GEOTECHNICAL POLICIES AND PROCEDURES MANUAL

CHAPTER 14

MAINTENANCE PHASE

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1. PURPOSE

Maintenance staff may contact Geotechnical Engineers regarding specific problems and when in need of immediate assistance. Monitoring of problem conditions may include field evaluations, documentation, and instrumentation. Recommendations should be provided when problem conditions are significant or when Maintenance staff has plans to make repairs.

2. INTRODUCTION

Typically, potential maintenance problems include roadway settlement/distortion, swelling ground, slope erosion, slope failures, rock slope degradation, rockfall hazards, and groundwater seepage. In addition, damage could occur to constructed items such as subdrains, horizontal drains, ground anchors, and wall systems. Earthquakes, heavy precipitation, fires and floods are causes of hazards and damage to facilities. Man-made hazards include vehicular damage to walls and foundations and geotechnical instrumentation. Some existing constructed items may need occasional maintenance, such as flushing and surging horizontal drains and unplugging subdrain discharge pipes. When requested, Geotechnical Engineers should visit the site to observe and document the occurring problems. By evaluating the problem areas, Geotechnical Engineers may decide to monitor the problems, recommend interim mitigation measures (within available Maintenance budget), or recommend a standard stabilization method (which could require new project funding and placement on the State Transportation Improvement Plan). The involved District Engineer evaluates the options.

3. RESPONDING TO MAINTENANCE REQUESTS AND EMERGENCIES

Generally, it is more cost effective to respond to maintenance requests than to emergencies. Working with Maintenance staff to investigate problem areas before they become emergencies assists to identify the cause of the problem and plan for an appropriate repair. Geologic conditions can result in hazardous conditions at or near roadways. However, impending geologic hazards could be difficult to identify by Maintenance staff. Geotechnical Engineers should evaluate the geologic conditions and potential hazards and provide recommendations regarding the relative risks that road users may face, as well as Maintenance staff that may be working in close proximity. In performing the site evaluation, Geotechnical Engineers are cautioned to follow safety practices for their own protection as well as others involved. (Refer to Department guidelines and OSHA.)

In geotechnical site problems, typically Geotechnical Engineers are requested to assess potential hazards and risks. In situations that could imperil the public, warnings may need to be provided and local road users and property owners notified. In extremely

hazardous situations, road closure may be required. In responding to such public safety issues, consult with the Principal Geotechnical Engineer, and the area Maintenance Foreman or Supervisor.

Depending on the maintenance cost of a problem and the availability of funds, Geotechnical Engineers may be asked to recommend interim solutions or “band-aid” mitigations rather than more permanent solutions. When responding to maintenance emergencies, a rapid response is often necessary to ensure public safety and maintain the integrity of the roadway. As maintenance repairs proceed, on site inspection and assistance should be provided to identify differing conditions and make field adjustments as required. Innovative and experimental mitigations may be appropriate, especially if they fit within budget constraints. Removal of slide debris from a roadway or ditch is often done to restore road service, but could cause additional slope distress and failures. Short-term options to a variety of maintenance problems could include surface water control/diversion, draining of trapped water, slope modifications (flatter slopes or benched slopes), rock inlays, berms, horizontal drains, dewatering wells, fabric walls and gabion walls (MSE), soldier pile and sheetpile walls, pin piles, pavement patching, bio-remediation (seeding, willow wattles, etc.), interim buttresses, injection or jet-grouting, scaling, preliminary rock bolts/bars and beams to pin rock that is on the verge of toppling, and unloading a slope to slow slide movements until a permanent solution is constructed. Sometimes these solutions are implemented without complete engineering analyses in order to provide a rapid response; however, Geotechnical Engineers must explain the uncertainties and risks to the decision-makers and follow through with thorough analyses to determine whether the implemented measures are adequate and whether additional or different measures would need to be included.

Sometimes the interim solutions are implemented to address immediate concerns, and are followed later by permanent solutions if greater funding becomes available and Plans can be prepared. Frequently, interim repairs are relied upon much longer than initially intended. Therefore, before recommending an interim or experimental solution, Geotechnical Engineers should consider the drawbacks related to the measure becoming permanent. Geotechnical Engineers should document and keep records of events regarding maintenance issues. With adequate risk/consequence evaluations, the Maintenance Division will be in a position to consider the relative advantages of each option when making decisions on how to proceed. In order to secure funding, for a maintenance project, typically, justification for need of mitigation is required. Larger projects typically need to be submitted for construction consideration.

