

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

**Groundwater Study
Study Plan Section 7.5**

**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

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1. INTRODUCTION

Section 1 (Part A) of the Initial Study Report (ISR) for this Groundwater Study (Study Plan 7.5) 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 Alaska Energy Authority's (AEA) 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 7.5 since the filing of the ISR in June 2014. As detailed below, AEA's recent activities for Study 7.5 have consisted of the following:

- Data collection has continued via a combination of telemetered wells, self-logging temperature and water level recorders and remote cameras. Quality control (QC) checks of existing data have continued, resulting in QC3 level data being made available to other resource users. The QC3 analysis was on data (water levels, water temperature, geotechnical and/or water-surface elevations) that were downloaded in 2014 from manual and telemetered installations as well as telemetered data received up through July 31, 2015.
- Two Technical Memoranda (TM) were prepared and submitted in September 2014 that presented results of preliminary groundwater (GW)/surface water (SW) analysis related to GW Study Objective 5 that pertains to the Riparian Instream Flow Study (RIFS) (Study 8.6) and GW Study Objective 6 that pertains to the Fish and Aquatics Instream Flow Study (IFS) (Study 8.5). The two TMs were:
 - Groundwater and Surface-Water Relationships in Support of Riparian Vegetation Modeling – Technical Memorandum, submitted to the FERC September 30, 2014
 - Preliminary Groundwater and Surface-Water Relationships in Lateral Aquatic Habitats within Focus Areas FA-128 (Slough 8A) and FA-138 (Gold Creek) in the Middle Susitna River – Technical Memorandum, submitted to the FERC September 30, 2014
- Participated in ISR meetings on October 16, 2014 to discuss the preliminary GW Study results and the plans for completing the study. The emphasis for this meeting was on any modifications of the study plan in light of the progress of the Study Plan and data collected.
- On December 5, 2014 AEA held a GW Study Technical Team meeting to discuss and solicit questions from Licensing Participants regarding the October ISR meetings and on the two September 2014 TMs noted above. A meeting summary was subsequently prepared and made available to the Licensing Participants on AEA's public website. A copy of the presentation materials and the meeting summary are included in SIR Study 7.5 as Appendix D.

- Submitted a Study Implementation Report (SIR) on November 6, 2015 that summarized Study 7.5 activities since June 2014.
- Three technical reports have been prepared and are included as Appendices A, B, and C to the Study Implementation Report (SIR) Study 7.5. Two of the reports describe further analysis of GW data including development of a series of water table maps for respective Focus Areas (Appendix A), and development and application of a preliminary MODFLOW GW model for FA-128 (Slough 8A) (Appendix B). The third report (Appendix C) provides a literature review of the 1980s GW studies and some additional contemporary relevant information pertaining to GW/SW interactions. The appendices include:
 - SIR Study 7.5, Appendix A – Preliminary Water Table Contour Maps for Focus Areas FA-104, FA-115, FA-128, and FA-138
 - SIR Study 7.5, Appendix B – Preliminary MODFLOW Three Dimensional Groundwater Model for Focus Area FA-128 (Slough 8A)
 - SIR Study 7.5, Appendix C – Summary Review of Susitna River Hydrogeologic Studies Conducted in the 1980s and other Non-Project Related Studies with Relevance to Proposed Susitna-Watana Dam Project

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 end of calendar year 2014 and up 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 7.5 in a manner that meets the objectives of the Commission-approved Study Plan.

2. BACKGROUND

2.1. Purpose of Study

The overall goal of the GW Study is to understand the effects of Project operations on GW/SW interactions at multiple spatial and temporal scales as they relate to aquatic and floodplain species in the Susitna River. The study is one part of a set of interdisciplinary resource studies that are designed to evaluate the overall effects of Project operations. The GW Study is specifically linked with both the RIFS (Study 8.6) and the IFS (Study 8.5) since the ecological functionality of riparian and aquatic habitats can be directly influenced by GW/SW interactions. It is therefore important to understand whether and the extent to which Project operations may influence those interactions, and how those effects may impact riparian and aquatic habitats. The study will use existing information and data, as well as new data collected during this and other studies to provide an overall understanding of GW/SW interactions at both the watershed- and local-scales. Where applicable, GW models (MODFLOW) will be developed and linked with other resource models (e.g., Open-water Flow Routing Model [OWFRM] [Study 8.5], SRH-2D hydraulic model [Study 6.6], River1D and River2D Ice Processes models [Study 7.6], 2D Fish Habitat models [Study 8.5], and Riparian Floodplain Vegetation modeling [Study 8.6]) to

evaluate different Project operational scenarios on GW/SW interactions and the resulting effects on riparian vegetation and fish and aquatics habitats.

