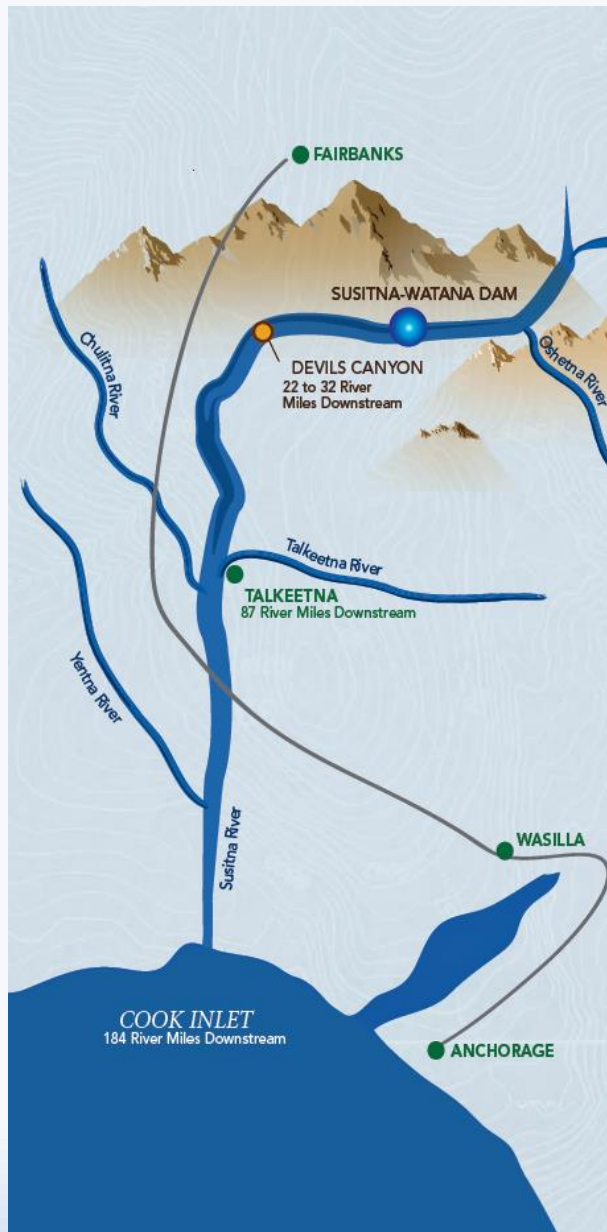


Initial Study Report Meeting

Study 6.5 Geomorphology

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Prepared by
Tetra Tech, Inc.



Study 6.5 Status

- **ISR Documents (ISR Part D, Section 4)**
 - Initial Study Report Parts A, B, and C (Jun 3, 2014)
 - Eight Technical Memorandums filed in Feb. – Mar 2013
 - One Technical Memorandum filed in May 2014
 - 2014-2015 Study Implementation Report (Nov 4, 2015)
 - Four Technical Memorandums filed in Aug 2014
 - Two Technical Memorandums filed in Nov 2014
 - Attach. 1 Delineation and Geomorphic Characterization TM
 - ISR Part D (Nov 6, 2015)
- **Status of Study Components (ISR Part D, Sect. 8)**
 - Completed Study Components (SC = Study Component)
 - SC2 – Sediment Transport Data Collection
 - SC4 – Assessment of Geomorphic Change in Mid. & Low. River
 - SC5 – Riverine Habitat vs. Flow in Middle River
 - SC7 – Riverine Habitat vs. Flow in Lower River

Study 6.5 Status (cont.)

