

REDEVELOPMENT OF THE GROUNDWATER SYSTEM AT A RECLAIMED LIGNITE SURFACE MINE, EAST TEXAS

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Strip mining for near-surface lignite disrupts the hydrogeologic system, resulting in localized dewatering of aquifers wherever the water table intersects a recoverable lignite seam. In addition, mining of the overburden exposes reducing zone sediments to oxidizing conditions, leading to a rapid change in groundwater chemistry upon resaturation. This study examined rates and sources of recharge, flow dynamics, and groundwater chemistry processes in the saturated zone of a reclaimed lignite mine in East Texas.

Lignite deposits at Big Brown Mine, located in the outcrop of the Calvert Bluff Formation, are interlayered within silty-sand and mud deposits. The reclaimed spoil has experienced a highly variable rate of resaturation. Water table increases during 1990-1991 ranged from 2 to 10 ft/yr. The higher rate of resaturation is attributed to fracture-enhanced recharge through clay-rich spoil during a period of unusually high rainfall. Fractures exist in the unmined clay facies and are further developed by mining processes. Groundwater flow modeling of a developing recharge mound indicates that permeability decreases with depth in reclaimed spoil. Hydraulic conductivity ranges from 10^{-3} to 10^{-5} cm/sec. Specific yield is generally low in the spoil aquifer, estimated at 4 to 6%, which results in relatively large water level increases per unit input of recharge.

Postmine groundwater chemistry exhibits a significant increase in dissolved solids, from permine concentrations of 100 to 1,700 mg/l, to postmine concentrations of 1,200 to 4,000 mg/l. Postmine water chemistry processes are dominated by pyrite oxidation, with a resultant increase in SO_4 concentrations. Postmine pH ranges from 4.6 to 6.4 and is greater than 6 in most areas of the reclaimed mine.

Redox reactions are occurring in the spoil aquifer, beginning with oxidation of organic carbon in the oxygenated recharge zones. Dissolved oxygen values range from 0 to 1.5 mg/l. Spoil groundwaters were analyzed for the following redox pairs: NO_3/NO_2 , NO_3/NH_3 , $\text{Fe}^{3+}/\text{Fe}^{2+}$, and $\text{SO}_4/\text{H}_2\text{S}$. Based on the $\text{SO}_4/\text{H}_2\text{S}$ redox pair, the pE of spoil groundwater ranges from 0 to -2.5. As sulfate reduction continues, SO_4 concentrations decrease

and HCO_3 concentrations increase. Where pE is lowest, the groundwater is at equilibrium with respect to calcite, siderite and iron sulfide. The precipitation of minerals in areas of active sulfate reduction provides a mechanism for reducing the concentrations of dissolved solids and may be important process affecting the long-term evolution of postmine groundwater.

The spoil aquifer comprises a local flow system that discharges slowly to area creeks and to the nearby Trinity River Valley. Groundwater discharge will be diluted in the streams by surface runoff in this humid subtropical climate, except during times of drought.

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