2.2. Study Components

The nine study objectives of the GW Study (Study 7.5) as established in RSP Section 7.5.1 are as follows:

1. Synthesize historical and contemporary groundwater data available for the Susitna River groundwater and groundwater dependent aquatic and floodplain habitat, including that from the 1980s and other studies including reviews of GW/SW interactions in cold regions (RSP Section 7.5.4.1.1).
2. Use the available groundwater data to characterize large-scale geohydrologic process-domains/terrain of the Susitna River (e.g., geology, topography, geomorphology, regional aquifers, shallow groundwater aquifers, GW/SW interactions) (RSP Section 7.5.4.1.2).
3. Assess the potential effects of Watana Dam/Reservoir on groundwater and groundwater-influenced aquatic habitats in the vicinity of the proposed dam (RSP Section 7.5.4.2).
4. Work with other resource studies to map groundwater-influenced aquatic and floodplain habitat (e.g., upwelling areas, springs, groundwater-dependent wetlands) within the Middle River Segment of the Susitna River including within selected Focus Areas (IFS Study 8.5) (RSP Section 7.5.4.3).
5. Determine the GW/SW relationships of floodplain shallow alluvial aquifers within selected Focus Areas as part of the RIFS (Study 8.6) (RSP Section 7.5.4.4).
6. Determine GW/SW relationships of upwelling/downwelling in relation to spawning, incubation, and rearing habitat (particularly in the winter) within selected Focus Areas as part of the IFS (Study 8.5) (RSP Section 7.5.4.5).
7. Characterize water quality (e.g., temperature, dissolved oxygen, conductivity) of selected upwelling areas that provide biological cues for fish spawning and juvenile rearing, in Focus Areas as part of the IFS (Study 8.5) (RSP Section 7.5.4.6).
8. Characterize the winter flow in the Susitna River and how it relates to GW/SW interactions (RSP Section 7.5.4.7).
9. Characterize the relationship between the Susitna River flow regime and shallow groundwater users (e.g., domestic wells) (RSP Section 7.5.4.8).

3. STATUS, HIGHLIGHTED RESULTS, AND ACHIEVEMENTS

The status of each of the nine study objectives completed in 2013 was reported in the June 2014 ISR Study 7.5 Part A, Sections 4 and 5. In general, activities pertaining to all of the objectives centered on the acquisition of data and information necessary to complete the respective study elements.

- Objectives 1 and 2 rely primarily on the compilation of existing information and therefore activities in 2013/2014 centered on first identifying sources of information and then acquiring that information.
- Activities completed in 2013-2014 for Objectives 3 and 4 involved coordinating with other resource leads to acquire information necessary to complete the study objectives. In the case of Objective 3, this involved coordination with the RIFS (Study 8.6), the Project Engineering Feasibility Studies Geotechnical Investigations, and the Geology and Soils Characterization Study (Study 4.5). For Objective 4, activities were coordinated with the Baseline Water Quality Study (Study 5.5).
- Objectives 5 and 6 are directly related to the RIFS (Study 8.6) and IFS (Study 8.5) studies, respectively, and activities completed in 2013-2014 (reported in the ISR) primarily involved the installation and monitoring of equipment and scientific instrumentation to collect GW and SW data for evaluating GW/SW interactions and how those interactions may be affected by Project operations. This included installation of sixty six (66) GW wells and data collection stations for measuring GW, SW, soil, meteorological, streambed temperature profiles, and water quality conditions in five Focus Areas (FA-104 [Whiskers Slough], FA-113 [Oxbow 1], FA-115 [Slough 6A], FA-128 [Slough 8A], and FA-138 [Gold Creek] within the Middle River Segment of the Susitna River. Some preliminary data analysis was completed for each of the objectives resulting in the preparation of two Technical Memoranda that were transmitted to the FERC and Licensing Participants in September 2014. Those TMs demonstrated the relationships between Susitna River flow/stage and GW levels in different lateral habitats. The relationships included those showing a direct response between SW and GW levels that was classified as riverine dominant; those showing a moderate response that was classified as riverine-upland transitional; and those showing little to no response that was classified as upland dominant.
- Objective 7 is linked with the Baseline Water Quality Study (ISR Study 5.5) and IFS (Study 8.5), and activities completed in 2013-2014 focused on coordinating water quality data collection activities within portions of Focus Areas potentially influenced by GW upwelling.
- Objective 8 is linked with the IFS (Study 8.5), the Fish Distribution and Abundance in the Middle and Lower Susitna River Study (FDAML) (Study 9.6), and the Ice Processes Study (Study 7.6), and activities completed in 2013-2014 involved coordinating and assisting with data acquisition during two winter field campaigns and collecting and disseminating data from remote station recorders.
- Objective 9 activities in 2013-2014 involved the installation of self-logging pressure transducers in four domestic wells within the Middle River Segment of the Susitna River and the monitoring of water levels within those wells.

