

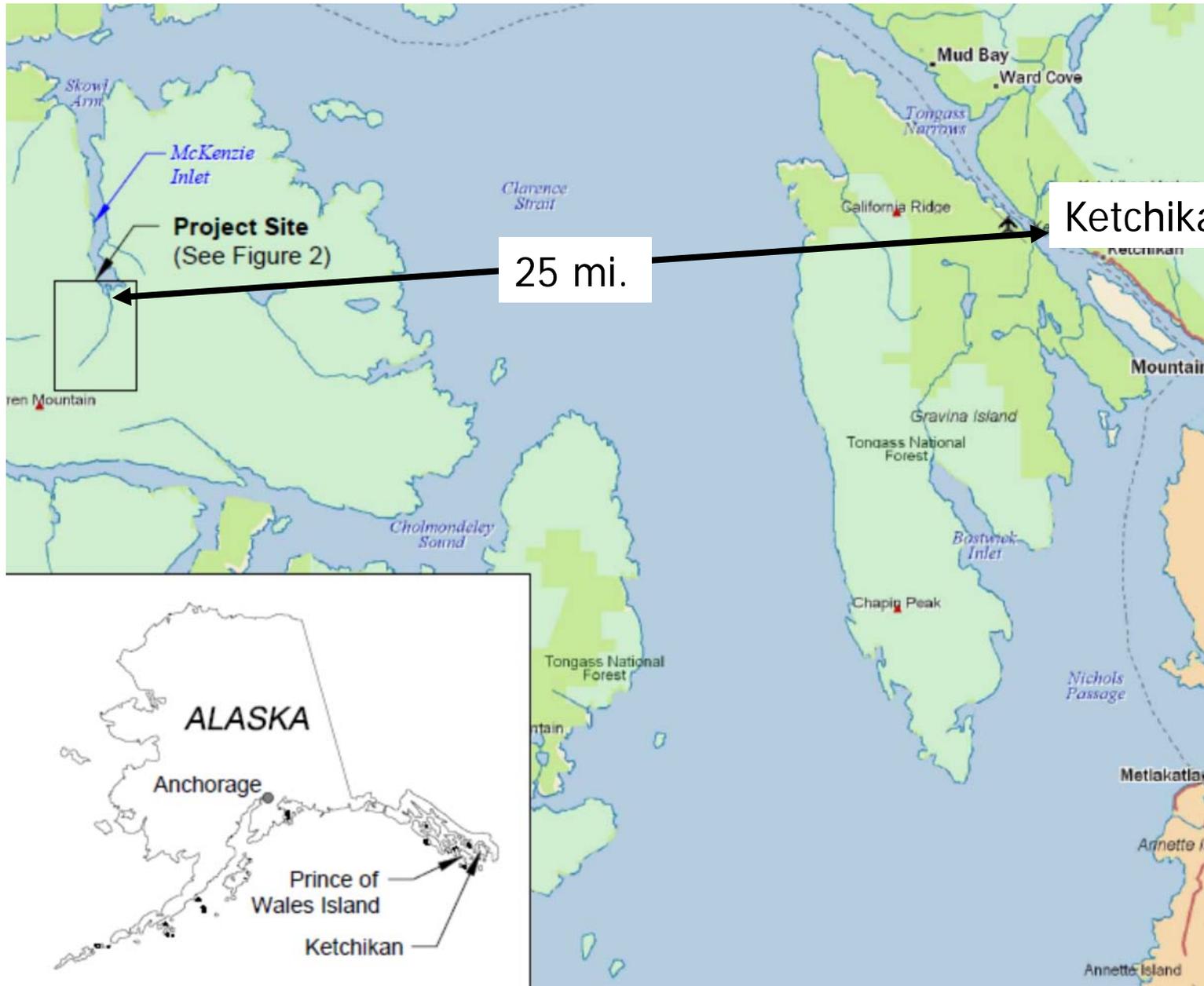
Khayyam Mine EE/CA: Investigation Challenges and Risk-Based Justification for No- Action Response Prince of Wales Island, Alaska

By John Bingham, PE

Is No Action Ever a Cleanup Action?

Summary

- Site Background & Mine History
- Project Background, Goals, & Approach
- Site Investigation Findings
- Engineering evaluation & cost analysis (EE/CA) remedial alternatives
- CERLA comparison → Does No Action protect environment?



