

December 16, 2008

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**SUBJECT: Geotechnical Evaluation of Steep Slopes
 New Railway Alignment at Train Mountain
 Klamath County, Oregon**

At your request, Applied Geotechnical Engineering and Geologic Consulting LLC (AGEGC) has completed a geotechnical evaluation of the moderately steep slopes along portions of proposed new railway alignments for the Train Mountain facility in Klamath County, Oregon. Our geotechnical evaluation included a review of available geologic information for the property, a ground-level reconnaissance of limited sections of the proposed alignments, and engineering analyses. This report describes the work accomplished and provides our recommendations for installation of the new railroad track.

We understand that the existing Train Mountain property located north of South Chiloquin Road will be developed by the Friends of Train Mountain with over 25 miles of additional 7½ in. gauge mainline track. The work will be phased over the next 4 to 6 years. The track typically is constructed with an 8-ft-wide section of ballast rock for support of the ties and track section and a total width of 10 ft to provide access to the track.

On October 22, 2008, a licensed geotechnical engineer from AGEGC completed a site visit to complete ground-level reconnaissance of the representative sections of the proposed railway alignments. Areas visited during our site visit included the Farmersville to Caboose Ridge, The Knob, Caboose Ridge, Hope to New England, and the Big Trestle Loop sections. The approximate locations of the alignments were staked in the field and located in the field during our site visit by you.

The surficial soils along the majority of the proposed alignments consist of medium stiff, brown silt. Local areas contain scattered angular basalt cobble and boulders. The upper 6 to 12 in. of soil typically is loose and has a low natural moisture content. Subgrade at the proposed trestle location includes outcrops of medium hard, competent sandstone (welded tuff). At the propose location of the northern abutment of the trestle, a backhoe encountered practical refusal on the sandstone at a depth of less than 2 ft.

Areas of shallow groundwater and/or springs were not observed adjacent to the proposed alignments during our site visit. Indications of large-scale, deep-seated slope instability that could affect the proposed alignments were not observed. Indications of soil creep were observed on slopes steeper than about 30%. Soil creep is the gradual downslope movement of surficial soils due to gravity, seasonal changes in the moisture content of the surficial soils, and freeze/thaw of the surficial soils.

CONCLUSIONS AND RECOMMENDATIONS

In our opinion, the proposed alignments are suitable for development with the proposed 7½ in. gauge railroad. The main geotechnical considerations for development of the alignments will be the grading of the slopes to minimize the risk of significant future slope movements.

General geotechnical recommendations for construction of the new railroad track are provided below.

- 1) Where the alignment crosses slopes steeper than 30%, the track section should be developed in a full cut. Fill should not be placed on slopes steeper than 30%. Cut slopes on the uphill side of the alignment should be graded to no steeper than 1¼H:1V. It should be anticipated that some sloughing/raveling of the cut slope will occur, especially until vegetation is reestablished on the cut slope. The downhill edge of the tracks should have a horizontal setback from the native slope below the alignment of at least 4 ft to reduce the risk of excessive settlement due to soil creep of the native surficial soils.
- 2) Where the alignment crosses slopes of less than 30%, the track section can be developed on cut and fill sections. Fill slopes should be graded to no steeper than 2H:1V. Cut slopes should be graded to no steeper than 1¼H:1V. The ground surface should be stripped of surface organics (typically to a depth of about 6 in.) in fill areas. The slope should be benched as the fill is placed to blend the fill with the native soils. Fill should be moisture conditioned (typically wetted) to within 3% of the optimum moisture content and compacted to at least 95% of the maximum dry density as determined by ASTM D 698. Based on our observations at the site and our discussions with you, we anticipate that if the proposed alignment located north of The Knob (on the alignment section to Caboose Ridge) requires trestle(s) for the alignment, the trestle foundations will need to be founded on undisturbed native subgrade or on structural fill placed on undisturbed native subgrade.
- 3) Based on our observations and our discussions with you, the local depression (old dozer track) along the proposed alignment on the northwest side of The Knob will require retention to provide the required grades. In our opinion, MSE walls and/or geotextile wrapped walls will be the most practical methods for site retention. The retaining wall designs should be completed by a licensed geotechnical engineer after final grades and exposed wall heights have been determined. In our opinion, if properly moisture conditioned and compacted, the on-site soils may be used for the majority of construction of the geotextile and/or MSE retaining walls. Imported crushed rock and geotextile fabric will be required for a drainage layer in the wall backfill.
- 4) Subgrade soils that are loose and/or disturbed during grading of the alignment should be wetted and compacted until firm (typically about 95% of the maximum dry density as determined by ASTM D 698 and within about 3% of the optimum moisture content).
- 5) Graded slopes should be protected from erosion as soon as possible after completion of grading. Where practical, concentrated surface water flow should not be allowed on the cut and fill slopes until vegetation is reestablished.

- 6) We anticipate that the proposed Big Trestle can be supported on standard spread footing foundations. The trestle and foundations should be designed by a licensed structural engineer working with the project geotechnical engineer. For preliminary design of the trestle, we anticipate that foundations can be designed on the basis of an allowable soil bearing pressure of up to 2,500 psf.

AGEGC is available to provide construction engineering services during grading for the railway alignment including evaluation of stripping, benching, cut slopes, and fill compaction.

LIMITATIONS

This report has been prepared to aid the Friends of Train Mountain in the design and construction of the proposed new mainline track. The scope is limited to the specific project and location described herein, and our description of the project represents our understanding of the significant aspects of the project relevant to the design and construction of the new track.

The conclusions and recommendations submitted in this report are based on our observations at the site. However, it is acknowledged that variations in soil conditions will exist from the locations observed during our site visit. If during construction, subsurface conditions different from those described in this report are observed or encountered, we should be advised at once so that we can observe and review these conditions and reconsider our recommendations where necessary.

Please contact AGEGC if you have any questions or require additional information.

Sincerely,
Applied Geotechnical Engineering and Geologic Consulting LLC



Robin L. Warren, P.E., G.E., R.G.
Principal



Renewal: June 2010