Since the June 2014 ISR, AEA has continued working on the GW Study (Study 7.5) resulting in the completion of several of the objectives and substantial advancement of several others. Details regarding the progress made on each of the objectives are presented in SIR Study 7.5, Sections 4, 5, and 6. Items of note are presented below as follows:

- AEA has completed the literature review of the 1980s GW studies and supplemental contemporary information pertaining to GW/SW interactions, and prepared a summary report. The report is presented as SIR Study 7.5, Appendix C and with its submittal Objective 1 has been met.
- AEA is also completing the GW upwelling mapping as specified in Objective 4.
- Data collection that will provide inputs needed to address Objectives 5, 6, and 8 and support Objective 7 has continued via a combination of telemetered wells, self-logging temperature and water level recorders and remote cameras, In addition, quality control checks of existing data have continued resulting in QC3 level data being made available to other resource users.
- Specific to Objective 5 and 6, two Technical Memoranda were prepared and submitted in September 2014 that presented results of preliminary GW/SW analysis that pertains to the RIFS (Study 8.6) and the IFS (Study 8.5), respectively. These included the following:
 - Groundwater and Surface-Water Relationships in Support of Riparian Vegetation Modeling – Technical Memorandum, September 30, 2014
 - Preliminary Groundwater and Surface-Water Relationships in Lateral Aquatic Habitats within Focus Areas FA-128 (Slough 8A) and FA-138 (Gold Creek) in the Middle Susitna River – Technical Memorandum, September 30, 2014
- As a follow-up to those submittals and the October ISR meetings, AEA held a Groundwater Study Technical Team Meeting on December 5, 2014 to discuss and solicit questions from Licensing Participants. A meeting summary was subsequently prepared and made available to the Licensing Participants on AEA’s public website. A copy of the presentation materials and the meeting summary are included as SIR Study 7.5, Appendix D.
- AEA has also developed a preliminary three-dimensional MODFLOW groundwater model for FA-128 (Slough 8A) that will have direct applicability in helping to address Objectives 5 and 6. The MODFLOW model will also be used for evaluating Project operational effects on GW/SW interactions during the winter (ice covered) periods and will help to address Objective 8. A report was prepared that describes the development of the MODFLOW model and is included as SIR Study 7.5, Appendix B. AEA is planning on developing similar MODFLOW models for FA-104 (Whiskers Slough), FA-115 (Slough 6A), and FA-138 (Gold Creek).
- Also of relevance to Objectives 5 and 6, AEA has developed a time series of water table maps for FA-104 (Whiskers Slough), FA-128 (Slough 8A), FA-115 (Slough 6A), and FA-138 (Gold Creek) that display water level contours under different seasonal conditions. These maps provide useful information regarding how different lateral habitats may respond to changes in river stage. A report was prepared that contains the maps and describes the methods used in developing them; the report is included as SIR Study 7.5, Appendix A.

- Concerning Objective 7, AEA has collected a robust set of water quality data from a number of studies (Studies 4.5, 5.5, 7.5, and 8.5) that has included data from GW wells and adjoining areas. Analyses have been completed to evaluate potential relationships of microhabitat variables (*Evaluation of Relationships between Fish Abundance and Specific Microhabitat Variables*, Study 8.5 FERC Submittal: September 17, 2014, Attachment G [R2 Resource Consultants]) to fish abundance, and the Baseline Water Quality Study (Study 5.5) has been completed. Overall, sufficient data have been collected and will be used in conjunction with Fish Habitat Models (Study 8.5), Water Quality models (Study 5.6), and the MODFLOW models (Study 7.5) to more fully evaluate how Project operations may affect both SW and GW water quality conditions as they may influence aquatic habitats. The objective of characterizing the water quality within areas influenced by GW upwelling has been met.