- **Status of Study Components (Cont.)**

- Study Components with Majority of Work Completed
 - SC1 – Reach Delineation and Geomorphic Characterization
 - SC3 – Sediment Supply and Transport Middle and Lower River
 - SC6 – Recon-Level Assessment of Project Effects
 - SC9 – Large Woody Debris
- Study Components with Substantial Work Remaining
 - SC8 – Reservoir Geomorphology
 - SC10 – Geomorphology of Stream Crossings
 - SC11 – Integration w/ Fluvial Geomorphology Study (Study 6.6)

- **Field Data Collection Status**

- All Data in Middle River and Lower River have been collected
- Data remaining reservoir area (Trib delta, reservoir erosion, LWD)
- Data remaining in transmission line and access corridor for X-ings

Study 6.5 Objectives

1. **Geomorphically characterize** the Project-affected **river channels and floodplain**
2. Collect **sediment transport data** to supplement historical data (USGS)
3. Determine **sediment supply and transport** in Susitna MR and LR
4. **Assess geomorphic stability/change** Susitna MR and LR
5. Characterize the surface area vs. flow relationships for **riverine macrohabitat** in the Susitna MR
6. Conduct a reconnaissance-level **geomorphic assessment of potential Project effects** on the Susitna MR and LR

Study 6.5 Objectives

7. Conduct a phased characterization of the surface area versus flow relationships for **riverine macrohabitat** types in the **Lower Susitna River** Segment
8. Characterize the proposed Watana **Reservoir geomorphology and changes** due to the reservoir
9. Assess **large woody debris** transport, recruitment, and influence on the geomorphology of the Susitna River
10. Characterize geomorphic conditions at **stream crossings** along **access road/transmission line** alignments
- 11. Integration with the Fluvial Geomorphology Modeling** below Watana Dam Study

Study 6.5 Components

1. Delineate Geomorphically Similar Reaches and Characterize the Geomorphology of the Susitna River (4.1, 4)*
 2. Bed Load and Suspended-load Data Collection (4.2, 10)
 3. Sediment Supply and Transport Susitna MR and LR (4.3, 15)
 4. Assess Geomorphic Change in Susitna MR and LR (4.4, 23)
 5. Riverine Habitat versus Flow in Susitna MR (4.5, 32)
 6. Reconnaissance-Level Assessment of Project Effects on Susitna MR and LR (4.6, 40)
 7. Riverine Habitat Area versus Flow in Susitna LR (4.7, 47)
 8. Reservoir Geomorphology (4.8, 53)
 9. Large Woody Debris (4.9, 58)
 10. Geomorphology of Stream Crossings along Transmission Lines and Access Alignments (4.10, 61)
 11. Integration with Fluvial Geomorphology Modeling below Watana Dam Study (4.11, 63)
- *(ISR Part A, Section #, pg. #)

Study 6.5 Variances

(ISR Part A Section 4, ISR Part D Section 6.1, SIR Section 4)

- SC1 - Opportunistic water quality samples were collected during the Upper River reconnaissance (SIR Section 4.1.1). This was not included in the Study Plan (RSP Section 6.5.4.1.2.3).
- SC2 - The **bed-material samples** (RSP Section 6.5.4.2.2) **were not collected** by the USGS in 2012 (ISR Part A Section 4.2.3).
- SC2 - **Bed load samples Susitna River at Tsusena Creek** (RSP Section 6.5.4.2.2) **were terminated** after 2012 (ISR Part A Section 4.2.3).
- SC3 - The initial sediment balance task calls for comparison of the total sediment load at the Sunshine and Susitna Station gages for wet, average, and dry years between pre- and post-Project conditions (RSP Section 6.5.4.3.2). Entire 61-year extended record was used (SIR Section 4.3.1).

