Susitna-Watana Hydroelectric Project Document
ARLIS Uniform Cover Page

Title: Fish and aquatics instream flow study, Study plan Section 8.5 : Initial study report -- Part B: Supplemental information (and errata) to Part A (February 3, 2014 Draft Initial Study Report)	**SuWa 223**
Author(s) – Personal:	
Author(s) – Corporate: R2 Resource Consultants, Inc.	
AEA-identified category, if specified: Initial study report	
AEA-identified series, if specified:	
Series (ARLIS-assigned report number): Susitna-Watana Hydroelectric Project document number 223	**Existing numbers on document:**
Published by: [Anchorage : Alaska Energy Authority, 2014]	**Date published:** June 2014
Published for: Alaska Energy Authority	**Date or date range of report:**
Volume and/or Part numbers:	**Final or Draft status, as indicated:**
Document type:	**Pagination:** 24 p.
Related work(s): The following parts of Section 8.5 appear in separate files: Part A ; Part A Figures ; Part A Appendices A-C ; Part A Appendices D-F ; Part A Appendices G-I ; Part B ; Part C with Appendices J-K ; Appendices L-O.	**Pages added/changed by ARLIS:**
Notes: Appendices J-O are in Part C.	

Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Fish and Aquatics Instream Flow Study
Study Plan Section 8.5

Initial Study Report
Part B: Supplemental Information (and Errata) to Part A (February 3, 2014 Draft Initial Study Report)

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

Prepared by

R2 Resource Consultants

June 2014

PART B: SUPPLEMENTAL INFORMATION (AND ERRATA) TO PART A (FEBRUARY 3, 2014 DRAFT INITIAL STUDY REPORT)

Part A Reference	Description
NOTE:	• Partial sentences at the top of a page are considered Sentence 1. • Partial paragraphs at the top of a page are considered Paragraph 1. • Paragraphs are numbered by their position on a page, not within a Section. • Paragraphs introducing a bulleted list, and the bulleted list that follows, are considered one paragraph.
Section 4.1.1, Page 7, Paragraph 1, Sentence 3	Revised as follows: For example, IFS-TT meetings have been held to discuss final selection of study sites (April 26, 2013), model selection (May 13, 2013), HSC/HSI sampling approaches (May 17, 2013 and June 11, 2013), the integration of resource models (IFS-TT Riverine Modelers Meeting [November 13-15, 2013]) and to demonstrate conceptually how the different models will be used for evaluating Project effects on fish habitat (IFS-TT Proof of Concept [POC] Meeting [April 15-17, 2014]).
Section 4.2.1.3, Page 15, Paragraph 1, Bullet 3	Revised as follows: Further hydrologic analysis will be completed as part of an Indicators of Hydrologic Alteration (IHA) analysis described in ISR Study 8.5 Section 7.3.1.5.
Section 4.3.1.2, Page 21, Paragraph 1, Sentence 3 (last)	The following sentence was added: The IFS-TT Proof of Concept Meeting (April 15-17, 2014) addressed representative years in more detail. Additional information on representative years is found in the Fluvial Geomorphology ISR Study 6.6, Appendix E and ISR Study 8.5, Appendix J (Representative Years).
Section 4.3.1.3, Page 21, Paragraph 3, Sentence 2 (last)	The following sentences were added: A TWG meeting occurred on March 21, 2014. This meeting reviewed candidate metrics and proposed analysis for IHA and EFC which would be used to compare existing and post-project conditions. Additional detail on steps to complete the IHA and EFC analysis is provided in ISR Study 8.5, Section 7.3.1.5.
Section 4.3.2.1, Page 21, Paragraph 6, Sentence 3	Revised as follows: Gaging of Fog Creek and Portage Creek will begin in 2014. See ISR Study 8.5, Section 7.3.1.2 for additional details.

Part A Reference	**Description**
Section 4.3.2.2, Page 22, Paragraph 2, Sentences 3 & 4	Revised as follows: The topic of representative years was discussed at both the IFS-TT Riverine Modelers Meeting (November 13-15, 2013), the Q4 2013 TWG meeting, and the IFS-TT Proof of Concept Meeting (April 15-17, 2014).
Section 4.3.2.2, Page 22, Paragraph 2, Sentence 7	Revised as follows: The IFS-TT Proof of Concept Meeting (April 15-17, 2014) provided recommended representative years and the rationale for selection. Additional information on representative years is found in IR Study 8.5, Appendix J (Representative Years) and Fluvial Geomorphology Modeling ISR Study 6.6, Appendix E.
Section 4.3.2.3. Page 22, Paragraph 4, Sentence 5	Revised as follows: A TWG meeting occurred on March 21, 2014. This meeting reviewed candidate metrics and proposed analysis for IHA and EFC which would be used to compare existing and post-Project conditions. Additional detail on steps to complete the IHA and EFC analysis is provided in ISR Study 8.5, Section 7.3.1.5.
Section 4.4.1.2, Page 24, Paragraph 5, Sentence 2	Revised as follows: A total of three versions of the model will be developed and provided for distribution with Version 1 developed and distributed in Q1 2013 and Version 2 of the model has been developed and distributed to interested resource studies. A description of the methods and results of Version 2 of the Open-water Flow Routing Model can be found in ISR Study 8.5, Appendix K. An updated version of Table 4.4-1 is also available in Appendix K.
Section 4.5.1.4, Page 29, Paragraph 1, Sentence 5 (last)	The following sentence was added: An example of a typical sampling site displaying the location of fish utilization and habitat availability measurements is presented in SUPPLEMENTAL INFORMATION (AND ERRATA) Supplemental Figure 4.5-1b.
Section 4.5.1.6.1, Page 32, Paragraph 1, Bullet 8	The following bullet was added: • Water temperature (to nearest 0.1°C), dissolved oxygen (ppm), and conductivity (µS) measurements were made at the lower, middle, and upper ends of each sampling site and at a subset of the individual fish observation points

Part A Reference	Description
Section 4.5.1.6.1, Page 32, Paragraph 1, Bullets 5, 6, and 7	The following bullets were removed: • Water temperature (ºC) • Dissolved oxygen (ppm) • Conductivity (µS)
Section 4.5.1.9, Page 34, Paragraph 4, Sentence 1	Revised as follows: The site-specific HSC/HSI curves based on the 2013 data are presented in ISR Study 8.5, Appendix M and include estimates of uncertainty based on standard errors from the logistic regression model.
Section 4.5.1.10, Page 34, Paragraph 5, Sentence 1	The following sentences were added: Instruments, methods, and approaches were tested during the pilot effort to develop a more robust winter study program for 2013-2014. Additional, more formalized surveys were completed in 2013-2014. Results of the 2012-2013 surveys are presented in ISR Study 8.5 Appendix L. Review and analysis of the 2013-2014 survey data is ongoing.
Section 4.5.1.10, Page 34, Paragraph 5, Sentence 3	Revised as follows: The winter IFS 2012–2013 pilot study was comprised of three components: 1) monitoring of intergravel temperature, dissolved oxygen, and surface water levels; 2) fish behavior and habitat use observations; and 3) winter fish capture (ISR Study 8.5, Appendix L).
Section 4.5.2, Page 41, Paragraph/Bullet 4, Sentence 3 (last)	Revised as follows: AEA distributed a Technical Memorandum in early 2014 (AEA February 2014) that described the results of the IFS pilot winter studies and presented a summary of methods and results at the March 21 TT meeting. This Technical Memorandum is now ISR Study 8.5, Appendix L. With the exception of Figure 9 in which a correction was made to the plots of Whisker Creek stage (WC-10), all text, figures, tables, and references are the same as in the original Technical Memorandum.
Section 4.6.1.3.1, Page 48, Paragraph 3, Sentence 1	The following sentence was added: More details were provided in the IFS-TT Proof of Concept Meeting (April 15-17, 2014) during which examples of both the SRH-2D and River2D model results were displayed for FA-128 (Slough 8A).
Section 4.6.1.4, Page 50	The following Section was added:

