How To Do A Resistivity Survey

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John Clarkstone

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1 Introduction

This document sets out the steps in performing a resistivity survey.

- initial planning
- equipment required
- performing the survey
- analysing the results
- writing the report

When is a resistivity survey useful

A resistivity survey can be used to identify the existence and location of underground features. In particular walls and ditches can be detected. The success of the technique depends on the size of the features, how deep they are and the degree of recent soil disturbance. It is also necessary to have a sufficiently large area to survey to get a good contrast of readings; 10m by 20m should be the minimum considered and then only if there are no obstructions such as trees.

2 Planning

Selecting The Site

Selection of the site is primarily determined by the research objective. A literature search, especially a study of available maps and any earlier reports will indicate that a site is or is not likely to have potential.

Metal detectorists may report collection of coins or other metal artefacts, utilities companies may discover structures when excavating. Members of the public may report objects found to the local museum.

Evidence from other survey techniques such as field walking, examination of aerial photographs, old photographs and postcards and local newspaper archives be useful techniques to be used prior to a survey.

Finally always talk to the locals, it is amazing what people will remember about what there grandparents told them.

It is good practice to have a written objective for the site, listing literature and maps that have been consulted prior to the survey.

Permissions

Permissions will be needed from the landowner and the tenant (if it is not the landowner). After initial contact and verbal agreement a letter should be sent stating what we intend to do and when, followed up by a phone call a week or two prior to the survey to check that access is still available.

If a site is scheduled, permission will be needed from English Heritage, this will need to be arranged by Pat Reid. It will always be necessary to check the site is not scheduled.

If the survey is to be on public land ???

Suitability of site

As stated in the introduction the success of the technique depends on the size of the features, how deep they are and the degree of recent soil disturbance. It is also necessary to have a sufficiently large area to survey to get a good contrast of readings; 10m by 15m should be the minimum considered and then only if there are no obstructions such as trees. The site should not be too uneven. The site should not be waterlogged or bone dry. Grassland is ideal. Ploughed fields should be avoided, however fields that have been harrowed after ploughing are OK. Fields that have been harvested leaving stubble are fine (wear Wellington boots or walking boots with thick socks or better still gaiters in stubble). Small trees and shrubs are not a problem provided there only one or two per survey square. Large trees especially conifers will preclude good measurements since they dry the soil unevenly.

Methods

There are two basic methods to perform a survey Grid and Transect.

Grid

A grid survey consists of measurements made in a grid pattern. This is the methods for performing a detailed survey.

Transect

A transect survey is performed by making measurements spaced along a straight line. A transect or series of transects is used in large areas where a line feature or building is believed to exist and its location is being investigated prior to performing a grid survey.

3 Equipment

Equipment List

Toolbox Containing

- Resistivity Meter
- Spare battery and small screwdriver
- Resistivity Meter Probes
- Two 50m tape measures
- Ropes with markers at 1m intervals, 20m long (4 in total)
- Ropes with markers at 1m intervals, 10m long (4 in total) – for smaller areas.
- Large screwdrivers to use as pegs to hold ropes in place (at least 8)
- Pencils, sharpener and rubber
- Compass

Resistivity Meter Frame
50m cable with remote probes
Pea sticks (at least 12 more for larger areas)
Clipboard with printed survey sheets
Laptop Computer to display the results

Description of the meter

The geophysics equipment consists of the meter, the frame, the cable and the reference probes. The meter is mounted on the frame by means of Velcro pads and connected to the frame with four 4mm banana plugs. The cable connects the frame to the reference probes. The probes on the frame are 0.5 metres apart and the reference probes are placed approximately 1.0 metres apart and at least 5 metres and preferably 10 metres away from the area to be surveyed. The meter has three controls that are in use at present.

