Groundwater Investigation & Characterization

It is estimated that groundwater supplies drinking water for nearly 50% of the total United States population and 99% of the rural population. Groundwater is a critical component in agriculture for irrigation and in many industrial processes. Unfortunately, groundwater resources are being stressed by increasing demands caused by population rise, environmental contamination, and the impacts of climate change. Therefore, locating new sources of groundwater and protecting our current resources is of paramount importance. HydroGEOPHYSIC, Inc. (HGI), as the name implies, has been involved with successful groundwater characterization and development projects since our formation in 1981. Our success is based on combining expertise and field data across the disciplines of hydrology, geology, geophysics, and engineering.

Range of Geophysical Techniques

HGI offers a range of geophysical methods which can assist in a variety of investigations relating to groundwater resources, including:

- Contaminant Mapping & Monitoring
- Aquifer Storage & Recovery Monitoring
- Hydrogeology Characterization
- Salt-water Intrusion Studies
- Recharge Basin Assessments
- Groundwater Exploration
- Karst Investigations
- Aquifer Characterization
- Fracture Mapping
- Basin Delineation

Groundwater Exploration

Optimizing the siting of groundwater wells, for municipal or industrial uses, can be critical to the sustainability and viability for the user. HGI uses a range of geophysical techniques, combined with geological and hydrogeological evidence, to help define potentially new zones for exploitation. Some direct uses of our studies have included the placement of wells within hard rock or deep basalt aquifers, defining basin geometry for groundwater modeling studies, and targeting productive zones within aquifers.

Case Study

Basin Mapping Survey

The results of a basin mapping study are shown to the right. This geophysical survey used gravity data, which is sensitive to subsurface material density variations, to accurately map the depth to bedrock and thickness of overlying alluvium without the need for costly and invasive exploration drilling. This information was used for siting groundwater wells to optimize production within the survey area (gray outline). The gravity model results were constrained with a number of seismic refraction and electrical resistivity survey lines (shown by the white lines) crossing the basin, which provided additional depth refinement and, most importantly, an indication of the more transmissive sediments needed for enhanced groundwater production.

Increased Alluvium Thickness

Bedrock Ridge

Shallow Bedrock

Deep Bedrock

Case Study

Groundwater Recharge Investigations

Artificial groundwater recharge through surface and subsurface methods provides a practical solution to additional water storage and assists with sustainable groundwater management, for example, recharge basins or ponds, spreading fields, infiltration basins, or injection wells. Geophysics can provide critical hydrogeologic information for siting recharge basins or injection wells, to maximize infiltration rates and reduce drilling costs. The geophysical techniques are noninvasive, and provide cost-efficient coverage across a range of scales. In addition, geophysics can be used to monitor infiltration over time to assess efficiency or help constrain where the water goes.

Case Study

Basin Recharge Characterization Survey

The example to the right displays a characterization survey of a potential recharge basin site. A series of 2D electrical resistivity lines were combined into a 3D model, with a selection of the resulting depth slices shown. These highlights an increase in coarse-grained sediments (lime to red clays) to the right side of the site. Based on these results, an optimized location for the new recharge basin was communicated to the client (white outline), whose follow-up coring indicated predominantly coarse-grained sediments associated with this area. This new recharge basin provided increased infiltration rates compared with previous installations by the client.

Below: Conducting time-domain electromagnetic (TDEM) survey along the California coastline to characterize salt-water intrusion.

Above: Controlled source audio-frequency magnetotellurics (CSAMT) survey in Arizona to map depth to bedrock and alluvium thickness for groundwater well siting study.