4. SUMMARY OF STUDY 7.5 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 | Description | Link |
|--|------------|---|---|
| Revised Study Plan: Section 7.5. Hydrology-Related Resources. Susitna-Watana Hydroelectric Project FERC Project No. 14241. | 12/14/2012 | The Revised Study Plan describes the study methods that will be used to evaluate Project effects, including the selection of study sites, collection of field data, data analysis, and modeling in the Middle and Lower Susitna River. | RSP for Study 7.5 |
| Revised Study Plan Determination Schedule. Susitna-Watana Hydroelectric Project FERC Project No. 14241. | 2/1/2013 | Following AEA's submittal of the RSP, FERC issued a Study Plan Determination Schedule. | FERC SPD for Study 7.5 |
| Study Plan Determination on 14 remaining studies for the Susitna-Watana Hydroelectric Project. Issuance 20130401-3022. | 4/1/2013 | FERC SPD for Study 7.5, which approved the study with additional recommendations. | FERC SPD for Study 7.5 |
| Technical Memorandum: Riparian Instream Flow, Groundwater, and Riparian Vegetation Studies FERC Determination Response | 7/1/2013 | When approving the Groundwater Study (RSP Section 7.5), the Riparian Instream Flow Study (RSP Section 8.6), and Riparian Vegetation Study (RSP Section 11.6), the Commission recommended that AEA file a Technical Memorandum that provides additional information on the methods for addressing several aspects of the study plan. | July 2013 TM for Studies 7.5, 8.6, and 11.6 |

| Title | Date | Description | Link |
|--|------------|--|---|
| Draft Initial Study Report for Study 7.5 | 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 7.5. This draft ISR was later republished as Part A of the final ISR. | Draft ISR for Study 7.5 (File 1) Draft ISR for Study 7.5 (File 2) Draft ISR for Study 7.5 (File 3) |
| Initial Study Report for Study 7.5 and Appendices | 6/3/2014 | This document is the Initial Study Report (Parts A, B, and C for Study 7.5. 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 7.5 (File 1) ISR Part A for Study 7.5 (File 2) ISR Part A for Study 7.5 (File 3) ISR Part B for Study 7.5 ISR Part C for Study 7.5 |
| Preliminary Groundwater and Surface-Water Relationships in Lateral Aquatic Habitats within Focus Areas FA-128 (Slough 8A) and FA-138 (Gold Creek) in the Middle Susitna River Technical Memorandum | 9/30/2014 | This Technical Memorandum provides an overview of the types of data and information that are being collected to support the Objective 6 activities of the Groundwater Study, and describes the methods and techniques that are being applied in analyzing the data leading to development of response functions to be used for evaluating Project operational effects. | Sept. 2014 TM for Study 7.5 |
| Groundwater and Surface-Water Relationships in Support of Riparian Vegetation Modeling Technical Memorandum | 9/30/2014 | This Technical Memorandum provides an overview of the types of data and information that are being collected to support the Objective 5 activities within the Groundwater Study, and describes the methods and techniques that are being applied in analyzing the data leading to development of response functions for evaluating Project operational effects. | Sept. 2014 TM for Study 7.5 |
| Groundwater Study (7.5): Initial Study Report Meetings. October 16, 2014 Part A – Transcripts Part B – Agenda and Presentations | 11/14/2014 | The Initial Study Report Meetings were conducted on 10/16/2014 with the licensing participants and Commission staff as part of the ILP process. The objective of the meeting was to discuss the study results and the plans for completing the studies, as well as any other participants' proposals, if any are provided. The emphasis for this meeting was on any modifications of the study plan in light of the progress of the study plan and data collected. | Transcript from ISR Meeting Materials from ISR Meeting |
| Groundwater Study (7.5): 2014-2015 Study Implementation Report, Susitna-Watana Hydroelectric Project FERC Project No. 14241 | 11/6/2015 | This Study Implementation Report describes AEA's overall progress in implementing the Groundwater Study since June 2014. The SIR is not intended to provide a comprehensive reporting of all field work, data collection, and data analysis since the beginning of AEA's study program, but rather to provide an update of information presented in ISR Part A for the Groundwater | 2015 SIR for Study 7.5 (File 1) 2015 SIR for Study 7.5 (File 2) |

