Team TBL # 6: Dahlin, Rosqvust and Leroux (2010) Resistivity-IP mapping for landfill applications

DUE: November 23, 2016

Overview

In this case history, DC resistivity and IP data are acquired across abandoned landfills. This is an opportunity to think critically about the relationship between two physical properties and associated site geology. The questions asked are meant to emulate those faced in real life situations.

Instructions

Answer the following questions within the context of the 7 step framework. Your answers should be brief, and point form can be used where appropriate. Individual exercise:

- Read the article:Dahlin, Rosqvust and Leroux (2010) and answer the following questions before the in-class TBL

Team exercise:

- Discuss the case history amongst yourselves
- As a team, answer the following questions
- You will hand this in at the end of the class

Resources

- Dahlin, Rosqvust and Leroux (2010)
- GPG:DC Resistivity
- GPG:Induced Polarization

Geophysical Interpretation

You, as the lead geological engineer or geologist, are faced with the problem of remediating the Waterval waste dump in South Africa. Based on the data presented in the case history you need to form an interpretation.

Figure 1 shows a site map taken from (Rosqvist et al., 2004) which provides an overview of the Waterval landfill site. It shows the general location of each survey line in relation to known infrastructure such as developed regions and the location of the culvert. The map also provides an estimate of the landfill boundary and old water filled clay quarries which are thought to be a source of the leachate. The numbered circles on several of the profile lines mark locations of boreholes where disturbed soil and groundwater samples where collected. These samples are very valuable since they help to ground truth the inversion results.

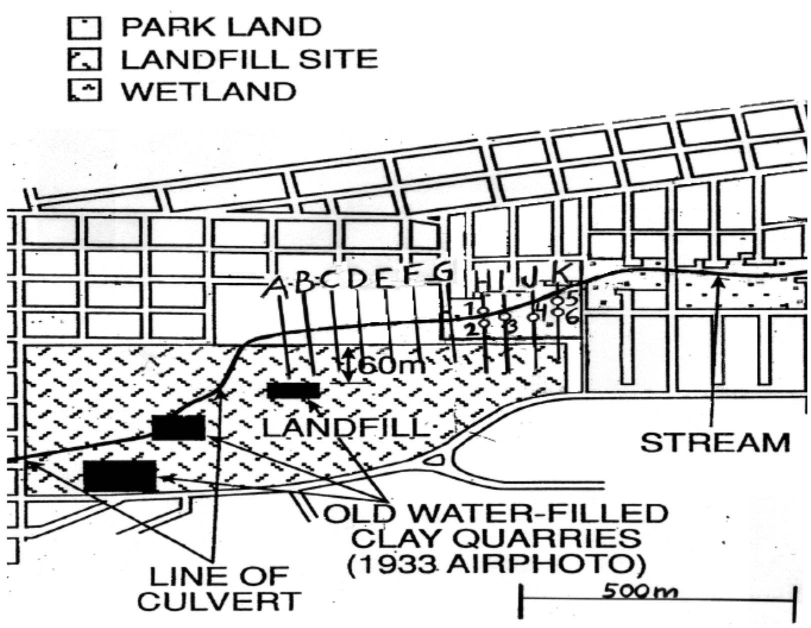
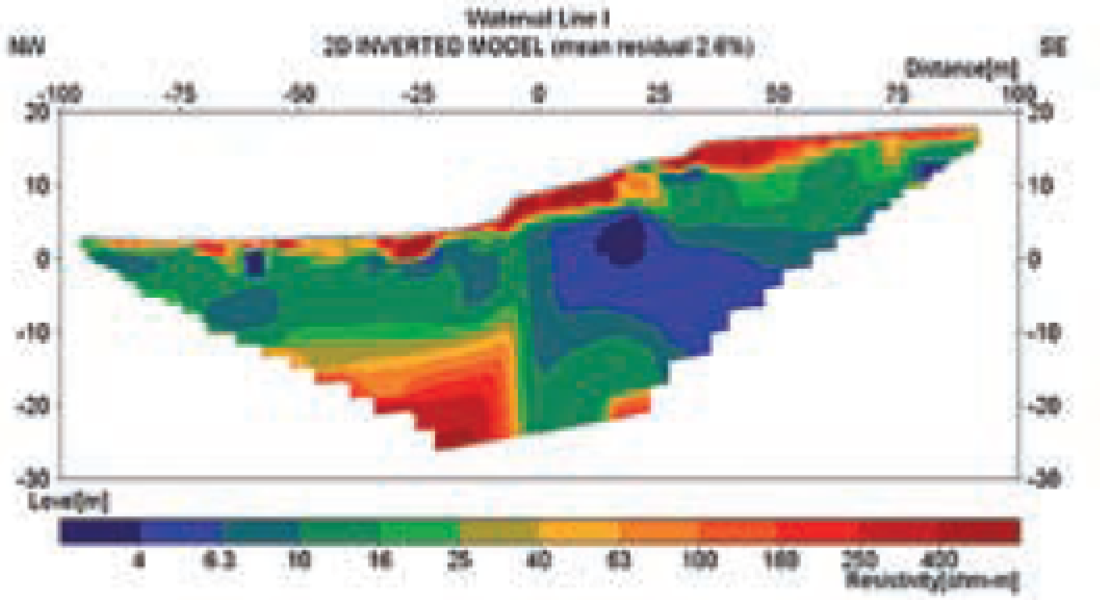


