



Red Devil Mine, June 1960

Red Devil Mine



Northern Latitudes Mining Reclamation
Workshop
May 11-12, 2011

Red Devil Mine Discussion Topics

- Regional Setting and Brief History of the Mine
- Red Devil Mine Remedial Investigation
 - Geology
 - Geophysical Survey
 - Technical Approach
 - Current Results/Additional Sampling
- Fish Tissue Study
- CERCLA Process and Project Timeline

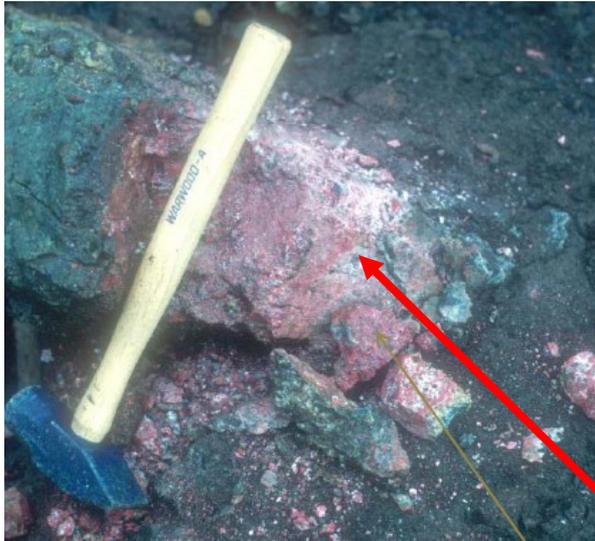
Regional setting

Mercury and the Kuskokwim River

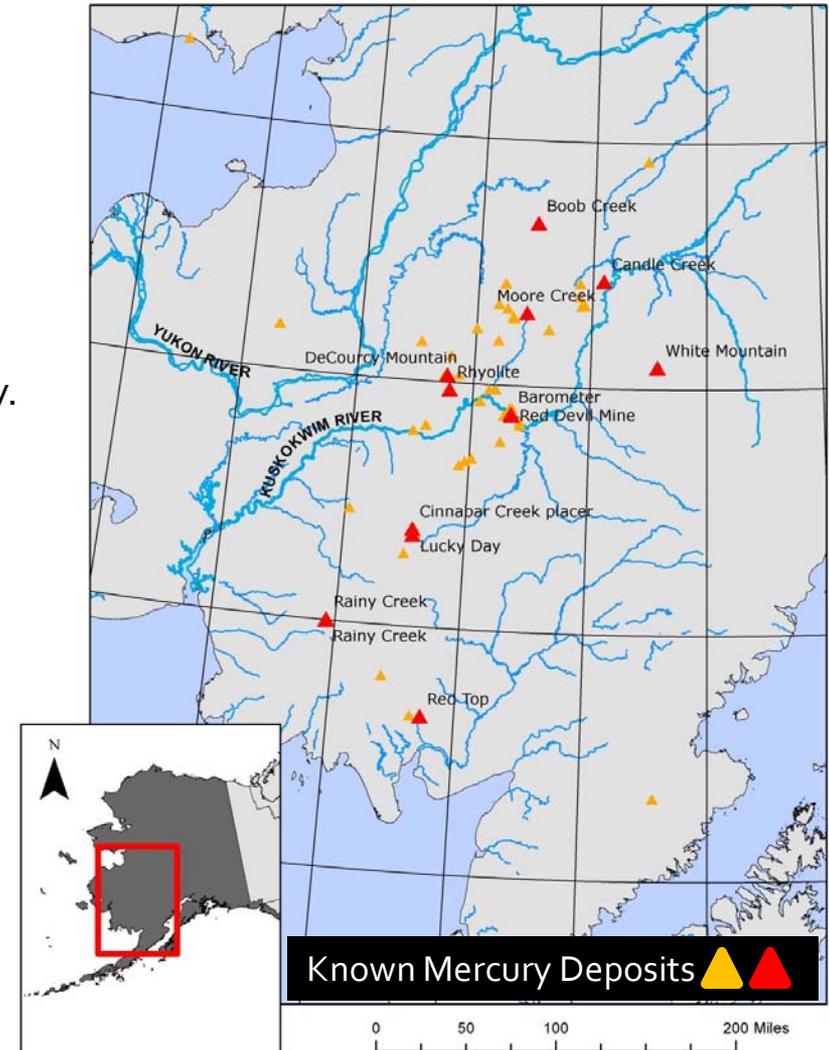
Approximately 1,400 tons of mercury have been produced from the region, which is ~99% of all mercury produced from Alaska.

Red Devil Mine produced nearly 87% of all mercury produced from Alaska.

Cinnabar is the principle ore mineral containing mercury.



