Mining and Fish

Can't we all just get along?

Presentation to RDC Breakfast Meeting
May 5, 2011

PacRim Coal, LP
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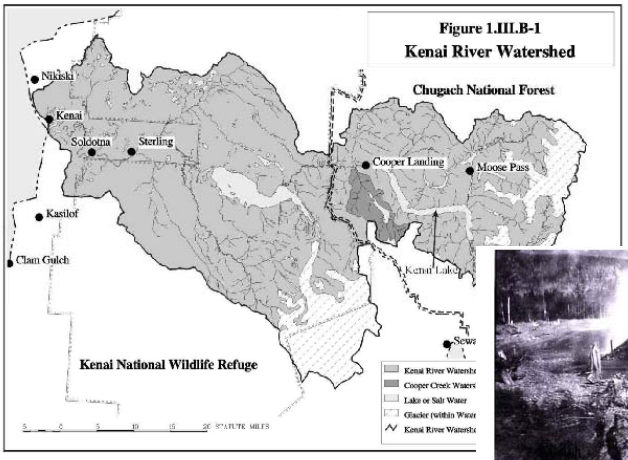
Historic Examples of Mining in and around Fish habitat in Alaska

1890's to present

Cooper Creek, Kenai River Drainage



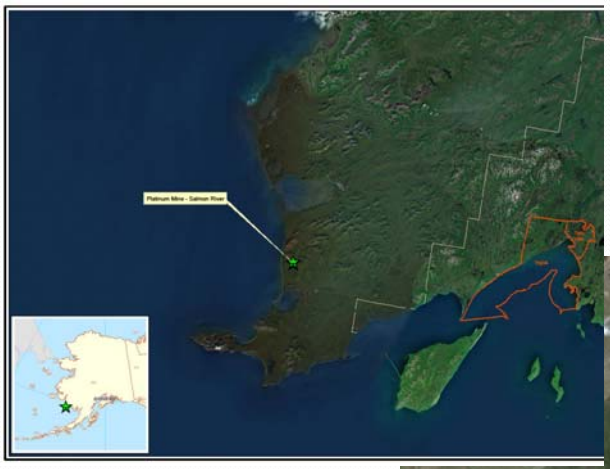
Gold discovery reported by Joseph Cooper in 1884

Hand and hydraulic mining from 1894 to 1917, 1930's and 1950's

Hydraulic Mining on Cooper Creek by Kenai Milling and Mining Co., circa 1910
(Photo Courtesy Mona Painter)

Recreational mining allowed since 1980

Salmon River, Goodnews Bay Area



Mining began in 1926 with draglines

Dredge operations operated by Goodnews Bay Mining Co. from 1937 to 1975

In excess of 7 miles of stream mined through, including headwaters

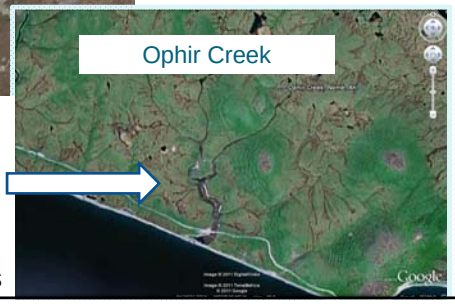
Still populated by salmon (ADF&G Anadromous Stream Catalogue)

