PELA GeoEnvironmental

Project Summary
Mining

Mining-Karst-Grouting

Water began to flow into a quarry through a karst conduit connecting the quarry to a large nearby creek. Flow into the quarry was about 4,000 gallons per minute (gpm). The site, a dolomite quarry in north-central Alabama, is in an area underlain by structurally deformed Cambrian carbonates with documented karst development. Field mapping identified a dominant fracture orientation that controlled groundwater flow and permitted development and implementation of a grouting program to inhibit water flow in the conduit.

The quarry and inflow point are about 400 feet southwest of the creek. Bedrock exposed in the bed of the creek is fractured and cavernous openings were observed, as was a sinkhole on the left bank (the southwest bank) of the creek. Quarry operators had repaired the sinkhole with gravel and other materials prior to the investigation, however, it was apparent that some water from the creek was flowing into the repaired sinkhole.

Dye in inflow

Based on stream gaging, the flow in the creek was about 5,000 gpm less (about 40 percent) downstream of the sinkhole than at the upstream measuring location. Dye was introduced into the stream near the sinkhole and appeared in the inflow of the quarry within about 4 minutes.

Based on the dye study, a grouting program was designed. Ten boreholes were drilled to depths as great as 120 feet below land surface in a line nearly perpendicular to the line between the sinkhole and the inflow. During drilling of some of these boreholes, water-filled cavities were penetrated and the water flowing into the quarry became muddy. All boreholes, and the sinkhole on the left bank of the creek, were grouted using high viscosity cement. As a result of the grouting program, inflow into the quarry was reduced to less than 1,000 gpm.

Drilling boreholes

Additional grouting is planned nearer the source to seal the main conduits upstream of the point where they bifurcate. The next phase of grouting may utilize materials other than cement to attempt to close smaller conduits.