- The on off switch
- The Test/Normal switch (Test position displays the voltage and current, Normal just displays the resistance)
- The output resistance selection switch (always leave set to 1 k position)

How it works

The meter works by passing a small electric current (which it measures) from one of the reference probe to one of the probes on the frame. The second reference probe and the second probe on the frame measure the voltage. The resistance is calculated by dividing the voltage by the current (Ohm's law for those who remember their GCSE or O-level science). To eliminate noise and other unwanted electrical effects are reduced by reversing the current 135 times a second and making a measurement each time. The results of the measurements are averaged for approximately half a second before being displayed.

Illustration 1: Earth Resistivity equipment

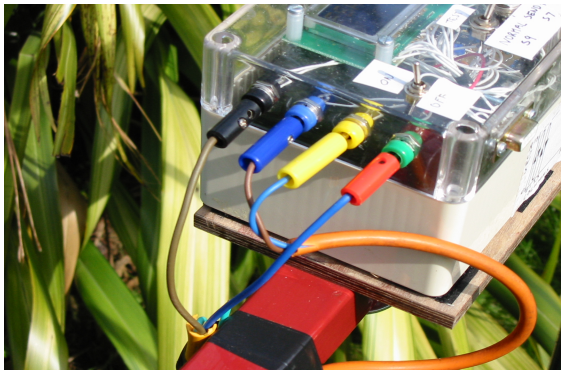


Illustration 2: Meter Connections

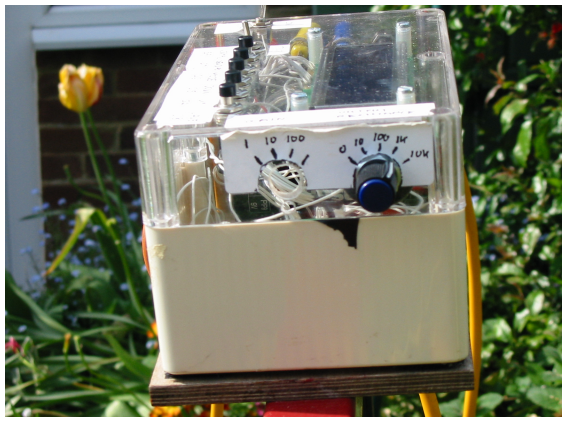


Illustration 3: Switch Setting

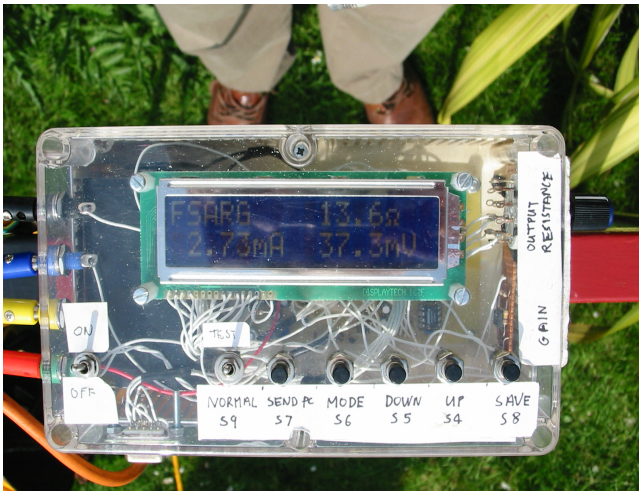


Illustration 4: View of Meter Display

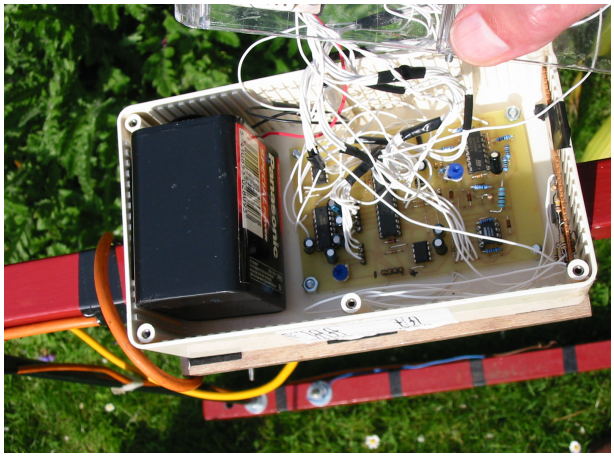


Illustration 5: The Battery

Basic Maintenance and Troubleshooting.