Part A Reference	Description
	4.6.1.4. Habitat Evaluation Metrics Development of the 1-D and 2-D hydraulic models will provide the basic analytical tools for completing a variety of targeted evaluations that are relevant to understanding the effects of Project operations on fish and aquatic resources. The majority of these analyses will be completed in 2015 after the 1-D and 2-D models are fully developed and operational scenarios are defined. Those analyses will include PHABSIM-related analysis that will be completed using both the 1-D and 2-D hydraulic models. In addition, the 2-D models will be utilized for completing an Effective Spawning/Incubation Analysis, Varial Zone Modeling, evaluating breaching flows, and habitat connectivity within Focus Areas (ISR Study 9.12), and River Productivity analysis. These are briefly discussed below relative to work completed in 2013. More details describing the methods that will be employed are provided in ISR Study 8.5, 7.6. *4.6.1.4.1. Weighted Usable Area Habitat Metrics* Weighted useable area (WUA) is the standard metric derived as part of PHABSIM type analysis. This metric represents an index of habitat area as defined for different species and lifestages of fish, and macroinvertebrates. In 2013, the basic data needed for completing WUA analysis were collected including the hydraulic and physical data to support development of the 1-D and 2-D hydraulic models (ISR Study 8.5, Section 4.3), and initial HSC/HSI data (ISR Study 8.5, Section 4.5) that will be used in developing HSC/HSI curves that interface with the habitat and hydraulic models to define habitat-flow relationships. These relationships will be defined for target fish species and life stages (ISR Study 8.5, Section 5.6.4.1) as well as macroinvertebrates (ISR Study 8.5, Section 5.6.4.1. and ISR Study 9.8). These models translate changes in water surface elevation/flow at each of the measured transects/study segments into changes in depth, velocity, substrate, cover, and other potential habitat (e.g., turbidity, upwelling). The 2-D hydraulic models do not include a spatial component for habitat analysis at the macrohabitat or mesohabitat scales. For this, development of a stand-alone Visual Basic (VB) model programmed specifically for this type of analysis, coupled with GIS tools was initiated in 2013. The VB model combines the HSC/HSI criteria with the output for each point/node in the hydraulic model (e.g., depth and velocity) to compute its habitat suitability value. The habitat suitability values for each node are then multiplied by the area of the mesh element to calculate the habitat area for each mesh element. A GIS tool is then used to evaluate habitat characteristics in the smaller habitat areas as subsets of the model domain.

Part A Reference	Description
	This process was demonstrated for FA-104 (Whiskers Slough) using the preliminary output from the SRH-2D hydraulic model provided by the Geomorphology program, during the November 13-15, 2013 IFS-TT Riverine Modelers Meeting. See 2-D Fish Habitat Middle River Focus Areas presentation (Miller and R2 2013). During the IFS-TT Proof of Concept Meeting in April 2014, these analyses were demonstrated for FA-128 (Slough 8a) (AEA 2014). Habitat modeling using weighted usable area indices is capable of evaluating both daily and hourly time steps. Evaluating the effects of changes in habitat conditions on an hourly basis may require additional habitat-specific models such as effective habitat and varial zone modeling. *4.6.1.4.2. Effective Spawning/Incubation Habitat Analyses* Effective Spawning/Incubation Habitat Analysis is focused on evaluating how Project operations may influence water level and other biologically important conditions over space and time relative to areas used for spawning/incubation. Effective Spawning/Incubation Habitats represent those areas that remain wetted and that provide suitable conditions throughout the entire period of incubation up to the time of fry emergence. The basic premise behind and steps involved in completing an Effective Spawning/Incubation Habitat Analysis are described in the RSP, Section 8.5.4.6.1.5. Because Effective Spawning/Incubation Habitat Analysis incorporates multiple resource components (e.g., water quality, groundwater, geomorphology) into the analysis, it was one of the primary habitat metrics discussed during the November 13-15, 2013 IFS-TT Riverine Modelers Meeting (AEA 2013) and the IFS-TT Proof of Concept Meeting in April 2014 (AEA 2014) to illustrate the integration of different resource models (ISR Study 8.5, Section 5.6). The Effective Spawning/Incubation Habitat Analysis is depicted in Figure 4.6-1 and will be based on identifying potential use of discrete channel areas (2-D mesh elements or larger spatial areas [referred to as “cells” in the RSP]) by spawning salmonids on an hourly basis. Use of each cell by spawning fish will be assumed to occur if the minimum physical parameters (e.g., water depth, velocity, substrate, and water quality) are within an acceptable range defined by HSC/HSI. The 2-D hydraulic models for a range of flows at specified intervals will be used to create the hydraulic habitat values. Species-specific HSC/HSI information used to identify potential use of a spatial area by spawning fish will be developed as described in ISR Study 8.5, Section 4.5. If suitable spawning conditions exist based on the hydraulic/HSC analysis, that spatial area will then be tracked on an hourly time step from the initiating time step through emergence to predict whether eggs and alevin within that spatial area were subject to interrupted upwelling, dewatering, scour, freezing, or unsuitable water quality (e.g., Figure 4.6-1). This process will be repeated for the potential spawning

Part A Reference	Description
	period based on the periodicities (ISR Study 8.5, Section 5.5.1.10). *4.6.4.1.3. Varial Zone Modeling* Fluctuations in flow will cause shallow portions of the river channel to alternate between wet and dry conditions; this area of alternating wet and dry is referred to as the varial zone (Figure 4.6-2). Flow reductions along the channel margins can cause stranding and trapping of juvenile fish and benthic macroinvertebrates within the varial zone. Repeated dewatering of the varial zone can result in reduced macroinvertebrate and algae density, diversity, and growth (Fisher and LaVoy 1972; Dos Santos et al. 1988). Analyses of Project effects on the downstream varial zone will be quantified as the frequency, magnitude, and timing of downramping events exceeding specified downramping rates; the frequency, number, and timing of downramping events that occur following varying periods of inundation (e.g., Figure 4.6-3); and the frequency, timing, and magnitude of potential stranding and trapping of aquatic organisms. In 2013, the basic tools and data needed for conducting Varial Zone Analysis were collected or developed including the Open-water Flow Routing Model, the topographic/bathymetric, hydraulic and physical data to support development of the 2-D hydraulic models (ISR Study 8.5, Section 4.3) and development of GIS topographic maps that will be used to assess stranding and trapping potential, and initial HSC/HSI data relative to fry and juvenile fish (ISR Study 8.5, Section 4.5). *4.6.1.4.4. Breaching Flows and Habitat Connectivity* The breaching or topping of off-channel habitat features by mainstem river flows not only affects the quantity of water within these features but water quality (turbidity and temperature) and habitat quality as well (RSP Section 8.5.4.6.1.1.5). Determining the relationships between mainstem river flow and overtopping or breaching of sensitive off-channel features within Focus Areas and other biologically relevant habitats will allow for the assessment of potential impacts of proposed winter Project operation scenarios on these areas. In 2013, the basic tools and data needed for conducting the breaching flow analysis were collected or developed including the Open-water Flow Routing Model, the topographic/bathymetric, hydraulic and physical data to support development of the 2-D hydraulic models (ISR Study 8.5, Section 4.3) and development of GIS topographic maps that will be used to derive breaching flow relationships (ISR Study 8.5, Section 4.5). The connectivity of habitats within Focus Areas and at the mouths of tributaries will be analyzed and reported in the Fish Passage Barriers Study (ISR Study 9.12) using modeling results developed as part of the instream flow study. In 2013, the basic tools and data needed for

