*University of Michigan* *Department of Civil and*

*Environmental Engineering*

**Semester Project** **– Part 2**

**CEE 546 – Slopes, Dams and Retaining Structures**

**Winter 2013**

**At the meeting:** You were well prepared for your meeting with Dr. Mary Murphy and made a good first impression. She had heard about you before, but you always need to maintain your reputation, especially to new clients.

Dr. Murphy provides you with a cross-section of the failed embankment section. A fill material (*soil 1*) overlies the native soils (*soil 3*) as shown in the section. A veneer of coal residual is locally dumped at the surface and is no thicker than 60 cm (*soil 2*).

She also provides you with available laboratory testing data on the engineered fill material (available on C-tools). She explains that there is not much information on the native soils since the railroad was built many years ago and the entire record is not available. There is also some uncertainty with regards to the depth of the two layers as indicated in the figure.

The photos that Dr. Murphy provided clearly indicate that there was water accumulation behind the railroad (see photos of vegetation on C-tools). This was obviously not intended. A nearby resident indeed confirmed that for some years now there was a small lake behind the railroad that was at least 2 ft deep where ducks used to swim. The resident would bring his grandkids to feed the ducks that were there almost throughout the year.

Dr. Murphy explains that due to the nature of the failure and the publicity associated with it, the final report needs to be due on Monday, April 22, 2013, by 5pm at 2362 GG Brown.

**Back in the office:** You have a tight schedule and you need to manage this appropriately. You need to analyze and interpret the existing data and get an estimate of the material properties involved and the associated uncertainties.

Start by processing the relevant information that you have for soil 1. Analyze the laboratory data and classify the soil according to the USCS. List the results for the relevant engineering properties. Soil 2 does not appear to play a critical role in the failure, but you are concerned about soil 3. You simply do not know how deep it extends and what its properties are. You will need to collect information on soil 3, but that process (field and laboratory testing) will take some time.

Using the available data, you start by performing simple stability analyses using Slope-W. Include soil 3 as a separate layer according to the geometry provided, but, until new information comes in, use the same properties for soil 3 as for soil 1 (this is obviously incorrect). For the time being ignore the presence of soil 2.

Perform stability analyses for:

1. Dry conditions
2. A 2 ft deep lake on the side of the embankment
3. A 4 ft deep lake on the side of the embankment

In performing the analyses, assume that the water will be draining at the toe of the embankment and that the water table is at the ground surface near the toe of the embankment. For this first set of analyses, use piezometric water pore pressures (i.e. no need to use Seep-W yet…).

A report with the results of these analyses is due on Monday, March 11th 2013. The report needs to include a discussion on your soil properties selection process, your estimated uncertainty of the results, and a list of information that you feel would help improve your analyses. The report should provide sufficient information to allow Dr. Murphy to verify your results (i.e. embankment geometry, soil properties, assumptions, stability method used, water table, etc.).