Some plans may be showing multiple buried pipelines, some lines out of place, others missing completely as they have now been removed. It is rare for service plans to be updated, so often digging based off the plans can pose an unacceptable risk which is easily prevented with robust service location, identification and documentation.

Locating services during the design/planning process of a project can prevent service strikes, redesigns and unsafe working environments. Implementing these investigations early can provide new accurate evidence of the underground service network in your worksite. These new plans will improve productivity and help to keep our workers safe.

Ground Penetrating Radar (GPR) and Electro-Magnetic Locater (EML) are two of the methods used in service locating.

GPR can “see” through almost all surface types (asphalt, soil, low moisture clay, non-reinforced concrete, gravel, sand). The GPR unit will send radar pulses into the ground, which reflect off items like metal, plastic, or concrete. Water also has a high reflectivity on the unit, which means the drier the ground conditions, the better the readings. Lots of ground moisture will cause noise in the data, making tracing or finding services difficult, and sometimes impossible.

With EML, we can confirm placement of any live electrical service, or any metallic lines. This is usually done by connecting to a tracer wire within the pipe, or to the electrical boxes above ground and passing a specific signal through the wire. While tracing the wire, spray marks are left on the ground, colour-coordinated to what the service is. If possible, depths to the top of pipe are also marked.

Example of EML markings

Example of Leica DS2000 markings

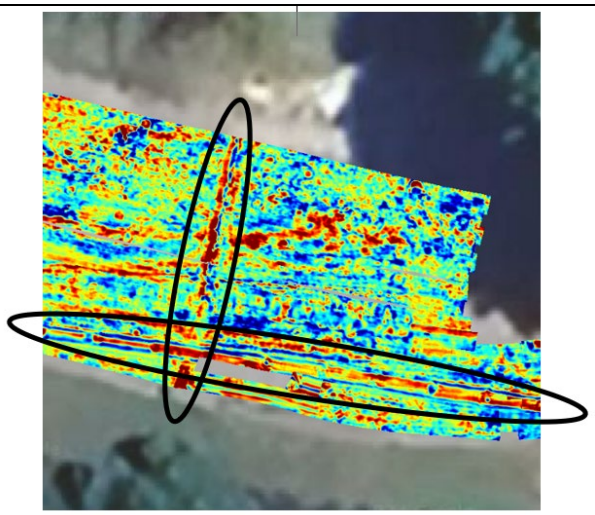
Our team has 2 different types of GPR. We have a Leica DS2000 GPR (a 2D unit), which is used similarly to the EML. This is taken out to find any services that cannot be traced with EML, (Water, stormwater, sewage etc.). This unit can read (depending on ground conditions) up to 4 metres deep. The 2D unit only has 2 antennas, one vertical and one horizontal. What this means, is that to find a buried service, you will need to run the unit perpendicular over the pipeline. You will have to do this every 5 or so meters, depending on intricacy. Like the EML, marks are sprayed on the ground as you go, with heights to the top of pipe. This is a longer process, especially in large work areas.

The second type of GPR we have is the IDS Stream DP (a 3D unit). This is an underground subsurface mapper. This unit (depending on ground conditions) can read up to 6 metres deep. The IDS has 30 antennas, 19 vertical and 11 horizontal.

Because of the large array of antennae built into the IDS, we have the ability to map an entire worksite and provide digital CAD products for the client. Rather than spraying as we go, which we do with the 2D unit, we methodically scan the full extent of a worksite. After this we carefully process the data, comparing to the existing service plans to best identify services, and provide digital 3D linework of the buried services.

We retain the ability to mark the services out on site with the digital linework, but this can be done as needed, rather than months in advance. The data remains valid, unlike spray paint which can be washed away.

Our 3D GPR unit does not show what each utility type is, just depth and location, however we can indicate service types through site reconnaissance, reference to existing plans and/or confirmation with EML.

Example of raw georeferenced software image note – the waste pipe (left to right) and water line (top to bottom)	*Example of georeferenced software image after inspection*
	

The IDS is new technology that is giving our teams the ability to design projects around existing services before work begins, preventing any future delays or strikes.

