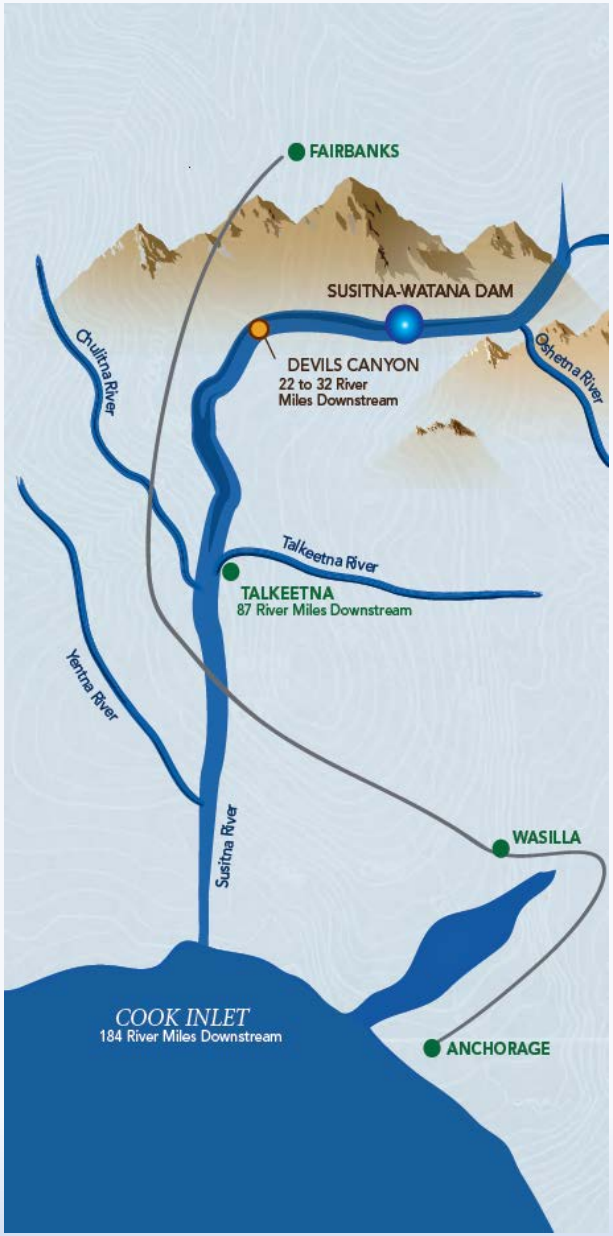


Initial Study Report Meeting

Study 8.5 Fish and Aquatics Instream Flow

March 24, 2016

Prepared by

R2 Resource Consultants

Study 8.5 Status

ISR Documents

- ISR Part A, B and C (Jun 3, 2014)
- Evaluation of Relationships Between Fish Abundance and Specific Microhabitat Variables (Sept 17, 2014)
- 2013-2014 Instream Flow Winter Studies (Sept 17, 2014)
- 2014-2015 Study Implementation Report (Nov 9, 2015)
  - Appendix B: Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8) *(replaces ISR Part C Appendix K)*
  - Appendix D: HSC Development (12 multivariate curves) *(replaces ISR Part C Appendix M)*
- ISR Part D (Nov 6, 2015)

Study 8.5 Status

- **Conceptual framework integrating riverine process and habitat models to support integrated resource analysis** (ISR Part A, Figure 4.1-1)
- **Field data collected at all 8 Middle River Focus Areas below Devils Canyon**
- **Field data collected at half of Lower River 1-D habitat modeling sites**
- **Mainstem and tributary hydrology data complete for MR below Devils Canyon**
- **Completed OWFRM from proposed dam site to Sunshine (PRM 187.2 to 87.9)**
- **Completed two years of HSC data collection in MR below Devils Canyon and one year in LR and MR above Devils Canyon**
- **Winter Studies**
  - Physical and biological data winter 2012/2013 and 2013/2014
  - Physical data winter 2014/2015
  - Instruments deployed winter 2015/2016
- **Proof-of-Concept Meeting April 2014 to evaluate integration of riverine models using Focus Area-128 (Slough 8A)**

Study Objectives - Fish and Aquatics Instream Flow

- **Map the current aquatic habitat in main channel and off-channel habitats of the Susitna River affected by Project operations.** This objective will be completed as part of the Characterization of Aquatic Habitats Study (Study 9.9) **(see ISR Part A, Figure 2-1).**
- **Select study areas and sampling procedures to collect data and information that can be used to characterize, quantify, and model mainstem and lateral Susitna River habitat types at different scales.** This objective will be completed via a collaborative process with the other resource studies (Riparian Instream Flow [Study 8.6], Groundwater [Study 7.5], Geomorphology [Studies 6.5 and 6.6], Water Quality [Studies 5.5 and 5.6], and Fish and Aquatics studies) **(described in ISR Part A, Section 4).**
- **Develop a mainstem Open-water Flow Routing Model that estimates water surface elevations and average water velocity along modeled transects on an hourly basis under alternative operational scenarios.** **(See ISR Part A, Sections 4.4 and 5.3.)**
- **Develop site-specific Habitat Suitability Criteria (HSC) and Habitat Suitability Indices (HSI) for various species and life stages of fish for biologically relevant time periods selected in consultation with the TWG.** Criteria will include observed physical phenomena that may be a factor in fish preference (e.g., depth, velocity, substrate, embeddedness, proximity to cover, groundwater influence, turbidity). If study efforts are unable to develop robust site-specific data, HSC/HSI will be developed using the best available information and selected in consultation with the TWG.
  (See ISR Part A, Sections 4.5 and 5.5.)

