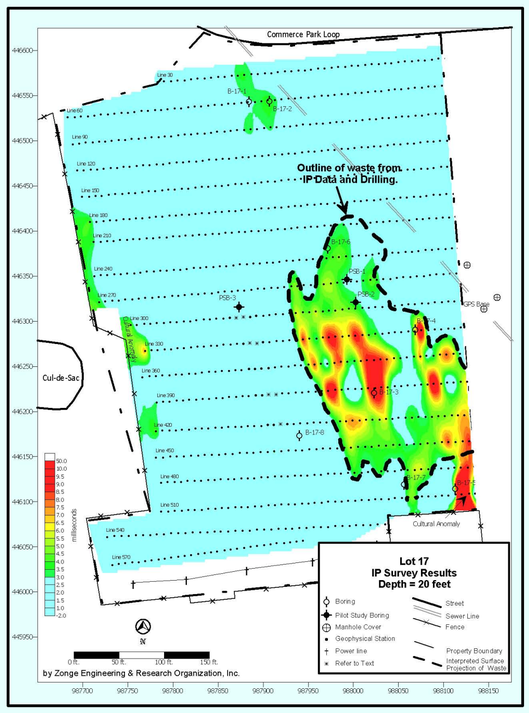
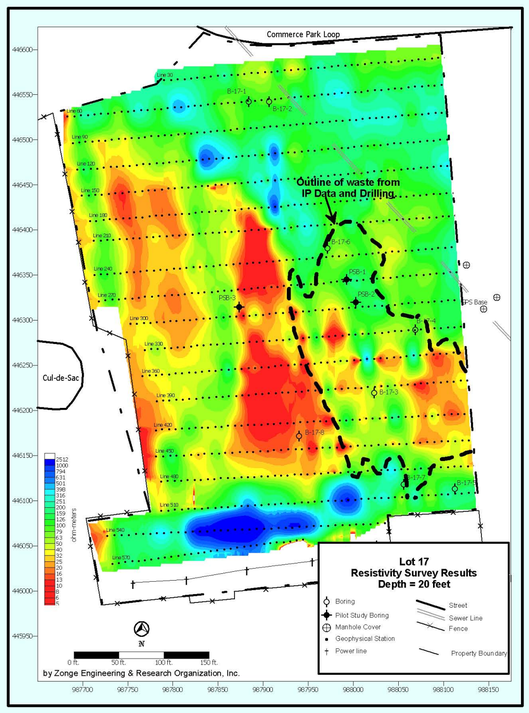
Induced Polarization for Landfill Delineation

Advantages and Improvements

Induced Polarization (IP) is a common tool in minerals exploration, but it is less-commonly applied to environmental problems due to the expense. However, multi-channel receivers, used in conjunction with multiplexers, now allow rapid, inexpensive surveys at many sites. The addition of IP information to the standard resistivity data allows more comprehensive interpretations, and in many cases, the IP data have been the definitive indicator of subsurface waste. In moderate and low resistivity environments, where there is little contrast between the low resistivity waste and background, IP anomalies indicate waste, while resistivity data provide useful background layering information.

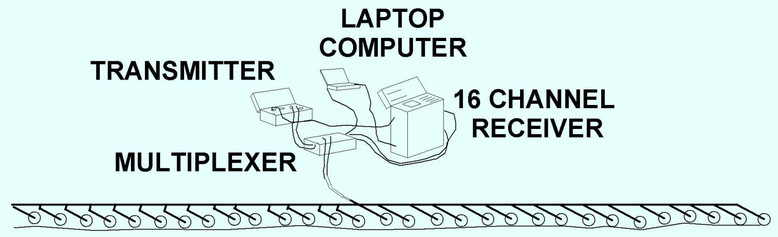


Plan View of IP Data at 20 foot Depth- Accurately Delineated Waste



Plan View of Resistivity Data at 20 foot Depth- Accurately Delineated Old Gravel Pits