Cinnabar



Red Devil Mine History

Red Devil Mine 1943



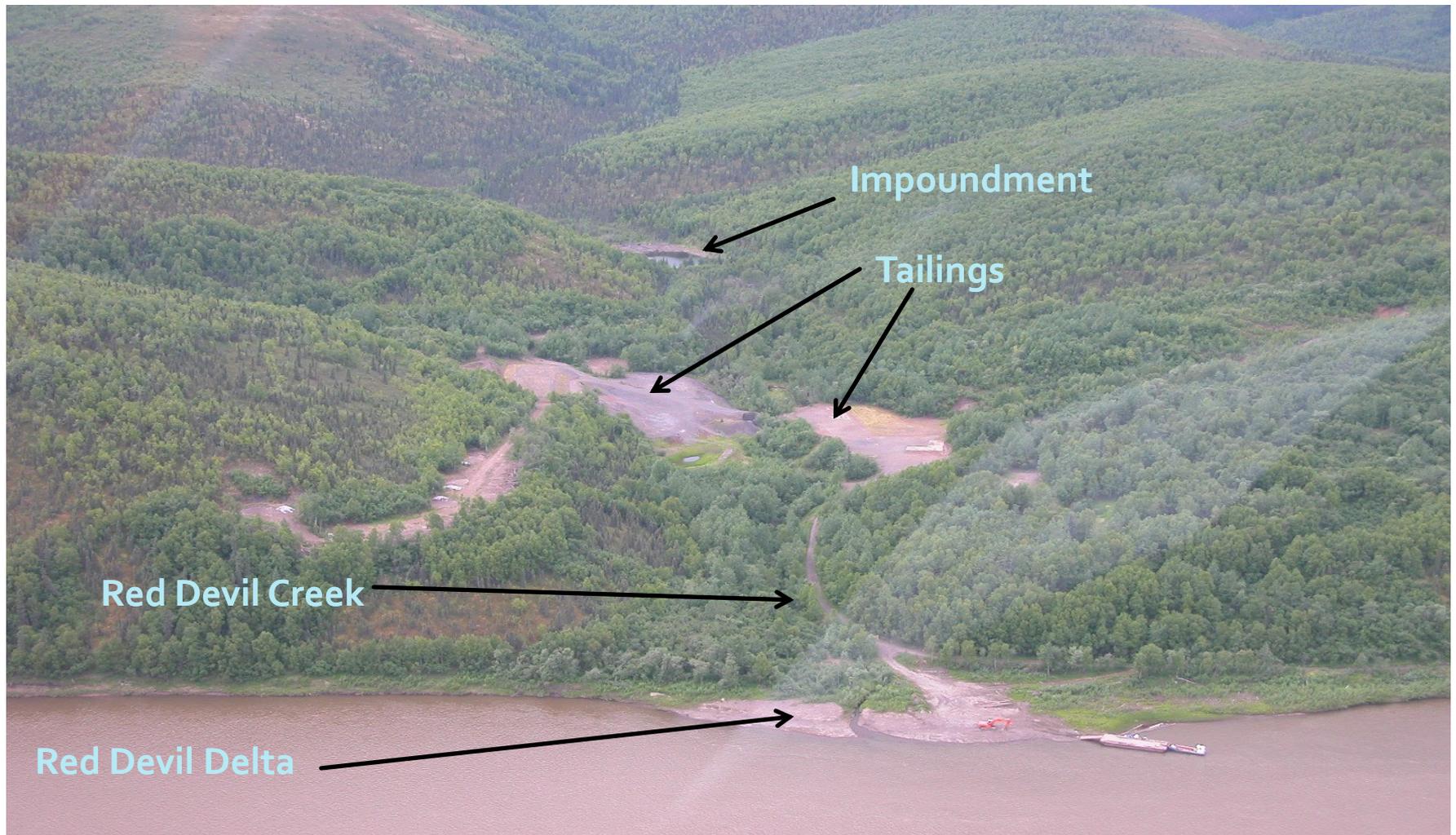
1943 Early Mine

1971 Mine Closes



Red Devil Mine 1974

Red Devil Mine Current View



Red Devil Mine Local Geology



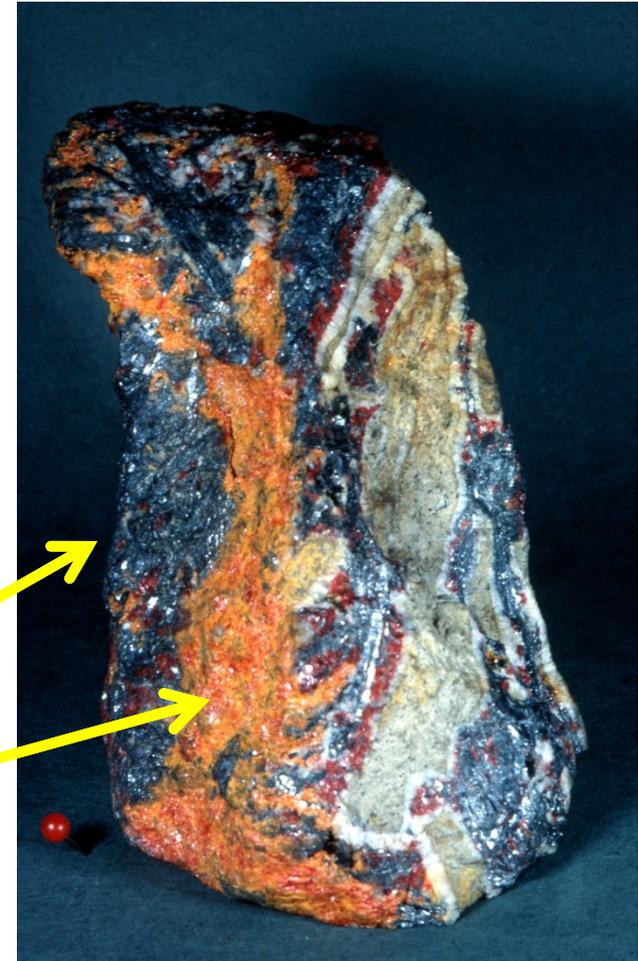
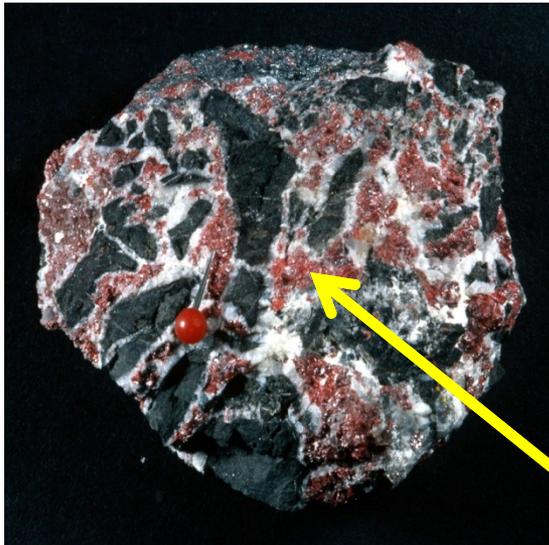
- Cretaceous Kuskokwim Group
- Interbedded greywacke and shale with variable dip between 45 and 55 degrees southwest
- Locally overlain by loess (up to 30 feet thick) and alluvium (up to 20 feet thick)
- Dominant faults strike northwest

