Case Study

Schlumberger WATER SERVICES

About Schlumberger Water Services

We offer innovative groundwater solutions through professional expertise to meet the advancing technological requirements of today's professionals.

Schlumberger's Water Services division specializes in assessing, developing, and managing groundwater resources using some of the finest, advanced and cost-effective technologies available today.

Whether you're looking for field-scale data collection, data management, modeling, or resource decision-making solutions, our teams of specialists are here to help you address all your groundwater projects safely and efficiently.

Applied Technologies:

- Visual MODFLOW*
- Remote Sensing Analysis
- GIS Mapping

Water Resource Management for Mining

Chile, South America

Gold and copper mining in the high altitudes of the Andes Mountains

Highlights:

- 3D geologic modeling used for comprehensive sensitivity analysis
- Groundwater extraction simulation
- Surface water and groundwater flow estimation
- Developed numerical model to visualize the impact of mining on surrounding areas

Background

The high altitudes of the Andes Mountains (4000 m +) are rich with copper and gold. However, one of the primary constraints on the ability to mine these minerals is the availability of water for processing activities. The mining operation will require a significant amount of water for its processes and dewatering wells would have to be established. To proceed, the mining industry is required to conduct an Environmental Impact Assessment (EIA) regarding, among other things, the impact on the natural environment caused by water extraction for mine process operations.

Challenges

llamas and flamingos are native to the area and rely heavily on the wetland areas and natural groundwater discharge nearby. One of the main challenges facing such an investigation is to determine an optimal well field design which will satisfy mining requirements, while reducing the impact on natural groundwater flow and conditions. To predict the short and long-term affects mining will have on groundwater resources, a better understanding of the geologic and hydrogeologic conditions of the area are required.

Solution

By using surface geophysical techniques in conjunction with pilot wells one can develop a clear understanding of the major elements of the groundwater system and the data gathered can be used to develop a numerical model.

Numerical modeling of the groundwater flow system often plays a primary role in these investigations, which are required to predict potential long-term impacts on the area surrounding the site.

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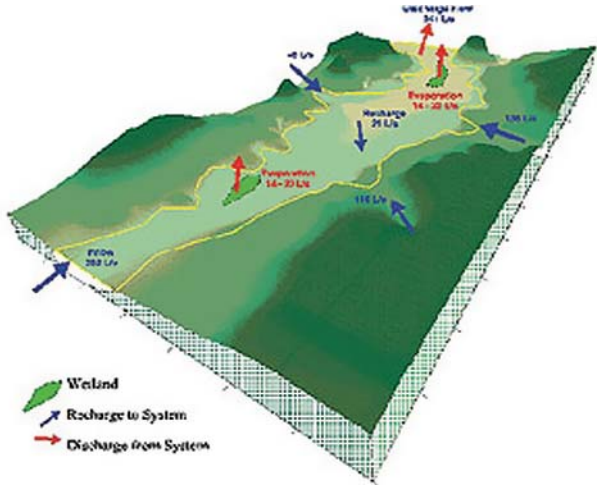
Case Study: Water Resource Management for Mining

The key to obtaining a sound hydrogeologic model is to first determine a sound water balance for the study area. This involves estimating the surface water and groundwater flow components into and out of the basin, and the uncertainty with each component. A numerical model was developed, using Visual MODFLOW to simulate the groundwater extraction and estimate impacts on wetlands and Salars throughout the area. Due to the uncertainty in the water balance components, a comprehensive sensitivity analysis was performed with the transient, three-dimensional model. Predictions of the change in discharge to the wetlands and when they will occur were the primary component in the EIA.



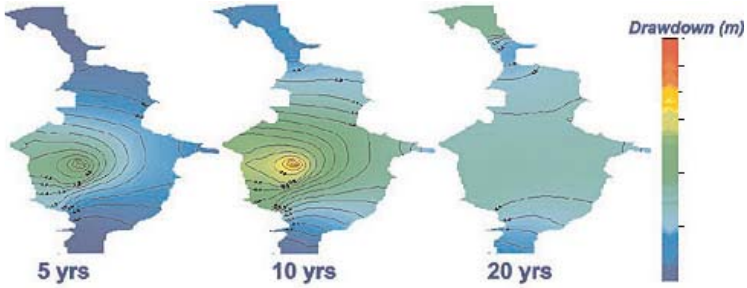
Results

Water Availability

Vast, coarse grained alluvial valley aquifers (200+ m thick) contain a great deal of water in storage, however the climate is that of a desert and recharge to the aquifer system can be as low as 1-20 mm/yr. The result of the dry climatic conditions can be observed throughout the high Andes in the form of Salars. These salt-water bodies are formed by strong evaporation conditions throughout the area, leaving dissolved salts behind to concentrate in the local discharge zones. The potential evaporation has been measured to be 1200-2400 mm/yr, far exceeding the annual precipitation.

Drawdown Propagates After Pumping Ceases

Another result of the low recharge to the aquifer is that drawdown propagates for extended periods beyond the cessation of pumping. One interesting phenomenon noted at this site was the effect of the geologic constriction in the northern portion of the aquifer. Drawdown within this zone is always < 1.0m - a result of the relatively high velocities through the constriction. Although counter-intuitive, points further down-gradient experience greater drawdown.



Drawdown propagates after pumping ceases

As a final result, the 3D numerical models were used to identify an optimal well field design that made the mine a viable operation with little impact on the nearby wetland area.

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