Wallowa Falls Hydroelectric Project

FERC Project No. P-308

Revised Study Plans – Geology and Soils

December 2011

Prepared by:
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Hydro Resources
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Portland, OR 97232

PACIFICORP ENERGY
A DIVISION OF PACIFICORP

For Public Review

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1.0 INTRODUCTION

PacifiCorp Energy (PacifiCorp) proposes to conduct a Geology and Soils Study to meet Federal Energy Regulatory Commission (FERC) licensing requirements, and a study request by the Oregon Department of Fish and Wildlife. The study will include a risk and needs assessment to identify long term surficial soil erosion and slumping potential and identify potential stabilization measures. The study will include the following components: 1) a desktop evaluation, 2) a geologic field reconnaissance, and 3) a remedial assessment.

2.0 STUDY DESCRIPTION AND OBJECTIVES

Per 18 CFR §5.11(d)(1), this section describes the goal and objectives of the study and the information to be obtained. FERC guidelines identify the requirement to describe geology and soils within and adjacent to the Project boundary and identify any issues pertaining to geology and soils attributed to the Project. The goal of this study is to evaluate the soil erosion, mass wasting, and slumping risk posed to both Project features and the surrounding environment. This information will be used to support a new FERC license application for continued operation of the Project.

The study has three principal objectives:

- Characterize the existing geology, soils and geomorphic processes of the Project area and current condition of the resource.
- Identify near-term and long-term surficial soil erosion, mass wasting, and slumping potential within and adjacent to the Project boundary.
- Identify possible remediation measures if needed.

3.0 RESOURCE MANAGEMENT GOALS

Per 18 CFR §5.11(d)(2), this section will address resource management goals of the U.S. Forest Service (USFS) regarding geology and soil resources.

3.1 Wallowa-Whitman National Forest Plan

The current Wallowa Whitman National Forest Land and Resource Management Plan (Forest Plan) became final in 1990. A revised plan is currently being developed under the Blue Mountains Forest Plan Revision which covers the Malheur, Umatilla and Wallowa-Whitman National Forests Collectively. The revised plan is scheduled to be released for public review and comment in 2011 with a final decision expected in 2012.

Chapter 4, Forest Management Direction, of the current Forest Plan (USFS. 1990) identifies the following management goal for soil and water. "To maintain and enhance soil productivity, water quality, and water quantity and to meet or exceed State water quality standards, and to acquire water rights for water uses under State law."

Additionally, the Forest Management Objectives section of Chapter 4 of the Forest Plan provides the following soils objective: "Standards and guidelines place high priority on the protection of soil and water." However, site specific goals for the Project Area are not identified.

4.0 EXISTING INFORMATION

Per 18 CFR §5.11(d)(3), this section will describe existing geology and soils information pertinent to the Project, and the need for additional information.

4.1 Geological Formations

The dominant underlying geologic formation of the Project vicinity is Miocene Columbia River Plateau Basalt (Kuehn, 1995). Subformations occupied by the Project include alluvial and glacial deposits at the powerhouse, tailrace and lower 500 feet of penstock, while the upper Project facilities are in the Clover Creek Greenstone formation (Oregon DOGMAI, 1941). The alluvial and glacial deposit subformation is the unconsolidated product of contemporaneous and near contemporaneous sedimentary deposition (Wagner, 1955). The Clover Creek Greenstone formation is made up of volcanic and metavolcanic rocks of mixed lithologies (Oregon DOGMAI, 2009). There are no faults or folds in the Project Area or in the immediate vicinity of the Project Area.

The geographic area around the Project was formed by extensive glaciation that occurred during the last ice age (Wisconsin Glacial Episode) as recently as 10,000 years ago (Budlong et. al. September 2005). The Wallowa Glacier was thought to be at its deepest near the junction of the East Fork and West Fork Wallowa River resulting in very deep glacial deposits in the area around the powerhouse and tailrace. Conversely the upper Project Area is located in a recently scoured area with relatively shallow soils.