Red Devil Mine Ore Deposits

Ore Minerals

- Hydrothermally developed as a result of the northwest-trending faulting
- Mineralized veins are mostly small and discontinuous
- Principal metallic minerals are:

Cinnabar (HgS)
Stibnite (Sb_2S_3) with
Realgar (As_4S_4),
Orpiment (As_2S_3),
Pyrite (FeS_2)



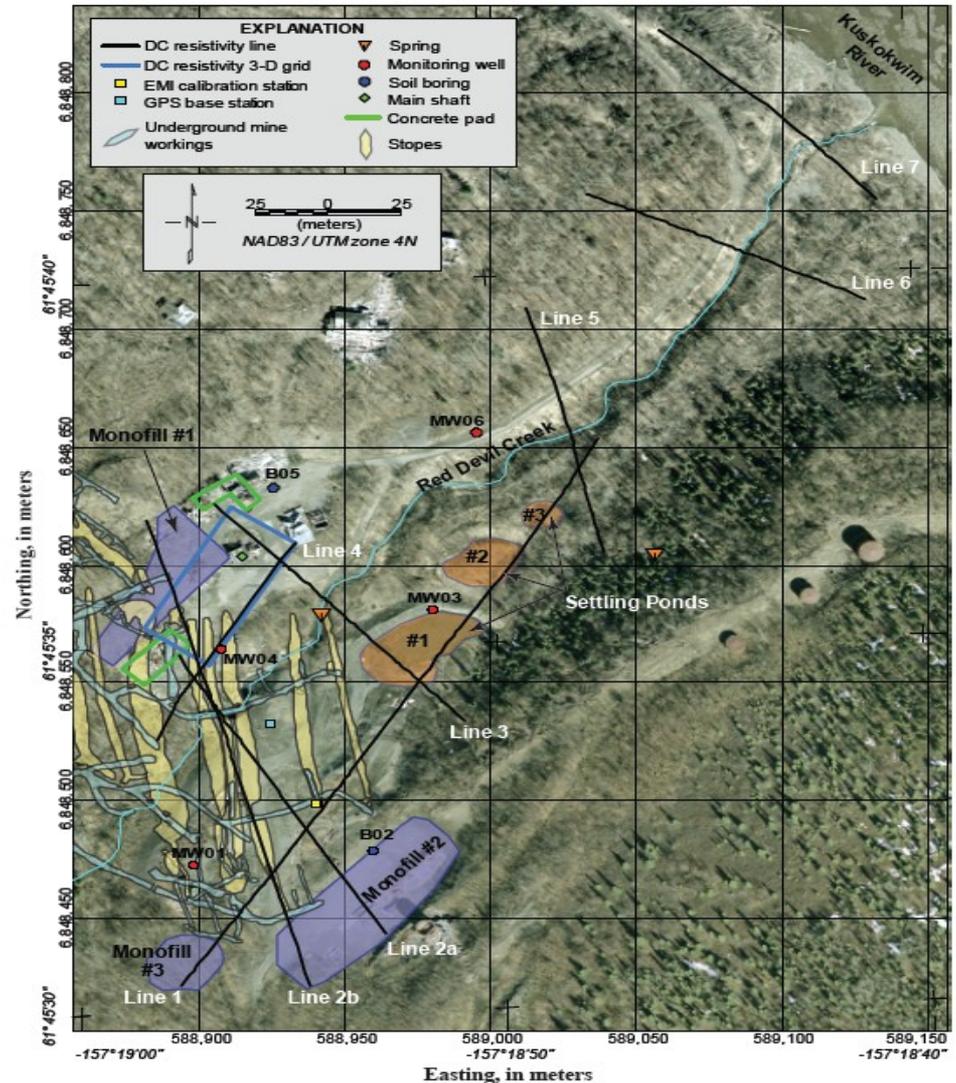
Red Devil Mine Geophysical Survey