Study Objectives - Fish and Aquatics Instream Flow

- **Develop integrated aquatic habitat models that produce a time series of data for a variety of biological metrics under existing conditions and alternative operational scenarios.** Metrics may include (but are not limited to) the following **(see ISR Part A, Sections 4.6 and 5.6):**
  - Water surface elevation at selected river locations
  - Water velocity within study area subdivisions (cells or transects) over a range of flows during seasonal conditions
  - Length of edge habitats in main channel and off-channel habitats
  - Habitat area associated with off-channel habitats
  - Clear water area zones
  - Effective spawning and incubation habitats
  - Varial zone areas
  - Frequency and duration of exposure/inundation of the varial zone at selected river locations
  - Habitat suitability indices.
- **Evaluate existing conditions and alternative operational scenarios using a hydrologic database that includes specific years or portions of annual hydrographs for wet, average, and dry hydrologic conditions and warm and cool Pacific Decadal Oscillation (PDO) phases.**
  (See ISR Part A, Sections 4.3 and 5.4.)

Study Objectives - Fish and Aquatics Instream Flow

- **Coordinate instream flow modeling and evaluation procedures with complementary study efforts,** including Riparian Instream Flow (Study 8.6), Geomorphology (Studies 6.5 and 6.6), Groundwater (Study 7.5), Baseline Water Quality (Study 5.5), Fish Passage Barriers (Study 9.12), and Ice Processes (Study 7.6) **(see ISR Part A, Figure 4.1-1).**
- **Develop a Decision Support System-type framework to conduct a variety of post-processing comparative analyses derived from the output metrics estimated under aquatic habitat models.** These include (but are not limited to) the following **(see ISR Part A, Sections 4.8 and 5.8):**
  - Seasonal juvenile and adult fish rearing
  - Habitat connectivity
  - Spawning and egg incubation
  - Juvenile fish stranding and trapping
  - Ramping rates
  - Distribution and abundance of benthic macroinvertebrates.

Study Components

1) IFS Analytical Framework
2) River Stratification and Study Area Selection
3) Hydrologic Data Analysis
4) Reservoir Operations Model and Open-water Flow Routing Model
5) Habitat Suitability Criteria Development
6) Habitat-Specific Model Development
7) Temporal and Spatial Habitat Analysis
8) Instream Flow Study Integration

Study Variances

- The Study Plan indicated **13 mainstem water-level recording stations** would be maintained (RSP Section 8.5.4.3.1). In 2013, after calibration of Ver.1 Open-water Flow Routing Model, 8 mainstem stations maintained, and 3 new mainstem and 8 tributary water-level recorders added. In 2014, water-level recorders maintained at 24 mainstem sites and 12 tributary sites **(SIR Appendix B).**
- The Study Plan indicated continuous stage measurements would be collected in the mainstem (RSP Section 8.5.4.3.1). Due to ice damage, flooding, land access issues, etc. some data gaps of water stage exist at gaging locations **(ISR Part A, Section 4.3.2).**
- The Study Plan included **continuous gaging of Fog Creek and Portage Creek in 2013** (RSP Section 8.5.4.4.1.1). Gaging instruments were installed at Fog and Portage creeks in 2014 and operated through September 2015. A rating curve could not be developed for Fog Creek, but spot measurements were used to develop tributary hydrology.
- The Study Plan indicated that **specific representative years** would be selected in consultation with the TWG in Q3 2013 (RSP Section 8.5.4.4.1.2). This selection was discussed at the November 13-15, 2013 Riverine Modelers meeting and Q4 2013 TWG meeting. **(ISR Part A, Section 4.3.2).** Recommendations and rationale for selection presented at April 15-17, 2014 Proof of Concept meeting and described in **ISR Part C, Appendix J**.
- The Study Plan indicated that **Indicators of Hydrologic Alteration (IHA)** metrics would be developed in consultation with the TWG in Q3 2013 and interim results of IHA-type analyses would be presented in the ISR (RSP Section 8.5.4.4.1.3). A description of the initial proposed methodology is provided in **ISR Part A, Section 5.3, and Section 7.3** and will undergo continued discussion with the TWG. Candidate metrics for IHA and Environmental Flow Components (EFC) were discussed at the March 21, 2014 Technical Team meeting.

Study Variances

- The Study Plan indicated **spawning redd dimensions** would be collected (RSP Sections 8.5.4.5.1.1.4 and 8.5.4.5.1.1.5). These were collected in 2012 but in 2013 deemed unnecessary for developing evaluation metrics **(ISR Part A, Section 4.5.2).**
- The Study Plan indicated that **substrate size** (dominant, sub-dominant, and percent dominant) would be characterized in accordance with a Wentworth grain size scale modified to reflect English units (RSP Sections 8.5.4.5.1.1.4, 8.5.4.5.1.1.5, 8.5.4.5.1.1.6.1, and 8.5.4.6.1.2.4). Field personnel found it impracticable to attempt to accurately differentiate gravel composition into three size classes in turbid water conditions and used two instead **(ISR Part A, Section 4.5.2).**
- The Study Plan indicated that **fish location in water column, focal point and mean column velocity** would be measured using a Price AA current meter (RSP Section 8.5.4.5.1.1.6.1). Most fish captures occurred using electrofishing, seining or a combination of the two methods which precluded the identification of fish focal point position within the water column **(ISR Part A, Section 4.5.2).**
- The Study Plan indicated that **mesohabitat type** would be recorded for fish observation/capture points (RSP Section 8.5.4.5.1.1.6.1). However, this task will be completed after the mesohabitat mapping task is complete by applying GIS data layers containing the location of HSC fish use observations **(ISR Part A, Section 4.5.2)** to denote mesohabitat types.