Vicinity Map

Site Background

- Remote site in Tongass National Forest
- Climate:
 - Avg. annual precip./snow ~105"/~45"
 - Avg. summer/winter temps. ~45-65°F/~27-42°F
- Ecology:
 - Mature/sensitive habitat: alpine, muskeg/bog, forest, wetland, riparian, & aquatic
 - Salmon in lower Omar Ck, not upper (falls)
- Geology: Mineralized zones Fe & Cu sulfides in host rock
- Hydrology: Omar Ck glacial basin with steep slopes



Hollis

Kasaan

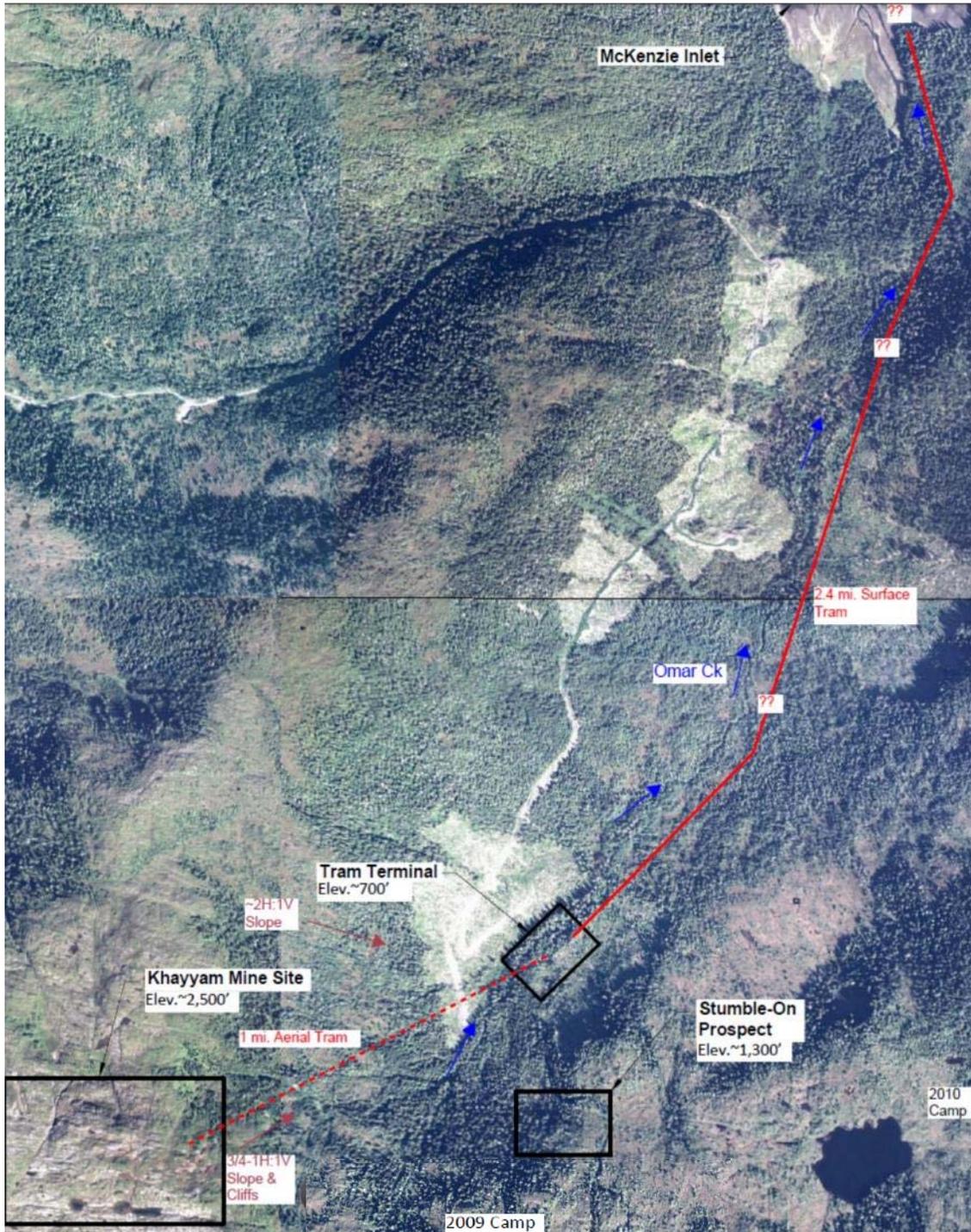
48 mi from
Hollis (140
people) on
ditched,
overgrown
logging road &
steep hike