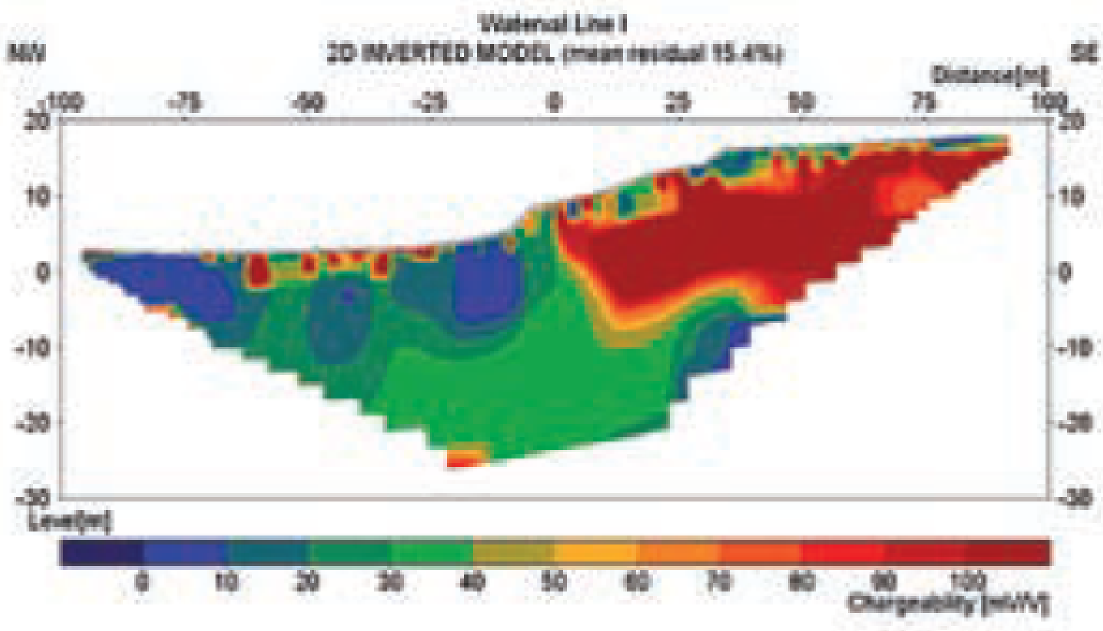
Figure 1. Map showing the resistivity sections and the locations of groundwater sampling at the Waterval landfill site

Figure 1: A site map taken from (Rosqvist et al., 2004) which shows the layout of the survey area.