Study Variances

- The Study Plan indicated that field surveys would be conducted **at potential stranding and trapping areas on an opportunistic basis** following up to three flow reduction events during 2013 (RSP Section 8.5.4.5.1.2.2). These surveys were assigned a low priority during the IFS TT POC meetings, April 15-17, 2014.
- The Study Plan indicated that 2012-2013 winter study results would be distributed to the TWG by Q3 2013 (RSP Section 8.5.4.5.1.2.1). The results were presented and discussed during an IFS TT meeting in March 2014 **(ISR Part A, Section 4.5.2; Part C, Appendix L).**
- The Study Plan indicated that macroinvertebrate sampling would occur at six stations, each with three sites (one mainstem site and two off-channel sites associated with the mainstem site), for **a total of 18 sites** (RSP Section 8.5.4.5.1.2.3). This sampling occurred at five stations on the Susitna River, each station with three to five sites (establishing sites at all macrohabitat types present within the station), for **a total of 20 sites (ISR Part A, Section 4.5.2).**
- The Study Plan indicated the **Deshka River Chinook Salmon and Yentna River Sockeye Salmon** datasets would be examined for flow-dependent biological cues (RSP Section 8.5.4.5.1.3). Mainly due to lack of the necessary data, the Deshka River and the Yentna River were not used for this study. Through further discussions with ADF&G, the **Taku River and Stikine River Chinook Salmon** stocks were selected **(ISR Part A, Appendix B).**

Study Variances

- The Study Plan indicated that an evaluation of the **representativeness of the Lower River study areas** was to occur by Q4 2013 (R2 2013b [Technical Memorandum, Selection of Focus Areas and Study Sites in the Middle and Lower Susitna River for Instream Flow and Joint Resource Studies – 2013 and 2014]). This task was **completed as part of the IFS TT POC Meetings, April 15-17, 2014** **(ISR Part C, Section 7.6).**
- 1-D fish habitat sites in the Lower River (LR-1 and LR-2) were to be measured in 2013. Only LR-1 sites measured. **Measurement of sites in LR-2 deferred to next study year.**
- The Study Plan indicated that the final approach and details concerning methods for conducting **temporal analysis and Project operational scenarios would be discussed with the TWG in Q4 2013** (RSP Section 8.5.4.7.1.1). The general approaches to be used for the spatial analysis of the fish habitat models and the temporal analysis for the different resource models were discussed as part of the November 13-15, 2013 Instream Flow Study Technical Team Riverine Modelers meeting. Potential application of the temporal methods and **options for the spatial analysis were presented during the IFS TT POC Meetings, April 15-17, 2014** **(ISR Part A, Section 4.7.2; Part C Section 7.7).**

Summary of Results – Hydraulic Data Collection

- Mainstem open-water transects measured between PRM 187.2 and PRM 29.9 (ISR Part A, Appendices A, C; and SIR Appendix C)
- In 2013, 8 tributary gaging stations with stage recorders, 2 tributary spot measurement stations (ISR Part A, Appendices E, F)
- In 2014, 11 tributary gaging stations with stage recorders, 9 tributary spot measurement stations (SIR Appendix B)
- In 2015, 5 tributary gaging stations with stage recorders collected through September 2015, 3 tributary spot measurement stations (SIR Appendix B)
- Middle River: 10 Focus Areas selected;
  7 measured in 2013, 1 measured in 2014
  - Bathymetry
  - Stage and flow
  - Surficial substrate and cover
  - Additional measurements at FA features in 2014
- Lower River: 5 tributary mouths and 6 mainstem sites selected in Lower River; 3 tributary mouths and 3 mainstem study sites measured in 2013

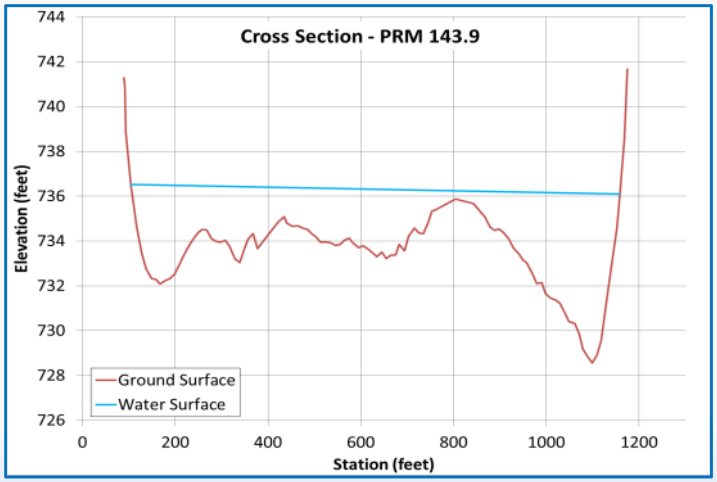
Summary of Results – Reach Scale Modeling

Open-water Flow Routing Model

- Version 1.0 (88 x-sections)
- Version 2 .0 (167 x-sections) (ISR Part C, App K) (PRM 187.2 to PRM 29.9)
- Version 2.8 (216 x-sections) (SIR Appendix B)
  (final for proposed dam site PRM 187.2 to USGS gage at Sunshine (PRM 87.9))