Note: SC = Study Component

Study 6.5 Variances

(ISR Part A Section 4, ISR Part D Section 6.1, SIR Section 4)

- SC 3 - The determination of effective discharge of the Susitna River below Tsusena Creek and at Gold Creek and Sunshine (RSP Section 6.5.4.3.2.4). Tsusena Creek location was not analyzed but additional locations were calculated at Susitna Station, Chulitna River, Talkeetna River and the Yentna River (ISR Part A Section 4.3.3).
- SC 3 – Videos of Susitna tributaries were opportunistically collected during reconnaissance trips in the Middle and Lower Susitna rivers (SIR Section 4.3.1). This was not in the Study Plan (RSP Section 6.5.4.3.2) but help document potential sources of sediment and mass wasting along the mainstem Susitna R.
- SC 5 - **Rather than obtaining three sets of aerial photography in 2012 at 23,000, 12,500, and 5,100 cfs (RSP Section 6.5.4.5.2.1) a single target flow of 12,500 cfs will be supplemented with Focus Area analyses (ISR Part C, Section 7.1.2.5; SIR Section 4.5.1).**

Study 6.5 Variances

(ISR Part A Section 4, ISR Part D Section 6.1, SIR Section 4)

- SC 9 - LWD study component opportunistically included August 2013 high-flow event (ISR Part A Section 4.9.3); this was an unanticipated event and was not included in the Study Plan (RSP Section 6.5.4.9.2).

Study 6.5 Summary of Results

(ISR Part A Section 5 and SIR Section 5)

- **SC 1: Reach Delineation and Characterize Geomorphology**
 - Geomorphic reach delineation and classification for the Upper, Middle, and Lower Susitna River Segments
 - Surficial Geologic Mapping in the Middle and Lower Susitna River Segments
 - Geomorphic surface mapping in 10 Focus Areas
 - Development of geomorphic succession model for the Middle Susitna River
- **SC 2: Sediment Transport Data Collection**
 - Collection and reporting of USGS sediment transport data from 2012 – 2014
- **SC 3: Sediment Supply and Transport**
 - Development of sediment transport relationships in the Middle and Lower Susitna River Segments

Study 6.5 Summary of Results

(ISR Part A Section 5 and SIR Section 5)

- **SC 4: Assess Geomorphic in the Middle River and Lower River**
 - Geomorphic feature delineation and Turnover Analysis for the Middle and Lower Susitna River Segments from 1950s, 1980s, and current aerial photography
- **SC 5: Riverine Habitat Vs. Flow in the Middle River**
 - Aquatic macrohabitat type mapping in the Middle Susitna River from 1980s and current aerial photography
- **SC 6: Recon-Level Assessment of Project Effects in MR and LR**
 - Critical literature review on dam effects on downstream channel and floodplain geomorphology and riparian plant communities and ecosystems
 - Refinement of sediment transport assessment results for pre-Project conditions

Study 6.5 Summary of Results

(ISR Part A Section 5 and SIR Section 5)

- **SC 7: Riverine Habitat vs. Flow in the Lower River**
 - Mapping of Aquatic Macrohabitat Types at selected sites in the Middle and Lower Susitna River Segments from 1980s and 2012 Aerials
 - Synthesis of the 1980s Lower Susitna River Segment aquatic habitat information
 - Stream Flow Assessment in the Middle and Lower Susitna River Segments
- **SC 8: Reservoir Geomorphology**
 - Estimations of reservoir trap efficiency performed to update upstream sediment supply to 1-D bed evolution model
 - Performed analysis of potential changes to sediment delivery from upper Susitna watershed into reservoir from glacial surges
 - Aerial reconnaissance of selected tributaries to reservoir performed

Study 6.5 Summary of Results

(ISR Part A Section 5 and SIR Section 5)

- **SC 9: Large Woody Debris**
 - LWD and log jams digitized in selected areas and geomorphic units in the Upper, Middle, and Lower Susitna River Segments from 1980s and current aerial photography
 - Data collected at all Middle River and Lower River LWD sites
- **SC 10: Geomorphology of Stream X-ings & Transmission Line Corridor**
 - Aerial reconnaissance of stream crossings along transmission lines and access alignments performed
- **SC 11: Integration with Fluvial Geomorphology Modeling (Study 6.6)**
 - Developed initial framework to identify qualitatively and semi-quantitatively anticipated trends and levels of Project effects on the channel and floodplain system and the physical habitat that lies therein.