Direct-current resistivity and electromagnetic induction

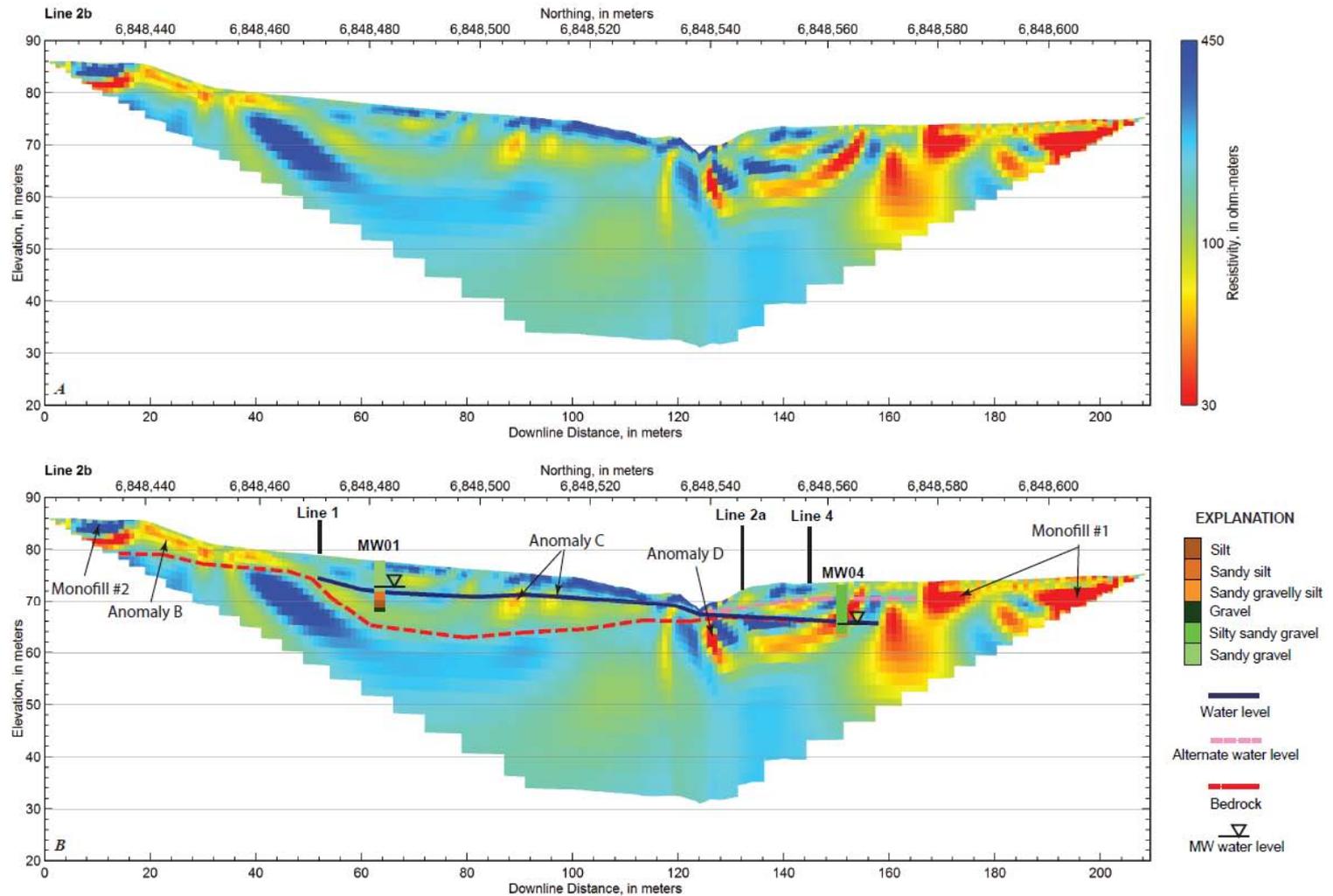
- Objectives:
 1. Top of bedrock
 2. Depth to groundwater
 3. Subsurface features that may influence groundwater

Underground workings

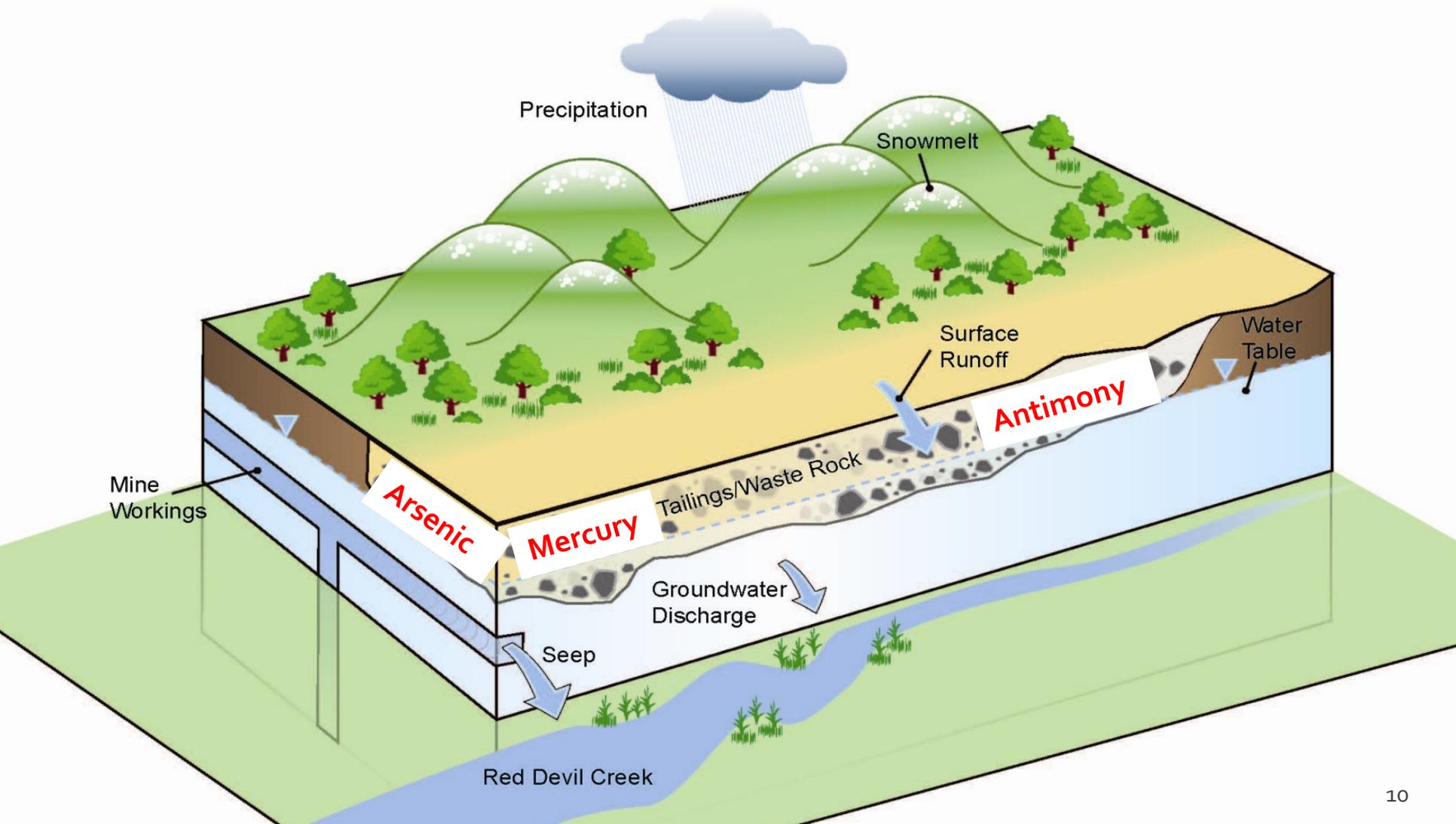
- High angle shafts
- Horizontal tunnels
- High angle stopes, predominantly trending NNW
- Workings south of RDC are the most recent and deepest