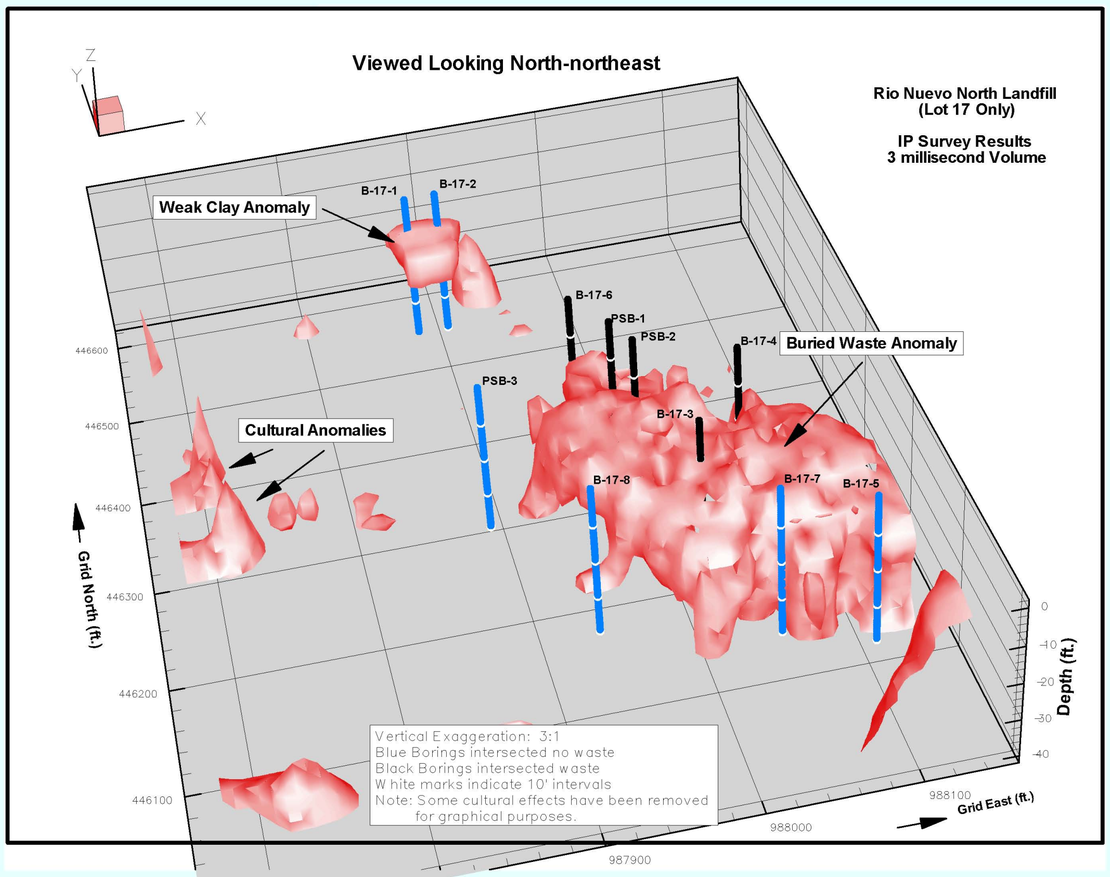
The Zonge Zeta* System



Typical Setup:

- Electrodes: 30
- Station Spacing: 1/2 Dipole
- N-spacings: 12 per diagonal (n=0.5, 1, 1.5, 2, ...)
- Data points per Spread: 234
- Typical Reading Time: 19 minutes
- Number of Spreads per day: 15 to 20

