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Report

High Resolution Resistivity Characterization Sand Draw Landfill Fremont County, Wyoming

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6.0 CONCLUSIONS

A set of 21 electrical resistivity transects were collected over the SDL, the proposed landfill expansion area, and adjacent properties to characterize lithologic and hydrologic boundaries. The lines were run in orthogonal directions, with 11 lines running in the west-east direction and 10 lines running in the north-south direction. If the lines were placed end-to-end, a total of 62,300 line-feet of data acquisition was achieved over three separate phases, with over 250,000 total data measurements.

The resistivity data were collected with the pole-pole array with stainless steel electrodes spaced 10 feet apart. The pole-pole array requires that a pole from each of the current transmission and voltage measurement dipole be placed far from the field of acquisition, effectively rendering them at infinity. The other two poles for current and voltage are moved inside the resistivity transect and each electrode has a turn at current transmission while all other electrodes measure the voltage. The resulting data set are processed using either HGI's proprietary HRR algorithm or 3D inversion. The HRR algorithm is a 2D plotting methodology sufficient for locating discrete subsurface targets along the individual profiles. Provided that sufficient data coverage and data density have been acquired, the two-dimensional data profile sets can be coalesced into horizontal slices at a fixed elevation. These slices will show general locations of resistive and conductive anomalies.

When comparing the resistivity data to the lithologic logs from boreholes near the HRR lines, a correlation between soil/rock type and lithologic layer could be seen. Deviations from the correlation could be attributed to the proximity of the borehole to the resistivity line or the seasonal fluctuations in the degree of water saturation manifested by collecting boring logs at different times of the year. The site is highly heterogeneous and large changes in rock type can occur over short distances.

From the Sand Draw data, several large discrete conductive bodies were identified east of the landfill, and in the southern and northwestern expansion areas. These are interpreted as fine grained claystones. These units likely contain bound up formation water making them highly electrically conductive but not capable of producing significant amounts of water.

A dominant resistive sandstone unit is located at depth beneath the existing landfill and extends to the north, southeast, and west. The domestic water well located next to the landfill shop facility intersects this poor quality water bearing sandstone and shows it to be confined above and below by thick claystone/siltstone units. Figure 10 shows that it may be possible to follow this unit both north and south southwest from the landfill.

The heterogeneity of the near-surface lithology suggests that a drilling program would be difficult to design to characterize the site without a priori knowledge. In certain areas, closely spaced wells would sample distinct lithologic units and could not be hydrogeologically correlated with certainty. For example, the contoured perched water areas presented in Figure 2 would need to cross a significant claystone unit shown in Figure 9 in the center of the northwestern expansion area to follow the calculated potentiometric surface.

Lastly, the resistivity data were inverted with EarthImager 3DCL (AGI), an inversion algorithm used to create a three-dimensional representation of the subsurface. Two inversion models were run on the data set, where a high density of resistivity data was acquired: the upper left corner of the expansion area and the lower section of the expansion area. The results of the inversion were presented as both solid model renderings of a fixed resistivity value and horizontal slices at fixed depths. Both domains showed a distribution of low resistivity and high resistivity zones that likely can be explained by differences in lithology. The lower domain appears to be more heavily fortified with electrically conductive claystone, while the upper left domain appears to have significant units of both electrically conductive claystone and more electrically resistive sandstone.

Based on Dr. Seigel's first principals approach, the Sand Draw facility deep water well, Inberg-Miller's monitoring well program, and the results of this geophysical investigation, it appears that three water zones exist at the Sand Draw Landfill; a deep (>300 feet belowground surface) regional aquifer, a deep perched water bearing unit (roughly 160 feet belowground surface), and a discontinuous near-surface variably saturated zone.

6.1 RECOMMENDATIONS FOR FUTURE WORK

Though the information gathered from the present geophysical investigation is significant in scope and content, additional work would greatly enhance the results of this project and augment the ongoing hydrogeologic investigations conducted by Inberg-Miller Engineers. Key questions that should be addressed are:

- What is the lateral extent of the 160 foot deep saturated sandstone unit?
- How deep is the regional aquifer?
- Are any of the three hydrologic units mentioned above connected?
- Are the saturated sandstone unit and the regional aquifer young or old water?
- What are the recharge rates of the discontinuous near-surface saturated zones?

6.1.1 What is the Lateral Extent of the 160 foot deep Saturated Sandstone?

The deep saturated sandstone could be an isolated localized unit without any significant extent. The landfill facility has been using the water for many years, but the volume of water they use is inconsequential compared with its potential storage capacity. Geophysics could be used to follow the unit north and southeast from the landfill, but this could be an expensive undertaking and it is not recommended. Another approach would be to drill a new deep well in the southeast corner or in the north of the landfill, or both, and conduct isotopic studies on the intersected