Red Devil Mine Geophysical Survey



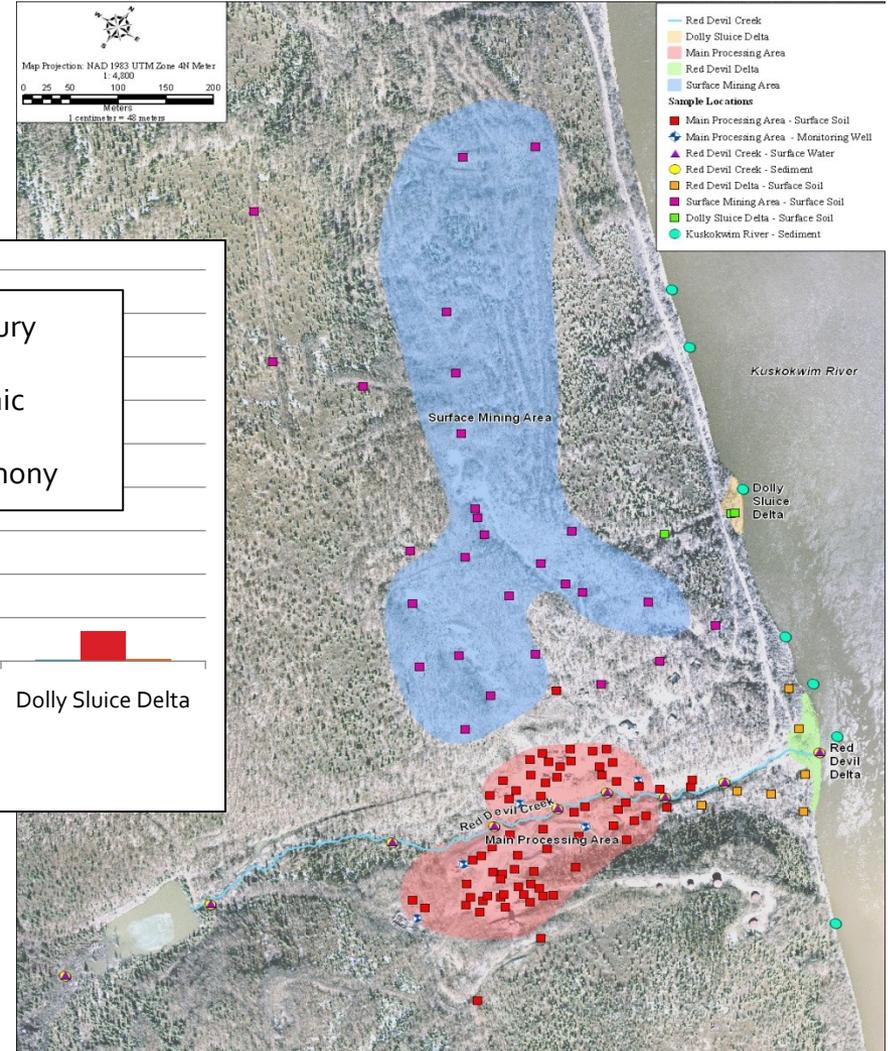
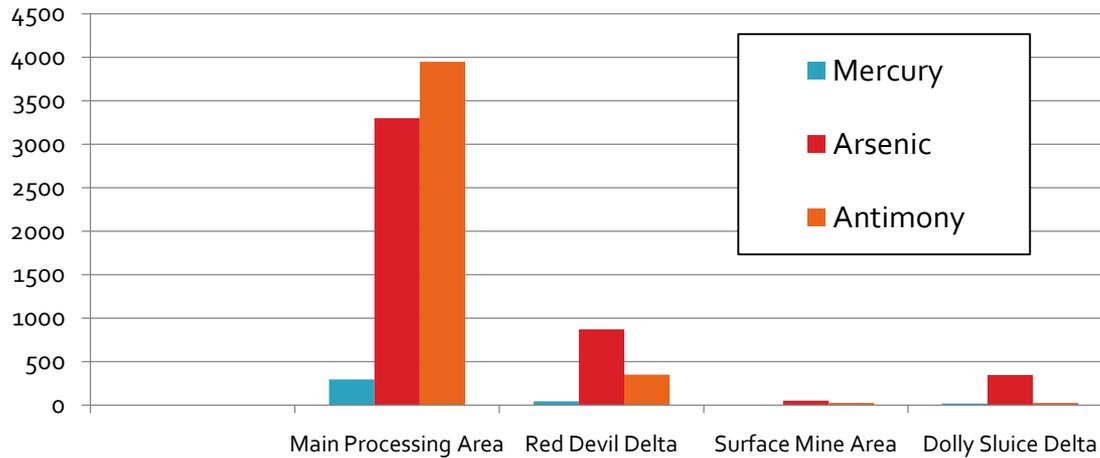
Red Devil Mine Remedial Investigation Technical Approach



