BC MEND ML/ARD ANNUAL WORKSHOP

MEND Presentation - Kemess South TSF – ML/ARD Management

November 26, 2024

Land Acknowledgement

We'd like to acknowledge the following:

- We are present and are fortunate to be here today on the traditional, unceded lands of the Musqueam, Squamish and Tsleil-Waututh First Nations or Coast Salish peoples
- We're fortunate to have the privilege of being partnered with Tse Keh Neh Nations (Tsay Keh Dene, Kwadacha and Takla) and Gitxsan Nii Gyap on the Kemess project
- The unique relationship that First Nations has with the land, waters and air where the mine is located and strive to conduct operations in consideration of the values of those Nations who have and will continue to occupy these lands for time immemorial

Amazay Lake – the Kemess project is located near this lake

Agenda

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1. Introduction
2. PAG waste and Tailings Management during Operations
3. Closure Water Quality Prediction and Current Trends
4. TSF Closure Design Criteria, and Care and Maintenance Operation
5. Summary

Kemess South Open Pit

Introduction

- The Kemess South (KS) Mine is located approximately 8km east of Thutade Lake, in the northern Omineca Mountains of north central British Columbia.
- The KS Mine has been in Care and Maintenance (C&M) since March 2011
- During operation KS TSF stores approx. 196 million tonnes of tailings and,
  - ~10 million tonnes of cycloned tailings used in the buttress
  - ~17 million tonnes of tailings were deposited into the open pit.

Reclamation activities included:

- NAG rock buttress (completed in 2012)
- Construction of the closure spillway (completed in 2016)
- Dismantling of the process water reclaim system and repurpose the tailings pipeline for emergency management (2016)
- Dismantling cyclone station and associated infrastructure (2016)
- Construction of surface water management structures to passively manage surface runoff (2017)

Kemess South TSF embankment looking South

TD to present slide

During the operational phase of the KS Mine, a number of programs were implemented to lay the groundwork for the reclamation and closure activities, including:

- Annual reclamation and revegetation programs;
- Fisheries habitat compensation program;
- Erosion control and soil stability and monitoring;
- Overburden salvage and stockpile program;
- Continuous geochemical characterization for mine waste management; and,
- Water quality prediction.

Major reclamation works completed during the C&M period included:

- The Non-Acid Generating (NAG) waste rock dump footprint was recontoured reclaimed in 2009 and 2010. Stockpile of Potential Acid Generating (PAG) waste rock were relocated to the open pit and subsequently inundated by the pit lake.
- TSF construction was completed in 2012 with final rockfill toe of the south abutment buttress. In the spring of 2017, the TSF reached full supply level and began passively decanting through the purpose-built spillway, as per the TSF closure design.

The majority of the reclamation work are completed and the TSF is currently discharging passively into the environment meeting all discharge requirements in the current C&M period. There are few remaining reclamation activities that are still in progress, but they have no impact on the water quality and low risk related to dam safety management.

Introduction – KS TSF Design for Closure

- Kemess South tailings were considered potentially acid generating (PAG) based on lithology and rheology, prior to additional flotation.
- The closure design objective of the KS TSF was to submerge PAG material under a water cover or, or at minimum, achieve 85% degree of saturation to limit oxidation and therefore acid generation of the tailings to minimize acid rock drainage (ARD).
- To achieve the closure objectives, the operation design incorporated number of features:
  - a downstream buttress and upstream extended beach constructed with cycloned non-acid generating (NAG) tailings to reinforce the modified centerline construction for long term stability.
  - the underflow tailings first went through a flotation circuit to remove the sulphide and produce NAG tailings for construction, coincidentally, it reduced the storage requirements of the TSF.

Kemess South TSF embankment

Tailings Characterization and Quality Control During Operation

- Testwork determined that additional flotation (cleaner circuit) can remove sulphide from the cycloned tailings sand for construction. Two specific types of ore were suitable for this flotation with no residual ML concerns.
- The first stage cyclone would separate the tailings, where only the underflow (coarse sands) would go through the cleaner circuit.
- The finished product from the cleaner circuit, now NAG (e.g. NPR >2), went through another cyclone to further separate the fines to meet design criteria, where the underflow will be used in dam construction.
- The byproduct from cleaner circuit, often called cleaner tailings and contains the sulphides, was discharged into the TSF, below the flood level, with the overflows (fine sands) from both cyclones.

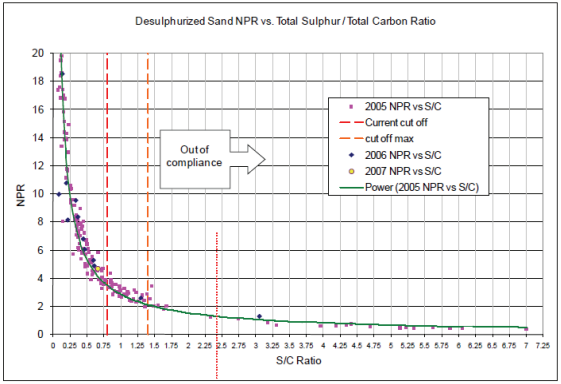


Figure 2.1: NPR vs. S/C Ratio Used by Kemess for NAG Cyclone Sand Control

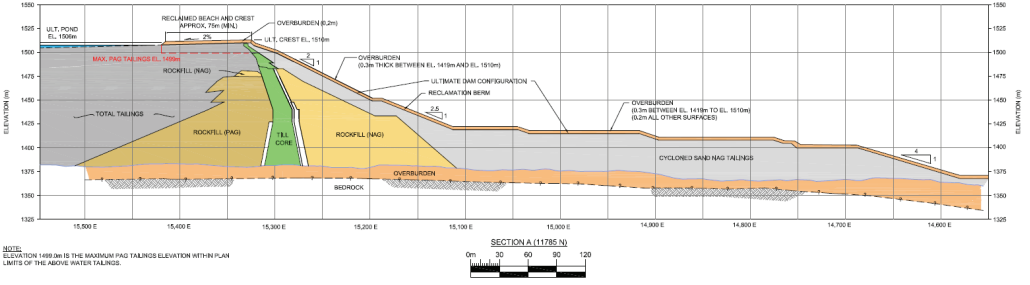
Figure from the 2010 KS Mine RCP.