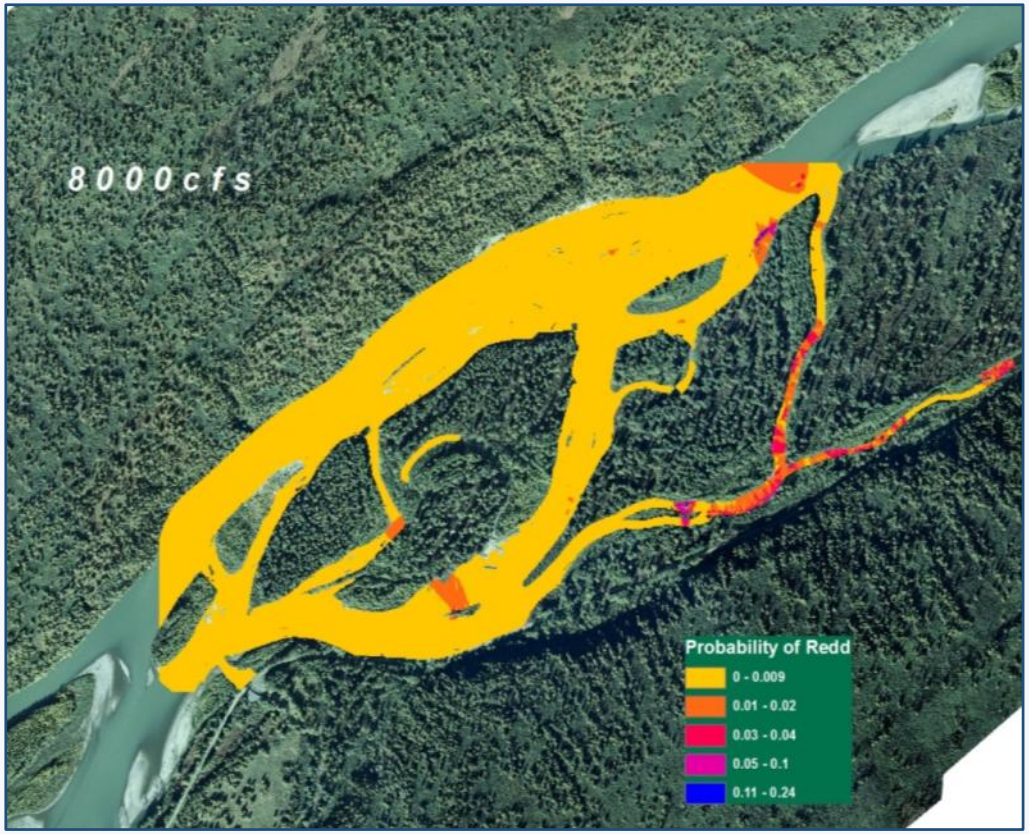
Uses and limitations of Open-water Flow Routing Model

- Open-water period (May to October)
- Intended use up to ~43,000 cfs (USGS gage at Gold Cr)
- Separate flow routing model being developed by Study 7.6 (Ice) for winter , ice-cover period



Summary of Results – Fish Habitat Modeling

- Riverine Modelers meeting held in November 2013
- Proof-of-Concept Meeting held in April 2014 (ISR Part C, Appendix N); FA-128 (Slough 8A) example
- Lower River Habitat Modeling (ISR Part A, Appendix I and Part C, Appendix O) ; Birch Creek tributary mouth example
- Visual Basic and associated GIS tools to integrate SRH-2D (open-water) and River2D (ice) hydraulic data and compute fish habitat metrics



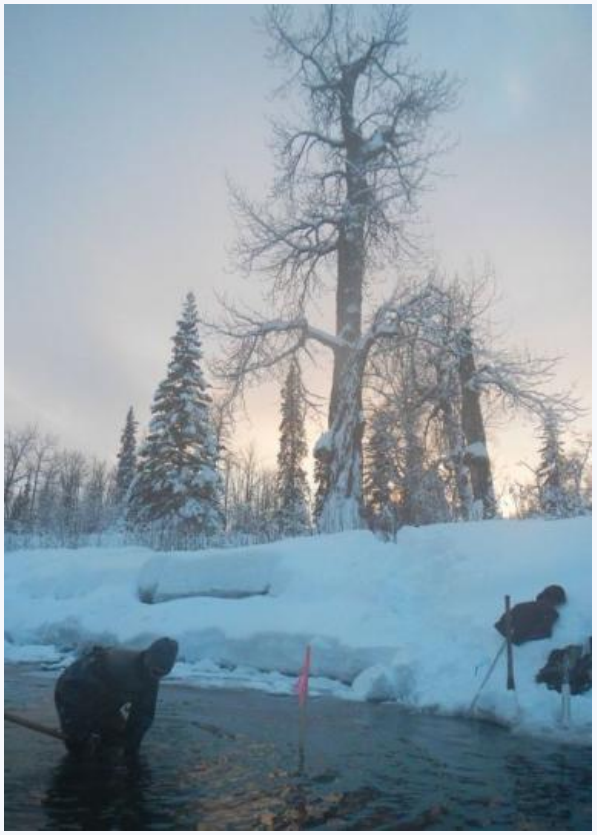
Example GIS layer of salmonid spawning habitat FA-128 (Slough 8A)