National Forest
Development Road 2150

4 Mi

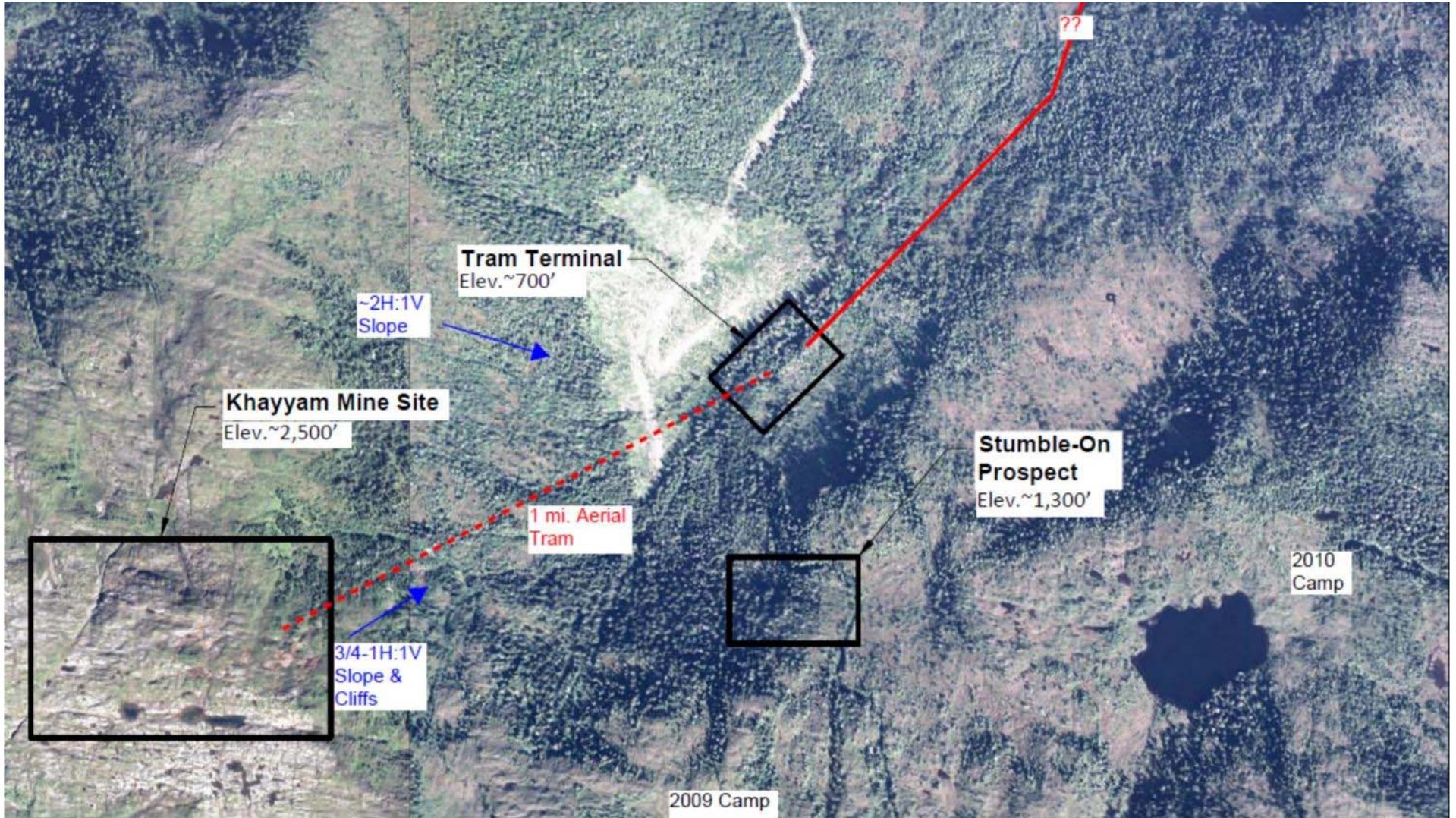
Vicinity Map





Site Map

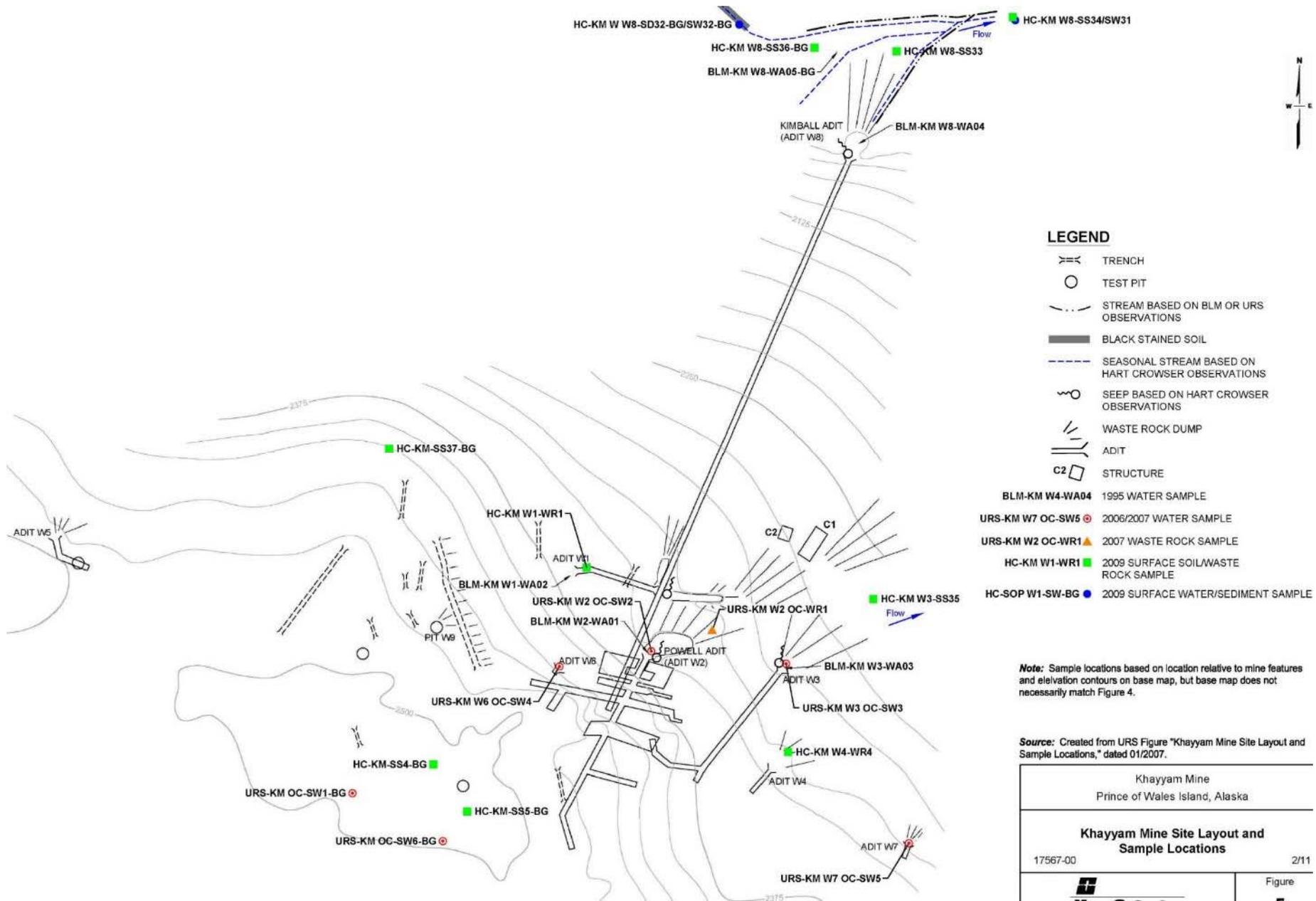




Site Map – Close Up

Mine History

- Found 1899, operated 1901- 1907
- 4,100 tons of Cu, Ag, Au ore mined, transported by tram to shipping terminal
- 3 Current Mine Areas:
 - Khayyam Mine: 8 adits, AMD, waste rock (WR) piles, exploration trenches
 - Stumble-On Prospect: 4 adits, WR, acid mine drainage (AMD)/‘black’ stained soil
 - Tram Terminal: by Omar Ck, ore piles, ‘black’ stained soil in a depression