Study 6.5 Summary of Results

Technical Memorandums

SC 1: Reach Delineation and Characterize Geomorphology

- 2015 SIR Attachment 1: **Geomorphic Reach Delineation and Characterization**, Upper, Middle, and Lower Susitna River Segments – **2015 Update** – Nov. 2015

SC 3: Sediment Supply and Transport

- Update of **Sediment Transport Relationships** and a Revised **Sediment Balance** for the Middle and Lower Susitna River Segments – Sept. 2014
- Susitna River **Historical Cross Section Comparison** (1980s to Current) – Sept. 2014

SC 4: Assess Geomorphic Change in the Middle River and Lower River

- **Mapping of Geomorphic Features and Turnover** within the Middle and Lower Susitna River Segments from 1950s, 1980s, and Current Aerials – Sept. 2014

SC 5: Riverine Habitat Vs. Flow in the Middle River

- **Mapping of Aquatic Macrohabitat Types at Selected Sites** in the **Middle & Lower Susitna River** Segments from 1980s & 2012 Aerials – Mar. 2013

Study 6.5 Summary of Results

Technical Memorandums

SC 5: Riverine Habitat Vs. Flow in the Middle River (cont.)

- **Updated Mapping of Aquatic Macrohabitat Types** in the Middle Susitna River Segment from 1980s and Current Aerials – Sept. 2014

SC 6: Recon-Level Assessment of Project Effects in MR and LR

- Reconnaissance Level **Assessment** of Potential **Channel Change in the Lower Susitna River** Segment – Mar. 2013
- **Stream Flow Assessment** – Mar. 2013
- **Dam Effects** on Downstream Channel and Floodplain **Geomorphology** and **Riparian Plant Communities and Ecosystems** – A Critical Literature Review – Nov. 2014 (Co-Authored with Study 8.6)

SC 7: Riverine Habitat vs. Flow in the Lower River

- Synthesis of **1980s Lower River Aquatic Habitat** Information – Mar. 2013

SC 8: Reservoir Geomorphology

- **Assessment of the Potential for Changes in Sediment Delivery** to Watana Reservoir **Due to Glacial Surges** – Nov. 2014

Decision Points from Study Plan

- Work performed in Study 6.5 supported Study 6.6 Decision Point on 1-D Bed Evolution extension below PRM 29.9 (Study 6.5 ISR Part C, 7.1.1.2; Study 6.6 ISR Part C, Section 7.1.1.1.2).
- The Study Plan (RSP Sections 6.5.4.4.2.1 and 6.5.5.5.2.2.) indicated a decision will be made on whether to acquire additional historical aerial photography for the Middle and Lower Susitna River. 60 years of aerials represented by the 1950s, 1980s and current provided excellent basis for the analysis of channel change. Based on this, it was decided no further historical aerials were required (ISR Part C, Section 7.1.1.4).

Decision Points from Study Plan (cont.)

- The Study Plan (RSP 6.5 Section 6.5.4.7.2.5) calls for a decision on whether to obtain aerial photography for two additional flows in the Lower River. Based on the results of the analysis of channel change for the target flow of 36,600 cfs, the decision was made to not obtain additional aerials (ISR Part C, Section 7.1.1.7).
- The delta formation task in this study component (RSP 6.5 Section 6.5.4.8.2.2) calls for the selection of tributaries to study for potential delta formation in the proposed reservoir fluctuation zone. Criteria were established and 6 tributaries were selected for study (ISR Part C, Section 7.1.1.7).

Decision Points from Study Plan

- In February 1, 2013 SPD FERC recommended that in support of the Glacier and Runoff Changes Study 7.7 that AEA “analyze the potential changes to sediment delivery from the upper Susitna watershed into the reservoir from glacial surges.”
- Potential additional sediment loading resulting from glacial surge was investigated (RSP Section 7.7.4.4 and RSP Section 6.5.4.8.2.1). Based on the evaluation, **it was determined no further geomorphic investigations were warranted for flow or sediment production from glacial surges.** This included the decision to not include a glacial surge sediment loading scenario in the reservoir sediment trap efficiency and sediment accumulation modeling to be performed in Study 6.5. (Assessment of the Potential for Changes in Sediment Delivery to Watana Reservoir Due to Glacial Surges Tech Memo [November 14, 2014]).