Summary of Results – IFS Winter Studies

Overview

1) **2012-2013 Data Collection (Pilot Study)**
   - Continuous water level, water quality monitoring
   - Fish capture, sampling (HSC/HSI)
   - Report: ISR Part C, Appendix L (June 2014)

2) **2013-2014 Data Collection**
   - Continuous water level, water quality monitoring
   - Fish capture, sampling (HSC/HSI)
   - Report: TM (Sept 2014); data thru pre-spring breakup
   - SIR Appendix A (Nov 2015); data thru Sept 2014



Summary of Results – ISR Part C, Appendix L

2012-2013 IFS Pilot Winter Studies

Field Study Results

- **Data Collection**
  - Continuous Monitoring: February – April 2013
  - Field Sampling: February, March, April 2013
  - 2 Focus Areas: FA-104, FA-128
- **Fish Capture and HSC/HSI**
  - 29 HSC observations
  - Juvenile Chinook (n=26), Juvenile Coho (n=3)
- **Water Level**
  - Main channel, side channel stage more variable than sloughs
- **Water Quality**
  - Intergravel water temps in main channel near 0°C
  - Intergravel water temps in sloughs 2-4 °C warmer
  - Dissolved oxygen levels near 5 mg/L in FA-128

Summary of Results

- *September 17, 2014 Tech Memo*
- *SIR Appendix A*

2013-2014 IFS Winter Studies

Field Study Results

- **Data Collection**
  - Continuous Monitoring: Sept 2013 – Sept 2014
  - Field Sampling: February, March ,and April 2014
  - 4 Focus Areas: FA-104, FA-128, FA-138 and FA-141
- **Fish Capture and HSC/HSI**
  - 28 Daytime electrofishing surveys (n=248 fish)
  - 16 Night electrofishing surveys (n=659 fish)
  - 262 HSC observations: 8 species, fry and juveniles
  - Coho (n=120), Sockeye (n=68), Chum (n=42)
- **Water Level**
  - Main channel and side channel surface water connectivity variable thru winter season
  - Side channel and slough habitats with little or no groundwater often dewatered or frozen
- **Water Quality**
  - Dissolved oxygen levels drop to 4 mg/L depending on groundwater source and proportion of flow

Summary of Results - HSC

Overview

- Priority ranking for 19 fish species for development of HSC/HSI (ISR Part A).
- Periodicity information by species, life stage, and river segment using 1980's and current fisheries data (ISR Part A, Appendix H).
- HSC sampling site selection relied on stratified random sampling and areas of known fish use, 57 sites in 2013 (ISR, Part A);
  72 additional sites added in 2014 (SIR, Appendix D); no data collection in 2015.
- HSC Data collection 1,371 observations of habitat use collected for 12 species in 2013 (ISR Part A);
  1,428 additional observations of habitat use collected in 2014 (SIR, Appendix D).
- Habitat use histogram plots (ISR Part A, Appendix G); Update histograms presenting habitat use by river segment and season (SIR, Appendix D).
- Evaluated relationship between fish abundance of other habitat variables (TM 09/17/2014).
- Draft HSC models for coho juvenile and chum spawning (ISR Part C, Appendix M);
  Expanded HSC model development to 12 species/life stages (SIR, Appendix D).
- Proposed future data collection and alternate HSC curve development methods for target species with small sample size (SIR, Appendix D).

Summary of Results - HSC

Additional HSC data collection

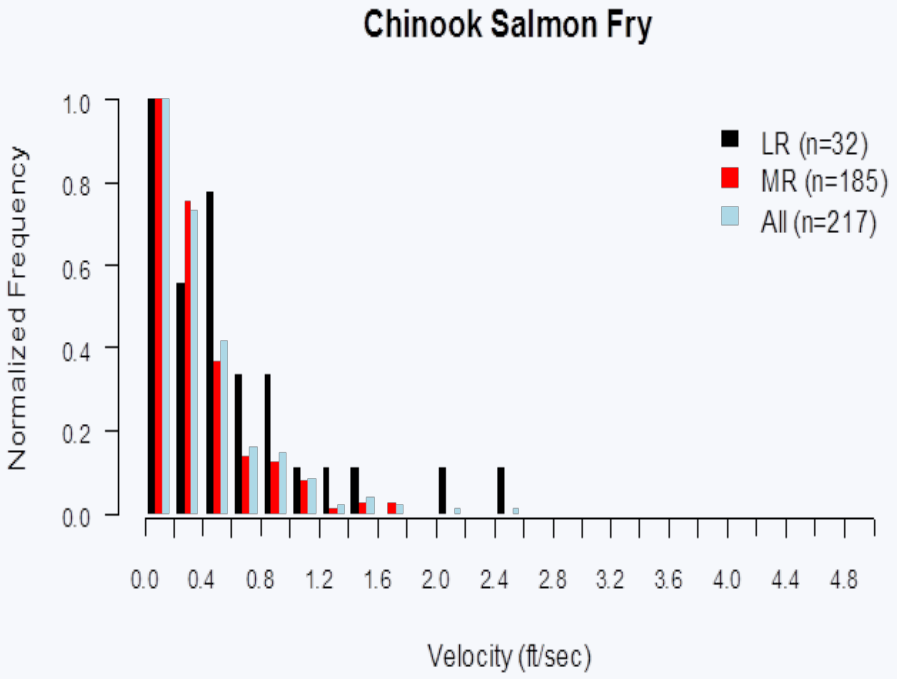
- Lower, Middle (above and below Devils Canyon)
- 2014 Sampling sessions:
  - May 20-June 7
  - July 15-22
  - Sep 17-24
- May-September 2014 Sampling
  - 72 sampling events
  - 1,366 habitat use measurements
  - 3,389 habitat availability measurements