Khayyam Mine Site



Khayyam Mine



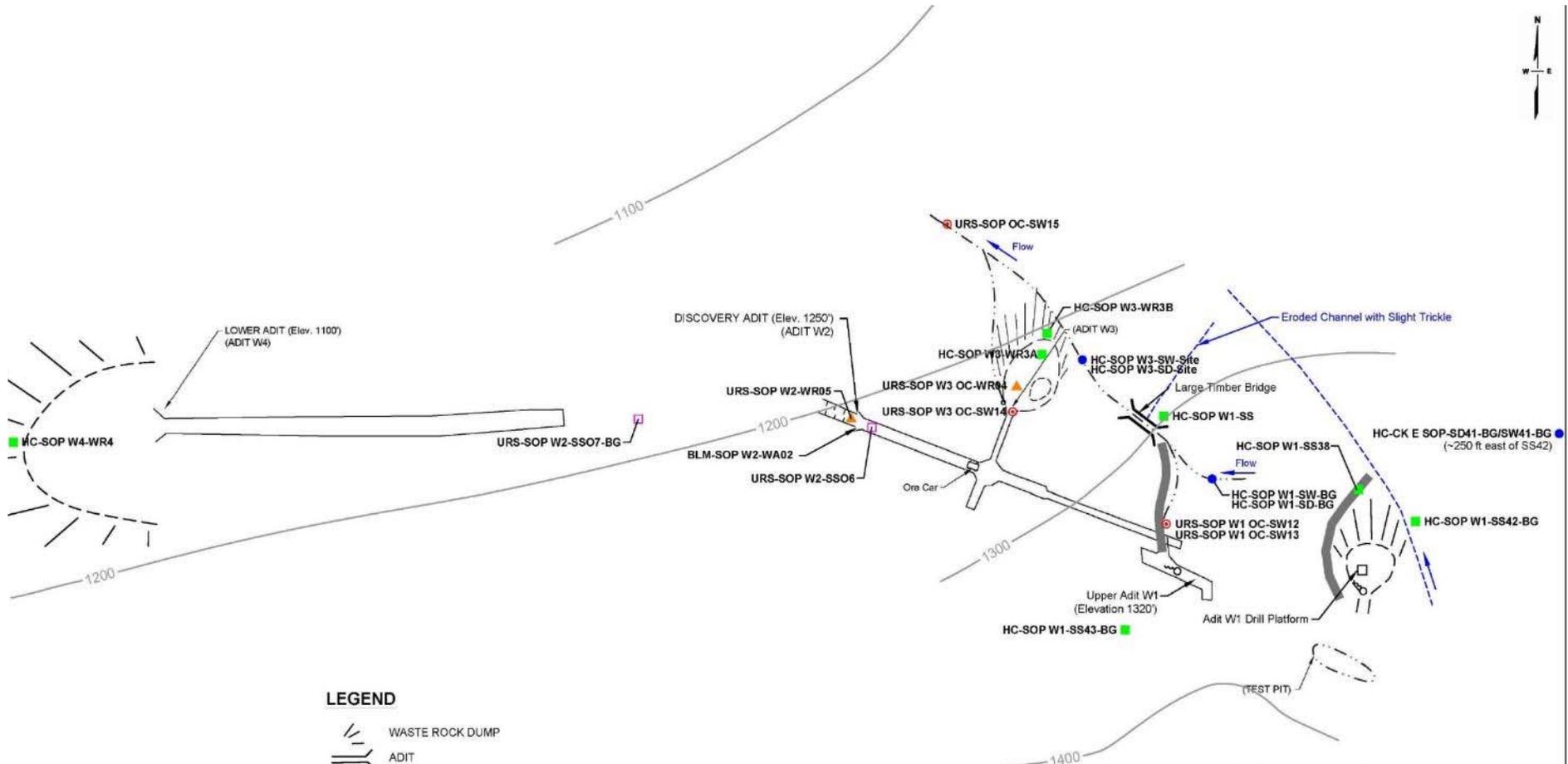
Khayyam Mine Adit W2



Omar Ck Drainage from W2



Khayyam Mine Adits



LEGEND

- WASTE ROCK DUMP
- ADIT
- STREAM BASED ON BLM OR URS OBSERVATIONS
- BLACK STAINED SOIL
- SEASONAL STREAM BASED ON HART CROWSER OBSERVATIONS
- SEEP BASED ON HART CROWSER OBSERVATIONS

- BLM-SOP W2-WA02 1995 WATER SAMPLE
- URS-SOP W3-OC-WR04 ▲ 2007 WASTE ROCK SAMPLE
- URS-SOP OC-SW15 ○ 2006/2007 URS WATER SAMPLE
- URS-SOP W2-SS06 □ 2007 URS SURFACE SOIL SAMPLE
- HC-SOP W1-SS ■ 2009 SURFACE SOIL/WASTE ROCK SAMPLE
- HC-SOP W1-SW-BG ● 2009 SURFACE WATER/SEDIMENT SAMPLE



Note: Sample locations based on location relative to mine features and elevation contours on base map, but base map does not necessarily match Figure 4.