Red Devil Mine Remedial Investigation

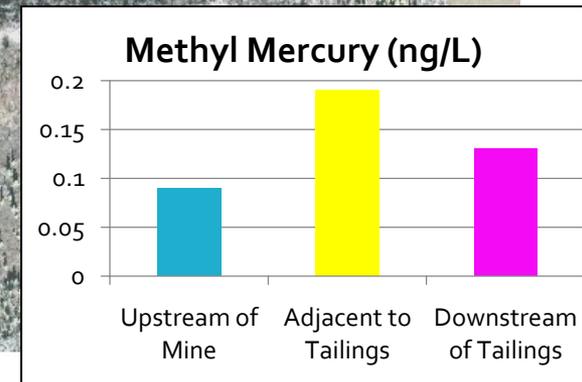
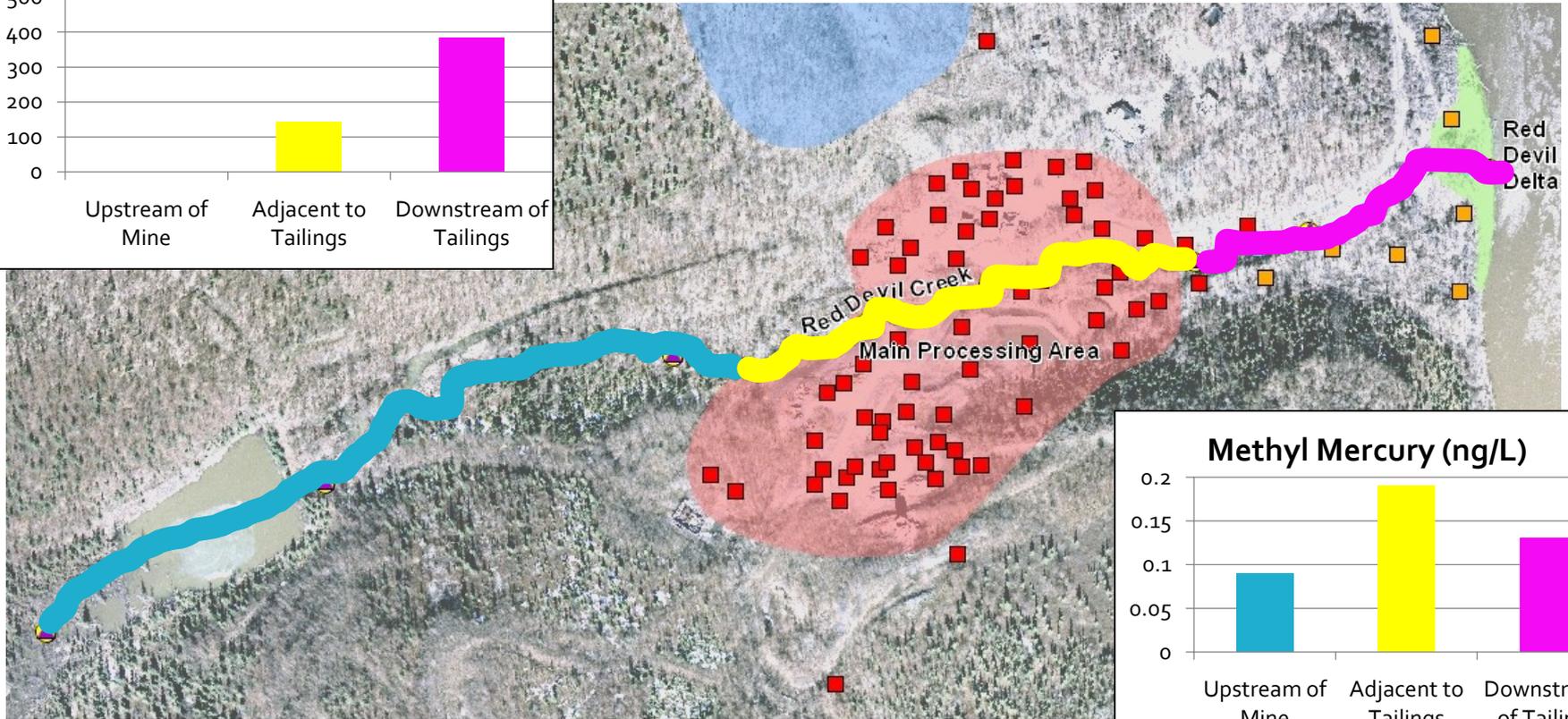
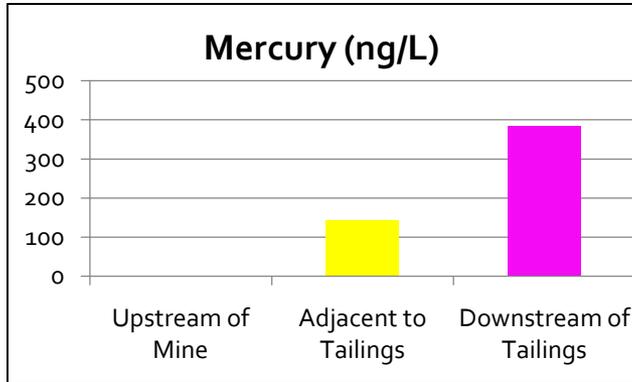
Sept 2010 Surface Samples

Contaminant Concentrations (mg/kg)