The most common problems are loose connections, a flat battery or excessively dry conditions.

Loose Connections

First check the banana plugs on the side of the meter are plugged in

Check the grey plug and socket on the meter frame (Note the black line indicating polarity).

Check the wires on the reference probes are attached.

Check the wires on the frame probes are attached.

Too Dry

If the readings are erratic or the display is showing ------ for the resistance, put the Test/Normal switch into the Test Position. If the current is below 0.5mA and the ground is dry there may not be a fault, it may just be too dry. Try setting the output resistance to 100 ohms if the readings are low all over the survey site, this may cure the problem. If only a small area is affected, divide the voltage by the current and note the currents and voltages meter separately so that the meter design can be improved.

Change Battery

Changing the battery. Remove the meter from the frame and place on a flat surface. Using the small (size 0) screwdriver undo the screw securing the lid of the meter, carefully lift the lid, taking care not to damage the wires. Carefully remove the battery which is held in by two Velcro pads. Detach the snap on terminals from the battery. Either peel of the stick on Velcro pads from the old battery and attach to the new battery (or fit new Velcro pads), Note Velcro strip can be bought, by the metre, at M&J Supplies. New batteries can be obtained from J C Lock and Safe in Faversham.

4 Setting Up

Chose Method

The choice of survey depends on the size of area to be surveyed. If there area is very large a series of transect surveys or a grid survey on a 2m or greater grid spacing is suitable. For small areas or if or one of the earlier surveys shows evidence of features of interest a grid survey at 1m intervals will reveal greater detail. Prior to digging a test pit the meter can be used to locate features such as walls more precisely by performing a transect at close intervals (0.5m or less).

This document describes a standard 1 metre grid survey.

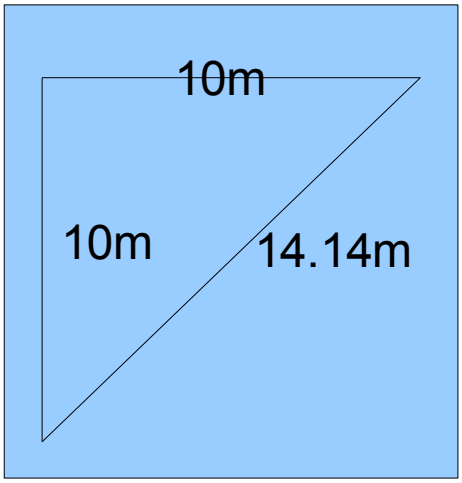
Baseline

First decide on the boundary of the area to be surveyed.

Set out a baseline for the survey. For smaller areas (less than 20m in the shorter dimension) a baseline down the longer edge is appropriate. For large areas a baseline bisecting the shorter side parallel to the longer side of the area will enable more accurately relocation of features at a later date. In irregular areas measure the area and judge how best to fit in a number of 10m or 20m squares and then set up the longest baseline that fits in with these squares. The baseline needs to be surveyed in as accurately as possible. The ends of the baseline will be marked by a pea stick at each end and at every 20m (or10m) along the baseline.

In an area with a building or other permanent or semi permanent feature (e.g. house, power pylon, large isolated trees, power or telephone poles) measure, and record in the site logbook, the distances of both ends of the baseline to two fixed objects and the distances between every pair of fixed objects used to measure. Doing this will enable the position of any features located by the survey to be relocated at a later date. Also record the compass bearing of the baseline and the length of the baseline.

Once the baseline is set out set out a grid of pea sticks at 10m or 20m intervals. Depending on the shape of the area. Make sure that the grid is sides are at right angles using tape measures as shown below.



5 Performing The Survey

Unwind the whole of the cable. Insert the remote probes at a point between 10 and 20m outside the grid to be surveyed. If surveying more than one grid square if possible position the probes so that two squares can be surveyed without having to move the reference probes as shown in figure 2. The two reference probes should be spaced about 0.5m apart.

