Tulsequah Chief Mine Remediation Options

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AGENDA

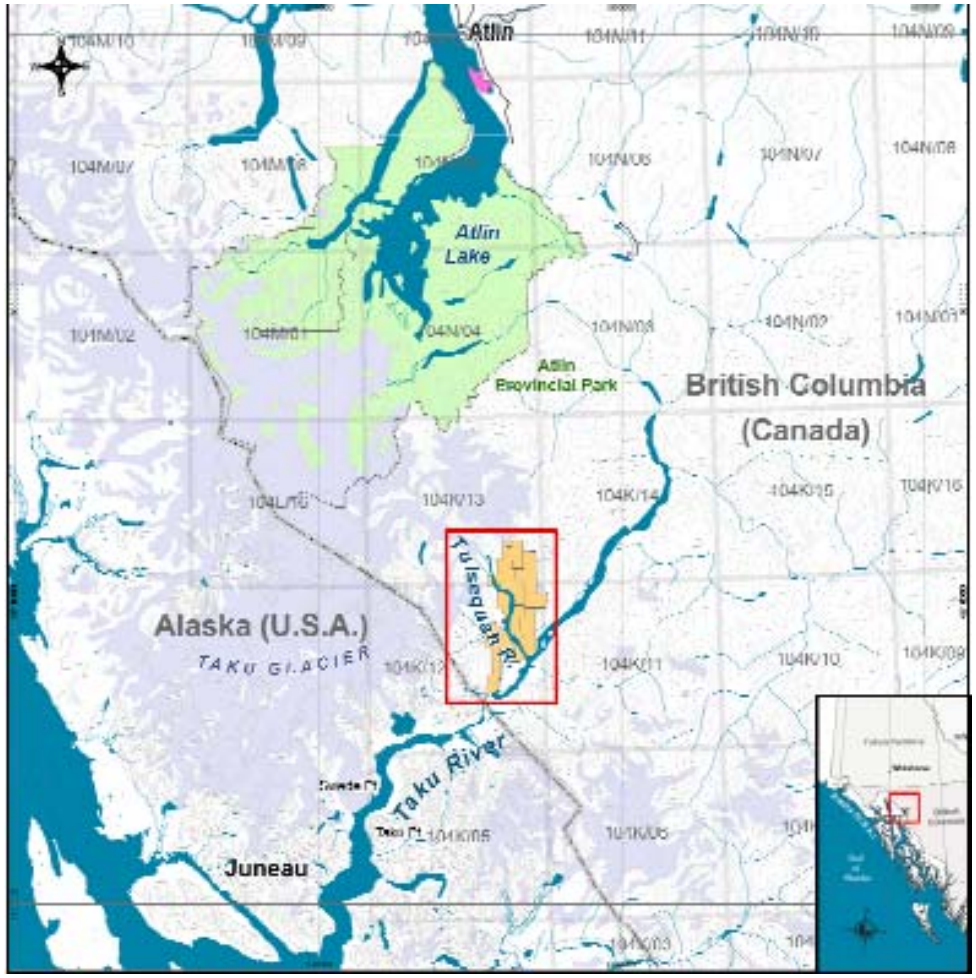
1. Site overview
2. Remediation study
3. Comparison of options
4. Next steps

SITE OVERVIEW

- Abandoned underground base metals mine operated from 1951 to 1957
- Currently acidic waters drains directly to the Tulsequah River
- Water treatment plant was constructed and operated January 2011 until June 2012
- Plant shut-down due to of poor efficiency
  - very dilute sludge
  - 6 km haul to pond

Location & history

- Remote site in Northern BC
- Fly-in or barge access only
- Sits on the bank of the Tulsequah River
- ~19 km upstream of the Taku River which flows to Alaska
- Previous remediation efforts were successful for a period but could not be sustained



Objective

Not about:

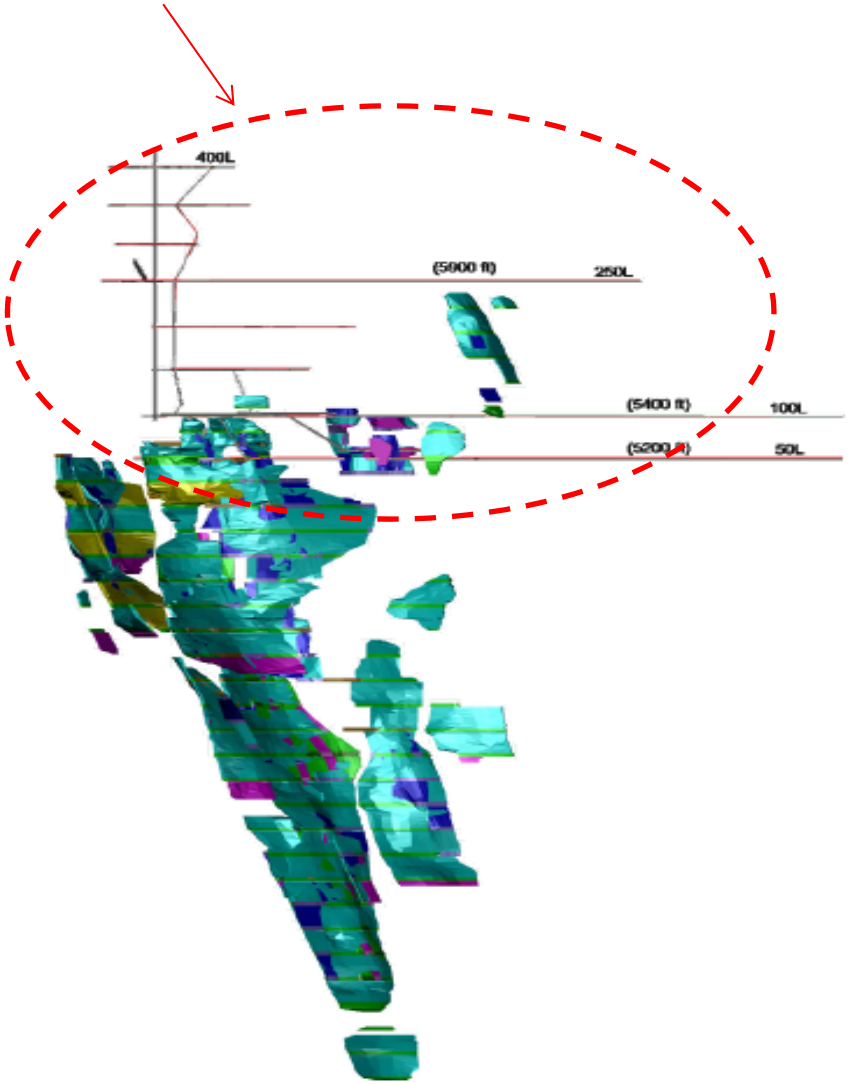
- water treatment
- ecological risk
- cleaning up PAG legacy
- backfill historic PAG rock

What this presentation will TRY to do:

Outline how a **collaborative approach** may help clean up a legacy site, while generating revenue and re-establish stakeholder trust

Previous plans

- Several previous studies and plans
- Industry – focus on continued development
- Government Agencies – focus on remediation

