

**Test Area Investigation Report
Mine Research Project GUE-70-14.10
BBC&M Engineering, January 2001 I-1**

**PART 1:
EXECUTIVE SUMMARY
SJN: 45041**

The GUE-70-14.10 Mine Research Project is the investigation of a 2,200-foot-long section of Interstate 70 in Guernsey County, Ohio. Portions of the project area pavement were damaged as a result of mine subsidence. The damaged areas were remediated in 1995 and concerns are present regarding the post-remediation condition of the soils and bedrock beneath the project. The objective of the investigation is to detect the presence and ongoing formation of voids or anomalies beneath the pavement using various geophysical, geotechnical, and groundwater investigative methods. The project is divided into three phases. The primary purpose of the Phase I Test Area Investigation was to field test and evaluate, on a small scale, the various field and analytical methods proposed for the project during the full site investigation (Phase II). The small test area consisted of the eastbound lanes between Stations 483+00 and 485+00. The work completed for the test area included an evaluation of methods for a groundwater investigation, geophysical investigations, and geotechnical analysis. For the groundwater investigation wells were installed into the coal zone aquifer and several unconsolidated granular water bearing strata. From the wells, groundwater flow and quality data were obtained and evaluated. The geophysical investigation included the completion of surface seismic and ground penetrating radar investigations, down-hole seismic and ground penetrating radar investigations, and down-hole geophysical logging. The geotechnical investigation included the evaluation of stratigraphy, soil and bedrock strengths, and an evaluation of piping potential. Phase I was successful in identifying the relative merits of the test methods used. Based on the findings of the Test Area Investigation, it is recommended that Phase II of the Investigation be generally conducted as follows:

- 1) A groundwater investigation should be completed to identify the vertical and horizontal flows (direction, gradient, velocity, and quantity) of groundwater within the grouted portion of the coal zone and saturated granular strata above the grouted portion of the mine complex. Beyond the limits of the grout curtain and within the boundaries of the right-of-way, static levels of the coal zone aquifer would be determined in order to verify the direction of flow within the grout curtain, to permit the collection of groundwater quality data for the comparisons of loadings from up-gradient to down-gradient across the grout curtain, and to permit the calculation of groundwater flow through the grout curtain using flow net methods. These investigations will assist in the assessment of ongoing formation of voids below the pavement due to groundwater movement and dissolution of grout.
- 2) Surface seismic and ground penetrating radar geophysical methods would be used to investigate the entire 2,200 feet of roadway. Seismic work would be completed on the north and south shoulders of both the eastbound and west bound lanes. Ground penetrating radar work would be completed in and along the traveled lanes. Lane closure would be required for the radar work.
- 3) Anomalous or unique areas identified during the full site geophysical investigation would be further investigated using additional surface and sub-surface (cross-hole ground penetrating radar

and seismic) geophysical methods. This work would attempt to confirm the presence of the anomalies, determine if the anomalous areas extend beneath the pavement, and delineate the vertical and horizontal extent of the areas. Temporary lane closure may be required to complete this work.

4) Geotechnical drilling, sampling, testing, and analysis would be performed in the confirmed anomalous areas to further characterize the subsurface conditions. This work would include drilling borings at or near the margins of the anomalies. The work might require temporary closure of traveled lanes. The details and the actual scope of work for Phase II will be presented in a Work Plan which will be submitted for approval prior to the initiation of the Phase II field work. Alternate methods of field investigation may be considered for implementation in Phase II which were not used during Phase I. Potential alternate methods are briefly discussed in this report. The scope of items actually completed may be limited by budgetary constraints. On this basis, the types of data to be collected and number and extent of anomalous areas to be evaluated will be prioritized. A more complete discussion of applicability, costs, and recommendations as to use of alternate methods will be included within the Work Plan for Phase II. During Phase I of the investigation, two anomalous areas were identified. Geophysical methods identified a soil “slump” feature beneath the traveled lanes near Station 484+00 (beneath and east of the original subsidence feature from 1995). Geotechnical drilling and sampling identified a depression in the bedrock surface and weak soils north of the eastbound lanes near Station 483+50 (west and north of the original subsidence feature). The conditions below these may be further investigated during Phase II of the Investigation. Lane closure may be required for this work.

The Phase I groundwater investigation determined groundwater flow in the coal zone within the test area to be generally to the northwest beneath the roadway. Horizontal and vertical velocities were generally very low and below values which would permit physical transport of any significant amount of soil material. Constituent concentrations generally increased from up- gradient to downgradient of the grout curtain; however, high concentrations of constituent minerals and Total Dissolved Solids typically associated with significant dissolution of grout were not observed. Dissolution of the grout curtain is believed to be occurring, but at a rate low enough that the effectiveness of the grouting program as a result of dissolution is not believed to be a significant concern. It should be noted that the relatively benign findings and recommendations regarding the groundwater investigation are based on the current static water levels and resulting groundwater flows. If ground water levels were to drop due to future mine dewatering, groundwater gradients, soil transport, and dissolution rates of the grout would increase.