Nome Area

Mined from 1898 through to today

Mid-1990's, efforts started to restore salmon habitat

Coho salmon population growing as a result of recent efforts



Mined extensively via 3 dredges over 2 miles of stream

Wild coho stocks are thriving in pools left behind by dredges

Middle Fork Red Dog Creek

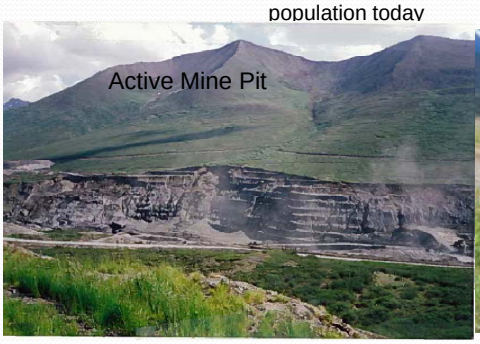
Before Mining →

After Mining →

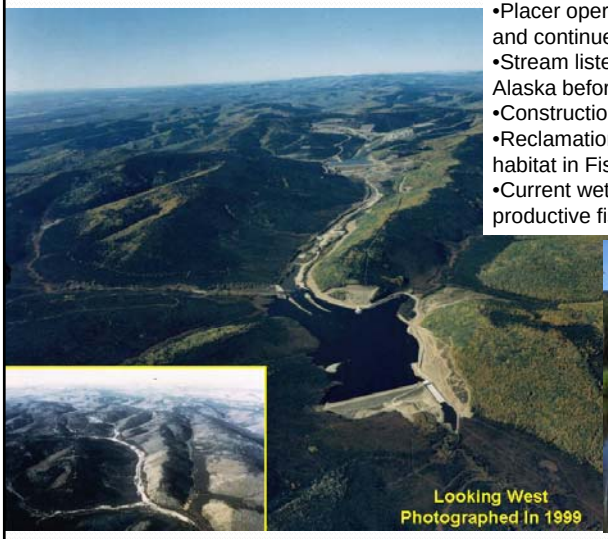
- Red Dog Mine constructed in 1980's
- Stream had limited fish activity pre-mining due to natural elevated metals
- By mid-1990's, ADF&G documented increased fish usage of local streams below mine
- Periphyton and Invertebrate communities now present (were absent before mining)

Valdez Creek, Denali Highway

- Operations dating back to early 1900's
- Early 1990's mine targeted a deposit 180 feet below a 2 mile stretch of the main channel of Valdez Creek.
- Operation encompassed an pit 2 miles long, up to 1200 feet wide and 180-280 feet deep
- Reclamation included sequencing pit backfill to support the reconstructed creek channel on top of backfill
- New channel and final lake pit is home to a healthy fish population today



Fish Creek, Ft. Knox Mine



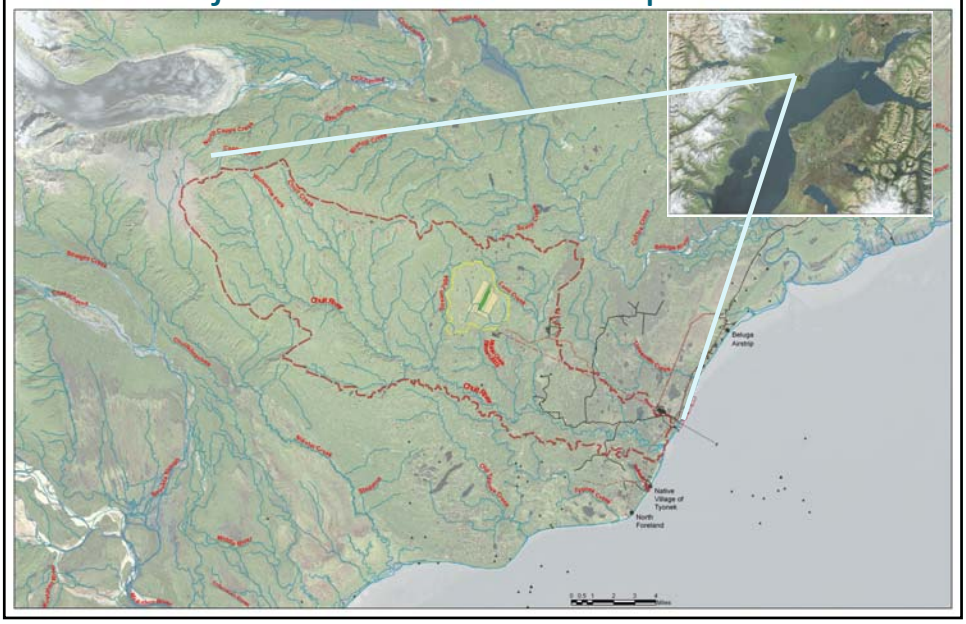
- Placer operations dating back to early 1900's and continued on and off through 1995
- Stream listed as impaired by EPA and State of Alaska before Ft. Knox construction began
- Construction of Ft. Knox mine began in 1995
- Reclamation goal included improving fish habitat in Fish Creek below mine
- Current wetlands below mine are highly productive fish habitat

Chuitna Coal Project

Key Considerations for Fish Populations

(Under environmental review process since 2006 and counting)