Part A Reference	Description
	conducting the connectivity and barrier analysis were collected or developed including the Open-water Flow Routing Model, the topographic/bathymetric, hydraulic and physical data to support development of the 2-D hydraulic models (ISR Study 8.5, Section 4.3) and development of GIS topographic maps that will be used to assess habitat connectivity – flow relationships (ISR Study 8.5, Section 4.5). The main goal of the connectivity analyses will be to evaluate the potential effects of Project operations on flow conditions that are related to the connectivity of and accessibility to fish habitats within Focus Areas and tributaries.
Section 4.6.2, Page 50, Paragraph 4, Sentence 5	Revised as follows: The field execution plan and schedule for 2013 was presented at an IFS-TT meeting on April 26, 2013 and progress updates on the field program were provided during each TWG meeting, including most recently, the IFS-TT Proof of Concept Meeting (April 15-17, 2014).
Section 4.7.1, Page 51, Paragraph 2, Sentence 3	Revised as follows: These were initially provided in the Study Plan, were discussed briefly during the IFS-TT Riverine Modelers Meeting (November 13-15, 2013), were presented in more detail during the IFS-TT Proof of Concept Meeting (April 15-17, 2014), and are described further in ISR Study 8.5, Section 7.7.
Section 4.7.2, Page 51, Paragraph 4, Sentence 4	Revised as follows: However, AEA provides more details concerning these methods in this ISR Study 8.5, Section 7.7 and which were described during the IFS-TT Proof of Concept Meeting (April 15-17, 2014).
Section 4.8, Page 52, Paragraph 1, Sentence 2	Revised as follows: These models are described in each of the respective ISR sections just noted and were also discussed during the IFS-TT Riverine Modelers Meeting (November 13-15, 2013), and during the IFS-TT Proof of Concept Meeting (April 15-17, 2014).
Section 4.8.1, Page 52, Paragraph 2, Sentence 5 (last)	Note: Potential methods and approaches for developing the DSS were not presented during the Proof of Concept meetings but are presented in ISR Study 8.5, Section 7.8. These methods will be discussed further with the TWG during 2014 and 2015.

Part A Reference	Description
Section 5.3.1, Page 57, Paragraph 4, Sentence 1	Note: Table 5.3-1 is first cited in this paragraph. An updated table is included in Appendix K as Table 6.1-1.
Section 5.3.1, Page 57, Paragraph 4, Sentences 7 & 8	Revised as follows: AEA is aware of a velocity profile QA/QC processing issue documented by the newly released USGS Office of Surface Water Technical Memo 2014.02 (USGS 2013). Resolution of the issue could result in an approximately one to six percent increase in flow values. At this time, no changes have been made to discharge calculations.
Section 5.3.1, Page 57, Paragraph 4, Sentence 8 (last)	The following sentence was added: The QC3 final data from stage and discharge surveys collected in 2012 and 2013 are provided in ISR Study 8.5, Appendix K (Hydrology and Version 2 Open-water Flow Routing Model).
Section 5.3.1, Page 58, Paragraph 4, Sentence 3	The following sentence was added: Stage data at ESS hydrology stations available through 2013 are provided in ISR Section 8.5, Appendix K (Hydrology and Version 2 Open-water Flow Routing Model).
Section 5.3.4, Page 60, Paragraphs 1-4 Sentence (all)	Revised as follows: Additional detail on the selection of representative years can be found in ISR Study 8.5, Appendix J (Representative Years). Recommended years include 1981 (wet), 1985 (average), and 1976 (dry). These candidate years were presented to the agencies at the April 15-17, 2014 Proof of Concept meeting. Once finalized, the hydrology associated with the three representative years will be used in multiple resource modeling efforts. Both the Reservoir Operations Model and the Open-water Flow Routing Model will have the ability to simulate the 61-year period of record, but these representative years may be used first to evaluate and consider specific operational conditions. Both the ice-processes flow routing and the sediment transport 1-D modeling will have the ability to simulate the abridged 50-year period of record. These three representative years may also be used for initial simulations to evaluate Project operations.
Section 5.3.5, Page 60, Paragraph 5, Sentence 3 (last)	Revised as follows: A TWG meeting occurred on March 21, 2014. This meeting reviewed candidate metrics and proposed analysis for IHA and EFC which would be used to compare existing and post-Project conditions. Additional detail on

Part A Reference	Description
	steps to complete the IHA and EFC analysis is provided in ISR Study 8.5, Section 7.3.1.5.
Section 5.4.1, Page 61, Paragraph 1, Sentence 6	The following sentence was added: Minor changes were made to this operating scenario based on expanded USGS data which is referred to as OS-1b.
Section 5.4.1, Page 61, Paragraph 2, Sentence 5 (last)	The following sentence was added: Minor changes were made to this operating scenario based on expanded USGS data which is referred to as OS-1b.
Section 5.4.2, Page 61, Paragraph 3, Sentence 2	The following sentence was added: Version 2 of the model has since been completed and made available to resource studies and is described in ISR Study 8.5, Appendix K (Hydrology and Version 2 Open-water Flow Routing Model).
Section 5.4.2.1, Page 61, Paragraph 5, Sentence 1	The following sentences were added: Additional field data were collected in 2013; data collection methods are described in ISR Study 8.5, Section 4.3 (Hydrologic Data Analysis). A description of methods and results of Version 2 of the Open-water Flow Routing Model is provided in ISR Study 8.5, Appendix K (Hydrology and Version 2 Open-water Flow Routing Model). The following sections are in reference to Version 1.
Section 5.5, Page 64, Paragraph 5, Sentence 2	Revised as follows: Data collection efforts represent those completed through late-September 2013, while the analysis of the information continued into mid-December 2013.
Section 5.5.5, Page 73, Paragraph 2	Note: Tables 5.5-5 and 5.5-6 are first cited in this paragraph. See updated Errata Table 5.5-5 and Errata Table 5.5-6 below.
Section 5.5.5, Page 73, Paragraph 3, Sentence (all)	Revised as follows: To detect the presence of groundwater upwelling, vertical hydraulic gradient (VHG) measurements were collected from within each of the 207 sample sites. Positive VHG values were considered an indication of groundwater upwelling, while negative VHG was considered an area of groundwater downwelling. Neutral VHG was considered an indication of

Part A Reference	Description
	no upwelling or downwelling at the site. Side slough and upland slough habitats had the highest frequency of positive VHG readings (Table 5.5-6). Tributary mouth habitats had the highest frequency of negative VHG indicating a strong signature for groundwater downwelling (Table 5.5-6). Forty-nine percent of all habitat availability measurements indicated the presence of groundwater upwelling with side channel, side slough, and upland slough macrohabitat areas having the largest number of positive measurements (Table 5.5-6). Main channel habitats had the highest number of neutral and negative VHG values.
Section 5.5.7, Page 74, Paragraph 2, Sentence 4	Revised as follows: A simplified example of the use of univariate-logistic modeling to predict the preference of depth, velocity, and substrate habitat use by spawning chum salmon sampling is presented in Figure 5.5-9 and Figure 5.5-10.
Section 5.5.7, Page 75, Paragraph 2, Sentence 3	Revised as follows: Draft habitat preference curves were presented to the March 21, 2014 TT meeting and again during IFS-TT Proof of Concept Meeting (April 15-17, 2014) (IFS-TT Proof of Concept Meeting Notes and Presentations [AEA 2014]).
Section 5.5.8, Page 75, Paragraph 3, Sentence 1	Revised as follows: Results of the 2012-2013 winter pilot studies are summarized below; additional details are presented in the ISR Study 8.5, Appendix L. Data collection for the 2013-2014 winter studies was recently completed with ongoing data analysis.
Section 5.5.7, Page 75, Paragraph 2 (all)	Revised as follows: This type of analysis is planned for all other species and life stages for which sufficient habitat utilization data are available. Additionally, the modeling will be used to predict habitat preference for the other variables listed above. Draft habitat preference curves for chum salmon spawning and coho salmon fry were presented to the TWG as part of the IFS-TT Proof of Concept Meeting (April 15-17, 2014) (ISR Study 8.5, Appendix N).
Section 5.5.8, Page 75, Paragraph 3, Sentence 1	Revised as follows: Results of the 2012-2013 winter pilot studies are summarized below; more details are presented in ISR Study 8.5, Appendix L.

