

Using a combination of electromagnetic instruments, a fast, accurate and cost-effective system of mapping soil conductivities is available. Electromagnetic terrain conductivity surveying is carried out using the Geonics Ltd. EM31 and EM34 terrain conductivity instruments.

The EM31 is an electromagnetic instrument consisting of a transmitter coil and a receiver coil at opposing ends of a 3.66 m boom. Together with the electronics package, the instrument is one person portable and has an effective penetration depth of six metres. The instrument is calibrated to adjust for the reduction of reading due to the instrument being held 1 metre above the surface.

The EM34 is a two person version of the EM31, designed to achieve greater penetration depths. The system consists of a separate receiver and transmitter. Using three inter-coil spacings, readings down to 60 metres are possible.

In operation, the transmitter coil induces eddy current loops in the earth. The magnitude of these current loops is proportional to the terrain conductivity in the vicinity of the loop. The current loop generates a magnetic field which is read by the receiver coil in a voltage related to the terrain conductivity. The conductivity is read in milliSiemens/metre (mS/m), units of conductivity. They can operate over a range of conductivities from a few mS/m to thousands of mS/m. If the earth is layered, with each layer of different conductivities, a simple layered earth model may be derived.

High rates of production are possible with both of these instruments as they are easily portable. If both instruments are being used together, a detailed image of the near surface and deeper soils is ascertained using the different spacings of

the EM34. In some cases, the integrated GPS system may be used for automated positioning information.

Both instruments are relatively unaffected by metallic objects and power lines. Neither machine requires ground contact, so regions of high resistivity such as bedrock, permafrost and gravel are easily surveyed. The advantages of using these instruments are improved conductivity resolution and the ability to operate over terrain where current injection problems occur.

The digitally recorded data is downloaded and plotted. The process is quick and easy to interpret. The usual presentation would be a plan view of the site with contours of the recorded conductivity. If varying EM34 separations were used, multiple maps would be produced to ease interpretation between depths.

The figure below illustrates the results of an EM31 survey to detect possible elevated conductivities due to the presence of any chlorides and dissolved salts in the earth materials and shallow groundwater. A wide band of elevated soil conductivity is seen running west to east from the salt shed. Outlining the extents of these elevated soils is important in the remediation process.

Applications:

- Mapping groundwater contaminant plumes
- Groundwater exploration
- Soils classification
- Sand and gravel location

