STATEMENT OF NEED:
Thousands of rock cuts are present throughout Ohio’s highway system. These rock facies are highly susceptible to rockfalls creating a serious hazard to the public and continuing maintenance problem and financial strain for District offices. Failure of rock facies is induced by differential weathering, erosion, steep-cuts, and well-developed joint sets. Surface and groundwater exacerbated these factors resulting in a state-wide problem. To date, no study has been conducted to rank-order the hazard potential of their failure or to determine their spatial distribution.

RESEARCH OBJECTIVES:
This study is essential to improve our investigative techniques involving rockfalls through the implementation of a state-wide rockfall ranking matrix which evaluates the hazard potential relative to remediation costs. Ultimately, this matrix provides an open and objective basis for project selection while providing optimum benefit of the public’s resources directed toward the elimination or reduction hazards associated with rockfalls. With limited funds, development and implementation of an unbiased selection process for rockfall remediation projects within the state is critical to legal predisposition.

The principal objective of this research involves the development of a rockfall hazard rating matrix and data management system in Ohio. This matrix accounts for variations in the topographical, geotechnical, and climatological conditions present throughout the state. Specific procedures for collecting field, laboratory, and other data required for rank-ordering of rockfall sites will be generated. Each priority site inventoried will include a cost analysis of the best remediation alternatives. Once complete, this research will establish the platform for ranking the state-wide inventory of hazardous rockfall sites while providing an estimated cost for remediation of Ohio’s priority rockfall sites on current state-of-science practices.

RESEARCH TASKS:
The research methodology conducted a review of any literature on a rockfall hazard rating systems. Each district office identified their three highest priorities, three medium priorities, and three lowest priorities of rockfall areas. Upon review of the spatial distribution and the geologic conditions, the researcher evaluated the submitted sites for spatial coverage of the state’s geologic setting. The researcher then selected a site for each of the priority ratings within each district. The researcher developed a ranking matrix which considered, but was not limited to, the evaluation criteria presented by ODOT. The matrix considered normalization of data and the use of weighing and reliability factors. The
matrix also addressed inclusion of criteria for cost alternative analysis. This analysis included all practical engineering alternatives to eliminate, prevent, minimize, or reduce the threat to traveling public. Each site included a recommendation for the most practical or set of practical alternatives. Upon development of the preliminary matrix criteria, the researcher evaluated each priority site selected by the district offices. The researcher established methodologies required in conducting the site evaluations. The methodologies included the requirement for quality assurance and quality control. Following data compilation, the researcher statistically evaluated the criteria to determine significance, correlations, etc. Revisions to the matrix were recommended by the researcher and supported by statistical data or other. All of the initial sites and remaining sites were evaluated with the revised ranking matrix. Sensitivity and reliability analysis were determined for additional refinement to the matrix. Weighing and reliability factors were considered accordingly.

A later phase of the research will involve the development of a data management system utilizing Microsoft Access and being compatible for use with Geomedia/Arcview, and ArcInfo formats. Following development of the data system, implementation of the rockfall rating matrix on a state-wide basis shall begin.

**RESEARCH DELIVERABLES:**
The principal deliverable from this research is the final report and all data, information and materials collected during the site evaluations. The secondary products included the database and reports from Jesse Davis entitled “An Evaluation of the Effectiveness of Catchment Ditches along Ohio Roadways” and from Carl Dokter entitled “The Development of Rockfall Hazard Potential Maps of State Route 7 along the Ohio River, Ohio, using a Geographical Information System”.

**RESEARCH RECOMMENDATIONS:**
No additional research is anticipated. Development of a web-based enterprise database is needed to integrate with the other geo-hazard inventory systems and the cost remediation database.

**PROJECT PANEL COMMENTS:**
A project panel was not required for this project.

**IMPLEMENTATION STEPS & TIME FRAME:**
Upon receipt of this final report from the researcher, OGE contracted with DLZ to draft a technical user manual. OGE will finalize the user manual by September of 2005.

At the same time, OGE is developing as MS Access Database to complement the user manual. OGE will contract with a geotechnical engineering firm to manage and conduct the initial population of the statewide rockfall inventory. This work will also include the development of cost estimates for remediation of priority sites. Technical training by OGE and full implementation of the inventory will begin by October of 2005.

**EXPECTED BENEFITS:**
- Initiation of remediation projects through the Geologic Site Management Program based on project selection using the rank-order.
- Project cost savings related to proactive avoidance of known and potential rockfall locations during project planning.
- Project cost and time savings through informed inclusion of rock slope design requirements and construction work items in contract documents.
EXPECTED RISKS, OBSTACLES, & STRATEGIES TO OVERCOME THEM:
Implementation with ODOT staff would place a significant demand on human resources. To counter this obstacle, SPR, Part 1 monies were requested and approved so that consultant could be used for initial population of the inventory database and for development and cost estimates are complete. Following this initial population, the work responsibilities fall back on the District Geotechnical Engineer.

OTHER ODOT OFFICES AFFECTED BY THE CHANGE:
The following ODOT Divisions will be affected through implementation of this new process: Construction Management, Highway Operations, Planning, and Production Management.

PROGRESS REPORTING & TIME FRAME:
During the initial data population phase, quarterly reporting will be required.

TECHNOLOGY TRANSFER METHODS TO BE USED:
The location information collected for the site will include spatial coordinates and information compatible with BTRS. All site data will be available through a MS Access database format.

IMPLEMENTATION COST & SOURCE OF FUNDING:
SPR Part 1 funds have been approved for $1.2 M for the first year of work. It is anticipated that completion of the inventory will take 2 to 3 years.

Approved By: (attached additional sheets if necessary)
Office Administrator(s):
Signature: Gene Geiger Office: OGE Date: 8/16/2005

Division Deputy Director(s):
Signature: Tim McDonald Division: Production Management Date: 9/9/2005