Part A Reference	Description
Section 5.5.8.2, Page 76, Paragraph 4	Note: Figure 5.5-16 is first cited in this paragraph. See updated Errata Figure 5.5-16 below showing corrected line representing Site WC-10 stage.
Section 5.5.12, Page 80, Paragraph 1, Sentence 5 (last)	Revised as follows: The status of this analysis is described in ISR Study 8.5, Section 7.7.
Section 5.5.13, Page 80, Paragraph 2, Sentence 8 (last)	Revised as follows: This was noted during the May 17, 2013 TWG meeting and again during the IFS-TT Proof of Concept Meeting (April 15-17, 2014) (IFS-TT Proof of Concept Meeting Notes and Presentations [AEA 2014]).
Section 5.6.3.1, Page 82, Paragraph 3, Sentence 3 (last)	Revised as follows: As noted in ISR Study 8.5, Section 4.6, there are currently two 2-D hydraulic models that were being considered for application in the Focus Areas, SRH-2D, a model from the US Bureau of Reclamation, and River2D, a model from the University of Alberta. These models were subsequently reviewed by the Geomorphology Study (Study 6.6) and resulted in the selection of the SRH-2D model for use during the open-water period. However, River2D is being applied by the Ice Processes Study (Study 7.6) during the ice covered period. During the IFS-TT Proof of Concept Meeting (April 15-17, 2014), both models were described and both were demonstrated as being able to provide necessary inputs into the fish habitat modeling. AEA, in consultation with the resource modelers subsequently selected the SRH-2D to provide hydraulic model inputs into the habitat models during the open-water period, and the River2D for providing hydraulic inputs during the ice covered periods (see ISR Study 6.6, Attachment A).
Section 5.6.3.2, Page 83, Paragraph 4, Sentence 4	Revised as follows: These calibrations relied on provisional tributary gaging results and results from Version 1 of the Open-water Flow Routing Model, and will be updated using results from Version 2 of the Open-water Flow Routing Model, which has been completed and is discussed in ISR Study 8.5, Section 7.3 and Appendix K.
Section 5.6.4.1, Page 84, Paragraph 4, Sentence 1	Revised as follows: This general process was demonstrated for FA-104 (Whiskers Slough) using the uncalibrated preliminary output from the SRH-2D hydraulic

Part A Reference	Description
	model provided by the Geomorphology program, during the IFS-TT Riverine Modelers Meeting (November 13-15, 2013) (Miller and R2 2013). More details were provided in the IFS-TT Proof of Concept Meeting (April 15-17, 2014) during which examples of habitat analysis were presented based on both the SRH-2D and River2D model results for FA-128 (Slough 8A) (see ISR Study 8.5, Appendix N and IFS-TT Proof of Concept Meeting Notes and Presentations [AEA 2014]).
Section 5.6.4.2, Page 85, Paragraph 1, Sentence 1	Revised as follows: AEA completed the initial model development for the Effective Spawning/Incubation Habitat Analyses of the Middle River Segment Focus Areas in 2013 (ISR Study 8.5, Section 4.6). The general process used for computing Effective Spawning/Incubation habitat was demonstrated for FA-104 (Whiskers Slough) using the preliminary output from the SRH-2D hydraulic model provided by the Geomorphology program, during the IFS-TT Riverine Modelers Meeting (November 13-15, 2013) (Miller and R2 2013). More details were provided in the IFS-TT Proof of Concept Meeting (April 15-17, 2014) during which examples of Effective Spawning/Incubation Habitat Analysis were presented based on both the SRH-2D and River2D model results for FA-128 (Slough 8A) (ISR Study 8.5, Appendix N and IFS-TT Proof of Concept Meeting Notes and Presentations [AEA 2014]).
Section 5.6.4.3, Page 86, Paragraph 1, Sentence 4 (last)	Revised as follows: The process that AEA will utilize for varial zone modeling is described in RSP Section 8.5.4.6.1.6.
Section 5.6.4.4, Page 86, Paragraph 2, Sentence 6 (last)	Revised as follows: The approach and methods that AEA will utilize for this analysis are described in RSP Section 9.12, ISR Study 9.12, and RSP Section 8.5.4.6.1.2.3.
Section 5.7, Page 86, Paragraph 4, Sentence 4 (last)	Revised as follows: These were initially provided in the Study Plan, discussed briefly during the IFS-TT Riverine Modelers Meeting (November 13-15, 2013), and are presented in more detail in ISR Study 8.5, Section 7.7. The methods were discussed further during the IFS-TT Proof of Concept Meeting (April 15-17, 2014) (IFS-TT Proof of Concept Meeting Notes and Presentations [AEA 2014]).

Part A Reference	Description
Section 6.3.1, Page 87, Paragraph 5, Sentence 2	Revised as follows: The results from the water surface elevation and discharge measurement surveys are used in development of Version 2 of the Open-water Flow Routing Model. Version 2 of the model has since been completed and made available to resource studies and is described in ISR Study 8.5, Appendix K (Hydrology and Version 2 Open-water Flow Routing Model).
Section 6.3.2, Page 88, Paragraph 4, Sentences 8 & 9	These sentences were deleted. Note: These statements are incorrect. Local benchmarks were surveyed which allows stage comparisons.
Section 6.3.4, Page 89, Paragraph 3, Sentence 3 (last)	Revised as follows: The IFS-TT Proof of Concept Meeting (April 15-17, 2014) provided recommended representative years and the rationale for selection. This rationale considered ice processes and break-up years. Additional information on representative years is found in ISR Study 8.5, Appendix J (Representative Years) and Fluvial Geomorphology Modeling ISR Study 6.6, Appendix E.
Section 6.3.5, Page 89, Paragraph 4, Sentence 3	Revised as follows: A TWG meeting occurred on March 21, 2014. This meeting reviewed candidate metrics and proposed analysis for IHA and EFC which would be used to compare existing and post-project conditions. Additional detail on steps to complete the IHA and EFC analysis is provided in ISR Study 8.5, Section 7.3.1.5.
Section 6.4.2, Page 90, Paragraph 3, Sentence (all)	Revised as follows: Version 2 of this model (ISR Study 8.5 Appendix K), incorporates the following additional information: • Tributary drainage areas are delineated and used to estimate lateral accretion flows. • Cross-sections extended up to higher elevations using LiDAR data and ground-based RTK-GPS surveys. • Includes additional pairs of flow/water surface elevations which have improved the steady-state calibration. • Additional cross-sections from the geomorphology study have been incorporated in the model. • Diurnal glacial melt fluctuations will be incorporated into Version 3 of the model.