4. RESEARCHING HISTORIC DATA

Although timeliness is important, Geotechnical Engineers should use available resources as time permits to identify the true cause of problems. Geotechnical Engineers should ask Maintenance staff for their experience in the area, consult geology publications,

and examine air photos (stereo pairs), research Department files for historic data, hazards, and prior projects. Geotechnical Engineers should review any available relevant Geotechnical Reports, instrumentation memorandums/data, and any notes to see if any unknown or unanticipated conditions were encountered or any unusual methods were used in construction of the facility.

Information sources and suggestions are described in the referenced manuals for various types of hazards. When responding to a rockfall hazard, Geotechnical Engineers should ask Maintenance staff how often rockfall events occur, where it comes to rest, how much material is typical for a single event, and whether it is comprised of individual blocks or a volume of numerous pieces.

Occasionally Geotechnical Engineers are involved in evaluating existing structure foundations for new loading conditions. These typically occur as part of a seismic or scour vulnerability assessment. An important part of the assessment is the type, depth, and condition of the structure foundation. The sources for this information may be as-built drawings, construction records, and Plans for the structure.

5. MONITORING GEOTECHNICAL PERFORMANCE

By regularly monitoring problem areas, Geotechnical Engineers can often reduce the uncertainties involved in the design of mitigation measures and permanent stabilizations. Instrumentation could be as complicated as extensometers and slope inclinometers or as simple as survey points. Regardless of the complexity of the monitoring program, Geotechnical Engineers should place and secure instruments as needed to survive for the duration of the intended monitoring period. For example, placing PK nails in pavement as survey points would not be a good choice where snow is plowed or pavement repairs may occur during the monitoring period. Existing structures that are potentially sensitive to vibrations or movement should be monitored. It may also be desirable to monitor groundwater level changes, settlement, heave, and/or lateral displacement of the roadway and structures.

6. ROCKFALL HAZARD RATINGS OF HIGHWAY SLOPES

Rockfall potential is inherent along roadways in mountainous terrain. Rockfall originates from both natural and man-made slopes because of geologic processes. The Rockfall Hazard Rating System (RHRS) is a rock slope management tool for quantifying the potential hazard a rock slope poses to users. The Department has implemented the RHRS. The RHRS database is valuable to the Department because, when fully implemented and maintained, it contains historical slope performance and quantifies the rockfall potential to provide a rational basis for determining project priorities.

The six steps in the RHRS process are summarized below:

- Slope Inventory (creating a geographic database of rockfall locations)

- Preliminary Rating (grouping the rockfall sites into three more manageably sized categories: A, B, and C)
- Detailed Rating (numerically prioritizing the identified rockfall sites from the least to the most hazardous)
- Preliminary Design and Cost Estimate (adding remediation information to the rockfall database)
- Project Identification and Development (advancing rockfall correction projects to construction)
- Annual Review and Update (maintaining the rockfall database)

Details of the RHRS and the procedures involved are described in the "FHWA Rockfall Hazard Rating System Participant's Manual", FHWA-SA-93-057, 1993.

7. MITIGATION OF SLOPE FAILURES AND LANDSLIDES

Mitigation of slope failures and landslides that are not part of design and construction contracts are often managed differently due to smaller funding sources and emergency response timeframe. Feasible solutions might not be able to fully stabilize the problem, but can be planned to reduce risk and maintenance. A source of guidance for maintenance-level slides is FHWA publication "Highway and Slope Maintenance and Slide Restoration Workshop Manual," FHWA RT-88-042, 1988.

8. REFERENCES

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FHWA, “Mechanically Stabilized Earth Walls and Reinforced Soil Slopes – Design and Construction,” FHWA-SA-96-071, 1996.

FHWA, “Rockfall Hazard Mitigation Methods – Participant’s Notebook,” FHWA-SA-93-085, 1993.

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FHWA, “Soils and Foundations Workshop Reference Manual,” NHI Course No. 132012, FHWA NHI-00-045, August 2000

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