

**Susitna-Watana Hydroelectric Project
(FERC No. 14241)**

**Geology and Soils Characterization Study
Study Plan Section 4.5**

**Part D: Supplemental Information to
June 2014 Initial Study Report**

Prepared for

Alaska Energy Authority



SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

Prepared by MWH

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TABLE OF CONTENTS

1. Introduction.....	1
2. Background	2
2.1. Purpose of Study	2
2.2. Study Components	2
3. Status, Highlighted Results, and Achievements.....	3
4. Summary of Study 4.5 Documents	4
5. New Study Documentation Supplementing the ISR.....	5
6. Variances	5
6.1. 2013 Study Season	5
6.2. 2014 – 2015 Study Season	5
7. Study Plan Modifications	6
7.1. Modifications Identified in ISR.....	6
7.2. Modifications Identified since the June 2014 ISR	6
8. Steps to Complete the Study	6

1. INTRODUCTION

Section 1 (Part A) of the June 2014 ISR for this Geology and Soil Resource Characterization Study (Study Plan 4.5) details the development of this study from the Revised Study Plan (RSP) in 2012, through the end of the 2013 study season. Section 7 of the ISR (Part C), filed in June 2014, sets forth AEA's plan and schedule, at that time, for completing this study and meeting the objectives of the RSP.

As detailed in Section 2.2 of the ISR Part D Overview, various circumstances have required AEA to extend the original timeframe for completing the Commission-approved Study Plan. However, AEA has made meaningful progress with this Study 4.5 since the filing of the ISR in June 2014. As detailed below, AEA's recent activities for Study 4.5 have consisted of the following:

- Exploration Program – limited subsurface investigations that included four borings, totaling 1853 lineal feet; two of the borings were cross-holes beneath the Susitna River and two inclined borings on the lower right abutment at the dam site.
- Laboratory testing of rock core samples for characterization of engineering properties.
- Geotechnical instrumentation was installed in the new borings - continuation of instrumentation monitoring for groundwater levels and ground temperature at the dam site.
- Dam site geologic characterization – compilation of surface geologic observations and core drilling and in situ testing, and discontinuity surveys to assess “geologic features” and rock structure.
- Surface fault rupture evaluation in the dam site area.
- Geotechnical instrumentation monitoring to characterize the groundwater and thermal conditions in the abutments.
- Seismicity cataloging, continue monitoring of earthquake events through the Project Seismic Monitoring Network.
- Crustal Seismic Source Evaluation.
- Preparation of final technical memorandum (TM) and reports – Geotechnical Data Report, Dam Site Geology Technical Memorandum, Seismic Network 2014 Annual Seismicity Report; and Crustal Seismic Source Evaluation Report.
- Completion of the 2014-2015 Study Implementation Report in October 2015.

The primary purpose of this Part D Supplemental Information to the ISR is to report on the implementation of the Study Plan from the filing of the ISR in June 2014, through the filing of this ISR Part D. In light of this additional implementation, this Part D also identifies AEA's

plans for completing Study 4.5 in a manner that meets the objectives of the Commission-approved Study Plan.

2. BACKGROUND

2.1. Purpose of Study

The goals of this study are to conduct a geology and soils evaluation to define the existing geological conditions at the dam site, reservoir, and access and transmission line corridors, and to develop design criteria to ensure that the proposed Project facilities and structures will be safe and adequate to fulfill their stated functions.

The study objectives are established in RSP Section 4.5.1:

- Identify the existing soil and geology at the proposed construction site, reservoir area, and access road and transmission line corridors.
- Determine the potential effects of Project construction, operation, and maintenance activities on the geology and soil resources (including mineral resources) in the Project area including identification and potential applicability of protection, mitigation, and enhancement measures.
- Identify known mineral resources and mineral potential of the Project area.
- Acquire soils and geologic information for the Project area for use in the preparation of a supporting design report that demonstrates that the proposed structures are safe and adequate to fulfill their stated functions.

2.2. Study Components

This study consists of the following components:

- Field site investigations, drilling and sampling, downhole testing and instrumentation, and instrumentation monitoring.
- Geologic mapping of the dam site and reservoir areas.
- Geologic characterization and identification of construction material sources.
- Assessment of seismic hazards, mineral resources, and reservoir slope stability.
- Monitoring of earthquake events in the Project area.
- Geologic and engineering analysis.