Part A Reference	Description
Section 6.5, Page 91, Paragraph 2, Sentence 2	Revised as follows: At this time, data collection efforts are on schedule to provide sufficient microhabitat use and availability data to develop site-specific HSC/HSI preference curves for the majority of the high and moderate priority species as listed in Table 4.5-2, and Table 5.5-3. As noted during the recent TWG meeting (March 21, 2014), for those species and life stages for which insufficient data are collected that would allow for development of preference curves, AEA will utilize other approaches for developing HSC curves including use of univariate models as well as application of utilization curves that can be derived using historic data and information,
Section 6.5.3, Page 92, Paragraph 2, Sentence 2	Revised as follows: Collection of both microhabitat use and availability data will allow for development of site-specific HSC/HSI curves for the majority of the high and moderate priority species.
Section 6.5.5, Page 92, Paragraph 4, Sentence 3 (last)	Revised as follows: Winter studies data collection was completed during the 2013-2014 winter season at additional sites within the Middle Segment of the Susitna River (ISR Study 8.5, Appendix L). If necessary, additional winter studies data collection is planned for the 2014-2015 winter season as described in ISR Study 8.5, Section 7.5.
Section 6.5.7, Page 92, Paragraph 6, Sentence 4 (last)	Note: Results of the River Productivity Study HSC/HSI models were not presented during the IFS-TT Proof of Concept Meeting (April 15-17, 2014) due to delays in receiving laboratory results. These data are anticipated to be available for analysis in 2014, which will result in development of a draft set of ecologically based metrics that can be used for evaluating Project effects. These metrics will be described in a draft Technical Memorandum that will be provided to the Licensing Participants in 2014.
Section 6.5.10, Page 93, Paragraph 5, Sentence 4 & 5	Revised as follows: Results of the fish distribution and water quality sampling were not available in sufficient time for presentation at the IFS-TT Proof of Concept Meeting (April 15-17, 2014). It is anticipated that most of the data will be available from the various studies in 2014.
Section 6.6,	Revised as follows:

Part A Reference	Description
Page 94, Paragraph 2, Sentence 3 (last)	Model development is on schedule and a more complete presentation of preliminary results was provided during the IFS-TT Proof of Concept Meeting (April 15-17, 2014) (IFS-TT Proof of Concept Meeting Notes and Presentations [AEA 2014]).
Section 6.6.3.1, Page 95, Paragraph 2, Sentence 4 (last)	Revised as follows: That analysis was based on the SRH-2D model, which is being used in the Geomorphology Studies (Study 6.6). The River2D model is being used by Ice Processes (Study 7.6). More details were provided during the IFS-TT Proof of Concept Meeting (April 15-17, 2014) during which examples of modeling results and habitat analysis were presented based on both the SRH-2D and River2D models for FA-128 (Slough 8A) (ISR Study 8.5, Appendix N and IFS-TT Proof of Concept Meeting Notes and [AEA 2014]).
Section 6.6.3.1, Page 95, Paragraph 3, Sentence 2	Revised as follows: That framework was presented and discussed at the IFS-TT Riverine Modelers Meeting (November 13-15, 2013) and described in more detail during the IFS-TT Proof of Concept Meeting (April 15-17, 2014) during which examples of actual modeling results and habitat analysis were presented based on both the SRH-2D and River2D models for FA-128 (Slough 8A) (ISR Study 8.5, Appendix N; IFS-TT Proof of Concept Meeting Notes [AEA 2014]).
Section 6.6.3.2, Page 96, Paragraph 1, Sentences 2 & 3	Revised as follows: Final calibrations were made in 2014 and relied upon Version 2 of the Open-water Flow Routing Model (ISR Study 8.5, Section 5.3; Appendix K). Preliminary results of the 1-D habitat modeling were presented during the IFS-TT Proof of Concept Meeting (April 15-17, 2014).
Section 6.6.4.2, Page 96, Paragraph 4, Sentence (all)	Revised as follows: AEA completed the initial model development for the Effective Spawning/Incubation Habitat Analyses of the Middle River Segment Focus Areas in 2013 (ISR Study 8.5, Section 4.6). The general process used for computing Effective Spawning/Incubation habitat was demonstrated for FA-104 (Whiskers Slough) using the preliminary output from the SRH-2D hydraulic model provided by the Geomorphology program, during the IFS-TT Riverine Modelers Meeting (November 13-15, 2013) (Miller and R2 2013). More details were provided in the IFS-TT Proof of Concept Meetings (April 15-17, 2014)

Part A Reference	Description
	during which examples of Effective Spawning/Incubation Habitat Analysis were presented based on both the SRH-2D and River2D model results for FA-128 (Slough 8A) (ISR Study 8.5, Appendix N; IFS-TT Proof of Concept Meeting Notes and Presentations [AEA 2014]).
Section 6.7, Page 97, Paragraph 2, Sentence 2	Revised as follows: Several general approaches for completing the Fish and Aquatics IFS temporal and spatial analyses were initially provided in the Study Plan (RSP Section 8.5.4.7), discussed briefly during the IFS-TT Riverine Modelers Meeting (November 13-15, 2013), and are presented in more detail in ISR Study 8.5, Section 7.7. The methods were discussed further during the IFS-TT Proof of Concept Meetings, April 15-17, 2014 (IFS-TT Proof of Concept Meeting Notes and Presentations [AEA 2014]).
Section 8, Page 103, Reference 3	This reference was deleted. Note: This Technical Memorandum is now ISR Study 8.5, Appendix L. This Appendix was originally prepared as a stand-alone Technical Memorandum in February 2014. For completeness, it has been re-issued and included in ISR Study 8.5 as Appendix L. With the exception of Figure 9 in which a correction was made to the plots of Whisker Creek stage (WC-10), all text, figures, tables, and references are the same as in the original Technical Memorandum.
Section 9, Pages 126-130, Table 5.3-1	Note: An updated table is provided in Appendix K, Table 6.1-1 (Susitna River transect data collected in 2012 and 2013).
Section 9, Page 145, Table 5.5-5	Note: See updated Errata Table 5.5-5 below.
Section 9, Page 146, Table 5.5-6	Note: See updated Errata Table 5.5-6 below.
Section 10	Note: Supplemental Figures for Supplemental Section 4.6.1.4 have been added below (Supplemental Figures 4.6-1, 4.6-2, and 4.6-3).
Section 10, Page 219, Figure 5.5-16	Note: See updated Errata Figure 5.5-16 below showing corrected line

