Electromagnetic Conductivity (EMI)

There are three basic methods for the use of magnetic fields in geophysics to detect patterns underground: gradiometery (which detects the ambient magnetic signals of subsurface patterns), conductivity (which detects in magnetization of underground patterns), and susceptibility (which detects patterns of attraction or repulsion to a magnetic field).

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What is a Conductivity Survey?

Conductivity survey, sometimes referred to as Electromagnetic Induction (EMI) is one of a group of technologies that can map the contents of the ground remotely and without digging. Conductivity instruments measure how easily an electrical current can pass through the ground. When a grave is excavated and backfilled it can sometimes result in a mixture of topsoil and subsoil. It might also contain different amounts of water from the surrounding area due to different levels of soil compaction. Both of these factors can influence the electrical properties of the grave. A conductivity survey identifies and maps these differences.

What Role Can It Play in Identifying Missing Children?

Identifying graves through conductivity survey is challenging. Like all geophysics techniques, the ability for a conductivity survey to identify a buried feature, such as grave, depends on how different the grave fill is from the surrounding soil. This will vary from site to site.

Generally speaking, conductivity surveys are not as effective at identifying graves as ground-penetrating radar (GPR). It is therefore likely to remain a secondary technique to complement the results from GPR investigations and to help improve confidence. However, there are certain situations where conductivity surveys will play a more significant role. The first is in areas where GPR survey is unsuitable. This might include areas of high soil conductivity (e.g. clay soils or salty soils near coastlines) or in areas where low lying vegetation prevents the efficient operation of the GPR. Conductivity instruments are not adversely affected by conductive soils and as they arecarried above the ground, they can clear low lying vegetation.

Secondly, conductivity instruments also offer advantages over GPR for the rapid coverage of large areas as they are generally much faster to use. This type of survey, often referred to as reconnaissance or prospection survey, is not used to identify the location of individual graves but rather to identify larger features such as buried building foundations or define areas of interest for further study. This can help improve the efficiency of GPR investigations.

One further advantage of a conductivity survey is that many EMI instruments simultaneously record the magnetic susceptibility of the soil. This allows you to investigate two different physical properties of the soil at the same time (see technical sheet on Magnetic Susceptibility).

What Are the Challenges of Conductivity Survey?

Conductivity surveys need to be collected carefully and require special training. Courses for Indigenous communities to build this capacity are being developed. Conductivity only works in some kinds of landscapes and conditions. It is adversely affected by the presence of metal (e.g. buried services) so areas immediately around buildings are likely to be too “noisy” for effective identification of graves. The interpretation of a burial in conductivity survey is complex and builds out of experience. It cannot locate children who do not have a burial. Our understanding of this tool improves if we share information between communities, but this can be difficult.