Source: Created from URS Figure "Stumble-On Prospect Site Layout," dated 12/2007.

Khayyam Mine Prince of Wales Island, Alaska	
Stumble-On Prospect Site Layout and Sample Locations	
17567-00	2/11
	Figure 4

Stumble on Prospect





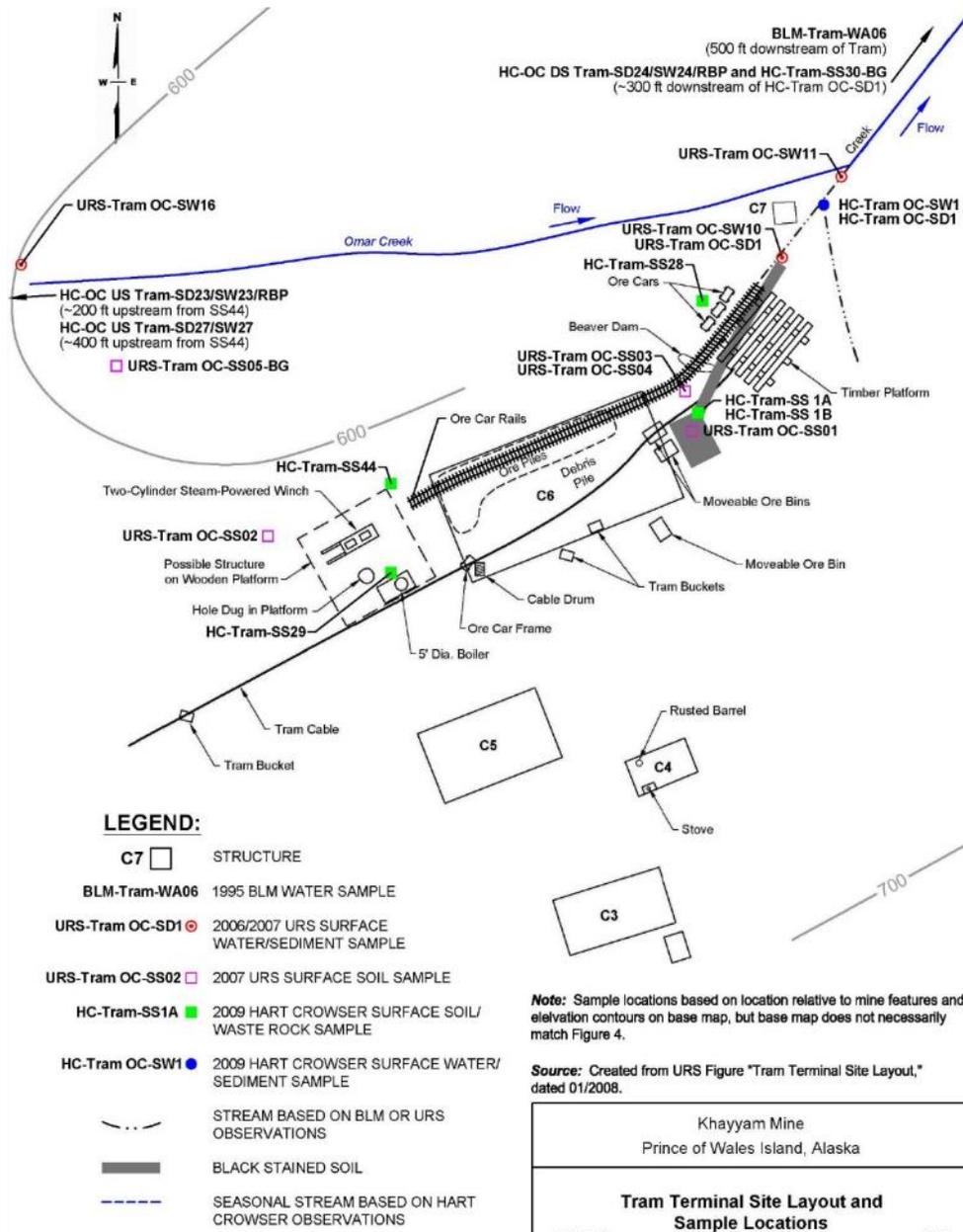
Adit W3

Stumble on Prospect



Black stained soil below Adit W1

Stumble on Prospect



Tram Terminal

Project Background

- Land Owner: US Forest Service (USFS)
- Prior Studies:
 - BLM 1995: mine inventory & water samples
 - 2008 PA/SI: site investigation & sampling
- Regulatory Framework
 - USFS is landowner & coordinating the work
 - CERCLA non-time critical EE/CA vs remedial investigation & feasibility study
 - Applicable or Reasonable & Appropriate Requirements (ARARs)
 - Other regulations must be followed unless less protective

Project Goals

- Resolve data gaps from prior studies
- Collect enough data to statistically compare impacted and background locations
- Develop removal alternatives appropriate for current site conditions
- Compare EE/CA alternatives with CERCLA criteria

Project Approach

- Remote Site Investigation Challenges
 - Helicopter access or ~48mi from Hollis
 - Weather late June 2009 vs late Aug. 2010
 - Waste rock, soil, surface water, “sediment” sampling
 - Rapid bioassessment protocol (RBP)
- Streamlined Risk Assessment
 - Human health
 - Ecological risk assessment
- Develop/compare EE/CA alternatives

Site Investigation Findings

- Metal COPCs (chemicals of potential concern)
 - Metals in groundwater not a concern since incomplete exposure pathway (2008 PA/SI)
 - Waste rock, soil, sediment, surface water COPCs determined with EPA statistical methods (ProUCL) & compared with background values
- Solid media chemical results:
 - Khayyam Mine(KM), Stumble on Prospect(SOP), Tram: waste rock, soil, ore pile > ADEC risk-based screening criteria (RBSC)
 - Some Omar Ck sediment d.s. of Tram >RBSC

Site Investigation Findings (cont'd)

- Surface water chemical results:
 - Khayyam Mine, Stumble on Prospect seeps:
 - Elevated metal concentrations > RBSC.
 - Ferric hydroxide precipitate (yellow boy) & field pH (2.8 – 6.7) indicative of AMD
 - Adit seeps mostly infiltrate near adits, but some go to small perennial tributaries of Omar Ck
 - Surface water & groundwater had no human health & ecological receptor complete pathways



Adits

SOI
EL~1

gle/Earth

Surface Water Flow Path

Steamlined Risk Assessment

- Human Health: no complete pathways for solid media or water
- Ecological:
 - 2 seasons of bug surveys in Omar Ck & reference creeks showed no adverse impacts to aquatic receptors despite some elevated metal concentrations in SW
 - Potentially complete pathways were identified for exposure of ecological receptors to solid media



RBP Bug Surveys



RBP Survey Bug 'Lode'

EE/CA Alternatives

- 4 for soil, waste rock, and spilled ore:
 - Alt. 1 - No Action
 - Alt. 2 - On-site capping
 - Alt. 3 - Consolidation in on-site repository
 - Alt. 4 - Consolidation & dispose off-site

Alternatives Comparison by CERCLA

- Alt. 1 is recommended because:
 - It protects human health & env. because:
 - Recreational users likely would not drink the obviously impacted water from the adits
 - Low metal concentrations & limited extent in mine waste would be a low risk to recreationalists
 - Soil, mine wastes, surface water, adit water, and sediments do not pose a risk to local populations of ecological receptors
 - Some mine wastes with elevated metals would remain on site, but have low impacts

Alternatives Comparison by CERCLA (cont'd)

- Alts. 2, 3, & 4 are not recommended:
 - Alts. 2, 3, & 4 cost >> Alt. 1, & provide marginal risk reduction
 - Alts. 2, 3, & 4 address elevated metal concentrations in wastes, but have >> env. risk from construction impacts to sensitive habitat & marginal risk reduction
 - Logging ~17 acres
 - ~3.5mi. new roads, staging, cut/fill slope
 - Long re-establishment
 - Temporary creek crossings in sensitive habitat
 - Potential const. release