2D resistivity and chargeability inversion models from profile I are presented in Figure 2. Together these models provide valuable information relating to the differences between the conductivity and chargeability of various regions. The two resistivity models shown in Figure 3 provide insight as to how things vary laterally and the borehole results along these profiles tie resistivities to specific units and confirm the presence of leachate. These results will form the basis for our interpretation and the construction of a geologic cross-section.



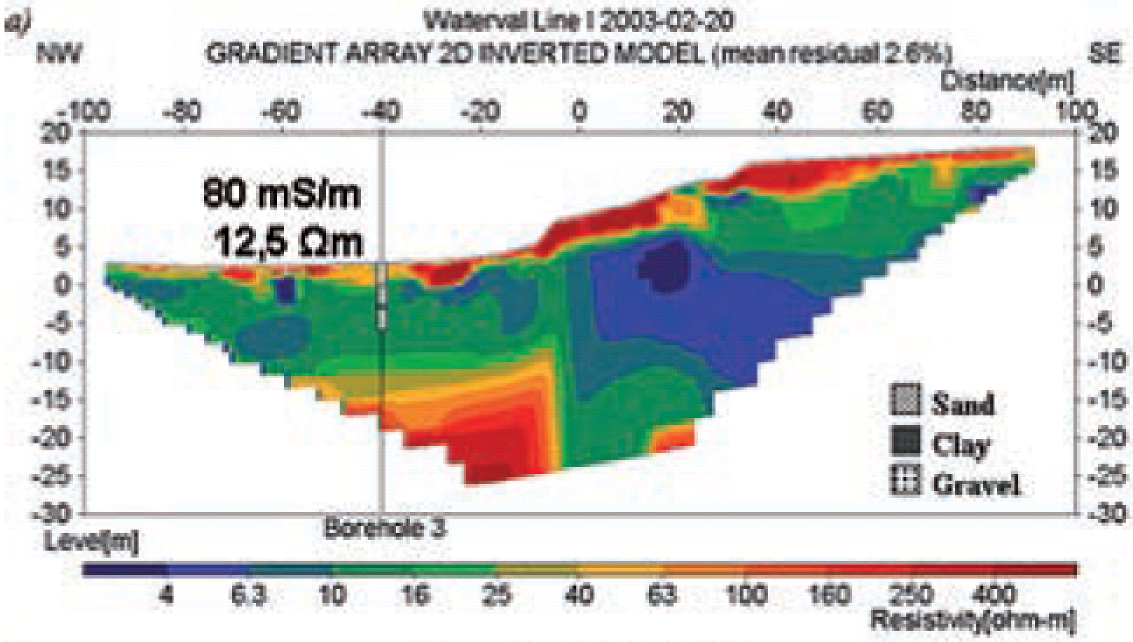
(a) 2D Resistivity Inversion Model



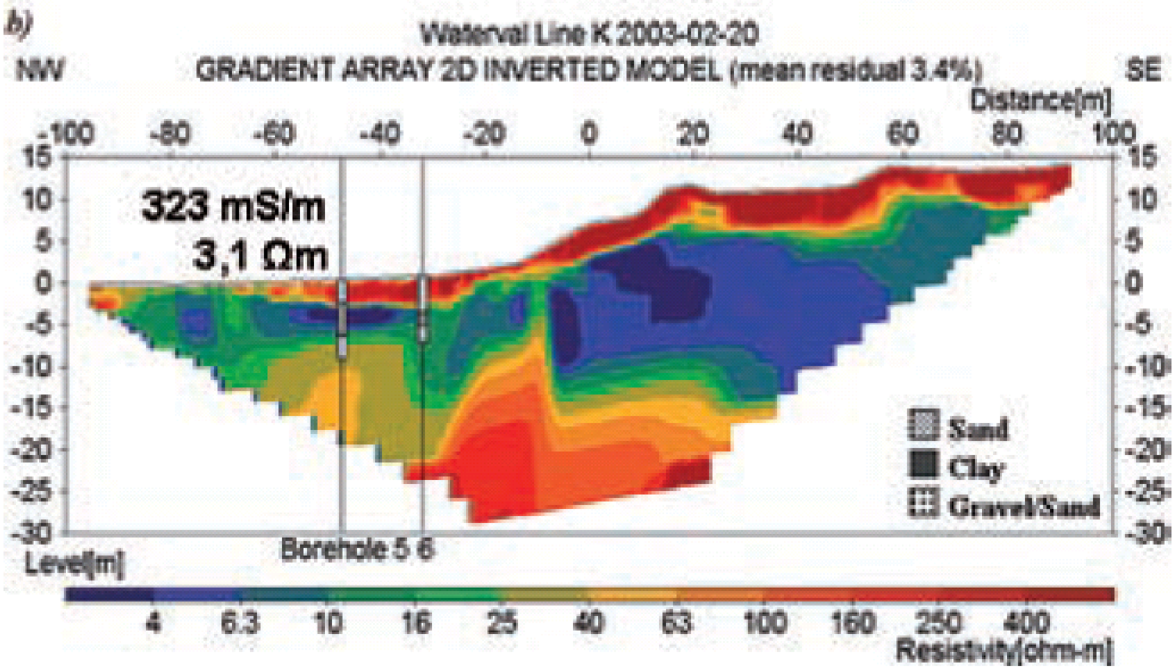
(b) 2D Chargeability Inversion Model

Figure 2: 2D resistivity and chargeability models from profile I.

Q1. Using all of the information at hand you now need to make some estimates of the resistivity and chargeability of the units/objects which you hope to map. A full list of these units/objects is included in table 1.



(a) 2D Resistivity Inversion Model: Profile I



(b) 2D Resistivity Inversion Model: Profile K

Figure 3: 2D resistivity models from profile I (3a) and profile K (3b) which show the lateral variations at units along the valley. Note the borehole measurements which provide lithological constraints and confirm the presence of leachate down toe of the landfill.

a. For each of these units/objects characterize the relative resistivity (ρ) and chargeability (η) as H, M, or L (high, moderate, or low) by filling in table 1.

Material	ρ	η
Surface rocks/gravels (Well drained)		
Clay/Silt		
Granitic basement		
Waste (Well drained)		
Waste (Saturated)		
Leachate plume		
Culvert		
Fault		