Project Location and Components

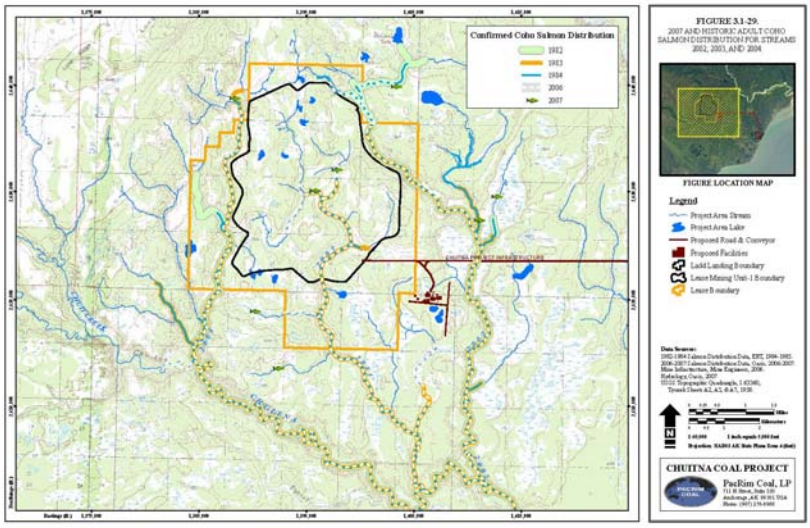


Water Management and Fresh Water Fish Protection Measures

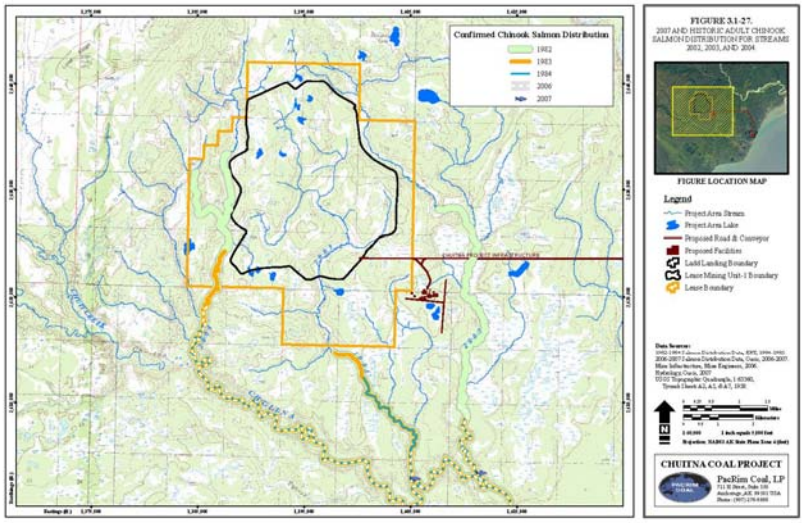
Key to this has been:

1. **Additional Baseline work** for generating added detail to fish species and abundance estimates in tributaries around project and improve understanding of area hydrology and hydrogeology
2. **Generate water management plan** that can address maintaining historic flows and quality to stream below and adjacent to mine site
3. **Identify case studies** of mitigations measures tested and employed around the northern Pacific, especially Alaska, British Columbia and Pacific Northwest
4. **Design mitigation measures** to be employed (in progress)
5. **Reclamation plan** that reconstructs streams in the mine area for future fish habitat

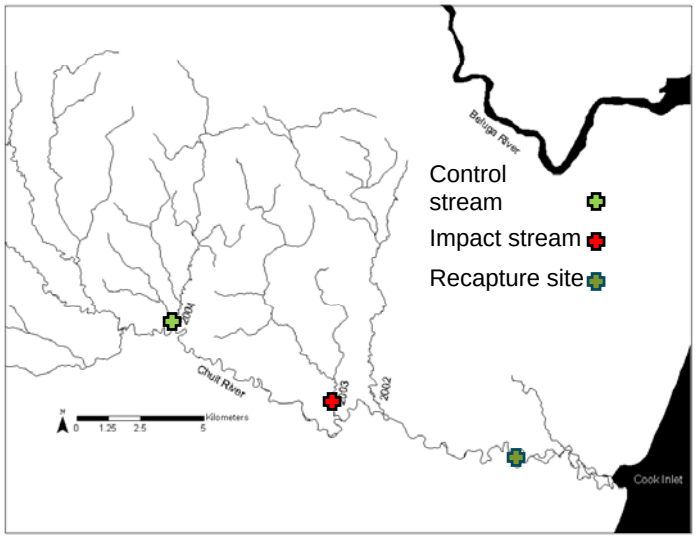
Adult Coho Salmon Distribution



Adult Chinook Salmon Distribution



Chuit River system – fish sampling locations (for abundance estimates)