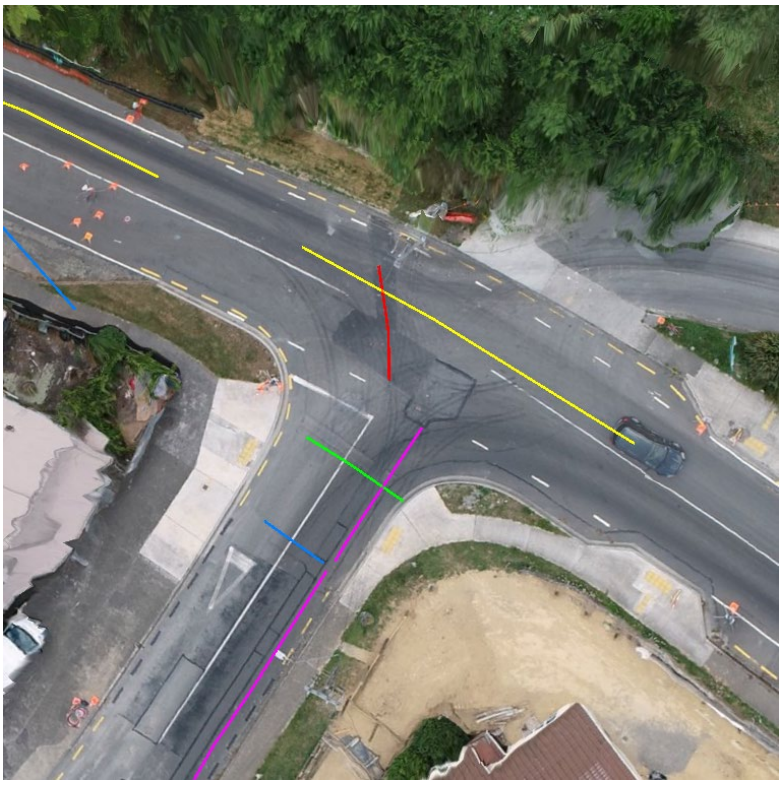
Initial data collection is methodical, and a little slower, however can be performed at any stage prior to work commencing and provides a complete, comprehensive dataset that can be relied on throughout construction.

Traditional 2D service location methodology can miss non-standard service geometry (e.g. curves and kinks) and, in the case of undocumented services, miss services altogether. The results are sprayed on site, with the risk that the marks wash away.

This modern 3D solution is significantly more robust, guaranteeing 100% coverage and storing the data digitally.

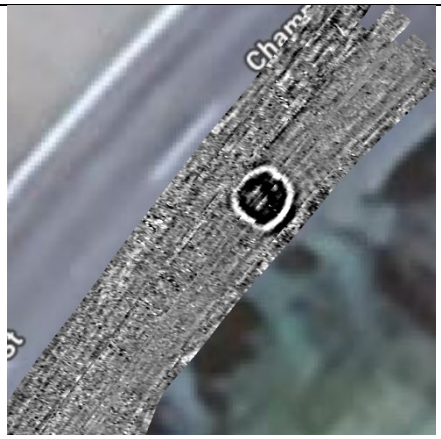
This technology also helps keep our workers on the ground safe from harm, decreasing the risk of service strikes.

Example of linework provided



Another component of the IDS is the ability to find voids. This has become increasingly helpful with road rehabilitations, being able to see potential potholes before they have formed and getting to the problem early.

In a recent test in Matamata, we were able to locate a void below the pavement of a roundabout and identify the likely failure of a stormwater pipe as the cause. This was subsequently confirmed with CCTV at the precise location that we had non-invasively identified. Armed with this information, we can proactively remediate the stormwater issue and repair the pavement before a significant failure occurs.

Example of void at 1 meter depth below surface	*Example of void at 3.5 meters deep below surface*
	

More Information

Follow this link to the Engineering Services homepage and the ES GPR Landing Page

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