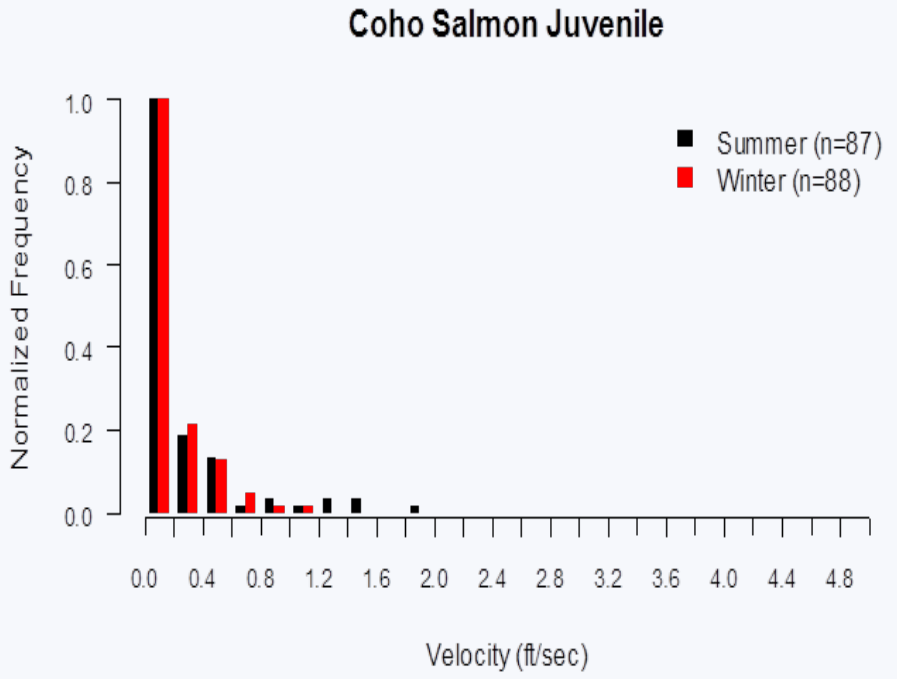
TM - Relationship Between Fish Abundance and Specific Microhabitat Variables (September 17, 2014)

- Determine if "strong" relationships are present between fish abundance and 8 additional variables
  - Predictive and direct relationship
  - Changes can be spatially and quantitatively predicted
  - Predicted changes observable at similar temporal scale
  - pH was the only variable to meet all criteria

Summary of Results - SIR Appendix D

HSC Model Development by River Segment





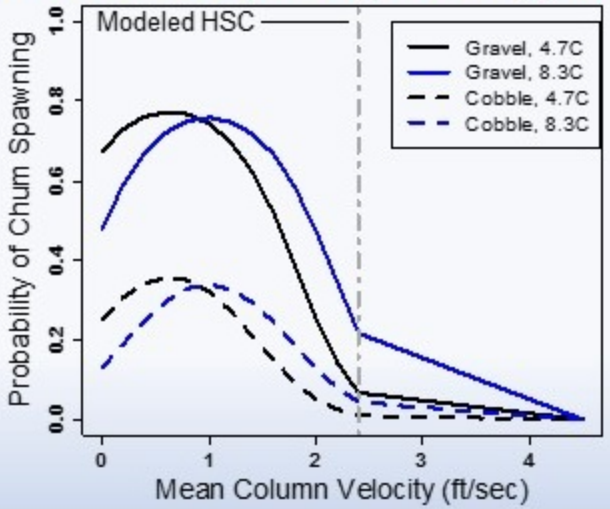
Summary of Results

(ISR Part C Appendix M and SIR Appendix A)

HSC/HSI Modeling

- Multiple logistic regression approach
  - Identify variables most predictive of fish presence/use.
  - Combine all significant predictors into a combined index of preference or suitability.
  - Identify interactions using multiple regression.
  - Compare models using Akaike's Information Criteria.

- Multivariate HSC models developed for 12 individual species/life stages:
  - Chinook Salmon fry and juvenile
  - Chum Salmon spawning
  - Coho Salmon fry and juvenile
  - Sockeye Salmon spawning,
  - Arctic Grayling fry and juvenile
  - Whitefish fry and juvenile
  - Longnose Sucker juvenile and adult



Summary of Results – SIR Appendix D

HSC Models by Species and Lifestage

Species	Life Stage	Number of Microhabitat Use Measurements	Multivariate Preference HSC Model	Proposed Alternate HSI Method	No HSC Proposed
Chinook Salmon	Fry	217	X		
	Juvenile	67	X		
Chum salmon	Fry	253			X
	Spawning	397	X		
Coho Salmon	Fry	274	X		
	Juvenile	87	X		
	Spawning	3			X
Pink Salmon	Fry	39			X
	Spawning	53		X	
Sockeye Salmon	Fry	357			X
	Spawning	244	X		

Summary of Results – SIR Appendix D

HSC Models by Species and Lifestage

Species	Life Stage	Number of Microhabitat Use Measurements	Multivariate Preference HSC Model	Proposed Alternate HSI Method	No HSC Proposed
Arctic Grayling	Fry	120	X		
	Juv	78	X		
	Adult	15		X	
Rainbow Trout	Fry	4			X
	Juvenile	7			X
	Adult	8		X	
Burbot	Fry	1			X
	Juvenile	5			X
	Adult	22		X	
Dolly Varden	Fry	21			X
	Juvenile	2			X
	Adult	3		X	