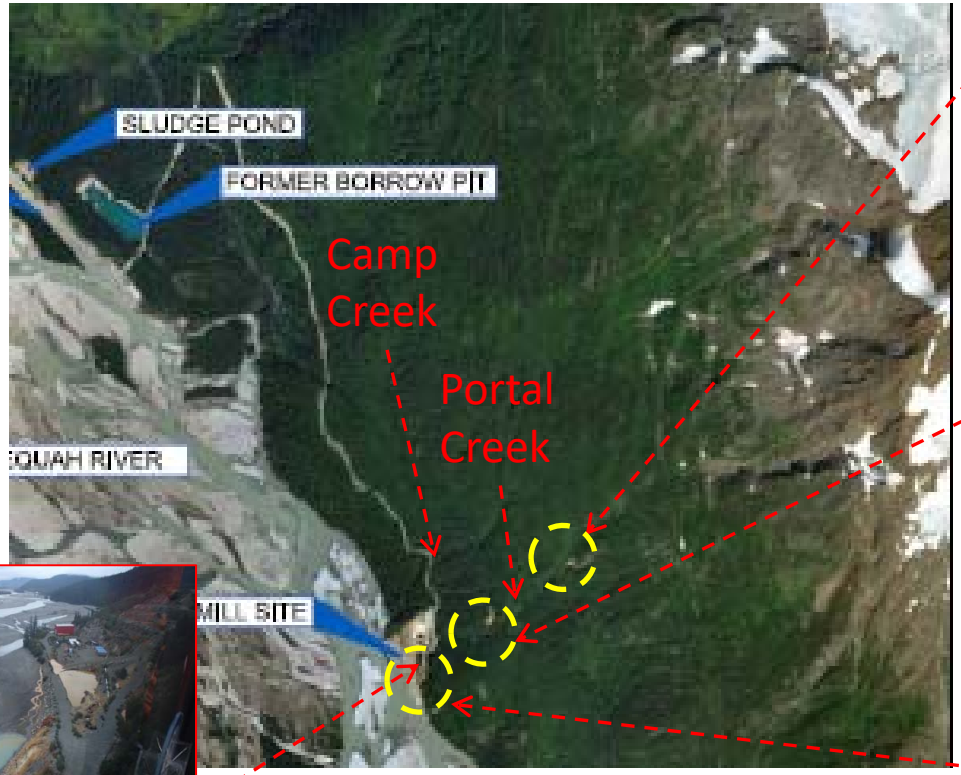


REMEDIATION STUDY

- Objectives:
  - Identify remediation options
  - Determine approximate costs / further work requirements
- Approach:
  - Evaluate previous activities and results
  - Assess requirements for compliance
  - Compare options - performance, cost and stakeholder expectations
- Study team :
  - West Face Capital - commissioned and funded study
  - SLR Consulting (Canada) Ltd. - overall study lead:
    - Ecology and water quality
    - Study objectives
    - Remedial options
    - Water treatment
  - Patterson & Cooke - underground opening backfill

Current conditions

- Acidic drainage emanating from portals
- Flows are all within Portal Creek drainage

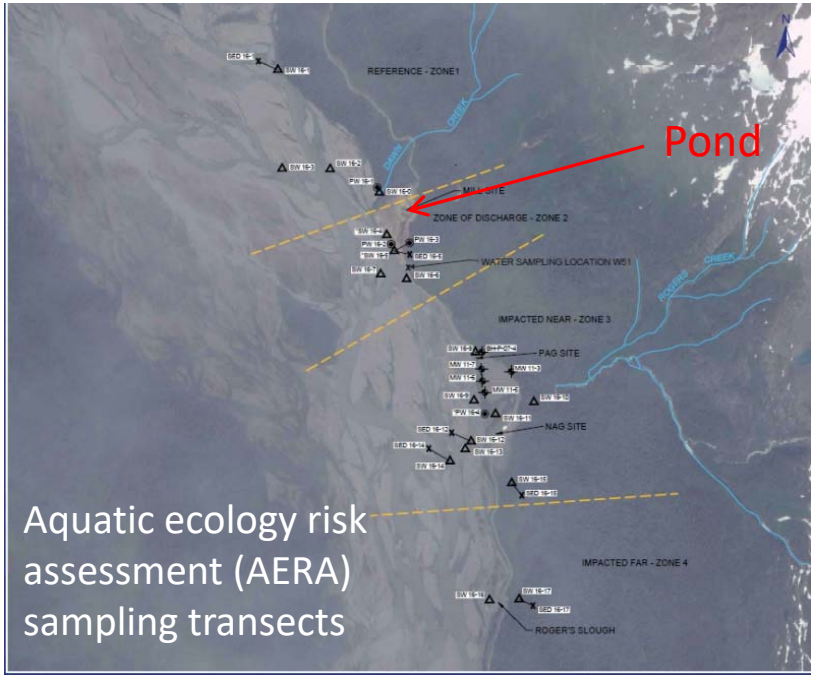


Site features

- Remediation work in 2011:
  - Water diversions constructed but are now damaged
  - Historic PAG (HPAG) facility construction started (grading, no liner)
  - Liner materials at site + some equipment

Ecological impacts

- 2016 SLR AERA study by SLR:
  - Site-specific fish toxicity levels
  - Al, Cu, Zn exceeded BC WQG 225m from pond
  - Toxicity Reference Values exceed for Cu, Zn
  - No fish toxicity at 2.5 km transect
- Impacts appear to be predominantly due to surface water overflow
- Possibly minor impacts from pond seepage