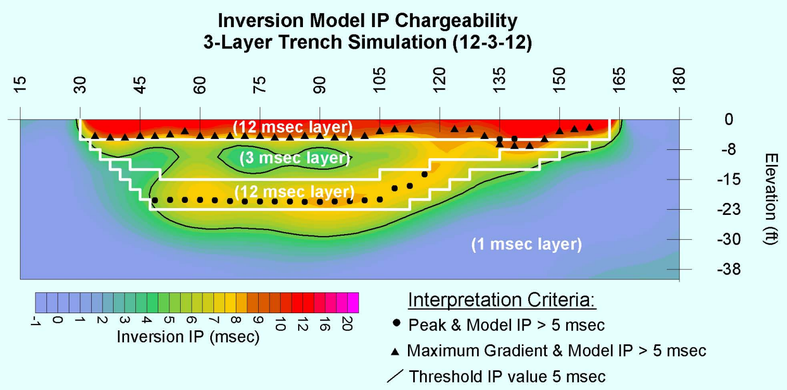
*** *Zonge Electrical Tomography Acquisition system***



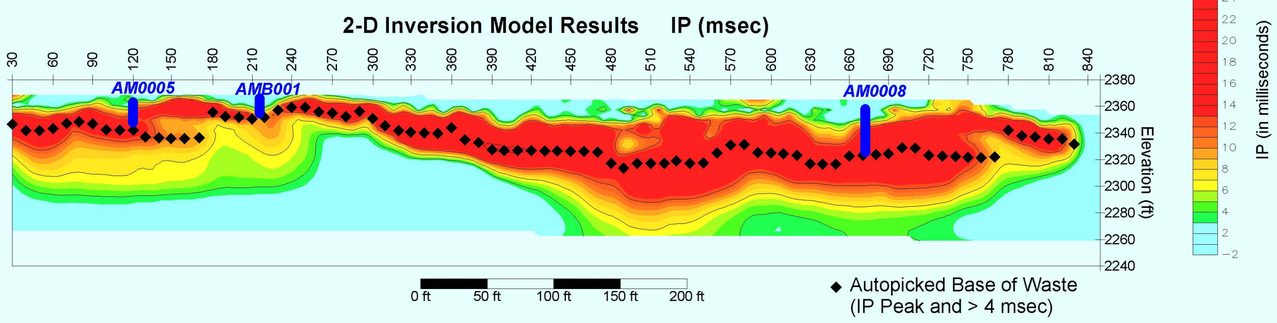
When a large grid of high resolution data is acquired, valid 3-D images of the subsurface can be generated. These types of images are very useful in visualizing the subsurface, particularly for non-geophysicists who are not accustomed to the traditional dipole-dipole pseudosections.

The above plot shows a 3-D perspective image of the subsurface waste at Lot 17 of the Rio Nuevo site near downtown Tucson. The red volume encloses all IP (chargeability) values greater than 3 milliseconds. Drilling confirmed that a 3-millisecond threshold defined the waste, and the soil cover thickness, boundaries, and base of waste agreed very well with the geophysics. This information allowed better planning for this lot with respect to clean-up, building placement, and possible subsidence problems.

Interpretation of Large Data Sets



The use of multi-channel receivers and multiplexer systems can generate very large data sets, and automated processing and interpretation methods are now available to more efficiently handle this aspect of the project. By their nature, smooth-model inversion programs produce smooth transitions, rather than hard contacts between layers. Automated programs that pick contacts in inverted data help the interpreter place contacts in the inversion results, and may be based on a simple fixed IP value (in simple two-layer cases), on maximum or minimum IP values (peaks or troughs in the cross section), maximum or minimum gradients in the IP, or based on a combination of criteria. The above model shows how three different "auto-pick" criteria correlate with the actual layering (actual layering in the original forward model is shown in white lines).



The above cross section is one line of data over an old, buried landfill called the "A" Mountain Landfill in Tucson, Arizona. A large grid of data was acquired and a very strong IP anomaly is associated with the landfill. The base of the landfill was "auto-picked" using the peak IP criteria. The results of the auto-pick under each station are shown as small black diamonds. Three drill holes are shown in blue, and are drawn to the base of waste that was determined from drilling. Very good agreement is seen between the auto-pick results and the drilling. This allows rapid volume estimates and guidance for additional drilling or trenching.

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