Summary of Results – SIR Appendix D

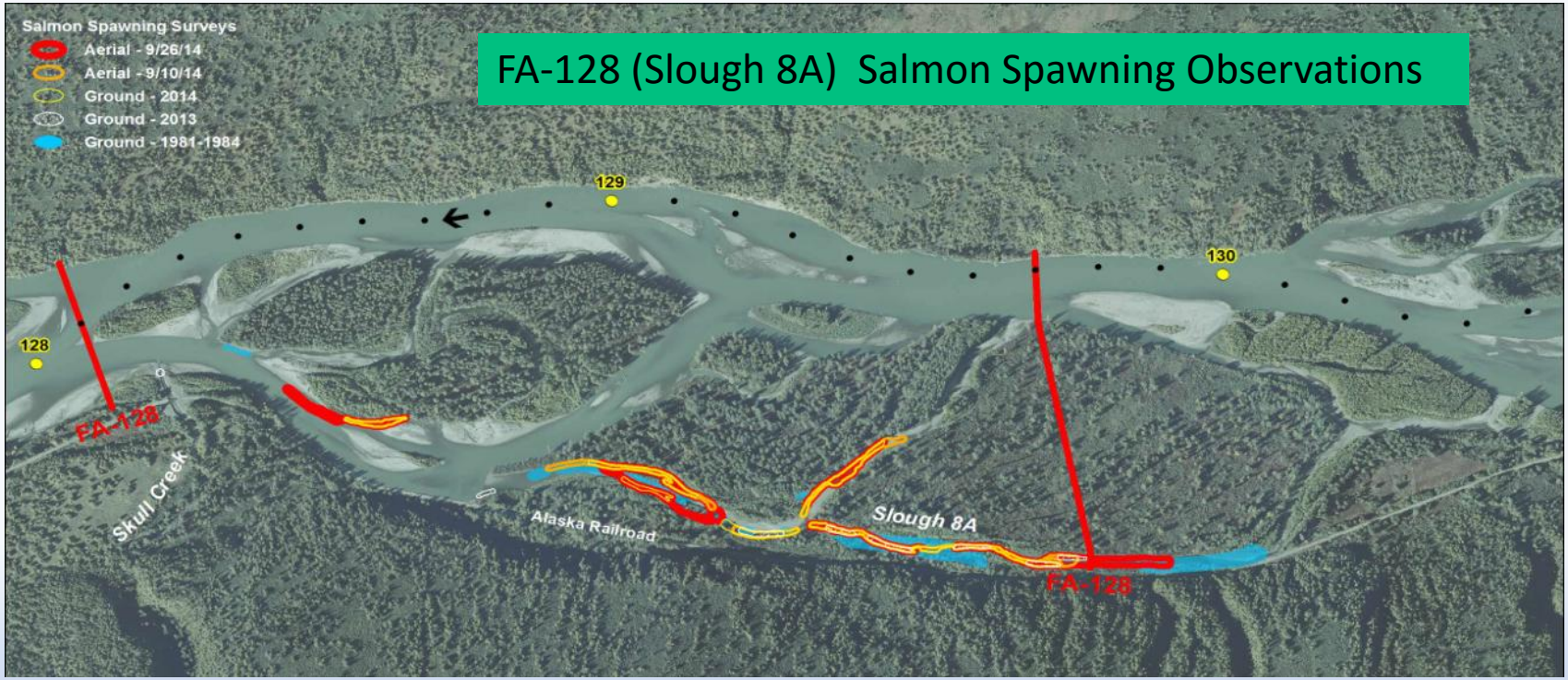
HSC Models by Species and Lifestage

Species	Life Stage	Number of Microhabitat Use Measurements	Multivariate Preference HSC Model	Proposed Alternate HSI Method	No HSC Proposed
Eulachon	Spawning	0		X	
Bering Cisco	Spawning	0		X	
Longnose Sucker	Fry	88	*Proposed*	X	
	Juvenile	97	X		
	Adult	71	X		
Whitefish (undiff)	Fry	105	X		
	Juvenile	101	X		
	Adult	35		X	

Summary of Results – SIR Appendix E, 2 files

Surficial Substrate and Cover and Salmon Spawning Observations by Focus Area

- 7 of 8 Focus Areas below Devils Canyon surveyed for substrate and cover in 2013
- FA-151 (Portage Creek) surveyed for substrate and cover in 2014
- Salmon spawning observations by Focus Area using two 2014 aerial spawning surveys , 2013 and 2014 ground-level observations, and 1981-1984 study results



AEA Proposed Modifications

(ISR Part C-Section 7, Part D-Section 7)

The schedule in the IFS Study Plan for completion of field data collection has changed. Two study seasons have been completed for many IFS study components, and a second study season is proposed for other components. AEA does not expect these changes in the schedule to impact AEA's ability to meet the objectives of the Study Plan.

7.1.1.2. **IFS Analytical Framework**

- No modifications to the Study Plan are needed to complete this study component and meet Study Plan objectives.