| Title | Date | Description | Link |
|--|-----------|---|--|
| | | Study. The SIR and its appendices describe the methods and results of these efforts, and discuss the results in terms of the stated objectives of the Groundwater Study (Study 7.5). | |
| SIR 7.5 Appendix A: Preliminary Water Table Contour Maps for Focus Areas FA-104, FA-115, FA-128, and FA-138 | 11/6/2015 | Water table maps for 6 seasonal periods for FA-104 and FA-128, 3 periods for FA-138, and 2 periods for FA-115. Describes the methods used and data associated with their development and contains a discussion of conclusions that can be drawn from the maps. | 2014-2015 SIR Appendix A for Study 7.5 (File 1) 2014-2015 SIR Appendix A for Study 7.5 (File 2) |
| SIR 7.5 Appendix B: Preliminary MODFLOW Three Dimensional Groundwater Model for Focus Area FA-128 (Slough 8A) | 11/6/2015 | Documents preliminary MODFLOW model development for FA-128 (Slough 8A) based on a conceptual model, and includes calibration details, describes model sensitivity, and presents preliminary results including figures showing model configurations, grid layout, boundary conditions, and calibration targets. The document also includes recommendations for further model refinement. | 2014-2015 SIR Appendix B for Study 7.5 |
| SIR 7.5 Appendix C: Summary Review of Susitna River Hydrogeologic Studies Conducted in the 1980s and other Non-Project Related Studies with Relevance to Proposed Susitna-Watana Dam Project | 11/6/2015 | Comprehensive reference document that summarizes groundwater studies conducted during the 1980s and studies from other sources and their relevance to the Susitna – Watana Dam Project | 2014-2015 SIR Appendix C for Study 7.5 |
| SIR 7.5 Appendix D: December 5, 2014 Technical Team Meeting Notes and Presentation | 11/6/2015 | December 5, 2014 Technical Team Meeting Notes and Presentation. The meeting served to address a variety of questions raised during the ISR meeting related to the overall GW Study, and included a discussion of the two Technical Memorandums filed September 30, 2014 (listed above). | 2014-2015 SIR Appendix D for Study 7.5 |

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 Study 7.5, during AEA's continued implementation of the Study Plan through October 2015.

| ISR Reference | Description |
|---|--|
| Part A, Section 4, Part A, Section 5, and Part A, Section 6 | <p>Part A, Section 4 is supplemented by SIR Study 7.5, Section 4: Methods.</p> <p>Part A, Section 5 is supplemented by SIR Study 7.5, Section 5: Results.</p> <p>Part A, Section 6 is supplemented by SIR Study 7.5, Section 6: Discussion.</p> <p>These sections are supplemented by the SIR Study 7.5, Appendices A, B, C, and D:</p> <p>Pacific Groundwater Group (PGG). 2015. Preliminary Water Table Contour Maps for Focus Areas FA-104, FA-115, FA-128, and FA-138. Susitna-Watana Hydroelectric Project, FERC No. P-14241 Submittal: 2014- 2015 Study Implementation Report, Study 7.5, Appendix A. Prepared for Alaska Energy Authority, Anchorage, Alaska.</p> <p>Pacific Groundwater Group (PGG). 2015. Preliminary MODFLOW Three Dimensional Groundwater Model for Focus Area FA-128 (Slough 8A). Susitna-Watana Hydroelectric Project, FERC No. P-14241 Submittal: 2014-2015 Study Implementation Report, Study 7.5, Appendix B. Prepared for Alaska Energy Authority, Anchorage, Alaska.</p> <p>Pacific Groundwater Group (PGG). 2015. Summary Review of Susitna River Hydrogeologic Studies Conducted in the 1980s and other Non-Project Related Studies with Relevance to Proposed Susitna-Watana Dam Project. Susitna-Watana Hydroelectric Project, FERC No. P-14241 Submittal: 2014-2015 Study Implementation Report, Study 7.5, Appendix C. Prepared for Alaska Energy Authority, Anchorage, Alaska.</p> <p>Geo-Watershed Scientific (GWS). 2015. December 5, 2014 Technical Team Meeting Notes and Presentation. Susitna-Watana Hydroelectric Project, FERC No. P-14241 Submittal: 2014-2015 Study Implementation Report, Study 7.5, Appendix D. Prepared for Alaska Energy Authority, Anchorage, Alaska.</p> <p>These sections are supplemented by the following September 17, 2014 submittals:</p> <p>Geo-Watersheds Scientific (GWS) and R2 Resource Consultants (R2). 2014. Groundwater and Surface-Water Relationships in Support of Riparian Vegetation Modeling, Study. Susitna-Watana Hydroelectric Project, FERC No. P-14241 Submittal: September 30, 2014, Attachment D, Study 7.5 Technical Memorandum. Prepared for Alaska Energy Authority, Anchorage, Alaska. http://www.susitna-watanahydro.org/wp-content/uploads/2014/09/07.5_GW_GWS_T5_TM_Riparian_Final_Draft_20140926.pdf.</p> <p>Geo-Watersheds Scientific (GWS) and R2 Resource Consultants (R2). 2014. Preliminary Groundwater and Surface-Water Relationships in Lateral Aquatic Habitats within Focus Areas FA-128 (Slough 8A) and FA-138 (Gold Creek) in the Middle Susitna River. Susitna-Watana Hydroelectric Project, FERC No. P-14241 Submittal: September 30, 2014, Attachment C, Study 7.5 Technical Memorandum. Prepared for Alaska Energy Authority, Anchorage, Alaska. http://www.susitna-watanahydro.org/wp-content/uploads/2014/09/07.5_GW_GWS_T6_TM_Aquatic_Hydro_Final_Draft_20140925.pdf.</p> |
| Part B | This ISR document provides supplemental information and errata to the ISR Part A |
| Part C, Section 7 | Part C, Section 7 is superseded by ISR Study 7.5 Part D, Section 8: Steps to Complete the Study and SIR Study 7.5, Section 7: Conclusion. |