3. STATUS, HIGHLIGHTED RESULTS, AND ACHIEVEMENTS

The following tasks were completed in 2013 and reported in Part A of the June 2014 ISR for Study 4.5:

- Exploration and testing activities were conducted in the dam site area to investigate potential construction material sources, Quarry A and M, and to augment the 1970s and 1980s site investigations particularly in lieu of the different dam type, a roller compacted concrete dam (RCC). The exploration and testing programs included core drilling, packer testing, downhole logging and instrumentation, Laboratory testing was performed of core and bulk rock samples and an instrumentation monitoring program was initiated to monitor groundwater and ground temperature.
- Recently acquired Light Detection and Ranging (LiDAR) imagery was used to perform desk top studies – an update of the regional terrain unit interpretation from the 1980s using the higher resolution imagery for the dam site and reservoir areas and a preliminary assessment of reservoir slope stability. In addition, an assessment of mineral resources, mineral claims, mineral licks and acid rock drainage (ARD), within the Project area was initiated however, due to site constraints, the study was not completed. Seismic hazard studies were also begun and included a preliminary seismic hazard assessment, establishment of a long-term earthquake monitoring network, determination of shear wave velocities to a depth of about 100 feet, lineament mapping and analysis using LiDAR and Interferometric Synthetic Aperture Radar (INSAR) imagery, and a preliminary assessment of reservoir triggered seismicity (RTS). The annual reporting of the seismicity data provided good definition of the crust and intraslab geometries and the current stress regime within the Talkeetna block.
- Some of the study components, begun prior to the filing of the ISR, were continued, including: additional site investigations at the dam site, laboratory testing of rock samples, crustal seismic source evaluation, and data acquisition efforts associated with the geotechnical instrumentation and seismic monitoring programs. Significant progress has been made in the geologic characterization studies at the dam site to meet the Study Plan objectives; however, non-dam site related studies were largely not conducted.
- The tasks which have been completed include the regional geology characterization of the dam site and reservoir areas (excluding the proposed corridors); a preliminary reservoir slope stability assessment; a site-specific seismic hazard assessment that included probabilistic and deterministic seismic hazard analysis (PSHA, DSHA), crustal seismic source evaluation, seismicity cataloging and analysis, and selection of seismic design parameters; a preliminary reservoir triggered seismicity study.

The study team has completed the following activities for Study 4.5 since the June 2014 filing of the ISR:

- Drilling in situ testing and instrumentation installation: two borings, cross-holes beneath the Susitna River and two inclined borings on the lower right abutment at the dam site.
- Laboratory testing of rock samples.

- Geotechnical instrumentation monitoring at sites at the dam site.
- Dam site geologic mapping and fault rupture evaluation.
- Seismic Network Monitoring of earthquake activity in the Project area.
- Crustal Seismic Source Evaluation.

4. SUMMARY OF STUDY 4.5 DOCUMENTS

Since filing of the RSP in 2012, AEA and FERC have prepared several documents pertaining to this study. To aid review by FERC staff and licensing participants, each of these documents is listed below. Each of these documents is accessible on AEA's Project licensing website (<http://www.susitna-watanahydro.org/type/documents/>) by clicking on the entry in the "Link" column in the table. In addition, these documents are available on FERC's eLibrary system (<http://www.ferc.gov/docs-filing/elibrary.asp>), in Docket No. P-14241.

Title	Date Filed	Description	Link
4.5. Geology and Soils Characterization (Revised Study Plan)	12/14/2012	This document presents the plan for this study, including goals, objectives, the study area, and proposed study methods for geology and soils.	RSP for Study 4.5
FERC Study Plan Determination for Study 4.5	2/1/2013	This document presents FERC approval of Study 4.5, which approved AEA's Revised Study Plan with no recommended adjustments.	FERC SPD for Study 4.5
Draft Initial Study Report for Study 4.5	2/3/2014	This draft of the ISR summarized the study methods and variances during the 2013 study season, and presented preliminary data collected for Study 4.5. This draft ISR was later republished as Part A of the final ISR.	Draft ISR for Study 4.5
Initial Study Report for Study 4.5	6/3/2014	This document is the Initial Study Report (Parts A, B, and C) for Study 4.5. Part A republishes the Draft ISR. Part B identifies supplemental information and errata in Part A. Part C presents study modifications and plans for completing the study.	ISR Part A for Study 4.5 ISR Part B for Study 4.5 ISR Part C for Study 4.5
Initial Study Report Meetings, October 22, 2014 (Parts A and B)	11/14/2014	Transcripts and AEA's agenda and PowerPoint presentations for the ISR meeting concerning the Project geology and soils studies.	Transcripts from ISR Meeting Materials from ISR Meeting
Geology and Soil Resource Characterization Study (4.5) –	11/6/2015	AEA's Study Implementation Report: a summary of field results	2014-2015 SIR for Study 04.5