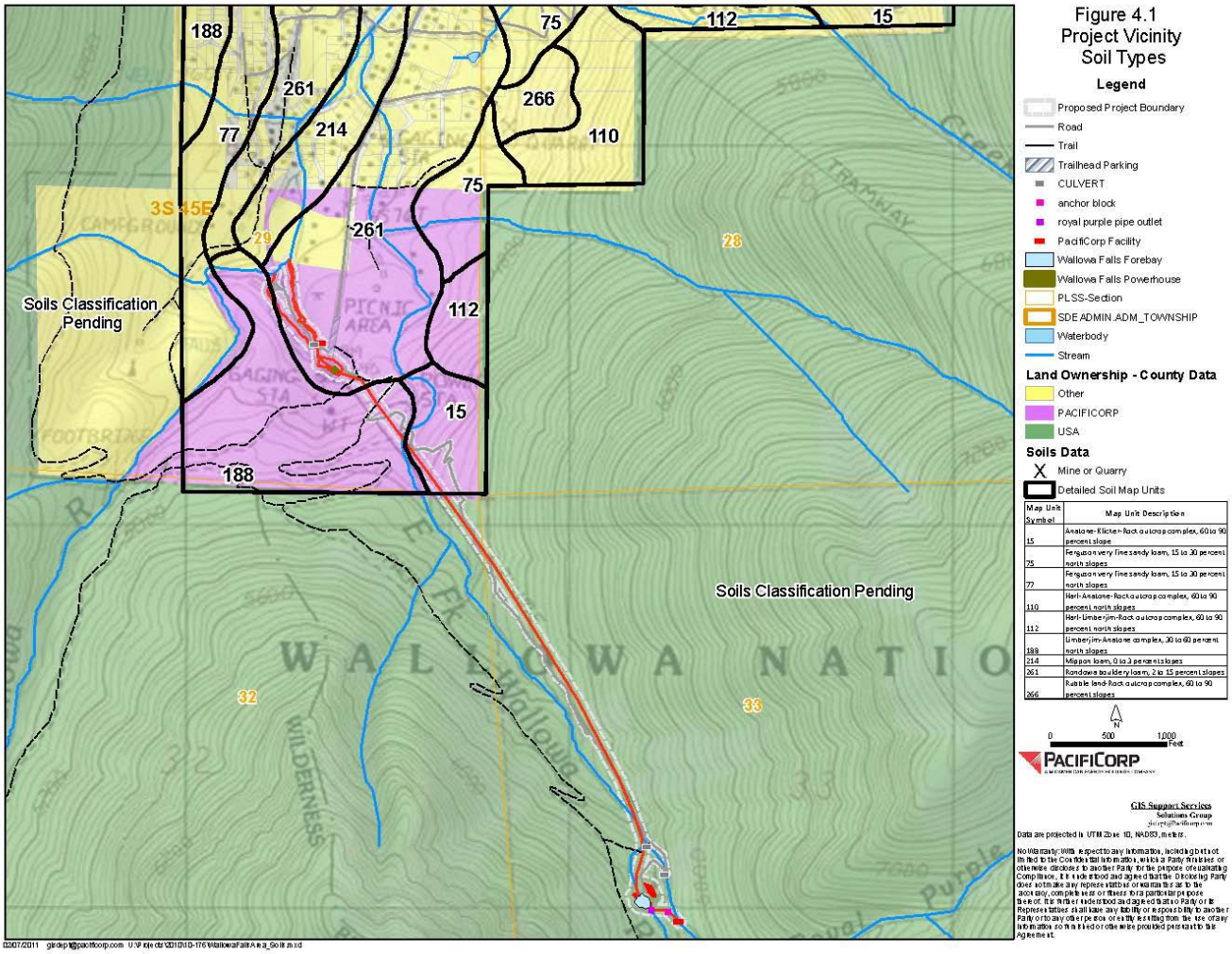
4.2 Soils

The United States Department of Agriculture and Natural Resources Conservation Service (USDA-NRCS) conducted a soil survey of privately owned lands in the Project vicinity in 1996. The subsequent report is the primary source of information for this discussion (Kienzle, No Date). The U.S. Forest Service is working on a sister document covering the Wallowa-Whitman National Forest portion of the Project vicinity but it has yet to be published.

There are numerous USDA-NRCS reported soil types in the Project vicinity and three reported soil types within in the Project area (Figure 4.2.1). The three reported soil types in the Project area are Anatone-Klicker-Rock-Outcrop complex (60 to 90 percent south slopes), Limberjim-Anatone complex (30 to 60 percent north slopes), and Rondowa Boulder Loam (2 to 15 percent slopes).

While the upper portion of the Project was not specifically covered in the USDA-NRCS document, it is reasonable to assume the majority of the Project penstock, diversion dams and forebay are on south facing Anatone-Klicker-Rock-Outcrop complex soils. This soil type occurs between 4,000 and 6,000 feet mean sea level (msl) and is comprised of Anatone type soils on convex south facing backslopes (50 percent of the area) and Klicker type soils on concave south

Figure 4.2.1. Project Vicinity Soil Types.



facing backslopes (30 percent of the area). The remaining 20 percent of the area is divided evenly between rock outcrops and contrasting inclusions. Both Anatone and Klicker soil types are derived from basalt based loess and colluviums with depths ranging from 10 to 40 inches. Klicker soils have an additional volcanic ash component in upper profiles.