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 Study Plan in 2013 with the exception of variances listed below that were described in ISR Study 7.5, Part A:

- Objective 1 - The schedule for completion of the annotated bibliography and literature review was adjusted to be complete in 2014 (ISR Study 7.5, Part A, Section 4.1.1).
- Objective 2 - The schedule for completion of the mapping of geohydrologic units and associated analysis will be completed in 2014 (ISR Study 7.5, Part A, Section 4.2.1).
- Objective 5 - The schedule for completion of the GW flow models, including model input and calibration data sets, files and model documentation was rescheduled into 2015 (ISR Study 7.5, Part A, Section 4.5.1).
- Objective 6 - The schedule for completion of the GW flow models, including model input and calibration data sets, files and model documentation was rescheduled into 2015 (ISR Study 7.5, Part A, Section 4.6.1).
- Objective 7 - The schedule for completion of the GW flow models, including model input and calibration data sets, files and model documentation was rescheduled into 2015 (ISR Study 7.5, Section 4.7.1); and water quality data from other studies completed in the first study year will be used in the next year of study to describe the differences between productive and non-productive habitat types (ISR Study 7.5, Part A, Section 4.7.1).

6.2. 2014 Study Season

The variances noted above that were contained in the June 2014 ISR have been updated as follows:

- Objective 1 - The schedule for completion of the annotated bibliography and literature review was adjusted to be complete in 2015. This objective has now been met (SIR Study 7.5, Appendix C).
- Objective 2 - The schedule for completion of the mapping of geohydrologic units and associated analysis will be completed once all necessary information has been assembled and reviewed (SIR Study 7.5, Section 4.2.1).
- Objective 5 – The schedule for completion of the GW flow models, including model input and calibration data sets, files and model documentation will commence in 2015 for FA-128 (Slough 8A) and will occur sequentially for FA-104 (Whiskers Slough), FA-115 (Slough 6A), and FA-138 (Gold Creek) once all necessary information has been assembled and reviewed. A preliminary MODFLOW model has been prepared for FA-128 (Slough 8A) and is included as SIR Study 7.5, Appendix B.
- Objective 6 - The schedule for completion of the GW flow models, including model input and calibration data sets, files and model documentation will commence in 2015 for FA-128 (Slough 8A) and will occur sequentially for FA-104 (Whiskers Slough), FA-115 (Slough 6A), and FA-138 (Gold Creek) once all necessary information has been

assembled and reviewed. A preliminary MODFLOW model has been prepared for FA-128 (Slough 8A) and is included as SIR Study 7.5, Appendix B.

- Objective 7 - The schedule for completion of the GW flow models, including model input and calibration data sets, files and model documentation will commence in 2015 for FA-128 (Slough 8A) and will occur sequentially for FA-104 (Whiskers Slough), FA-115 (Slough 6A), and FA-138 (Gold Creek) once all necessary information has been assembled and reviewed. A preliminary MODFLOW model has been prepared for FA-128 (Slough 8A) and is included as SIR Study 7.5, Appendix B; and water quality data from other studies completed in the first study year will be used in the next year of study to describe the differences between productive and non-productive habitat types (ISR Study 7.5, Part A, Section 4.7.1). This latter variance no longer applies inasmuch as the analysis of relationships on microhabitat parameters that included water quality has been completed, with results presented in a Technical Memorandum (Evaluation of Relationships between Fish Abundance and Specific Microhabitat Variables, Study 8.5 FERC Submittal: September 17, 2014, Attachment G [R2 Resource Consultants]).