Title	Date Filed	Description	Link
2014-2015 Study Implementation Report and attachments		in 2014-2015.	

5. NEW STUDY DOCUMENTATION SUPPLEMENTING THE ISR

The following table identifies and describes additional reports and other documents that update, refine, or otherwise supplement certain sections of the ISR pertaining to this Study 4.5, during AEA's continued implementation of the Study Plan since the ISR was filed in June 2014.

ISR Reference	Description
Part A, Section 4	This Section is updated and supplemented by the Study Implementation Report (Section 4), describing the study methods and variances in 2014 -2015.
Part A, Section 5	This section is updated and supplemented by the Study Implementation Report (Section 5), describing the study results in 2014 -2015.
Part A, Section 6	This section is updated and supplemented by the Study Implementation Report (Section 6), discussing the study results in 2014 -2015.

6. VARIANCES

6.1. 2013 Study Season

The following variance is reported in the June 2014 ISR:

- Due to land access restrictions in the study area in 2013, the planned field exploration and testing program, specifically geologic mapping, geophysical surveys, drilling and testing, and excavation of an exploratory audit at the dam site, were deferred. In areas where land access restrictions were imposed, no on-the-ground activities could be performed. In these areas, field investigation and data collection were limited to aerial reconnaissance, a high-level review in connection with reconnaissance geologic mapping activities associated with development of the regional geology, mineral resources assessment, and continuation of seismic hazard studies.

6.2. 2014 – 2015 Study Season

The following variances occurred following the filing of the June 2014 ISR:

- As explained in Section 1.3 of the ISR Part D Overview and Section 3 of the Study Implementation Report for Study 4.5, in 2014 AEA included the Denali East Corridor Option as an additional, alternative north-south corridor alignment for transmission and access from the dam site to the Denali Highway.

- Also in 2014, as explained in Section 1.3 of the ISR Part D Overview and Section 3 of the Study Implementation Report for Study 4.5, after the ISR was filed with FERC in June 2014, AEA eliminated the Chulitna Corridor from further study.

7. STUDY PLAN MODIFICATIONS

7.1. Modifications Identified in ISR

Section 7 of the ISR (Part C) details the following modification for this study following the 2013 study season:

- As explained in the ISR (Part C), in 2014 AEA included the Denali East Corridor Option as an additional alternative north-south corridor alignment for transmission and access from the dam site to the Denali Highway. This change was implemented as a variance in 2014 (see Section 6.2 above).

7.2. Modifications Identified since the June 2014 ISR

The following modification, added after the June 2014 ISR and prior to the 2014 field season, was implemented during the 2014 field season:

- As explained in Section 1.3 of the ISR Part D Overview, AEA removed the Chulitna Corridor from the study area.

8. STEPS TO COMPLETE THE STUDY

In light of the variances and modifications described above, the steps necessary for AEA to complete this study are summarized below. As necessary and appropriate, these steps have been updated from those appearing in Section 7 of the ISR (Part C).

- Mineral resource assessment - an assessment of the mineral resources within the Project area was initiated and an interim report prepared (Golder 2014, Attachment 1). The catalog of claims and prospects will need to be updated.
- Geotechnical Exploration – field investigations and testing will be conducted in the future to characterize the geology and soil resources, determine construction impacts, and mitigate the impacts in the dam site area, reservoir area, construction material sources, and access road and transmission line corridors.
 - Reservoir area – studies will be completed to evaluate geology and soils resources with respect to reservoir slope stability in the Watana Creek area where thawing and degradation of the bluffs that will come in contact with the reservoir is occurring.
 - Access Road and Transmission Line Corridors - studies to evaluate the geology and soils resources relative to develop and characterize the geologic conditions and uncertainties, identify suitable construction material sources, and to identify

mitigation measures due to construction and operation on the geology and soils resources.