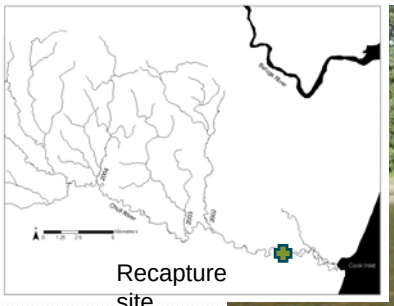
Stream 2003 Weir

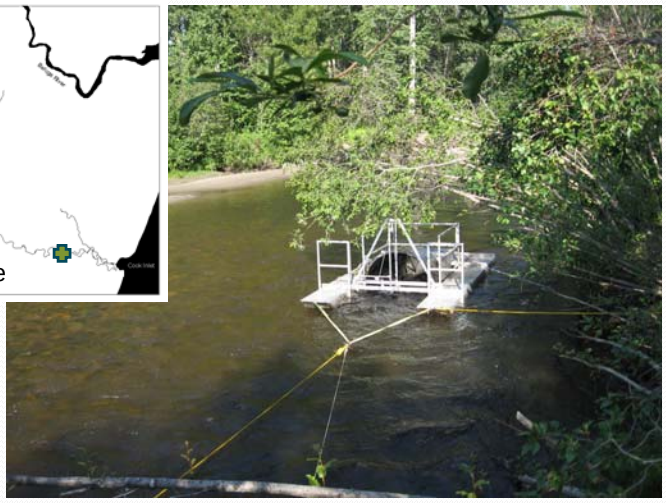
Stream 2003 Weir

Weir necks down to a funnel that traps fish in a live box until sampled

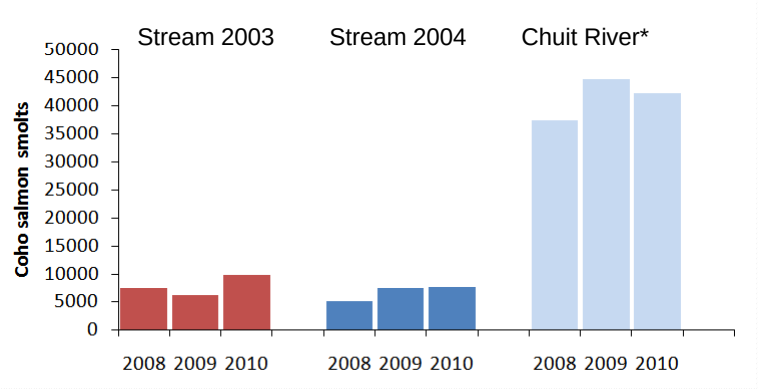
Video chute operates 24/7 to monitor any upstream migrants, or smolts that avoid the live box

Smolts were recaptured downstream in the Chuit river using rotary screw traps





Smolt Count Results



*Overall Chuit River smolt outmigration includes only that portion of the system above the Tyonek Bridge at River Mile 3.7