7. STUDY PLAN MODIFICATIONS

7.1. Modifications Identified in ISR

Section 7 of the ISR (Part C) details modifications for this study following the 2013 study season. These modifications were listed as follows:

- The schedule for completion of the annotated bibliography and literature review was adjusted to be completed in 2014. This will allow additional information to be incorporated from the 1980s references located that the Alaska Resources Library and Information Services (ARLIS) library is still processing. This change in schedule will not impact the objectives of the study. AEA is scheduled to complete the annotated bibliography and literature review in 2014. (See discussion in ISR Study 7.5, Part A, Section 4.1).
- The schedule for completion of the mapping of geohydrologic units and associated analysis was adjusted to be completed in 2014. This will allow incorporation of supporting information from other studies to be used to meet the study objectives. This change in schedule will not impact the objectives of the study. AEA is scheduled to complete the mapping of geohydrologic units and associated analysis in 2014. (See discussion in ISR Study 7.5, Part A, Section 4.2).
- The schedule for completion of the GW flow models, including model input and calibration datasets, files, and model documentation was rescheduled into 2015 to provide better integration with other hydrologic modeling efforts. This change in schedule will not impact the objectives of the study. AEA is scheduled to complete the first phase of GW flow models and associated analysis in 2014. (See discussion in ISR Study 7.5, Part A, Sections 4.5, 4.6, and 4.7).

7.2. Modifications Identified since the June 2014 ISR

The modifications listed in the June 2014 ISR (see above) were all focused on schedule adjustments that were also described as variances. Modifications pertain to methodological adjustments for which AEA is not proposing any for the completion of this study.

8. STEPS TO COMPLETE THE STUDY

In light of the variances 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).

8.1. Existing Data Synthesis – Study Objective 1

AEA has completed this study component and has prepared a summary report that describes the literature review. The report is provided as SIR Study 7.5, Appendix C.

8.2. Geohydrologic Process-Domains – Study Objective 2

A substantial amount of data have been collected from field studies, observations, and information gathered as part of the literature review as well as from other studies from which to develop a conceptual understanding of the regional GW processes. The next step will be to define the GW regional scale relationship to local flow systems in the Middle River and Lower River segments and the relationship with the process-domain river segments. Additional analysis will be completed to determine those processes at the Focus Area scale, which will provide an indication of how those processes are functioning within the entire Middle River Segment.

8.3. Watana Dam / Reservoir – Study Objective 3

AEA will continue with the Project Engineering Feasibility Studies and Geotechnical Investigations, and the Geology and Soils Characterization Study (Study 4.5) (see SIR Study 4.5, Sections 4.3.2, 5.3.3, and 5.4.3 for descriptions of methods and results) and these efforts will meet study objectives set forth in the FERC-approved Study Plan.

8.4. Upwelling / Springs Broad-Scale Mapping – Study Objective 4

AEA is in the process of completing the upwelling broad-scale mapping analysis for identifying GW areas throughout the entire Middle River Segment of the Susitna River.

8.5. Riparian Vegetation Dependency on Groundwater / Surface-Water Interactions – Study Objective 5

The combination of data and analysis collected and completed in 2013 coupled with additional data and analysis completed in 2014 and 2015 has provided a solid framework of information and allowed the development of preliminary modeling tools for FA-128 (Slough 8A) from which

to evaluate Project operational effects on GW/SW interactions. However, that model will require refinement and further calibration and as well, additional models are needed for other Focus Areas before they can be reliably used for evaluating overall Project effects on GW/SW interactions and resulting effects on riparian vegetation.

The overall steps needed to complete this study component include:

- Compilation, review, and analysis of empirical GW and SW data collected from Focus Areas at locations selected to support the RIFS (Study 8.6);
- Development of fully calibrated MODFLOW GW models in FA-128 (Slough 8A), FA-104 (Whiskers Slough), FA-115 (Slough 6A), and FA-138 (Gold Creek);
- Running the OWFRM (Study 8.5) and SRH-2D hydraulic models (Study 6.6) for locations proximal to or within the Focus Areas for different Project operational scenarios for the open-water periods;
- Completion and running of the River1D and River2D Ice Processes models (Study 7.6) for locations proximal to or within the Focus Areas for different Project operational scenarios for the winter ice covered periods;
- Routing outputs from the OWFRM and SHR-2D models for the open-water periods and the River1D and River2D models for the winter-time periods reflective of different Project operational scenarios through the respective MODFLOW models to evaluate effects on GW/SW interactions;
- Provision of MODFLOW outputs and other related GW/SW data specific to the Focus Areas to the RIFS (Study 8.6);
- Assist the RIFS (Study 8.6) in using the MODFLOW outputs and other information in first characterizing the natural floodplain vegetation GW and SW maintenance hydroregime, and then evaluating Project operational effects on floodplain vegetation (SIR Study 8.6, Sections 4.6 and 5.6.); and
- Linking MODFLOW outputs with the 2D PHABSIM Fish Habitat models (Study 8.5) for evaluating Project operational effects on GW/SW interactions and effects on overwintering rearing habitats and egg incubation and embryo survival.