A section of the lower Project penstock is on north facing Limberjim-Anatone complex soils. This soil type occurs between 4,700 and 5,400 feet msl and is comprised of Limberjim type soils on north facing concave backslopes (50 percent of the area) and Anatone type soils on north facing convex backslopes (35 percent of the area). The remaining 15 percent of the area is contrasting inclusions. The Limberjim soil type is derived from volcanic ash over colluvium and residuum derived from basalt and andesitic tuff breccias with a depth to bedrock of 40 to 60 inches.

Management considerations for Anatone, Klicker, and Limberjim soil types that are applicable to the Project include the following:

- High erodability in areas of low plant cover;
- Site disturbance, including construction activities, may result in slope instability problems such as soil erosion, sloughing, and raveling;
- Cool soil temperatures and a short growing season limit the period of plant growth;
- Soils are prone to compaction;
- Erosion control measures may be needed to reduce soil loss from cut and fill slopes;
- Soil is susceptible to being pushed from its natural position during equipment operations;
- Un-surfaced roads on hillsides are sticky and soft when wet and dusty when dry; and
- Special precautions may be needed to control soil loss following activities that expose the soil.

The powerhouse, tailrace, and short section of penstock immediately above the powerhouse are on the Rondowa bouldery loam, 2 to 15 percent, soil type. Parent material is mixed glacial till with an influence of loess and minor amounts of ash in the upper part. Soil depth to bedrock is typically over 60 inches. Management considerations for Rondowa soils applicable to the Project include the following:

- Soil is prone to compaction;
- Disturbed areas are subject to soil erosion;
- Excavation increases the risk of water erosion; and
- Excavation is hampered by the boulders and cobbles in the soil.

The erosion and slump occurring on the upper portion of the forebay access road is likely of the Anatone-Klicker-Rock Outcrop soils type and is subject to the management considerations described above.

Additional information is needed regarding slope stability and the risk of slope failure along the forebay access road and penstock alignment. This information would be used to identify possible stabilization measures as needed.

5.0 NEXUS TO PROJECT

Per 18 CFR §5.11(d)(4), this section will describe any nexus between Project operations and effects on geology and soils.

The Project has potential direct and indirect effects on geology and soil resources within and adjacent to the Project boundary and in the affected reach of the river below the dam. These potential effects include surficial slumping, soil erosion, and mass wasting along the forebay access road, and potential erosion in the event of penstock failure or rupture.

6.0 STUDY AREA

This section will introduce the study area pertinent to the specific resource area. The Study Area consists of lands and waters within and adjacent to the proposed Project boundary including the forebay access road, penstock, tailrace, bypass reach, and Wallowa River from the East Fork and West Fork confluence to Wallowa Lake.

7.0 METHODS

Per 18 CFR §5.11(b)(1) and §5.11(d)(5), this section will provide a detailed description of the proposed study methodology, including data collection and analysis techniques, or objectively quantified information, sampling strategy, and a schedule including appropriate field season(s) and the duration.

The study will include a qualitative discussion of the following: systemic geomorphic processes from the Project forebay to Wallowa Lake, the Project's potential sediment contribution in the context of the larger basin geomorphology, the potential for sedimentation to affect aquatic habitat in the lower East Fork Wallowa River and Wallowa River from the confluence of the East Fork and West Fork to Wallowa Lake, and seasonal changes in sediment transport capacity.

The geology and soils evaluation will be performed in phases as identified below. The phased approach will enable an initial screening of all areas in the study area to assure all locations of interest are identified. The latter phases will focus on higher risk areas identified in the screening studies. The geology and soils evaluation will be performed by a professional geologist and/or geotechnical engineer experienced in geologic hazard evaluations at similar facilities. The evaluation will be performed in the summer or fall months when the ground is clear of snow.

7.1 Desktop Evaluation

- The evaluation will include review of soil, maps, geology maps, and related publications to identify soil types and geologic features that have susceptibility to erosion and mass wasting.
- Topographic maps will be reviewed to identify steeper areas that have a higher probability of instability.
- Maps and engineering drawings of the Project will be reviewed to determine where natural landforms have been modified, and identify areas along water conveyance structures where there is the potential for inadvertent discharges into erosion sensitive areas.
- A document search and review will also be performed to identify areas that have been previously evaluated or remediated.
- The above information will be evaluated as a whole to identify locations for further evaluation.

7.2 General Geologic Field Reconnaissance

- A general field reconnaissance of the study area will be performed to confirm the results of the desktop evaluation and document geomorphic processes and geologic conditions.

