NJCU Field Geophysics Exercise - Resistivity Profile in an Urban Setting *(v1, June 2007)*

Dr. Bill Montgomery, Dept of Geoscience/Geography, New Jersey City University;
wmontgomery@njcu.edu

Expected Student Outcomes:

- Become familiar with electrical resistivity data collection techniques
- Mark surface electrode locations with GPS (optional)
- Interpret resistivity data at an urban location near sea level
- Use monitoring well records to help constrain geophysical interpretation

Scenario / Introduction

The City of Jersey City Planning Office has asked you to run an electrical resistivity profile over an abandoned industrial site in order to help characterize the subsurface. The City is planning to re-develop this acreage into an urban park and needs as much information as possible about the site. This area is very near other areas that have been mapped as containing historic fill, some of which may contain metallic debris. It is also at an elevation that is very close to sea level, which suggests that the water table (top of groundwater) could be very shallow here.

Procedure / Discussion

Resistivity Line - Our group set up one long (140 m; approx. 450 feet), NE-SW-trending line with a 2-meter electrode spacing (Fig. 1, locator map). The "zero" point of the line (Fig. 2) is the NE edge. Resistivity data was automatically collected with an internal computer processor. GPS points were taken at every other electrode, starting at the zero point on the NE edge, and may be available for download in the future. There are 3 profiles on Fig. 2: uppermost is the measured apparent resistivity pseudosection, bottom is the inverted resistivity model, and the middle is the calculated apparent resistivity pseudo section that would be generated by the resistivity model shown on the bottom. This bottom resistivity model represents the electrical properties of the subsurface geology and hydrogeology that would produced the middle section if an electrical survey were performed. There is an 18% error in the fit between the measured apparent resistivity (top) and and the calculated apparent resistivity. Note the pronounced low resistivity zone (deep blue) evident on all of the lines, extending from roughly 2m (6 ft) to 7m (22 ft) in depth on the inverse model. Resistivity data has been calculated to a depth of 11 m (35 ft).

Geology - New Jersey Geological Survey geologist Scott Stanford has studied much of the deeper well control in Jersey City (Fig. 3), including several older wells in the general area, and maps a very complex stratigraphic sequence. It starts with artificial fill that varies in thickness from 5 - 20 feet that overlies Quaternary glacial deposits of variable thickness. The glacial deposits (associated with Wisconsinan advances & retreats in New Jersey) unconformably overlie Triassic sedimentary deposits that are intruded by the Jurassic Palisades Sill.

Well control - Fig. 1 shows the locations of 2 sets of monitoring wells; one set is +/- 1000 feet to the NE (Whitlock Cordage Corp, WCC) and another is +/- 500 feet to the SW (Hudson County Chromate Site 186, HCCS 186). Maximum depth is 16-18 feet (5.5 - 6.0 m). Artificial fill is described in the upper samples, including pieces of brick, steel, timber, and even some chromate waste. The wells barely penetrate into red, tan, and brown silty sands that Stanford maps as Quaternary in age, where they stop. Depth to Jurassic-Triassic bedrock is estimated by Stanford to be about 60 feet below surface in this area, but this is highly speculative. Static water levels (representing the water table) in both the HCCS and WCC wells are approximately +10 feet MSL, or about 5 feet below grade (ground level).

Task - Create a hydrogeologic interpretation of the resistivity profile, including top of groundwater (water table) and base of artificial fill.