8.6. Aquatic Habitat Groundwater / Surface-Water Interactions – Study Objective 6

The combination of data and analysis collected and completed in 2013 coupled with additional data and analysis completed in 2014 and 2015 has provided a solid framework of information and allowed the development of preliminary modeling tools for FA-128 (Slough 8A) from which to evaluate Project operational effects on GW/SW interactions. However, that model will require refinement and further calibration and as well, additional models are needed for other Focus Areas before they can be reliably used for evaluating overall Project effects on GW/SW interactions and resulting effects on fish and aquatic habitats.

The overall steps needed to complete this study component include:

- Compilation, review, and analysis of empirical GW and SW data collected from Focus Areas at locations selected to support the IFS (Study 8.5);
- Development of fully calibrated MODFLOW GW models in FA-128 (Slough 8A), FA-104 (Whiskers Slough), FA-115 (Slough 6A), and FA-138 (Gold Creek);
- Running the OWFRM (Study 8.5) and SRH-2D hydraulic models (Study 6.6) for locations proximal to or within the Focus Areas for different Project operational scenarios for the open-water periods;
- Completion and running of the River1D and River2D Ice Processes models (Study 7.6) for locations proximal to or within the Focus Areas for different Project operational scenarios for the winter ice covered periods;
- Routing outputs from the OWFRM and SHR-2D models for the open-water periods and the River1D and River2D models for the winter-time periods reflective of different Project operational scenarios through the respective MODFLOW models to evaluate effects on GW/SW interactions; and
- Provision of MODFLOW outputs and other related GW/SW data specific to the Focus Areas to the IFS (Study 8.5) for input into the 2D PHABSIM Fish Habitat models (SIR Study 8.5, Sections 4.6 and 5.6) for evaluating Project operational effects on summer and fall rearing habitats, spawning and incubation habitats, overwintering rearing habitats, and overwintering egg incubation and embryo survival.

8.7. Water Quality in Selected Habitats – Study Objective 7

AEA has collected a robust set of water quality data from a number of studies (Studies 4.5, 5.5, 7.5, and 8.5) that has included data from GW wells and adjoining areas. Analyses have been completed to evaluate potential relationships of microhabitat variables (*Evaluation of Relationships between Fish Abundance and Specific Microhabitat Variables*, Study 8.5 FERC Submittal: September 17, 2014, Attachment G [R2 Resource Consultants]) to fish abundance, and as well, the Baseline Water Quality Study (Study 5.5) has been completed. Overall, sufficient data have been collected and the objective of characterizing the water quality within areas influenced by GW upwelling as specified by this study component has been met.

The next step will be to incorporate the data within the Water Quality models (Study 5.6) and link model outputs to the 2-D Fish Habitat models (Study 8.5) and in terms of temperature to the MODFLOW models to more fully evaluate how Project operations may affect both SW and GW water quality conditions as they may influence aquatic habitats.

8.8. Winter Groundwater / Surface-Water Interactions – Study Objective 8

AEA will continue to collect data at selected GW well stations throughout the 2015-2016 winter period. These data along with GW and SW data collected during the winters of 2012-2013 (pilot

winter studies), 2013-2014, and 2014-2015 will provide a substantial database of information from which to evaluate winter GW/SW interactions.

The steps to complete this study component include:

- Development of calibrated MODFLOW GW models in FA-128 (Slough 8A), FA-104 (Whiskers Slough), FA-115 (Slough 6A), and FA-138 (Gold Creek);
- Completion of the River1D and River2D Ice Processes models that will provide river wide and Focus Area predictions of river stage within lateral habitats under different flow conditions during the winter ice covered periods (Study 7,6);
- Routing outputs from River1D and River2D models that reflect different winter-time Project operational scenarios through the MODFLOW models to evaluate effects on GW/SW interactions (including upwelling and downwelling) during the winter period; and
- Linking MODFLOW outputs with the 2-D PHABSIM Fish Habitat models for evaluating Project operational effects on GW/SW interactions and effects on overwintering rearing habitats and egg incubation and embryo survival.

8.9. Shallow Groundwater Users – Study Objective 9

Four homeowner wells were instrumented with continuously recording pressure transducers in 2013 and have provided data up through September 2015.

The next step will be to compile the data from these wells in combination with SW data collected on the mainstem Susitna River, and outputs from the OWFRM (Study 8.5) and Ice Processes River1D (Study 7.6) hydrology models near the well locations to evaluate potential Project operational effects on shallow GW wells within the Middle River Segment. Data from the two wells located near/within FA-138 (Gold Creek) may also prove useful during development of the MODFLOW model for that Focus Area.