

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

**Ice Processes in the Susitna River Study
Study Plan Section 7.6**

**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

HDR

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1. INTRODUCTION

Section 1 (Part A) of the June 2014 ISR for the Ice Processes in the Susitna River Study (Study Plan 7.6) 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 7.6 since the filing of the ISR in June 2014. As detailed below, AEA's recent activities for Study 7.6 have consisted of the following:

- AEA held an ISR meeting for the Ice Processes in the Susitna River Study on October 17, 2014.
- Completion of observations and documentation of the timing, progression, and physical processes of freeze-up and break-up during 2012–2014, including open lead surveys (RSP Sections 7.6.4.1-7.6.4.3).
- Continuation of River1D modeling of the Middle River reach (RSP Section 7.6.4.6).
- Continuation of River2D modeling of selected Focus Areas in the Middle River reach (RSP Section 7.6.4.7)
- Development of 2014-2015 Study Implementation Report (SIR) for Study 7.6 Ice Processes in the Susitna River Study.

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 7.6 in a manner that meets the objectives of the Commission-approved Study Plan.

2. BACKGROUND

2.1. Purpose of Study

The Ice Processes in the Susitna River Study (Study 7.6) will further the understanding of natural ice processes in the Susitna River and provide a method to model/predict pre-Project and post-Project ice processes in the Susitna River. This multi-year study was initiated in 2012; and is ongoing. The study will provide a basis for impact assessment, which will inform the development of any necessary protection, mitigation, and enhancement measures. The study also will provide ice processes input data for other resource studies with winter components (e.g., Fluvial Geomorphology Modeling below Watana Dam Study [Study 6.6], Instream Flow Studies [Studies 8.5-8.6], Instream Flow Riparian [ISR Study 8.6], and Groundwater Study [Study 7.5]).

2.2. Study Components

This study consists of the following components:

- Document the timing, progression, and physical processes of freeze-up and break-up during 2012–2014 between tidewater and the Oshetna River confluence (PRM 235.2 [RM 233.4]), using historical data, aerial reconnaissance, stationary time-lapse cameras, and physical evidence.
- Determine the potential effect of various Project operational scenarios on ice processes downstream of Watana Dam using modeling and analytical methods.
 - Develop a modeling approach for quantitatively assessing ice processes in the Susitna River.
 - Calibrate the model based on existing conditions. Use the model to determine the extent of the open water reach downstream of Watana Dam during Project operations.
 - Use the model to determine the changes in timing and ice-cover progression and ice thickness and extent during Project operations.
- Develop detailed models and characterizations of ice processes at instream flow Focus Areas in order to provide physical data on winter habitat for the Fish and Aquatics Instream Flow Study (Study 8.5).
- Provide observational data of existing ice processes and modeling results of post-Project ice processes to the Fluvial Geomorphology Modeling below Watana Dam Study (Study 6.6), Groundwater Study (7.5), Instream Flow Studies (Studies 8.5-8.6), Fish and Aquatics Study (Studies 9.12), Riparian Vegetation Study Downstream of the Proposed Susitna-Watana Dam (Study 11.6), Recreation and Aesthetics Studies (12.5-12.7), and Socioeconomic and Transportation Study (Study 15.7).
- Research and summarize large river ice processes relevant to the Susitna River, analytical methods that have been used to assess impacts of projects on ice-covered rivers, and the known effects of existing hydropower operations in cold climates.

3. STATUS, HIGHLIGHTED RESULTS, AND ACHIEVEMENTS

The following tasks were completed in 2013 and reported in Part A of the ISR for Study 7.6:

- Field data on ice processes were collected through aerial surveys, ground-based time-lapse cameras, and research of historic observations. Field observations were conducted for the 2012 breakup, 2012 freeze-up, and 2013 breakup in addition to open lead surveys conducted in March 2013 as described in the Study Plan.
- Field observations were also conducted during the 2013 freeze-up and 2014 breakup periods including open lead surveys during February and April 2014.

- A River1D model was developed of the Middle River reach of the Susitna River and River2D models of select Focus Areas were developed and open water calibration initiated.
- An assessment of the effects of increased winter flow on the ice conditions and stage in the Lower River was completed using HEC-RAS.
- A literature review and white paper were completed describing hydropower projects and their effects in northern countries.

The study team has completed the following activities for Study 7.6 since the June 2014 filing of the ISR:

- Completion of a Technical Memorandum describing detailed ice observations from October 2013-May 2014, filed in September 2014.
- Development of an alternate format to graphically present the freeze-up progression and open lead survey data presented in the Study 7.6 SIR.
- Continued River1D model development and open water calibration.
- Continued River2D model development and open water calibration of the FA-128 (Slough 8A) Focus Area.

