


SUSITNA-WATANA HYDRO *Clean, reliable energy for the next 100 years.*

Technical Team Meeting

Proof of Concept: Effective Spawning Habitat Analysis

April 15-17 2014

Prepared by
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POC – Effective Spawning Habitat Analysis

- Identify potential use of discrete channel areas suitable for chum salmon spawning and track the area (hourly) through the subsequent spawning and incubation period:
 - ✓ Dewatering
 - ✓ Freezing
 - ✓ Breached
 - ✓ scour
 - ✓ Intragravel temperature
 - ✓ Intragravel dissolved oxygen

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- **Data Needs:**
 - ✓ **Spawning habitat suitability & distribution***
 - ✓ **Substrate composition***
 - ✓ **Spawning and incubation timing or periodicity***
 - ✓ **Presence of groundwater upwelling***
 - ✓ **Intragravel water temperature**
 - ✓ **Intragravel dissolved oxygen**
 - ✓ **Hourly water surface elevations (dewatering)***
 - ✓ **Hourly air temperature (<0 Celsius)**
 - ✓ **Breaching flows***
 - ✓ **Redd scour***

*Available for Proof of Concept

POC – Effective Spawning Habitat Analysis

HSC Chum Spawning Model – Best Fit

$$\log\left(\frac{p}{1-p}\right) = C_k + 19depth - 18depth^2 + 6.8depth^3 - 0.91depth^4 + 3.9vel - 1.9vel^2 + \gamma_{site} + \varepsilon,$$

where

$$C_{UPGR} = -10$$

$$C_{UPCO} = -14$$

$$C_{NOGR} = -13$$

$$C_{NOCO} = -15$$

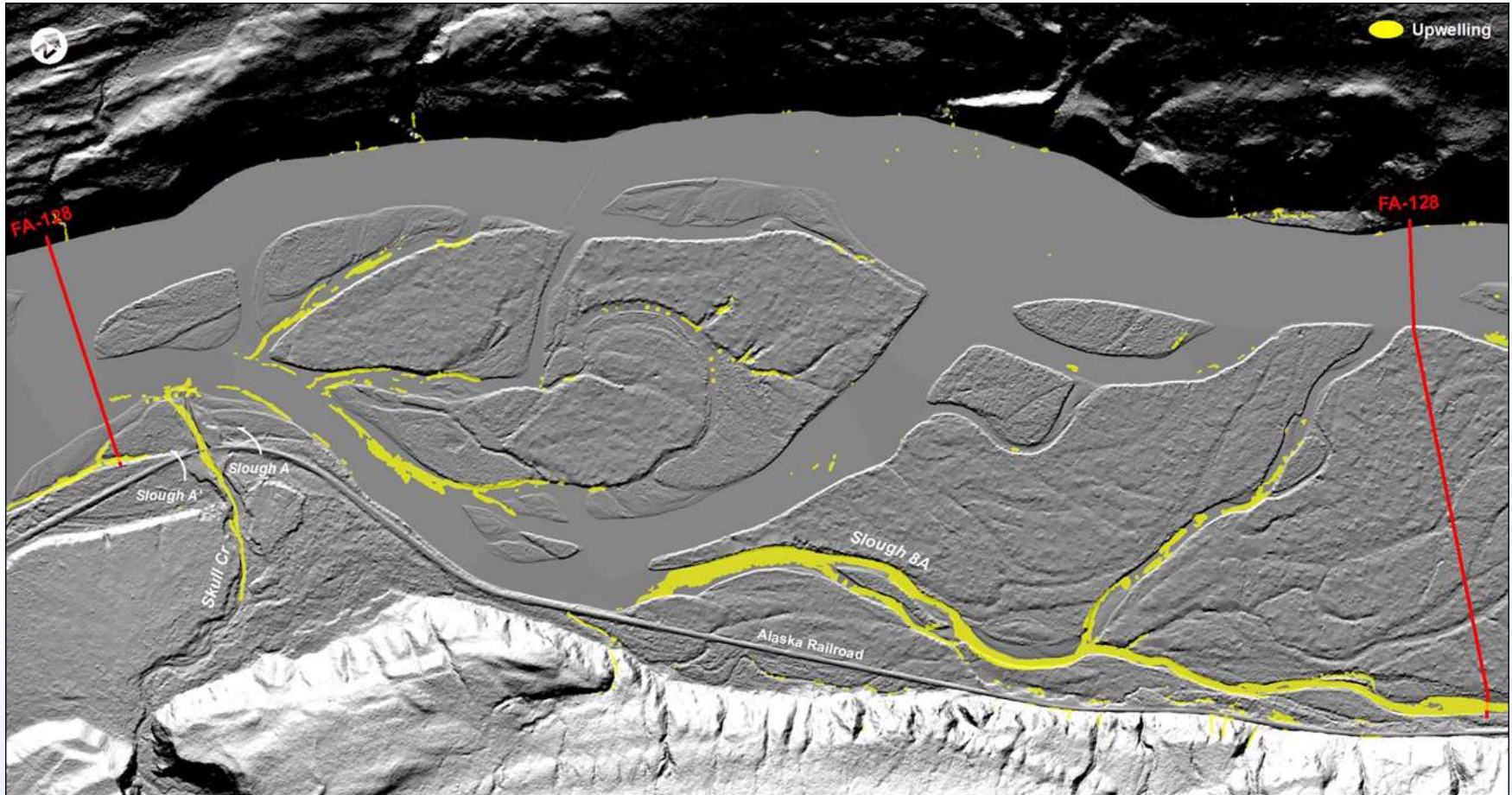
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Periodicity of chum salmon utilization among macro-habitat types in the Middle (RM 184 – 98.5) segment of the Susitna River by life history stage.