Table 1: Relative resistivity (ρ) and chargeability (η) of different objects and units.

b. For each of the units/objects in table 1 provide a brief justification for the relative resistivity (ρ) and chargeability (η) levels that you assigned. These can be general interpretations based on the materials, correlations drawn from the data, and information from the site map.

- Surface rocks/gravels (Well drained):

- Clay/Silt:

- Granitic basement:

- Waste (Well drained):

- Waste (Saturated):

- Leachate plume:

- Culvert:

- Fault:

Q2. Now that you have compiled a list of the relative properties of each unit/object, you will produce a geologic cross-section which includes the units/objects identified in table 1 by collectively interpreting all of the data pertaining to profile K.

a. On the paper provided, begin by setting up your horizontal and vertical axes and sketching the topographic profile.

b. Now sketch in your interpreted boundaries for each of the units and mark the location of the fault and culvert.

c. For each unit/object provide an assessment of how confident you are in your interpretation of its perceived boundaries. Provide support from statements and images in the case history.

Q3. While the analysis you have done thus far provides a good basis for a remediation plan, more information is needed to fully characterize the extent of the waste and the leachate plume. Discuss how you might build upon the geophysical work which has already been completed in order to develop an actionable remediation plan. In your response consider how you would use the additional data profiles shown in Figure 1, and how you would decide if/where additional information, in the form of geophysical data or boreholes, is required.