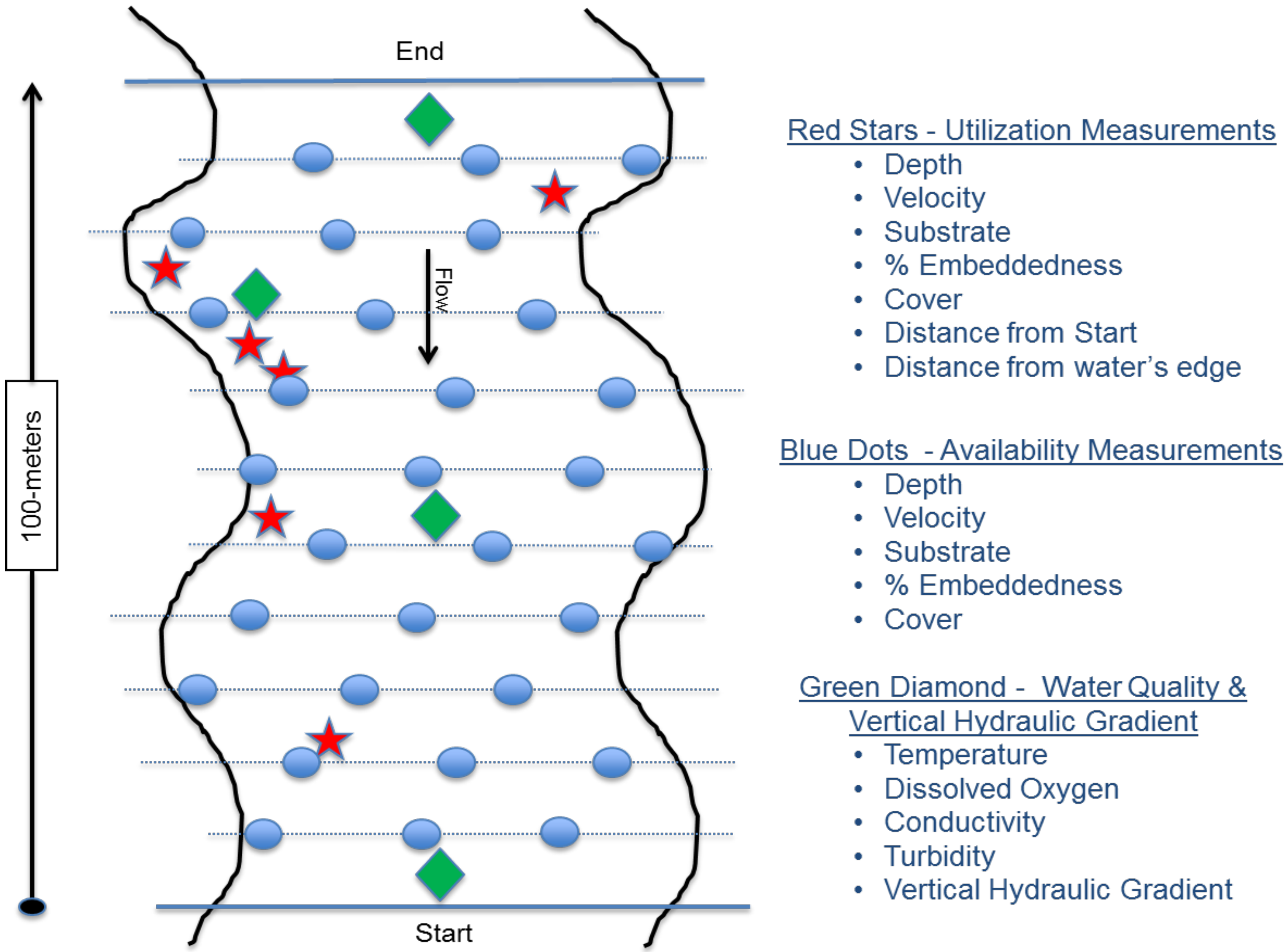
Part A Reference	Description
	representing Site WC-10 stage.
Appendix B, Section 1, Page 1, Paragraph 4, Sentence 4	Revised as follows: The Copper River was also considered by the ADF&G but because of data quality issues, particularly a lack of juvenile data and less than reliable return per spawner data for that system, it was not recommended for evaluation (J. Klein, ADF&G, personal communication, September 29, 2013).
Appendix B, Section 3.2, Page 4, Paragraph 7, Sentence 4	This sentence was deleted. Note: Data through September 2012 do exist and were mistakenly not delivered from ADF&G to AEA, so it was not possible to include the data in this analysis.
Appendix D, Page 1, Row 17	ISR_8_5_IFS_HSC_CurveData.xlxs Note: This data set has been updated and was used in creating the draft HSC curves for spawning chum salmon and fry coho salmon presented in ISR Study 8.5, Appendix M (HSC Curve Development).
Appendix D, Page 1	The following data files were added to the GINA website in support of Appendix K (Hydrology and Version 2 Open-water Flow Routing Model): ISR_8_5_IFS_2012&2013TransectQ&WSEMeasurements.xlsx ISR_8_5_IFS_2014WinterGagingMeasurementsSummary.xlsx

Errata Table 5.5-5. Summary statistics for water quality variables collected during summer 2013 in habitat units within the Middle Segment of the Susitna River, Alaska.

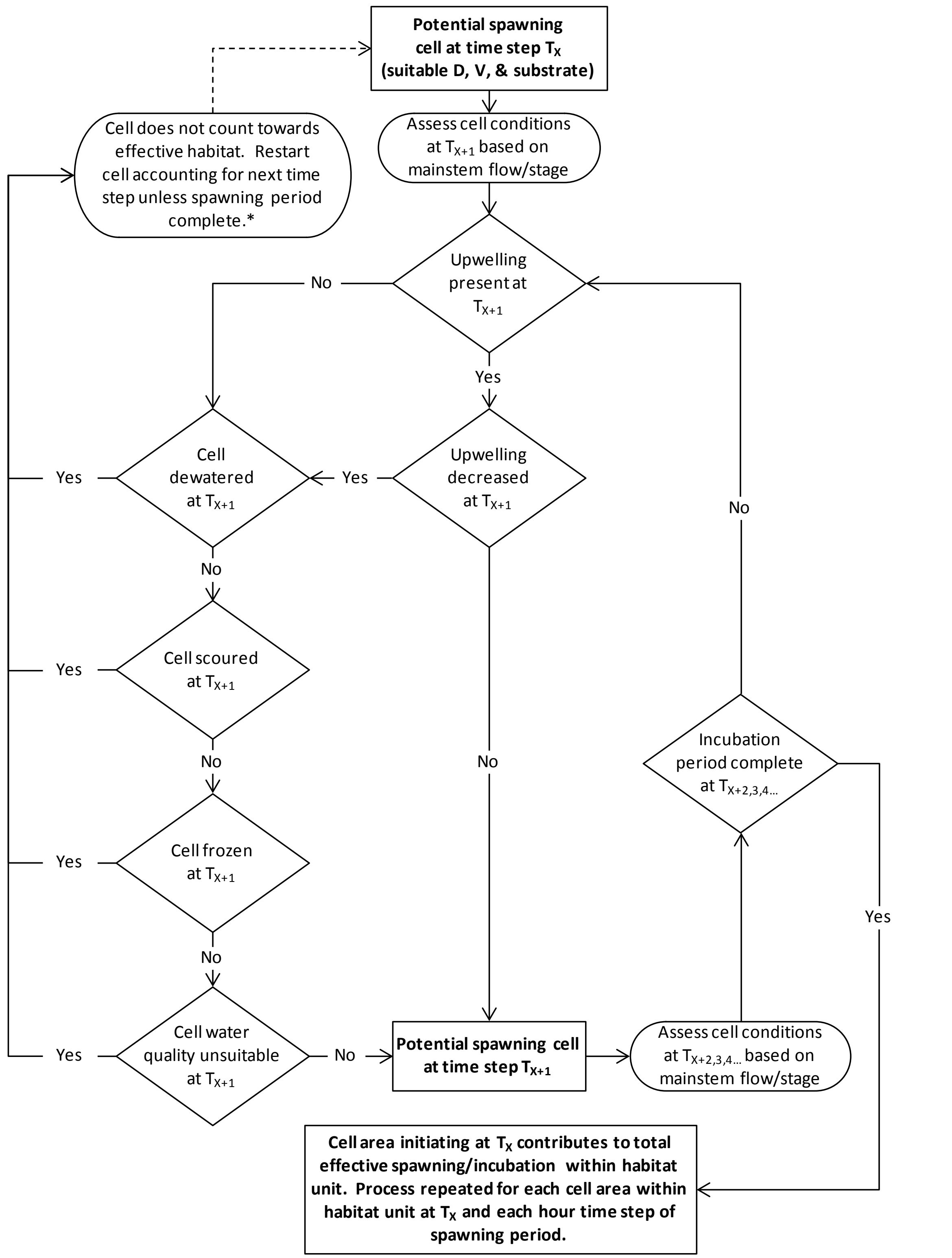
Statistic	Main Channel	Side Channel	Backwater	Clearwater Plume	Side Slough	Upland Slough	Tributary	Tributary Mouth	Total
	Temperature (°C)								
Max	17.3	16.7	13.2	14.9	17.9	26.7	17.1	16.4	**26.7**
Mean	12.5	10.4	10.3	11.2	9.4	10.4	13.1	10.4	**10.9**
Min	7.7	3.2	7.5	7.1	4.6	3.6	7.8	5.4	**3.2**
Count	784	926	24	93	663	540	166	101	**3297**
	Conductivity (uS)								
Max	173	258	126	95	328	381	78	253	**381**
Mean	143	159	96	69	179	136	44	128	**146**
Min	100	43	28	19	28	23	24	66	**19**
Count	784	926	24	93	663	540	166	101	**3297**
	Dissolved Oxygen (mg/L)								
Max	12.5	13.0	10.5	11.8	12.4	12.8	11.8	12.7	**13.0**
Mean	11.0	10.7	9.5	10.8	10.0	8.1	10.3	10.8	**10.3**
Min	10.1	6.7	8.6	8.8	5.3	3.4	8.2	7.9	**3.4**
Count	685	861	24	93	654	536	166	110	**3129**
	Turbidity (NTU)								
Max	962	528	89	21	95	312	3	10	**962**
Mean	209	73	49	8	7	28	1	3	**77**
Min	1	1	10	2	1	1	0	1	**0**
Count	784	926	24	93	663	540	166	101	**3297**

Errata Table 5.5-6. Number of water quality observations by metric bin and habitat type collected during summer 2013 HSC surveys in the Middle Segment of the Susitna River, Alaska.