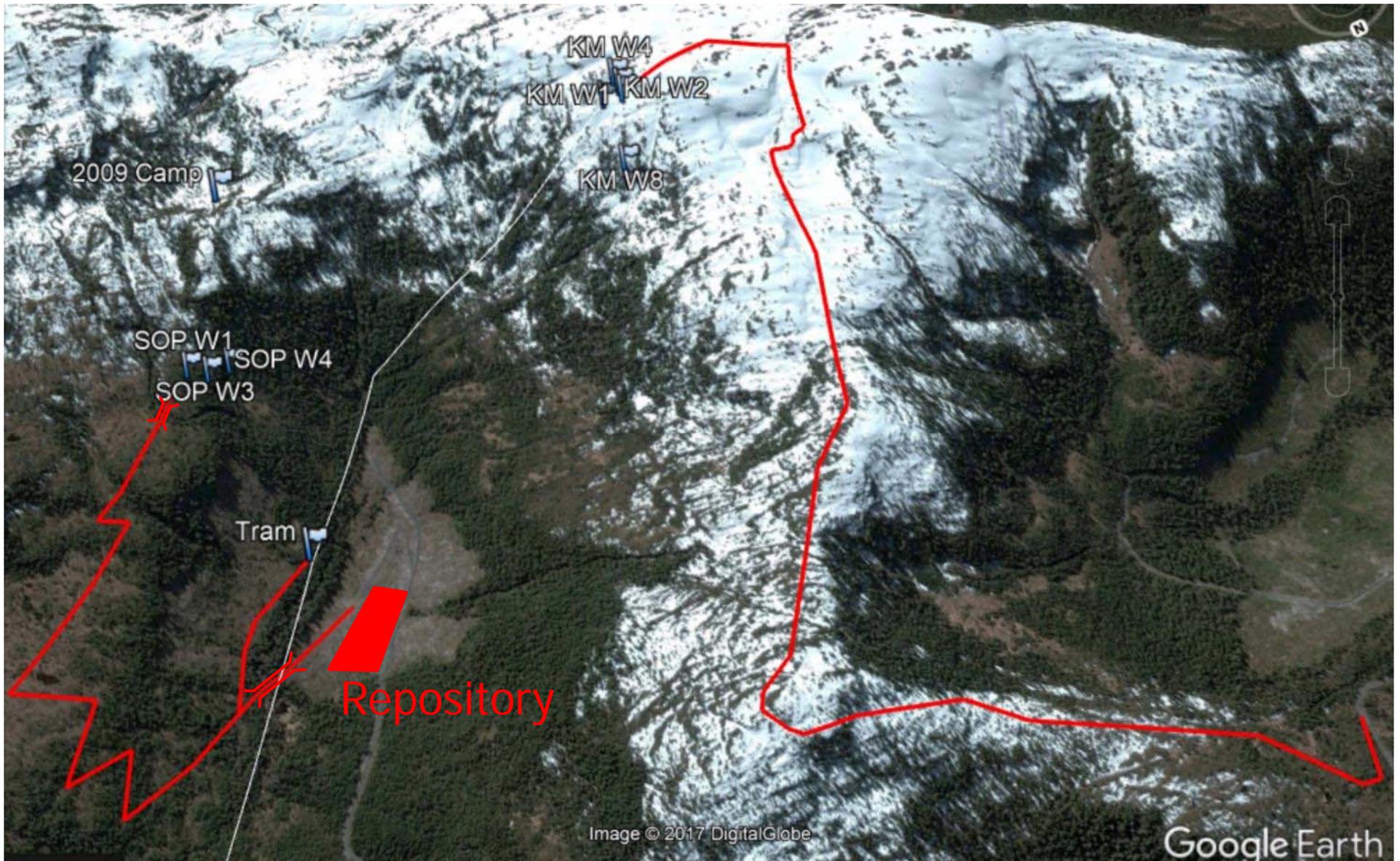
CERCLA Support of No Action

- CERCLA allows selecting a remedy not satisfying an ARAR if implementing it causes more risk to human health & the environment than other alternatives



No Action





Cleanup Action Impacts

Conclusions

- No Action selected because:
 - Effects of release of existing COPCs (no human health & partial ecological risk)
Less Than
 - Temporary & permanent impacts of construction in mature & sensitive habitat
- Caveats:
 - Remote site with mature & sensitive habitat
 - Need sufficient data to perform risk assessment
 - EE/CA is a Draft
- Risk assessment results & ARARs generally support the CERCLA No Action Alt.

Acknowledgements

- USFS
- Hart Crowser staff that survived the field work, weather, & lodging