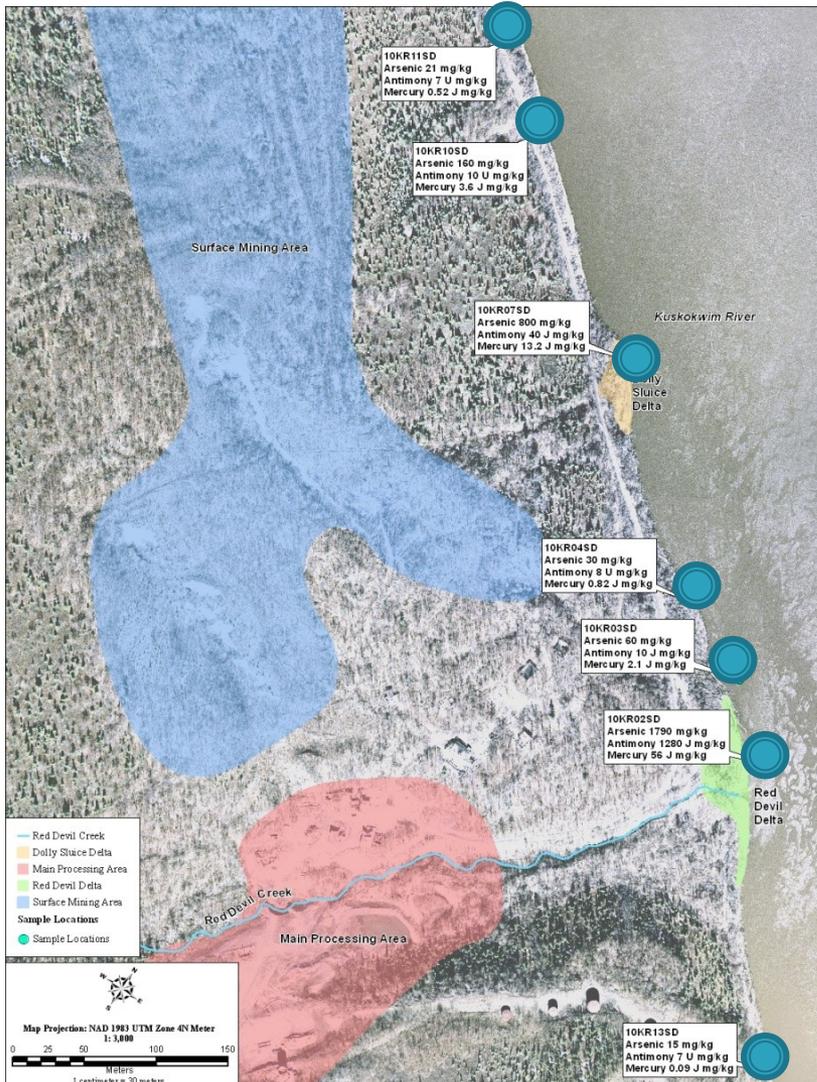


Red Devil Mine Remedial Investigation

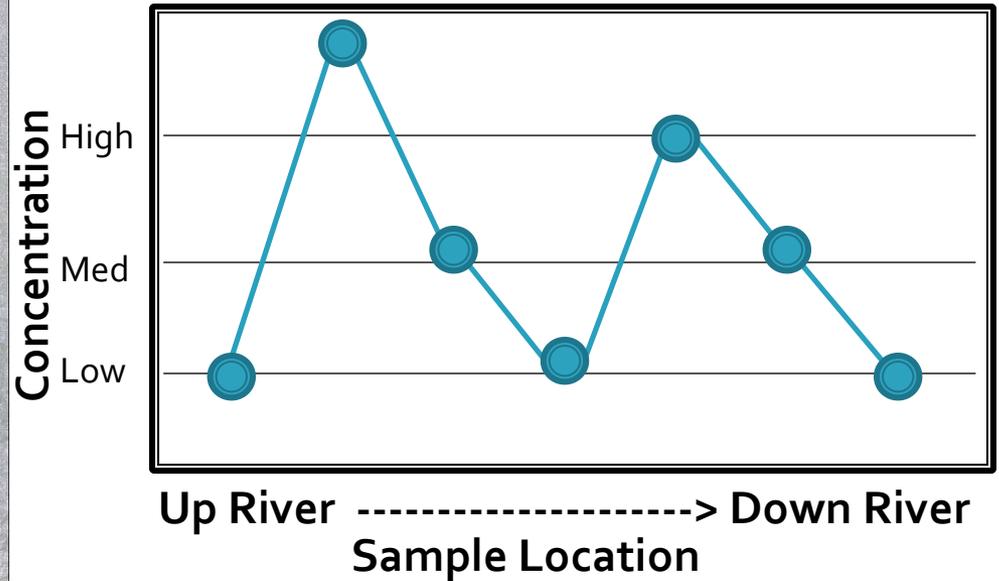
Sept 2010 Red Devil Creek



Red Devil Mine Remedial Investigation Existing Data/ 2010 Sampling Event

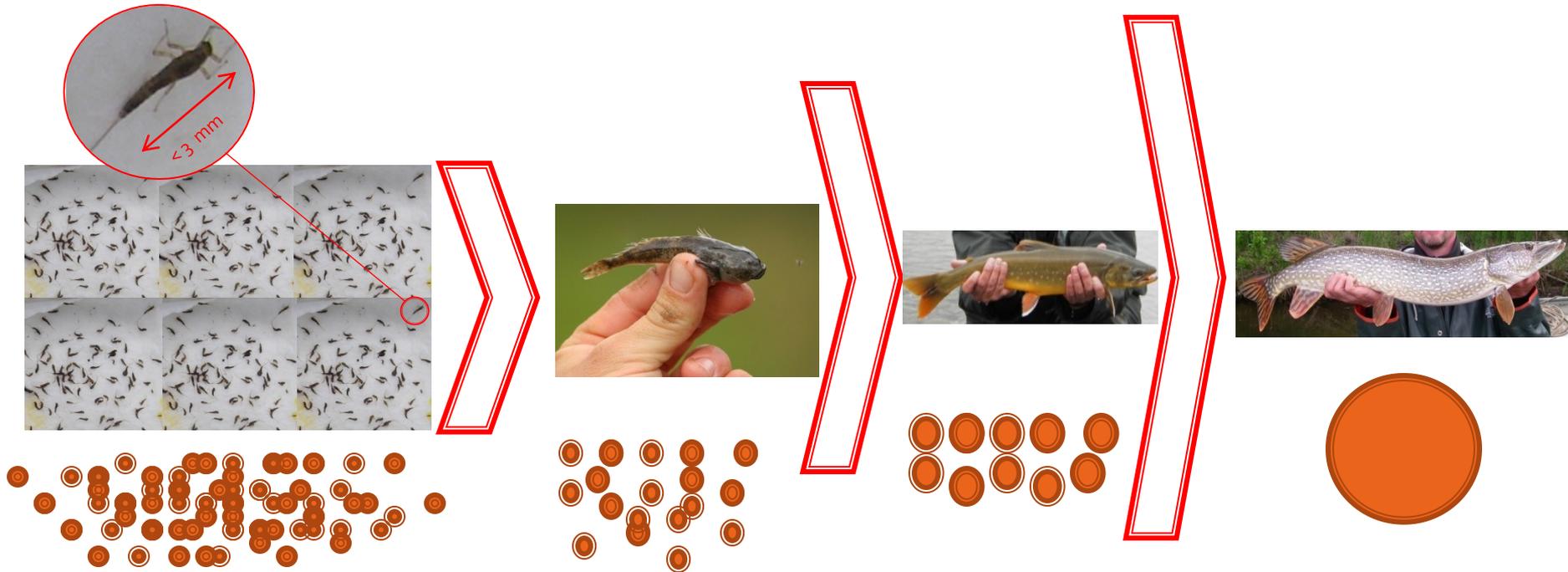


Mercury – Arsenic - Antimony



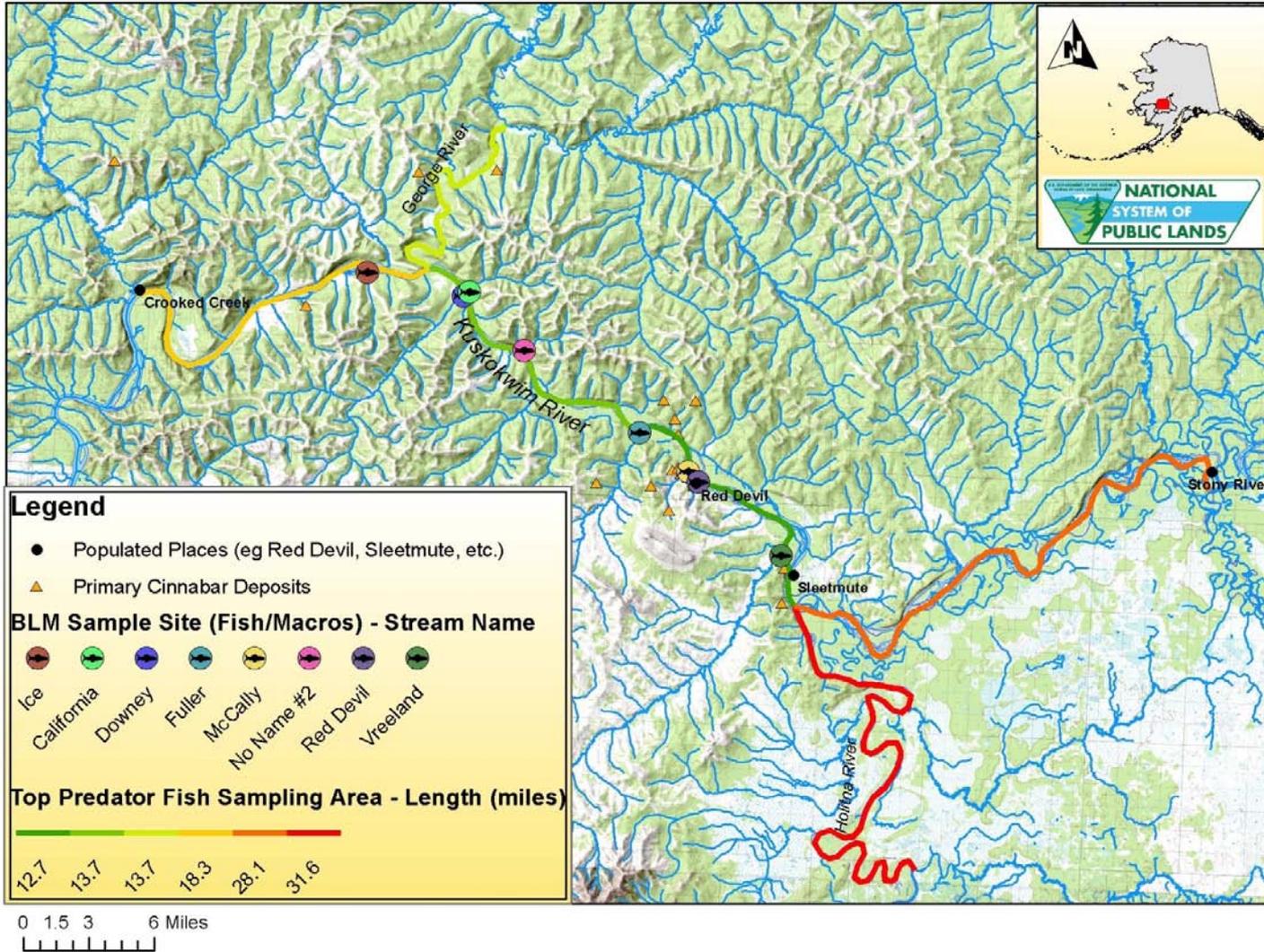
Fish Tissue Study

Methylmercury - Why we are looking at fish and bugs?



- Methylmercury most often results from microbial activity in wetlands, the water column, and sediments, and it is the form of mercury that presents the greatest environmental risks to human health (EPA 2001).
- Methylmercury is retained in fish tissue and is the only form of mercury that biomagnifies in aquatic food webs (Kidd et al. 1995).

Fish Sampling Areas and Locations



Fish Samples and Analyses

Fish Collected for Metals Analysis (June & October)

- Kuskokwim River: 68 Burbot/ 86 Pike/ 21 Sheefish/ 7 Dollies/ 16 Grayling
- Holitna River: 2 Burbot/ 36 Pike/ 12 Sheefish
- George River: 16 Burbot/ 17 Pike/ 7 Sheefish/ 7 Grayling

Analyzed muscle and liver tissue for 19 metals on all the fish submitted.

- Aluminum, Arsenic, Boron, Barium, Beryllium, Cadmium, Chromium, Copper, Iron, Mercury, Magnesium, Manganese, Molybdenum, Nickel, Lead, Selenium, Strontium, Vanadium, and Zinc.

Red Devil Mine CERCLA Process and Project Timeline

Years 2010 and beyond

2010 2011 2012 2013 2014 2015 2016 2017

RI/FS

Proposed
Plan/ROD

Remedial
Action

Long Term
Monitoring

Fish
Tissue
Sampling

Fish
Telemetry