Water Management
Sources of Water from Mining Area

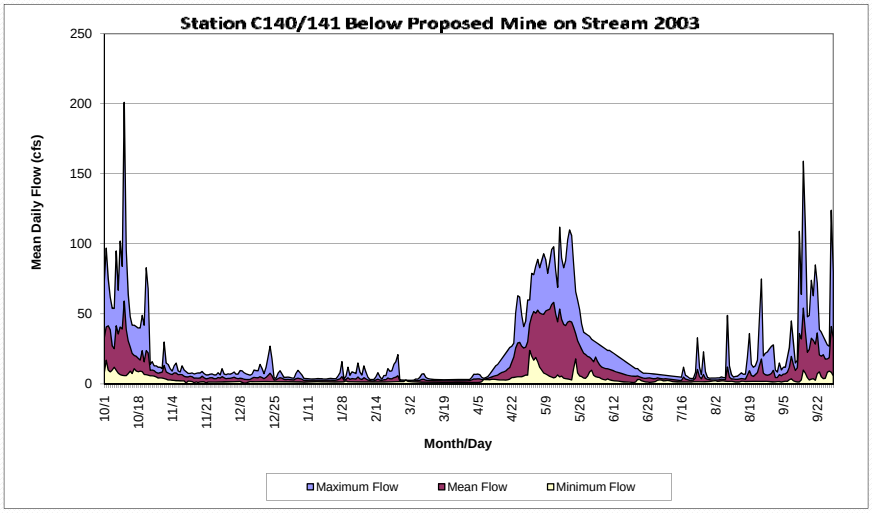
- Precipitation and Runoff
  - Rainfall (Stormwater)
  - Snowmelt
- Groundwater
  - Dewatering of gravels above coal formation
  - Reduce Hydrostatic Head in Sub Red 1 Sand Formation
- There is **no processing** of the coal needed for this project. It will be excavated, crushed and shipped to the port.

KEY POINT: The sources of water released from the mine site will consist of rainfall, snowmelt and groundwater – period!

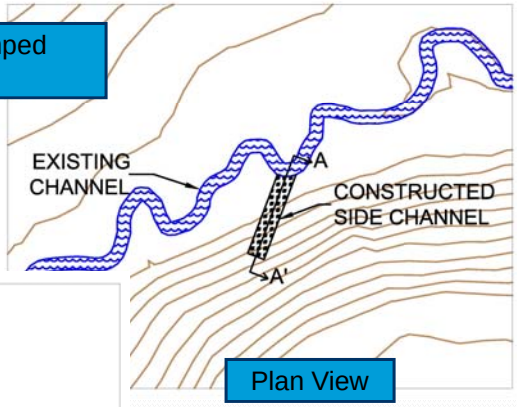
Water Management
Goals of Water Management Plan

- Maintain historic **baseflow levels** in below mine area and in adjacent tributaries
- Design **peak discharge** outflows from mine area to be at or below historic peak flow levels
- **Quality of discharge** water to meet APDES permit limits with existing water quality considered

Flow Targets for Discharge

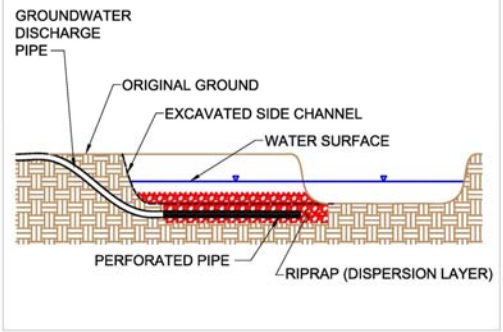


Outfall Structure for Pumped Groundwater

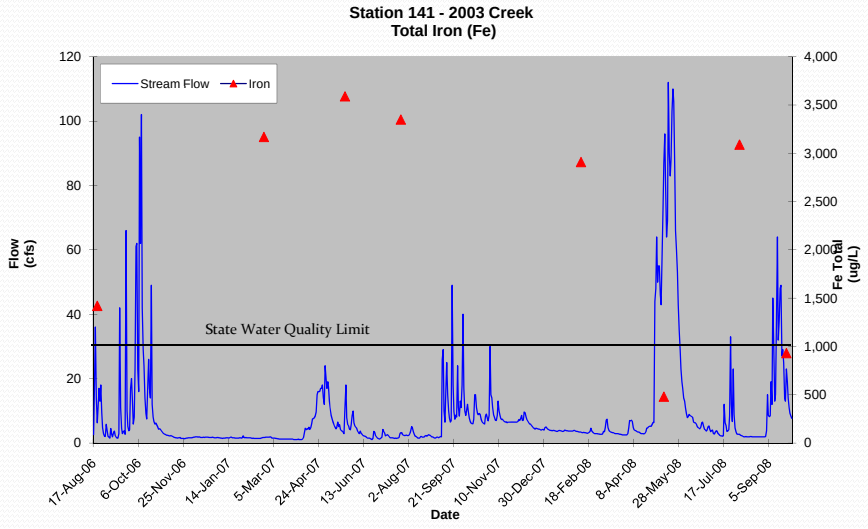


Plan View

Side View



Water Quality – Existing Quality



Proposed Fish Protection
Creation of Habitat and Habitat Reconstruction

- **<u>During Mining</u>**
  - Create side channel habitat below mine area (rearing and spawning)
  - Nutrient Addition
  - Monitor and Adjust as needed
  - Alternative plan options (ARED)
- **<u>After Mining</u>**
  - Reconstruct channel in reclaimed mine area
  - Leave mitigation channels below mine area
  - Leave sedimentation ponds as lake feature
- There will be **more** habitat after mining than exists before mining

