Technical Team Meeting
Proof of Concept Meeting
Open water 1-D Fish Habitat Analysis
Lower River
April 15-17, 2014
Prepared by Golder Associates
Overview

• Presentation overview:
  – Describe the 1-D habitat objectives
  – Describe the modeling approach
  – Present metrics for coho salmon spawning and juvenile rearing

• Note: The examples shown are for illustration of the process - model inputs and outputs and are based on preliminary draft results and are subject to revision
1-D Fish Habitat Modeling Objectives

• Compute weighted usable area (square feet / 1000 feet) for current open water conditions
  – Habitat in terms of WUA for species and life stage of interest (open water) based on depth, velocity and substrate/cover

• Compute WUA for project operation open water conditions
  – Same as above

• Inundation (breaching) of lateral habitats in open water

• Compare project operation to current conditions to determine change
Review of 1-D Based Habitat Model

• Traditional PHABSIM/IFIM approach
  – Hydraulics and suitability criteria
  – Calculates weighted usable area
  – Open water conditions only

• Data dependencies from the following: 2013 LiDAR, hydraulic models for open water, substrate and cover data from field data collection, HSC and HSI analysis

• Groundwater and water quality assessed and integrated external to habitat model
Review of 1-D Based Habitat Model

• No attempt to generate whole-channel model due to channel complexity
  – Multiple smaller study sites and models to represent major habitat units

• HEC-RAS used for hydraulic modeling
  – Incorporates tributary inflows, split channels
  – Allows use of the 1-D open water flow routing model results for model set-up and calibration
  – Predict proportional flow within study sites
Lower River 1-D Fish Habitat PHABSIM Sites

- 2 of 5 Lower River Fish Habitat IFS Sites shown for POC
Lower River
1-D HEC-RAS
Results -
PRM97 Site

- Wetted area based on LiDAR, simulated water level and mainstem flow at PRM 97
  - Low Flow – 30,000 cfs
  - Medium Flow – 60,000 cfs
  - High Flow – 120,000 cfs
Lower River
1-D HEC-RAS
Results -
Birch Creek Site

- Wetted area based on LiDAR, simulated water level and Birch Creek Slough Flow
- Low Flow – 300 cfs
- Medium Flow – 650 cfs
- High Flow – 2,800 cfs
Review of 1-D Based Habitat Model

• PHABSIM used for velocity and habitat modeling
  – Single velocity calibration data set collected at high flow in 2013

• Model uses HSC and HSI analysis for evaluation
  – Current iteration using 1980s HSC curves
POC – Spawning Habitat Analysis

Periodicity of sockeye salmon utilization among macro-habitat types in Lower (PRM 102 – 0.0) segments of the Susitna River by life history stage. Shaded areas indicate timing of utilization by macro-habitat type and dark gray areas represent areas and timing of peak use.

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<tr>
<th>Life Stage</th>
<th>Main Channel</th>
<th>Side Channel</th>
<th>Tributary Mouth</th>
<th>Side Slough</th>
<th>Upland Slough</th>
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Birch Creek Slough (PRM 94.8) Weighted Useable Area

- **Coho Salmon - Spawning**
- **Coho Salmon - Juvenile**

**Birch Creek Slough Discharge (cfs)** vs. **WUA (ft²/1000ft)**
Q-q Relationship between Susitna River at PRM 94.8 and Birch Creek Slough

\[ y = -6 \times 10^{-8}x^2 + 0.042x - 174.36 \]

\[ R^2 = 0.9973 \]
Dry Year (1976) - Birch Creek Slough (PRM 94.8) Flows

Discharge (cfs) vs. Date

- Existing Conditions
- OS 1b
- Birch Creek Inundation

Start Date: 4/30/1976
End Date: 10/27/1976

Graph shows the discharge in cubic feet per second (cfs) for Birch Creek Slough (PRM 94.8) from April 30, 1976, to October 27, 1976. The graph includes three lines indicating different conditions: Existing Conditions, OS 1b, and Birch Creek Inundation.
Dry Year (1976) - Birch Creek Slough (PRM 94.8) Hourly Coho Salmon Juvenile Habitat

Weighted Useable Area (ft²/1000 ft)

Date

Existing Conditions

OS 1b
Dry Year (1976) - Birch Creek Slough (PRM 94.8) Percent Change in Coho Salmon Habitat between OS 1b from Existing Conditions

Relative Change in Habitat (%)

- Juvenile
- Spawning

Date
Wet Year (1981) - Birch Creek Slough (PRM 94.8) Flows

Discharge (cfs)

Date

Existing Conditions
OS 1b
Birch Creek Inundation

Wet Year (1981) - Birch Creek Slough (PRM 94.8) Coho Spawning Habitat Time Series

- Weighted Useable Area (ft²/1000 ft²)
- Date

- Existing Conditions
- OS 1b
Wet Year (1981) - Birch Creek Slough (PRM 94.8) Coho Juvenile Habitat Time Series

Weighted Useable Area (ft\(^2\)/1000 ft)

Date


Existing Conditions

OS 1b
Wet Year (1981) - Birch Creek Slough (PRM 94.8) Percent Change in Coho Habitat between OS 1b from Existing Conditions

- Coho Salmon - Juvenile
- Coho Salmon - Spawning

Relative Change in Habitat (%)

Date

Evaluation Metrics

• Range of metrics available from time series analysis based on WUA results
  – Percent change statistics

• Breaching Analysis
  – Frequency, duration and timing
  – Connectivity and flow depth at tributary mouths
  – Breaching of side channels, side sloughs, etc.
Extrapolation of Results for Lower River

• Similar series of habitat results for each study site will be generated
  – Each site represents different habitat unit
  – Follow approaches discussed for middle river to extrapolate habitat results

• Option to focus on major tributary mouth connectivity
  – Sites have focused on tributary mouth locations
  – Site-specific results to each tributary mouth studied, no extrapolation necessary
Summary

• Open water fish habitat results only
• Approach provides tabular outputs for input to DSS or other decision processes
• Groundwater and water quality integrated independently
• A similar approach will be used on other species and life stages of interest for each Lower River fish habitat IFS site
1-D Fish Habitat
Lower River

Questions