Metric Bin	Main Channel	Side Channel	Backwater	Clearwater Plume	Side Slough	Upland Slough	Tributary	Tributary Mouth	Total
	Temperature (°C)								
0-4.9	0	54	0	0	30	27	0	0	**111**
5.0-9.9	195	364	12	15	365	198	18	27	**1194**
10.0-14.9	396	410	12	78	230	269	103	64	**1562**
15.0-19.9	193	98	0	0	38	37	45	10	**421**
20.0-24.9	0	0	0	0	0	9	0	0	**9**
Total	**784**	**926**	**24**	**93**	**663**	**540**	**166**	**101**	**3297**
	Conductivity (uS)								
0-86	0	41	3	70	123	126	166	56	**585**
87-173	769	632	21	23	246	262	0	20	**1973**
173-258	15	253	0	0	75	89	0	25	**457**
259-344	0	0	0	0	219	46	0	0	**265**
>344	0	0	0	0	0	17	0	0	**17**
Total	**784**	**926**	**24**	**93**	**663**	**540**	**166**	**101**	**3297**
	Dissolved Oxygen (mg/L)								
0-4.9	0	0	0	0	0	35	0	0	**35**
5.0-9.9	0	146	18	14	241	373	42	20	**854**
10.0-14.9	693	652	6	79	339	76	124	71	**2040**
≥15	0	0	0	0	3	0	0	0	**3**
NA	91	128	0	0	80	56	0	10	**365**
Total	**784**	**926**	**24**	**93**	**663**	**540**	**166**	**101**	**3297**
	Turbidity (NTU)								
≤30	220	490	12	93	630	445	166	101	**2157**
>30	564	436	12	0	33	95	0	0	**1140**
Total	**784**	**926**	**24**	**93**	**663**	**540**	**166**	**101**	**3297**
	VHG								
Negative	305	73	0	0	22	21	29	55	**505**
Neutral	399	275	9	48	222	108	87	34	**1182**
Positive	80	578	15	27	419	411	50	12	**1592**
NA	0	0	0	18	0	0	0	0	**18**
Total	**784**	**926**	**24**	**93**	**663**	**540**	**166**	**101**	**3297**

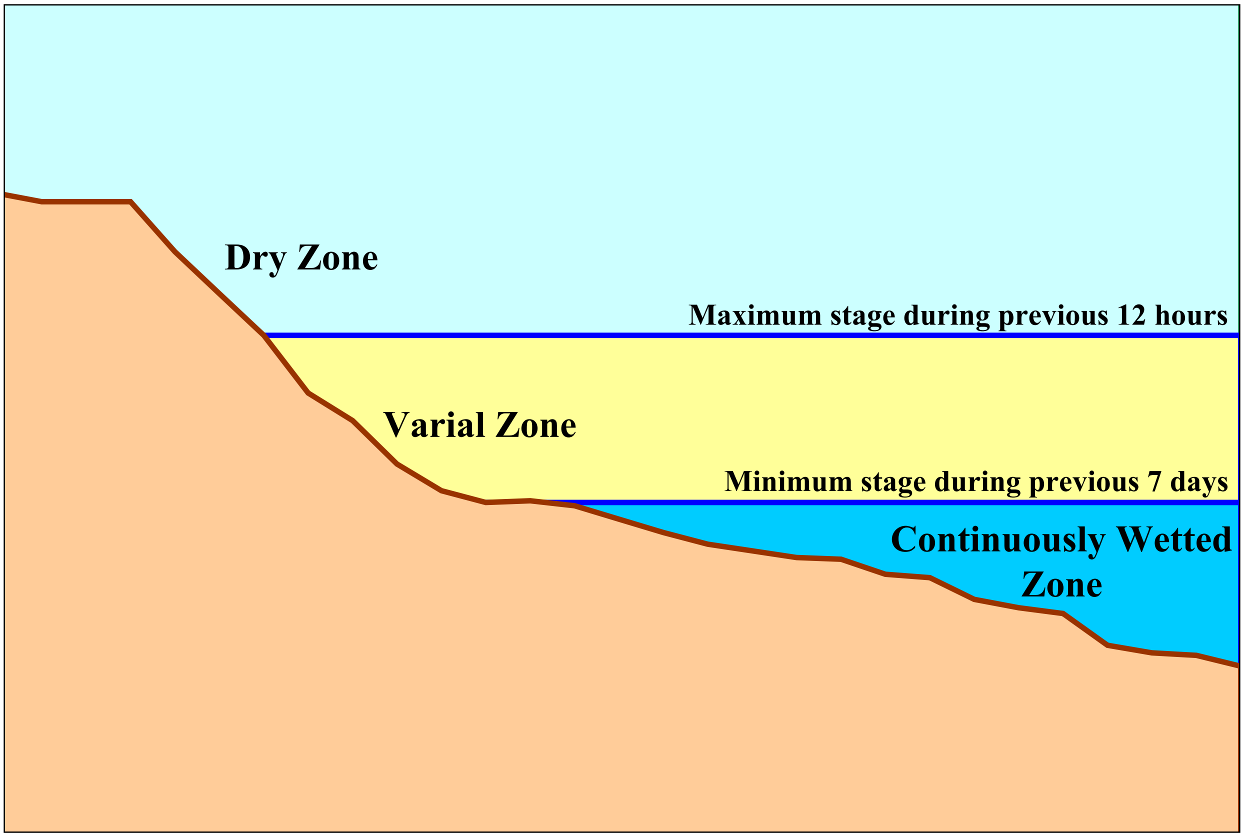


Supplemental Figure 4.5-1b. Illustration of typical sampling site displaying location of fish utilization measurements (red stars), habitat availability measurements (blue dots), and water quality and vertical hydraulic gradient measurements (green diamonds) within a 100-meter sampling site.