7.3 Targeted Geologic Field Reconnaissance

- Site-specific reconnaissance will be performed at locations identified in the desktop evaluation and general field reconnaissance described in Section 7.2 above.
- Initial screening will be performed at identified locations to determine if the location has a plausible risk of erosion or mass wasting.
- Site-specific reconnaissance is anticipated to be performed along the forebay access road and penstock alignment.
- Data collected at locations of interest will include: geographic coordinates, representative site photographs, location description, soil types, and field sketches of location features.

7.4 Results and Remedial Assessment Recommendations

- Locations where site-specific analyses were performed will be evaluated for their probability and consequences of erosion or mass wasting.
- Conceptual options and cost estimates to remediate locations of interest will be developed.
- Identification of regulatory authorizations and permitting required to implement site remediation will also be performed.

8.0 PROGRESS REPORTING

Per 18 CFR §5.11(b)(3), this section will discuss provisions for periodic progress reports, including the manner and extent to which information will be shared; and the time allotted for technical review of the analysis and results.

A study progress meeting will be held in October of 2012. A study progress report (draft Technical Report) will be made available for 30 day stakeholder review and comment in November, 2012. Stakeholder comments will be addressed in the initial study report. The initial study report will be made available for review in mid January, 2013; followed by an initial study report meeting in late January, 2013.

9.0 FINAL PRODUCT

A final Technical Report will be made available for stakeholder review in June, 2013. The Final Technical Report will include the following items:

- Desktop Evaluation
    - Listing of materials reviewed for the desktop evaluation;
    - Criteria used during desktop evaluation to identify locations of interest; and

    - Listing of locations of interest identified in desktop evaluation.
- General Geologic Field Reconnaissance
    - Description of field methods, review general geomorphic processes in the study area mass wasting and sedimentation risk; and
    - Identification of locations of interest not identified in desktop evaluation.
- Targeted Geologic Field Reconnaissance
    - Listing and overall site map of locations where Targeted Geologic Field;
    - Reconnaissance was performed; and
    - Description of field methods.
    - For each location a site description will be provided which will include:
        - Location name;
        - Location coordinates;
        - Location description;
        - Representative site photographs;
        - Sketch of location features at approximate scale; and
        - Assessment probability and consequences of erosion or mass wasting.
- Results and Remedial Assessment Recommendations
    - Summary discussion of systemic geomorphic processes including mass wasting and sediment transport capacity.
    - Listing and overall site map of locations where remedial assessments were performed.
    - For each location assessed, a description of conceptual remediation options will be provided which will include:
        - Location name;
        - Remediation description;
        - Sketch of remediation features at approximate scale;
        - Conceptual cost estimate of remediation; and
        - Listing of anticipated regulatory authorizations and permitting required for implementation.

10.0 SCHEDULE

Per 18 CFR §5.11(b)(2), the schedule for the Geology and Soils Study is provided in Table 10.0-1 below.

Table 10.0-1 Schedule for Geology and Soils Study.

Component	Completion Date
Desktop Evaluation	June 2012
Field Reconnaissance	July 2012
Remedial Assessment	August 2012
Study Progress Meeting	October 2012
Study Progress Report	November 2012
Initial Study Report filed with FERC	January 2013
Initial Study Report meeting	January 2013
Meeting Summary filed with FERC	February 2013
Final Technical Report*	June 2013

** Assumes one season of data collection.*

11.0 LEVEL OF EFFORT AND COST

Per 18 CFR §5.11(d)(6), the estimated costs for this study are provided in Table 11.0-1 below.

Table 11.0-1 Estimated Cost for Geology and Soils Study.

Activity	Labor	Per-Diem	Materials and Equipment	Total
Desktop Evaluation	$17,200	$0	$600	$17,800
Field Reconnaissance	$16,320	$1,650	$2,400	$20,370
Remedial Assessment	$15,680	$0	$800	$16,480
Reporting	$20,000	$0	$1,200	$21,200
Total	$69,200	$1,650	$5,000	**$75,850**

12.0 REFERENCES

USFS. 1990. Wallowa-Whitman National Forest Land and Resource Management Plan. Department of Agriculture, Baker City, Oregon. April 1990.

Kuehn, S.C. The Olympic –Wallowa Lineament, Hite Fault System, and Columbia River Basalt Group Stratigraphy in Northeast Umatilla County, Oregon (Master's thesis). May 1995. Washington State University. http://academics.concord.edu/sckuehn/msthesis/msthesis.html

Geologic Map of the Wallowa Lake Quadrangle.
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Budlong, Bryce, J.R. Collier, Calvin Davis, David E. Gilbert, Rob Ledgerwood, and Jay Van Tassell. September 2005. Eastern Oregon Geology Vol. 2, The Bathymetry and Sediments of Wallowa Lake, Northeast Oregon. Science Department- Badgley Hall, Eastern Oregon University, La Grande, OR 97850-2899. http://www.eou.edu/geology/wallowalake.html.

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