4. SUMMARY OF STUDY 7.6 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	Description	Link
7.6 Ice Processes in the Susitna River Study (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 ice processes.	RSP for Study 7.6
Susitna River Ice Process Study Report	3/7/2013	Technical memorandum documenting baseline winter ice conditions on the Susitna River between Cook Inlet and the Oshetna River confluence near river mile (RM) 234 with respect to the location of open leads in the ice cover in late winter, the progression of breakup in 2012, including the locations and effects of ice jams, the progression of freeze-up 2012-2013 and the interaction between river ice processes and riparian vegetation and fish habitat.	Ice Processes Study Report

Title	Date	Description	Link
FERC Study Plan Determination for Study 7.6	4/1/2013	This document presents FERC approval of Study 7.6, which approved AEA's Revised Study Plan with recommended adjustments.	FERC SPD for Study 7.6
Draft Initial Study Report for Study 7.6	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 7.6. This draft ISR was later republished as Part A of the final ISR.	Draft ISR for Study 7.6 Appendices A - B
Initial Study Report for Study 7.6	6/3/2014	This document is the Initial Study Report (Parts A, B and C) for Study 7.6. 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 7.6 ISR Part A Appendices A - B ISR Part B for Study 7.6 ISR Part C for Study 7.6
Technical Memorandum Detailed Ice Observations October 2013 – May 2014	9/17/2014	September 17, 2014 FERC Filing Attachment B - Ice Processes in the Susitna River Study (Study 7.6), filed by AEA	Detailed Ice Observations TM
Initial Study Report Meetings, October 17, 2014 (Parts A and B)	11/15/2014	Transcripts and AEA's agenda and PowerPoint presentations for the ISR meeting concerning the Ice Processes in the Susitna River filed by AEA	ISR Meeting A – Transcripts ISR Meetings B – Agenda and Presentations
Ice Processes in the Susitna River Study (Study 7.6) – 2014 – 2015 Study Implementation Report	11/6/15	The 2014-2015 Study Implementation Report summarizes activities since the June 2014 ISR and includes: Appendix A – Alternate Visualizations of Freeze-up Progression and Open Leads Appendix B - Appendix B: River1D Model Initial Open Water Calibration and Validation Appendix C - River2D Open-Water Modeling Report Focus Area 128 (Slough 8A)	2014-2015 SIR for Study 07.06 (File 1) 2014-2015 SIR for Study 07.06 (File 2) 2014-2015 SIR for Study 07.06 (File 3) 2014-2015 SIR for Study 07.06 (File 4)

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 7.6, during AEA's continued implementation of the Study Plan through calendar year 2014.

ISR Reference	Description
Part A, Section 4	This Section is supplemented by Study 7.6 SIR, Section describing 2014-15 study plan implementation.
Part A, Section 5	This section is supplemented by Study 7.6 SIR, Section 5 and Appendix A: Visualizations of Ice Progression and Open Lead Surveys, Appendix B: River1D Model open water calibration, and Appendix C: River2D model of FA-128 open water calibration describing 2014-15 results.
Part A, Section 6	This section is supplemented by Study 7.6 SIR, Section 6 and Appendix A: Visualizations of Ice Progression and Open Lead Surveys, Appendix B: River1D Model open water calibration, and Appendix C: River2D model of FA-128 open water calibration describing comparisons to 1980's results.
Part C, Section 7.1	This section is supplemented by Study 7.6 SIR, Section 7.
Part C, Section 7.3	This section is superseded by ISR Study 7.6 Part D, Section 8.

6. VARIANCES

AEA implemented the methods as described in the Study Plan with the exception of the variances reported in the June 2014 ISR.

6.1. 2013 Study Season

AEA implemented the methods as described in the 7.6 Study Plan in 2013 with the exception of variances listed below that were described in ISR Part A.

- No significant variances were made. Minor variances pertaining to the originally proposed time-lapse camera locations in Section 4.2 of the RSP have been made to provide for improved coverage and views of freeze-up and break-up processes.

6.2. 2014 – 2015 Study Season

AEA implemented the methods as described in the 7.6 Study Plan in 2013 with the exception of variances listed below that were described in ISR Part A.

- No significant variances were made. Minor variances pertaining to the originally proposed time-lapse camera locations in Section 4.2 of the RSP have been made to provide for improved coverage and views of freeze-up and break-up processes.

7. STUDY PLAN MODIFICATIONS

7.1. Modifications Identified in ISR

Section 7 of the Study 7.6 ISR (Part C) details modifications for this study following the 2013 study season. These modifications are generally summarized as follows:

- The Study Plan had indicated that time lapse cameras would be located at FA-151 (Portage Creek) and FA-184 (Watana Dam). Lack of Cook Inlet Regional Working Group (CIRWG) land access in 2013 prevented the placement of these proposed cameras. The number of flights and video coverage obtained during the freeze-up through breakup period in 2013-2014 provided adequate coverage of the ice processes and ice-covered conditions at the FA-184 (Watana Dam) site to meet the study objectives.

7.2. Modifications Identified since the June 2014 ISR

As detailed in the Study Implementation Report, AEA plans modifications to this study to complete the study in a manner that meets Study Plan objectives. These modifications are generally summarized as follows:

- Development of alternate visualizations of the freeze-up progression and open lead survey data previously presented in the Study 7.6 ISR and Technical Memorandum filed in September 2014.
- Additional field measurements of ice thickness, snow depth, and water surface elevation taken during the winter at FA-128 (Slough 8A) to assist in calibration of the River1D and River2D modeling efforts.

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). These tasks remain to complete the study.

1. Complete the ice-covered calibration of the River1D river ice processes model for existing conditions, including updates to geometric data from 2014 field studies (RSP Section 7.6.4.6).
2. Using the calibrated River1D model, simulate existing and proposed Project operational scenarios for the 50-year hydrologic record during ice-covered periods (RSP Section 7.6.4.7).

3. Develop detailed River2D models of the Focus Areas (FA), calibrate the models and use them to simulate depth and velocity during ice-covered periods using cold, warm, and average representative years of the hydrologic record (RSP Section 7.6.4.8).
4. Conduct model accuracy and error analyses for the River1D and River2D modeling efforts (RSP Section 7.6.4.9).