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**APPLICATIONS OF INVESTIGATION, MONITORING,  
AND MODELING TO REMEDIATION OF BRINE SQUEEZED  
OUT OF RETSOF SALT MINE**

John M. Nadeau and Samuel W. Gowan  
Alpha Geological Services, Inc.

**Abstract:** The Retsof Mine in Livingston County, New York had completely filled with saturated brine by 1996 following a collapse on March 12, 1994 and subsequent flooding with ground water. Elevated levels of saline water were encountered above the mine within the collapse zone in 2003. Ongoing monitoring shows that this salinity is increasing and is connected to the upward rise of brine from the mine. A conceptual remedial plan was developed in 2003 to control the movement of this brine. The main goal of the remedial plan is to prevent the saline water and brine from entering the overlying aquifer system at the base of the glacial valley. The remedial plan consists of pumping brine from the fractured bedrock in the collapse zone at a rate equal to the calculated brine squeeze rate from mine closure. The desired effects of brine remediation pumping are to reduce the salinity in bedrock zones between the mine and the overlying fresh water aquifer system, to maintain the saturated brine at a constant elevation above the mine, and to prevent fresher water from being drawn down into the salt horizons where there could be opportunity for further dissolution and subsidence.

The remedial plan was designed, and continues to evolve, based on data collected using multiple tools that include, geophysical logging, ground water sampling and analysis, ground water and geochemical modeling, and subsidence monitoring. Caliper and gamma-ray geophysical logging were employed to confirm the location of significant stratigraphic contacts, to refine the existing monitoring program, and to aid in the development of the ground water model. Caliper and acoustic televiewer logging were used to locate and evaluate the extent of fracture zones in the bedrock to determine the optimal placement of the pumps in the brine remediation wells. Proper placement of the pumps is critical to maintain a stabilized brine profile without causing localized upwelling or drawdown of the saturated brine.

A ground water model has been designed, and continues to be refined, to accurately represent the post-collapse environment above the mine in the vicinity of the collapse zone. This model is being used to simulate the effects of various pumping scenarios on the existing brine profile and on the long-term rate of brine movement. Geochemical modeling is being employed to simulate historical changes in water chemistry based on the hydrogeologic conditions after the collapse, and the future effects on water chemistry, based on water mixing from pumping effects. The geochemical modeling also will be used to simulate the potential for dissolution or precipitation of mineral compounds as the result of the contact of various water chemistries with the different types of rocks in the collapse area. Dissolution of gypsum and anhydrite minerals located in rock layers above the mine are of particular interest because exposure of these rocks to fresh water and varying degrees of unsaturated brine pose a threat for potential future subsidence. Subsidence data is being collected at regular intervals to monitor changes in the subsidence rate that may be caused by remedial activities. These tools have been, and will continue to be, used to characterize the collapse zone environment and guide the remedial activities at the mine site.

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