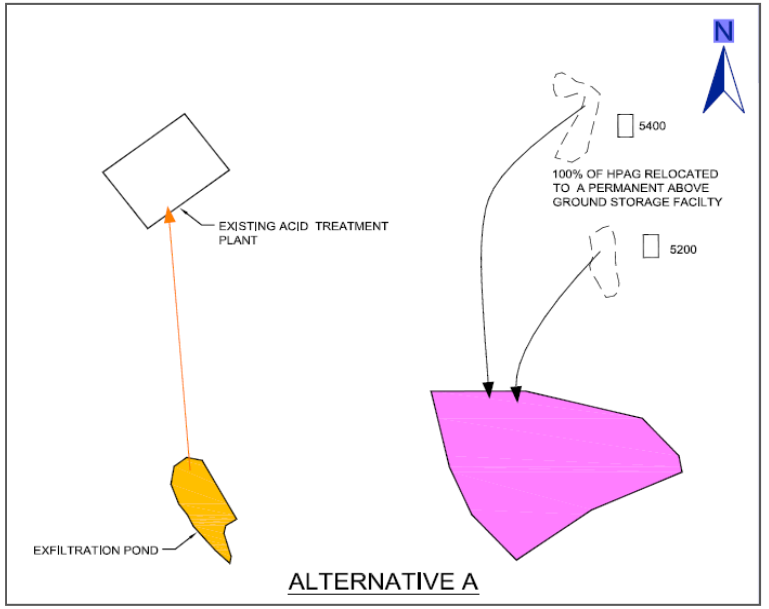
Aquatic ecology risk assessment (AERA) sampling transects

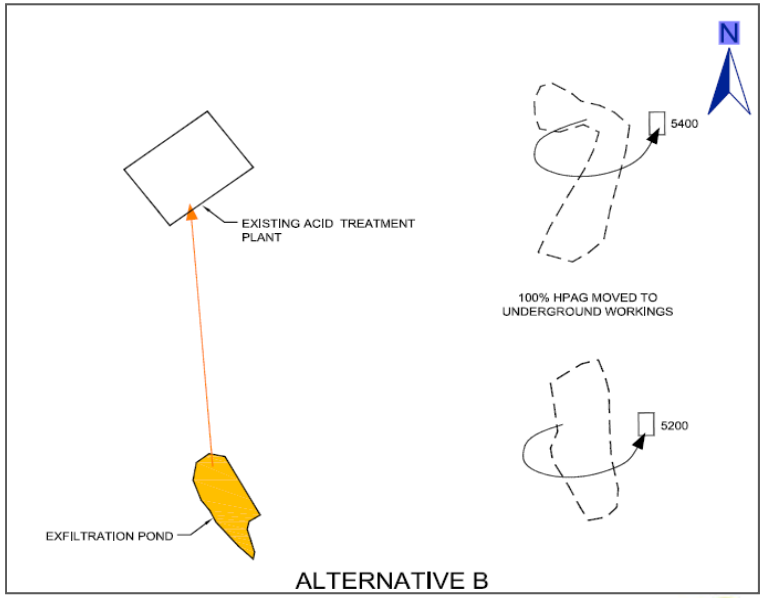
REMEDIATION OPTIONS

- Common objectives:
  - Stop surface overflows - repair pond, upgrade treatment plant , add pumping
    - WTP is in good condition, add pumps, tankage, and thickener to improve performance
    - Implement freshwater diversions to reduce flows (plant capacity 40 m^3/day)
    - Operate Exfiltration Pond at a low level to reduce seepage and store storm runoff
  - Mitigate HPAG rock drainage - relocate or cover in-place (to shed runoff)
  - Inhibit or control portal drainage - closure plugs, or manage with pipelines to treatment
- Two categories considered:
  - *Remediation Options* – clean-up only (no plan for new mining)
  - *Closure Options* – achieve compliance, remediate as part of mine development

Remediation Options (clean-up, no mining)

- Alternative A
  - Upgrade treatment plant
  - Relocate HPAG to permanently lined facility
  - Pump from pond to treatment plant
  - Maintain pond empty to reduce seepage
- Alternative B
  - As above but move HPAG underground
- Alternative C
  - Hybrid of A and B
  - Addresses risk of limited underground capacity