7.2.1.2. **River Stratification and Study Area Selection**

- No modifications to the Study Plan are needed to complete this study component and meet Study Plan objectives

7.3.1.2. **Hydrologic Data Analysis**

- Three instead of five representative years were selected to represent wet/warm (1981), average (1985), and dry/cool (1976) conditions(RSP, Section 8.5.4.4). Two additional years were considered to represent warm and cold Pacific Decadal Oscillations but were not included since analysis did not support the distinction (ISR Part C, Appendix J).
- Final IHA and EFC metrics will be developed with input from the TWG and other resource disciplines after the Open-water Flow Routing Model is finalized (RSP, Section 8.5.4.4).

7.4.1.2. **Reservoir Operations and Open-water Flow Routing Modeling**

- Instead of HEC ResSim, the reservoir operations model (MWH-ROM) is being used to forecast reservoir outflows(RSP, Section 8.5.4.3).

AEA Proposed Modifications

(ISR Study 8.5, Part C-Section 7, Part D-Section 7)

7.5.1.2. **Habitat Suitability Criteria Development**

- No modifications to the Study Plan are needed to complete this study component and meet Study Plan objectives.

7.6.1.2. **Habitat-Specific Model Development**

- As described in ISR Section 4.6.2, AEA deferred LR-2 field studies (near PRM 67) from 2013 to the next study period. All other methods for Lower River fish habitat modeling will remain unchanged from the methods described in RSP Sections 8.5.4.2 through 8.5.4.7.

7.7.1.3. **Temporal and Spatial Habitat Analyses**

- Temporal analyses include extrapolating the results of 2-D modeling of Focus Area fish habitats from existing conditions (i.e., License Year 0) to future conditions (i.e. Years 25 and 50). Spatial analyses include applying 1-D and 2-D fish habitat model results from modeled to non-modeled areas. General approaches for temporal and spatial analysis were discussed during the November 13-15, 2013 IFS TT Riverine Modelers Meeting (AEA 2013), and were more specifically described during the IFS TT POC meeting on April 15-17, 2014 (AEA 2014b). The final approaches for both the temporal and spatial analysis were to be provided in the ISR (RSP Section 8.5.4.7.1.3); and while discussion occurred during implementation of the Study Plan in 2013 and early 2014, decisions on the final approaches are deferred to the next study period.

7.8.1.3. **Instream Flow Study Integration**

- No modifications to the Study Plan are needed to complete these study components and meet Study Plan objectives

Steps to Complete Study

- **Lower River Field Data Collection**
  - Mainstem and tributary gaging (open-water).
  - Mainstem transects (bathymetry, stage, and flow).
  - Measure Lower River Segment 2 (LR-2) transect cross-sections near PRM 67 (mainstem, side channel, Sheep and Caswell creeks).
  - 2nd summer season of HSC measurements.

Steps to Complete Study

- **Middle River Field Data Collection**
  - Measure FA-173 (Stephan Lake Complex), FA-184 (Watana Dam) bathymetry, stage, flow, substrate, and cover measurements.
  - ESS station above Devils Canyon.
  - 2nd summer season of HSC measurements above Devils Canyon.
  - Continuous water level and water quality data at 27 sites Sep 2014-Sep 2015
  - Continuous water level and water quality data at 21 sites Sep 2015-Sep 2016
  - One winter season of combined fish sampling and water level and water quality monitoring at FA-104 (Whiskers Creek), FA-128 (Slough 8A) and FA-138 (Gold Creek).

Steps to Complete Study

- **Reach Scale Modeling**
  - Finalize Open-water Flow Routing Model (Version 3.0).
  - Integrate open-water and ice-cover flow routing during fall and spring transition periods.
  - Finalize reservoir operations model to forecast reservoir outflows under Existing and Alternate Operational Scenarios.
- **Lower River Transect Habitat Modeling**
  - Finalize transect hydraulic modeling at fish habitat study sites.
  - Adjust periodicity and HSC for Lower River as needed.
  - Calculate fish passage and habitat connectivity metrics.
  - Calculate Weighted Usable Area for target species for open-water period.
  - Calculate Weighted Usable Area time series for open-water period.

Steps to Complete Study

- **Middle River Focus Area Habitat Modeling**
  - Complete SRH-2D (open-water) and River2D (ice) 2-D hydraulic modeling at all Focus Areas.
  - Finalize fish species periodicity and HSC/HSI.
  - Finalize Visual Basic and associated GIS tools to compute fish habitat metrics.
  - Conduct fish habitat modeling that integrates both SRH-2D (open-water) and River2D (ice) hydraulic data.
  - Develop varial zone models for Middle River Focus Areas.
  - Calculate breaching flow/habitat connectivity metrics.
  - Prepare effective spawning : incubation habitat metrics at Focus Areas.
  - Conduct salmonid rearing habitat analyses.
  - Calculate fish habitat metrics for Middle and Lower River under Existing Conditions and Alternate Operating Scenarios, and Years 0, 25, and 50.

Steps to Complete Study

- **Decision Support System**
  - Calculate Index of Hydrologic Alteration (IHA) and Environmental Flow Components (EFH) using Version 3 of Open-Water Flow Routing Model.
  - Finalize temporal and spatial habitat extrapolation process.
  - Finalize process for evaluating uncertainty in evaluation metrics.
  - Finalize integration process for fish habitat metrics.
  - Finalize integration process for other riverine and reservoir related interests.
  - Integrate metrics for riverine and reservoir related interests under Existing Conditions and Alternate Operating Scenarios.
  - Integrate metrics for riverine and reservoir related interests under Year 0 and future conditions (Years 25 and 50).

Licensing Participants Proposed Modifications to Study 8.5?

- Agencies
- CIRWG members and Ahtna
- Public