PGC Group Pty Ltd trading as

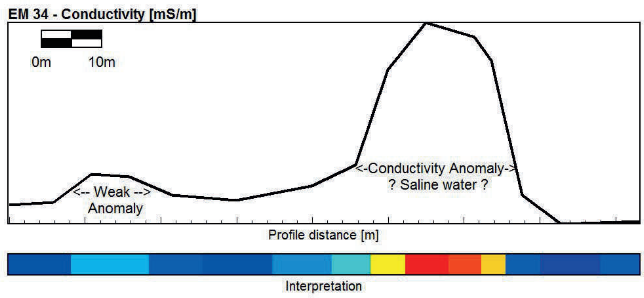
PGC Geophysics

EM34 Application - Mapping contaminated (saline) water

EM 34 application - Mapping Contaminated (or fresh) water

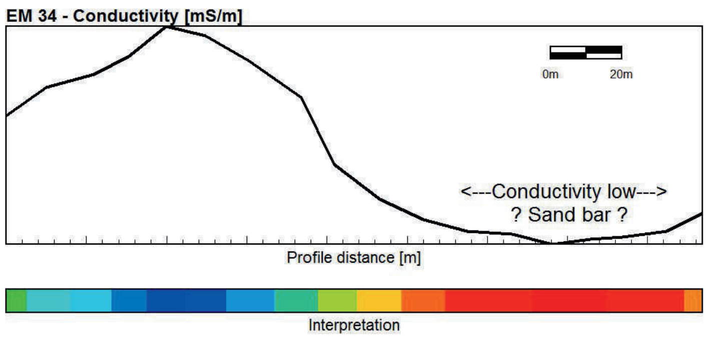
> PGC Geophysics specialises in resistivity surveys in the minerals, and near-surface engineering geophysics markets. PGC owns and operates an ABEM Terrameter LS2 and for smaller profile style investigations, an EM34.

EM34 can be used to detect contaminated ("salty") water in the soil and upper basement as contaminated water commonly has a higher electric conductivity than the more resistive rocks and sediments. In addition, the EM34 can be used to detect fresh water in waterways and sediments with a high content of clay (mud), as clay has a higher electric conductivity than fresh water. A few typical case studies are presented below. As these investigations are commonly conducted as profiles across possible water paths, they are presented in section views.



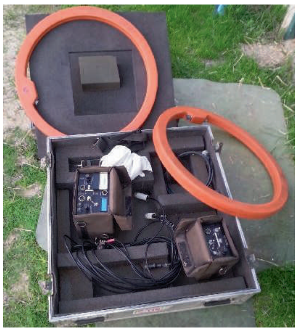
Case Study 1, Contaminated water

The survey aim in Case Study 1 was to locate any sub-surface contaminated/saline water in profiles cross slopes below containment dams. The graph on the left presents the results with a 10m coil separation and with vertical coils. As the conductivity profile clearly presents, there is a section with high conductivities at the right side of the profile, interpreted as saline water flow in the subsurface. In addition, there is a potential minor flow about 10m from the left edge. The interpretation below the graph indicates the conductive sections in red and the resistive sections in blue. The section contains 16 readings and took eight minutes to acquire.



Case Study 2, Fresh water aquifer

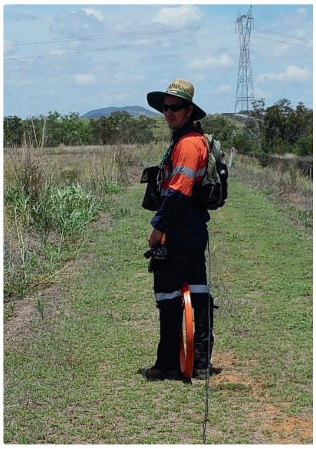
The survey area in Case Study 2 covered the head waters of a small creek, almost entirely overgrown, and the targets were sand bars suitable for water bores. The section view to the right displays the results of 20m coil separation, with an average conductivity typical of sandy-clayey soil at the left side, and a wider lower conductivity section, interpreted as a sand bar, at the right side of the section. This sandbar was later confirmed by drilling to contain sand that was able to produce fresh water at the level required.



The section illustrates the value in conductivity measurements, and how a conductivity low in an otherwise average conductive environment can assist in mapping the target. The area of interest is the conductivity low in the profile, represented by the red colours in the interpretation bar below the profile. The section comprises 18 readings and took 20 minutes to acquire.

The image to the left shows the EM34 and its shipping container.

EM34 surveys are fast, non-intrusive surveys that produce an estimate of the bulk conductivity of the ground. The survey consists of two coils about 60cm in diameter moved by two survey operators. During readings they are kept at a specific separation with the assistance of a reference cable, 10m, 20m or 40m in length. The wider the separation, the deeper the instrument will investigate.

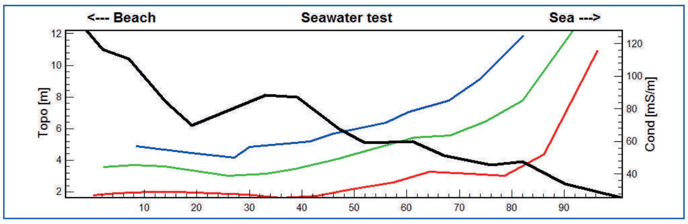


The survey is commonly measured along lines traversing the target, with line spacing and station intervals set to optimise the likelihood of success and the time frame for acquisition. Survey parameters can be tightened during acquisition in areas of interest to increase the success of the survey.

After some initial testing a preferred survey configuration, coil orientation, reference cable length and station interval, are set. The Horizontal Dipole (vertical coils as in picture to the right) is preferred to the Vertical Dipole given its lower sensitivity to misalignments of the coils, see text box below. Reference cables of 10m and 20m lengths are the cables most commonly used, and with a single reference cable and measurments in the Horizontal Dipole orientation, daily production rates in the order of 200+ are likely in open country.

Case Study 3, Seawater test

To demonstrate its increasing depth of detection with longer reference cables, the result of a sea water test on a sandy beach in Case Study 3 is included below. The thick black line represents the topography, sloping to the sea on the right. The three lines are the three reference cables used, 40m (blue), 20m (green) and 10m (red). The readings using the longer cables clearly detected the conductivity of the (ingressed) saline ground water at greater depth, futher inland than those using shorter cables.



EM34-3 is a conductivity mapper that has been successfully used all over the world. The instrument measures a "bulk" conductivity in the ground between two coils and the results are directly given in conductivity [mS/m]. EM34 is a very rapid non-intrusive survey instrument.

The two coils are connected by a reference cable of 10m, 20m or 40m. Increasing the coil separation increases the depth of investigation as indicated in the table below. The coils can be kept vertically standing up (Horizontal Dipole, HD) or flat on the ground (Vertical Dipole, VD), with different sensitivities and depth of investigation.

Coil spacing (metres)	Exploration Depth (metres)	
	HD	VD
10	7.5	15
20	15	30
40	30	60

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PGC Geophysics offers near surface ERI in geotechnical applications:
- Contamination plumes, seepages
- Faults, shears, alterations
- Depth of weathering
- Groundwater, salinity
- buried objects, tanks cavities

Ron Palmer PGC's principal consultant, offers 30 years experience in geophysics and exploration/project management. Ron and his crew are based in Brisbane and operates in all States and Territories as well as New Zealand.

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