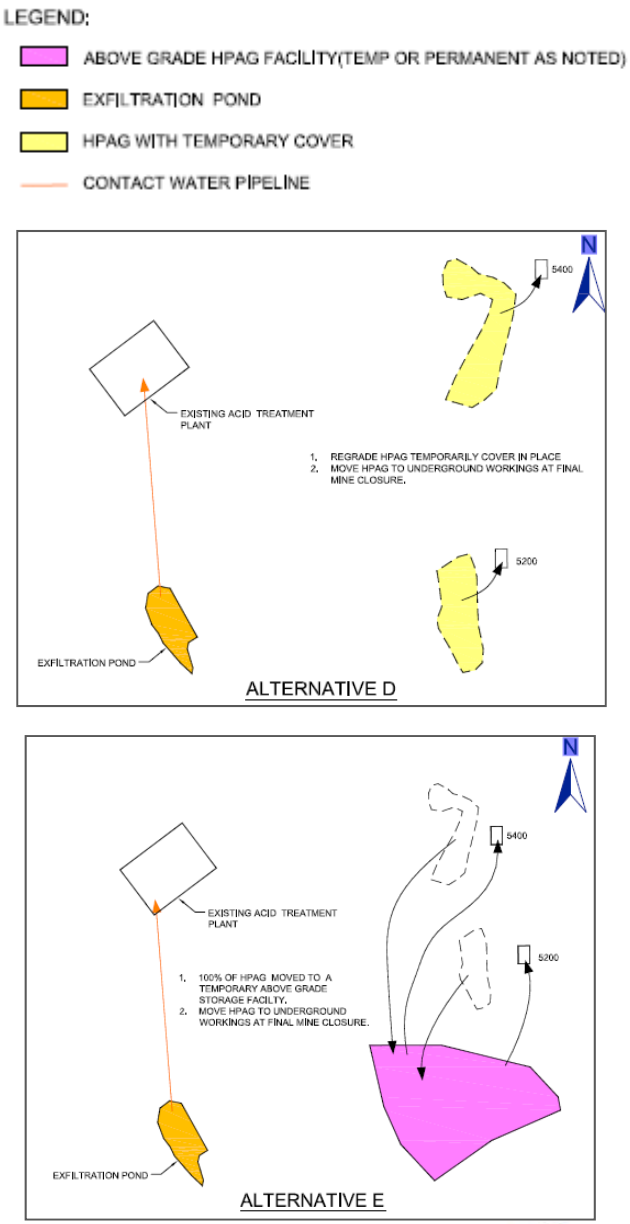


LEGEND:

- ABOVE GRADE HPAG FACILITY(TEMP OR PERMANENT AS NOTED)
- EXFILTRATION POND
- HPAG WITH TEMPORARY COVER
- CONTACT WATER PIPELINE

Closure Options (compliance, then develop mine)

- Alternative D
  - Cover HPAG in-place (temporary)
  - Progressively move PAG rock/tailings underground for
- Alternative E
  - Relocate HPAG to temporary facility
  - Move all PAG rock/tailings underground for closure
- Alternative F
  - Install new water treatment plant to handle all flows



The preferred alternatives

- Alternative C is the preferred *Remediation Option*
  - Upgrade water treatment plant
  - Maximize underground storage of HPAG rock
  - Place closure plugs in portals
  - Construct a permanent lined surface HPAG facility
  - On-going water treatment
- Alternative D is the preferred *Closure Option*
  - Upgrade water treatment plant
  - Temporary cover for HPAG (water-shedding)
- Cost of *Remediation Options* ~ 2x *Closure Options* (order-of-magnitude)
- Common treatment plant upgrade (new equipment)
  - Pre-contact tank to improve HDS operation
  - 3m diameter sludge thickener
  - Sludge pumps
  - Expand building ~ 6m

NEXT STEPS

- Consultation, then refine plans:
  - First Nation (TRTFN)
  - Provincial & Federal Authorities
- Sampling of water and HPAG:
  - Geochemical sampling to determine extent of HPAG
  - Water quality sampling for plant upgrade design
- Develop permitting plan & schedule
- Advance design
- Implementation:
  - **Achieve compliance before moving to new development (!)**
  - Phased implementation is practical:
    1. Repair the treatment plant & install pumps and pipelines
    2. Construct or repair freshwater diversions (to divert storm runoff)
    3. Relocate HPAG
    4. Other remediation activates

Conclusions

- Clean-up will cost a lot of taxpayer money
- Lack of trust that mine development can successfully clean up the site
- A **collaborative approach** may work for all:
  - Step 1 – Establish Trust: Work with communities to bring the site into compliance
  - Step 2 – Mine Development: Clean up site in tandem with mining
  - Step 3 – Closure – Close out site properly; Plug ramps