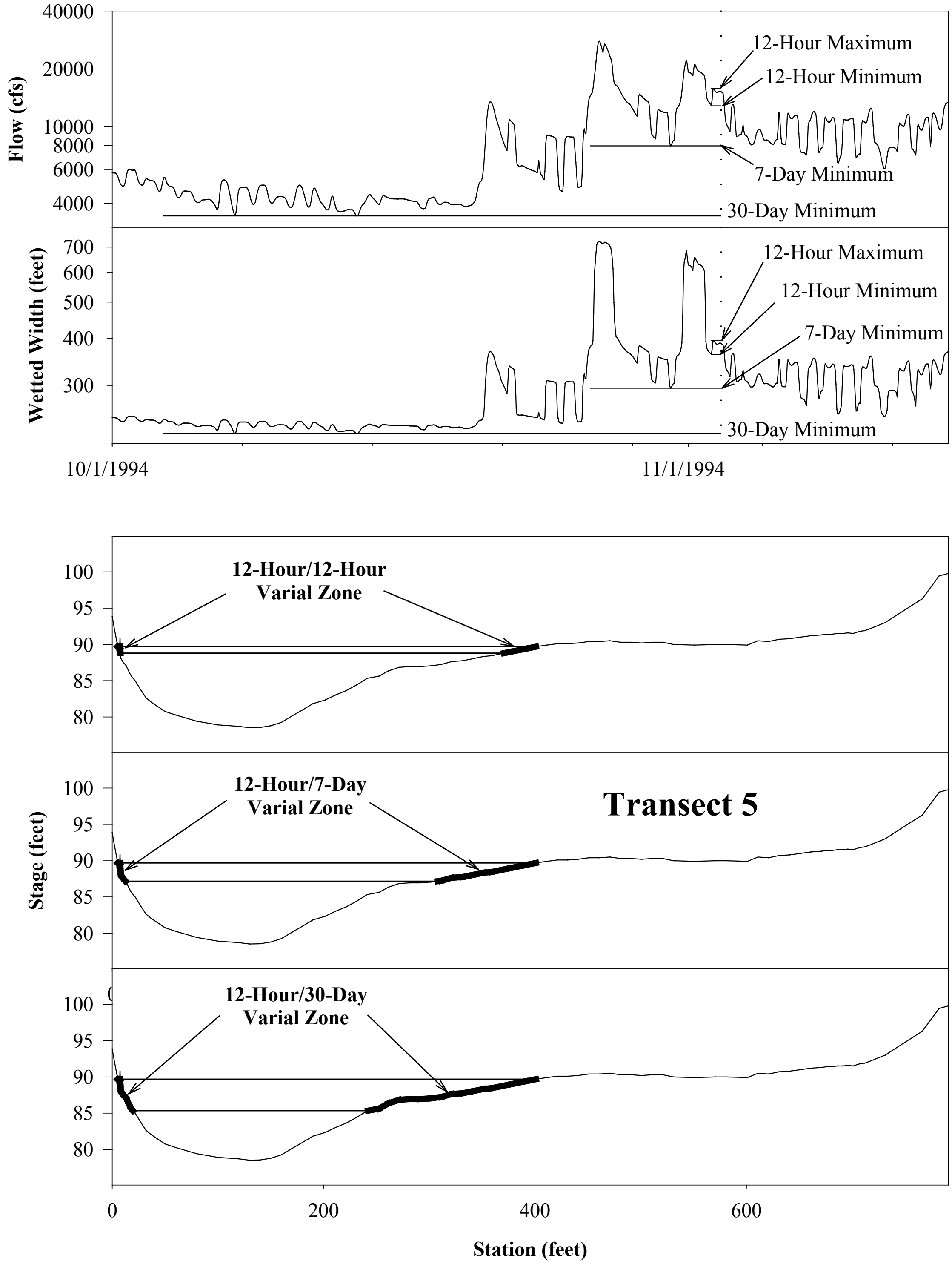


* If subsequent time step is still within the spawning period and the cell still meets criteria for the duration of incubation period, effective habitat for this cell would be weighted according to the duration of the remaining spawning period.

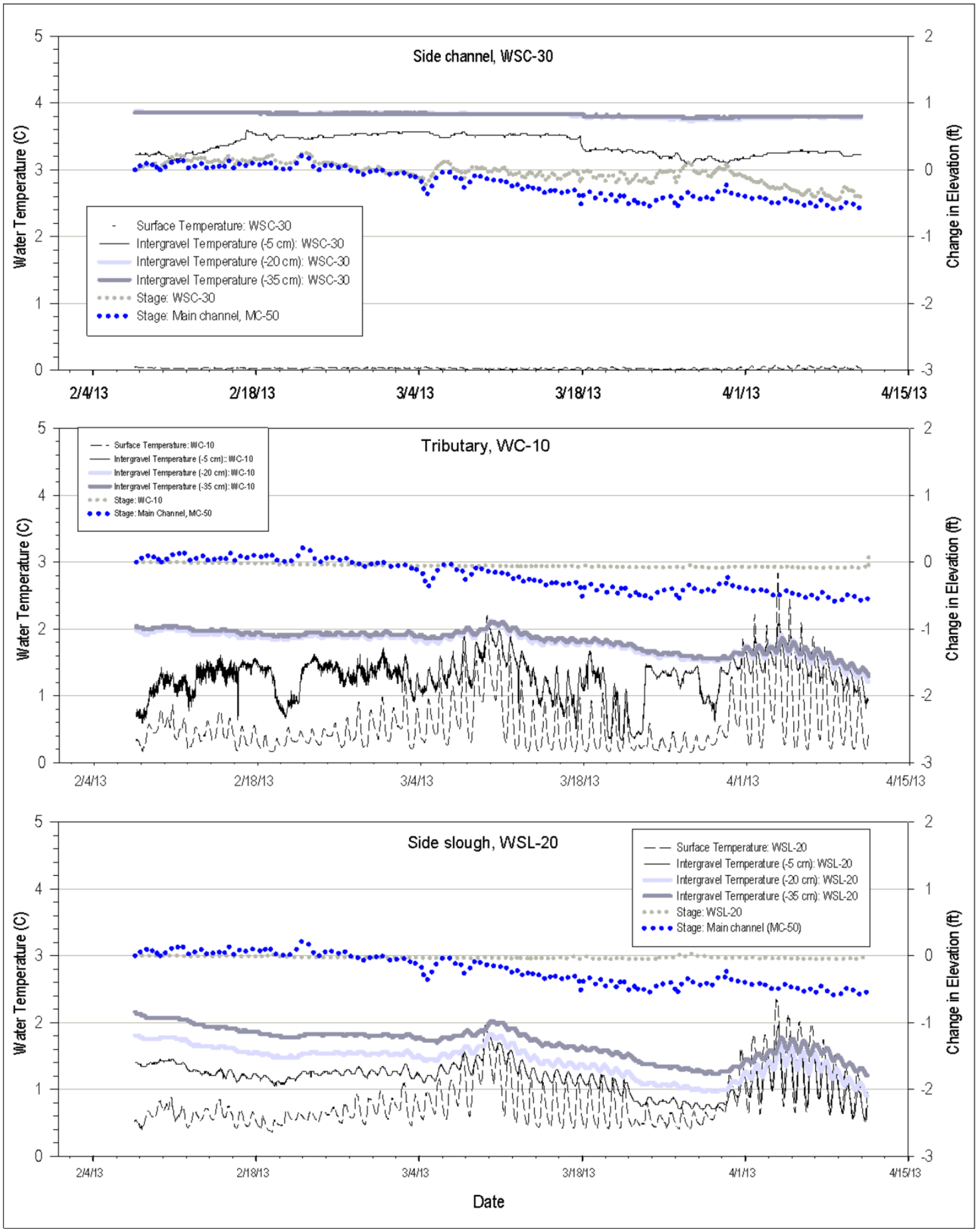
Supplemental Figure 4.6-1. Conceptual diagram depicting the Effective Spawning/Incubation Model.



Supplemental Figure 4.6-2. Conceptual framework of the Varial Zone Model.



Supplemental Figure 4.6-3. Illustration of 12-hour/12-hour, 12-hour/7-day, and 12-hour/30-day varial zones modeling scenarios assuming single transect analyses (adapted from Hilgert et al. 2008).



Errata Figure 5.5-16. Comparison of continuous surface and intergravel water temperatures at side channel (WSC-30), tributary (WC-10) and side slough (WSL-20) sites relative to change in normalized water surface elevation at each site and at main channel site MC-50. Water elevations were normalized to zero at the start of main channel stage data collection on February 7, 2013.