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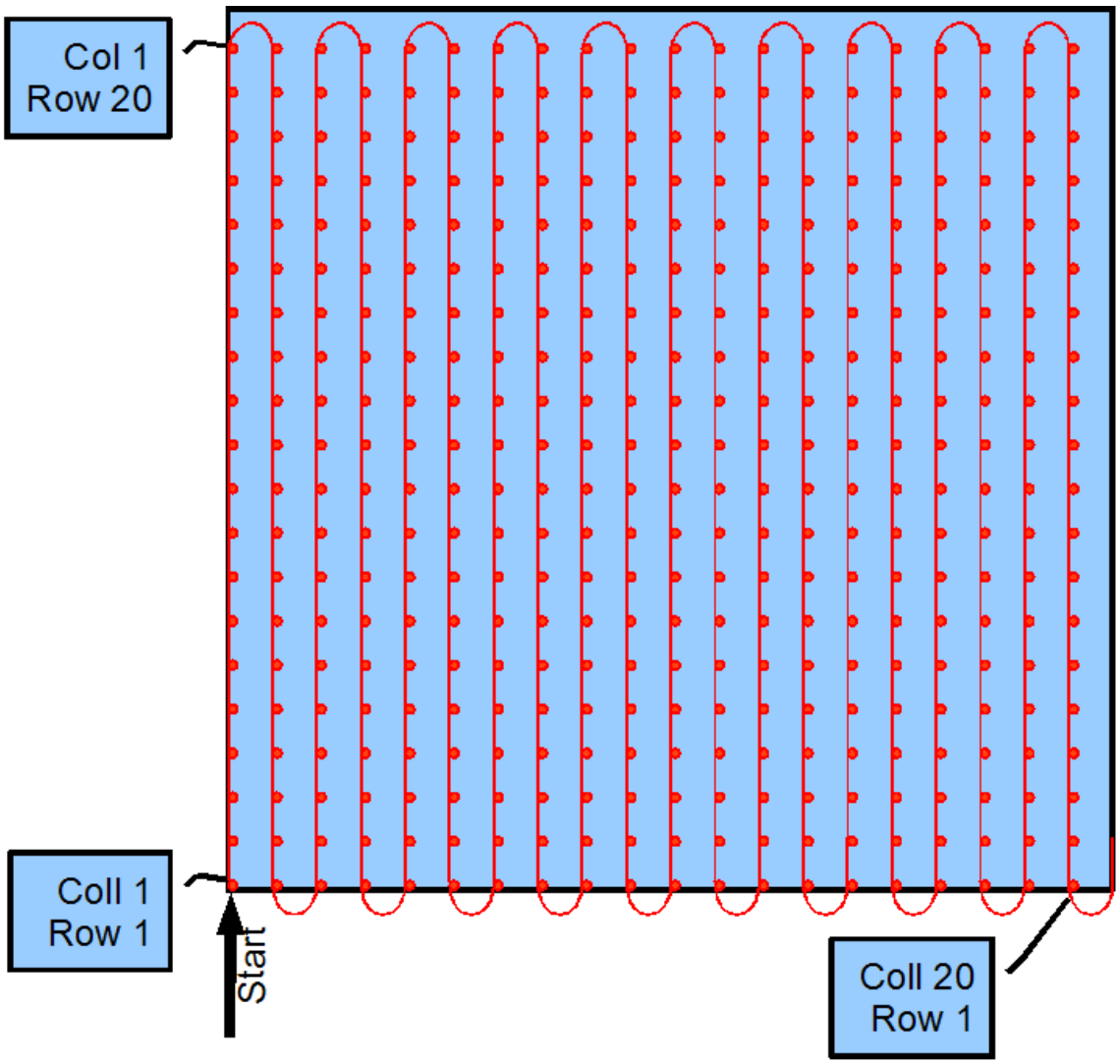

6 Storing and Analysing the Results

7 Writing the Report