AEA Proposed Modifications to Study 6.5

- Due to supply limited nature of the Middle River, proposed to not perform effective discharge calculation with any operation scenario in the Middle River (**SIR Section 7.2.1**).
- Proposed to determine effective discharge for the Lower River, however instead of using sediment transport rating curves, the 1-D bed evolution model sediment transport results would be used (**SIR Section 7.2.1**).
- Proposed modification to replace the Grant et al. (2003) framework for analyzing the downstream impact of the Project with the framework for 1st and 2nd-order analysis of dam effects on river morphology developed as part of the Study 6.5 (**SIR 6.5 Section 7.2.2**).

AEA Proposed Modifications to Study 6.5

- Proposed to not perform the determination of the Modified Braiding Index (MBI) for the Middle River segment because the planform does not consist of dynamic multiple bar-braided channels within a braid plain (SIR Section 7.2.2).
- Proposed to not perform the determination of the MBI in the Lower River segment as the results will not produce useful information beyond the current assessment of potential Project impacts (which includes the streamflow assessment, sediment transport assessment and framework for First-order and Second-order analysis of dam effects on river morphology) (SIR Section 7.2.2).

AEA Proposed Modifications to Study 6.5

- Based on the October 16, 2014 ISR Meeting, it was decided to develop a 1-D bed evolution model to determine the depositional characteristics of the sand and larger sediment fractions of sediment inflow to the reservoir for various operation scenarios in the upper end of the reservoir (**SIR 6.5 Section 7.2.3**).

Steps to Complete Study 6.5 (ISR Part D, Section 8)

- **SC1 – Reach Delineation and Geomorphic Characterization**
 - Integration of other study information on, FGM (Study 6.6), ice processes (study 7.6), and riparian IFS (study 8.6) to correlate and understand development of different aged surfaces
 - Prepare comprehensive Technical Memorandum to integrate information from various studies to provide a thorough characterization of the key geomorphic processes that create and maintain the geomorphic features of the Susitna River
- **SC3 – Sediment Supply and Transport Middle and Lower River**
 - Determine sediment balance, effect. Q and bed mob. for scenarios
 - Evaluate sed. transport rating curves based on 2014 USGS data

Steps to Complete Study 6.5 (ISR Part D, Section 8)

- **SC6 – Recon-Level Assessment of Project Effects**
 - Use 1-D bed evolution model results to perform streamflow assessment, sediment transport assessment, and 1st/2nd order framework assessment for each project scenarios
 - Complete concurrent streamflow analysis at 3 Rivers Confluence
- **SC8 – Reservoir Geomorphology**
 - Cord. with Study 5.6 on trap efficiency for fine materials
 - Address delta formation task data collection and analysis including 6 selected tributaries and the 1-D modeling / assess. with Study 9.12 on potential barriers
 - Conduct reservoir erosion task including data collection and analysis

Steps to Complete Study 6.5 (ISR Part D, Section 8)

- **SC9 – Large Woody Debris**
 - Perform field inventory of LWD in Upper River
 - Perform evaluation of interaction of LWD with aquatic habitat, geomorphological process, ice processes and riparian processes.
- **SC10 – Geomorphology of Stream Crossings on Transmission Lines and Access Agreements**
 - Conduct field work to collect data at stream crossings
 - Analyze data collect in the field at stream crossings
- **SC11 – Integration with FGM Study (6.6)**
 - Review final results of pre-Project 1-D and 2-D model runs and interpret in terms of geomorphic response
 - Review final results of post-Project 1-D 2-D model runs and interpret in terms of geomorphic response

Licensing Participants Proposed Modifications to Study 6.5?

- Agencies
- CIRWG members and Ahtna
- Public