Examples of Habitat Creation from Material Site

Example of a constructed side channel (Illabot groundwater channel, Skagit River, WA)

Potential Material Sites or Rearing Ponds

Nutritient Addition

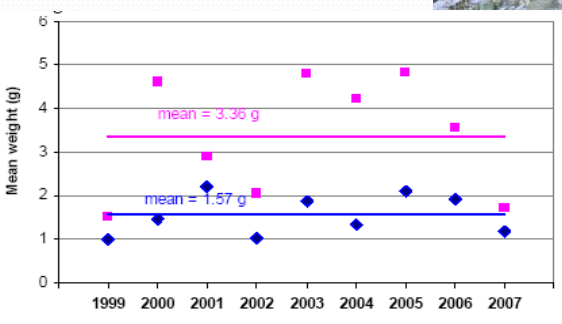


Figure 22. Mean weights of steelhead/rainbow fry captured in the upper two sites in Grilse Creek from 1999 to 2007.

Salmon Carcass Analog

Revillagigedo Island, Southeast Alaska
Year: 2002
(Only option that provides direct food source For juveniles)

Pink salmon analogs were added to channels on Revillagigedo Island, southeast Alaska in five treatments. Each treatment differed in pink salmon carcass concentration (0-4 carcasses/m²). Each channel was then stocked with age-0 coho salmon to document if there was an increase in growth rates from carcass additions.

RESULTS
Results indicated that the coho significantly increased in size and weight; however, incremental increases sharply diminished at carcass-loading levels above 1 carcass/m². Cutthroat trout and Dolly Varden grew significantly faster during the period when carcasses were added to the system compared to the control reaches.

Source: Wipfli, M.S., J.P. Hudson, J.P. Caouette, and D. T. Chaloner. 2002. Marine Subsidies in Freshwater Ecosystems: Salmon Carcasses Increase the Growth Rates of Stream-Resident Salmonids. Trans. Am. Fish. Soc: Vol.132. No.2, pp.371-381.

ARED System

Alaska Resource & Economic Development, Inc
730 Case Ave., Ste., 3; PO Box 559; Wrangell, AK 99929

Developed and distributed by Brian Ashton (Wrangell, Alaska)

Has been employed in Alaska streams (Anvil Creek near Nome, Moose Creek near Sutton)

ARED System

Key Premise – designed to use existing wild salmon stock in a stream to enhance system fish population by improving survival of the early life stages

Sample of Calculation and how gains are made:

Normal Salmon spawning success rate: 5-10%
Survival of eggs to fry stage – 5-30%
Fry to Smolt survival rate – 10-20%
Smolt to Adult Return rate – 10-30%

ARED concentrates on the initial stages:

- increase spawning success rate to near 100% and;
- egg to fry survival to up to 80%

Conclusion: Only need small portion of the natural returning population to sustain and boost population

Mine Reclamation

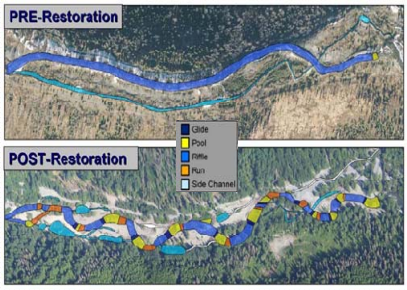
Hydrologic Considerations of Reclamation

Active pit mining through multiple sedimentary layers

Reclaimed mine area:

- backfill returned in layers
- Near-surface layers support reconstructed stream channel

Post-Mine Channel Reconstruction



Sample Meander Construction

*The Chuitna Coal Project is not a choice between a coal mine **or** fish –*

It is designed for BOTH

Mining and Fish CAN get along!!