Life Stage	Habitat Type						Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Main Channel	Side Channel	Tributary Mouth	Side Slough	Upland Slough	Tributary												
Middle Susitna River																		
Adult Migration	■	■	■	■										■	■	■		
Spawning	■	■	■	■										■	■	■		
Incubation	■	■	■	■			■	■	■	■	■	■	■	■	■	■	■	■
Fry Emergence	■	■	■	■				■	■	■	■	■	■					
Age 0+ Rearing	■	■	■	■				■	■	■	■	■	■	■	■			
Age 0+ Migration	■	■	■	■							■	■	■	■				

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FA-128 Areas of predicted groundwater upwelling



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Spawning Period

- Define potential spawning areas using site-specific HSC preference for chum spawning
- Define spawning periodicity based on 1980's and 2012/2013 data
- Proportion chum spawning run within the spawning period:
 - ✓ August 1 – 23 = 10% of the run
 - ✓ August 24 – September 21 = 80% of the run
 - ✓ September 22 – October 15 = 10% of the run
- Presence of groundwater upwelling using 2012/2013 TIR mapping, open leads, and positive VHG measurements



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Incubation Period (phases)

Define phases of chum incubation: egg/embryo, alevin, and emergence

- Egg and alevin phase have different sensitivities to water temperature, dissolved oxygen, dewatering, and freezing
- Number of days to achieve each phase is driven by **intragravel** water temperature and accumulated thermal units (ATU)

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Incubation Period (dewatering)

Spawning areas with and without upwelling:

- With upwelling: No mortality due to dewatering
- Without upwelling: if dewatered >48-hrs during egg phase then lose spawning area; if dewatered >1-hr during alevin phase then lose spawning area

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Incubation Period (freezing)

Spawning areas with and without upwelling:

- With upwelling: No mortality due to egg freezing
- Without upwelling: if spawning area dewatered and air temp. <0 c for >24 -hrs during egg phase, then lose spawning area

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Incubation Period (breaching flows)

Off-Channel Spawning areas with upwelling:

- If cold surface water (<1 c) is forced into the intragravel environment during egg phase for >48-hrs, then lose spawning area

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Incubation Period (redd scour)

All Spawning areas:

- If spawning area experiences scour during any phase of incubation, then spawning area is lost

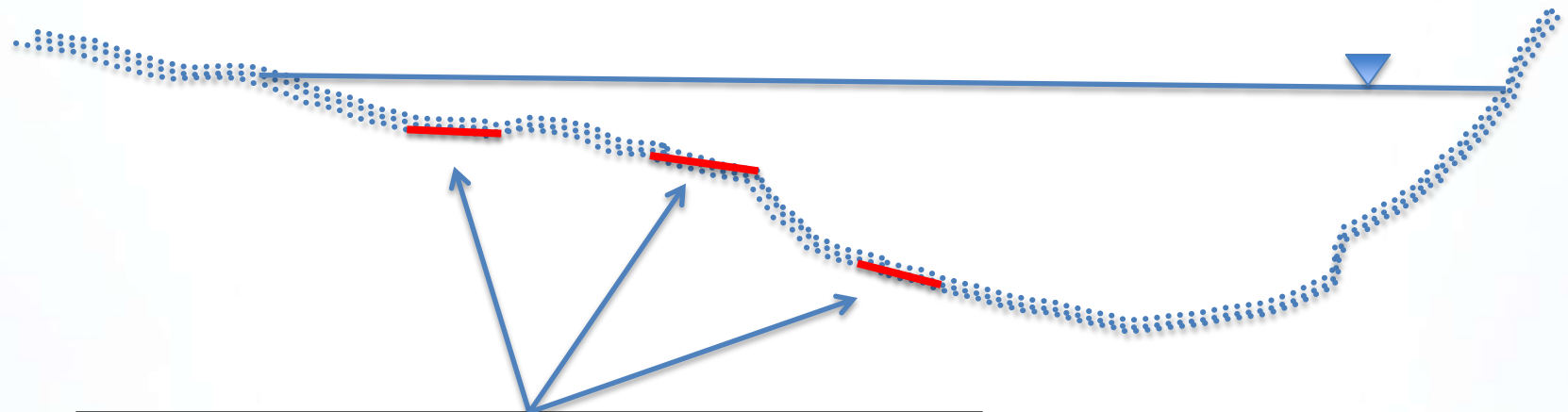
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Incubation Period (Dissolved Oxygen)

All Spawning areas:

- If intragravel D.O. falls below 3 mg/l for >48-hrs during the egg phase, then spawning area is lost

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Potential Spawning and Incubation Areas

- Suitable depth, substrate, and upwelling

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