AT to present slide

.To monitor the NPR, mine personnel collected grab samples from the cyclone underflow every 6 hours during operation. During periods of changes, such as when ore type was changed, sampling was done every 3 hours over a 12-hour period. A correlation between the sulphur:carbon ratio (S:C) and NPR was used to determine an allowable cut-off for material. An S:C ratio of <0.8 was chosen as the breakpoint for downstream placement which corresponds to an NPR of >4 (See Figure 2). When S:C ratio exceeds 0.8 then the cyclone stream is switched off and whole tailings is deposited into the TSF.

PAG Waste and Tailings Management during Operation

- Majority of the tailings and PAG waste rock have been placed within the tailings impoundment upstream of the low permeability core.
- NAG waste rock was used for construction of the downstream dam shell from 1996 through 2002.
- From 2003 through 2008, cyclone NAG sand was used for construction. Up to 2001, PAG waste rock was placed within the TSF for submergence upon closure.
- Post 2001, Kemess permitted a, temporary, external PAG stockpile located immediately adjacent to the open pit to be rehandled back into the pit at closure. From 2002 onward, the upstream shell of the dam was constructed from quarried NAG rock.



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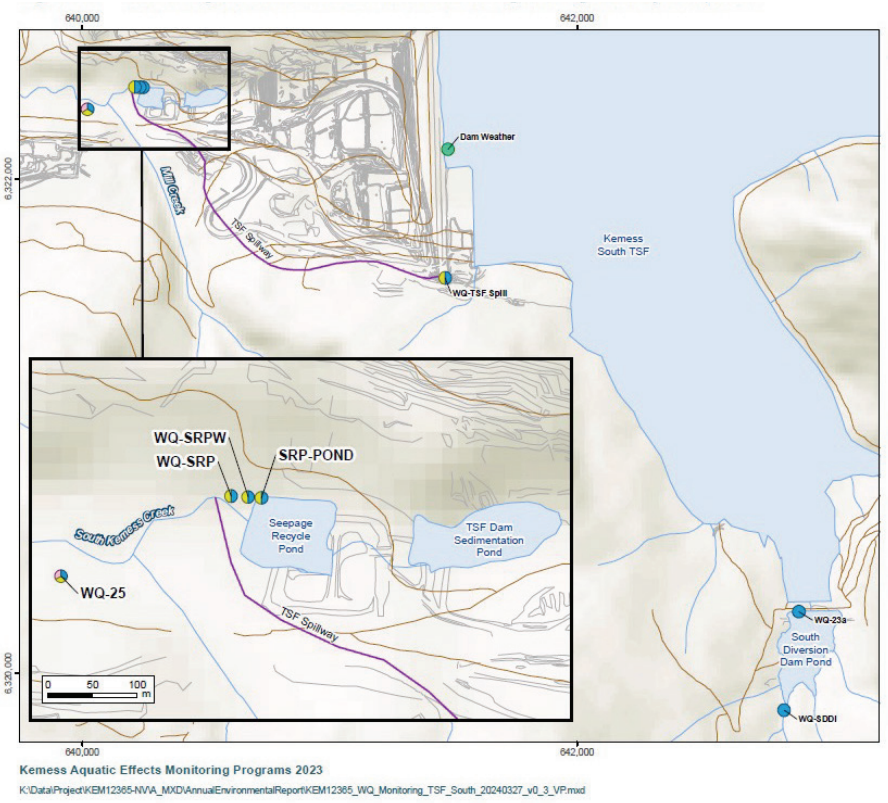
The construction of the downstream shell of the tailings dam was converted from NAG waste rock and selected fills to the use of NAG cyclone sand in 2003. The cyclone sand plant, built on the south abutment of the tailings dam, was commissioned in December 2002. The cyclone plant would only operate on specific types of tailings and periods of the year to satisfy closure objectives and construction quality control, respectively. The underflow cyclone sand was compacted in the downstream shell according to construction specifications and overflow was directed into the TSF. The cyclone plant was decommissioned in 2009.

Closure Water Quality Predictions

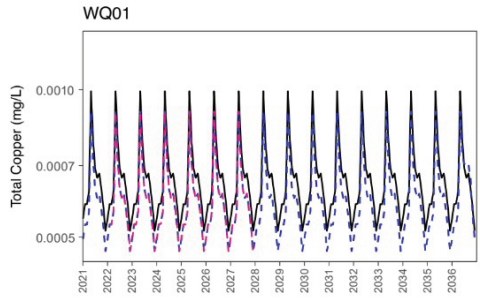
- Water balance/water quality model updated in 2022 to meet EMA req's
- Key model node WQ-01, receive existing seepage flows and future overflows from the Kemess South Open Pit in Post-Closure, in addition to spillway discharges from the KS TSF
- EMA permit limits for TSS, pH and field turbidity. 2022 WB/WQ model, screening indicated that all permitted monitoring stations would produce water quality within the permitted limits.
- 2022 results indicated some metals (i.e. Cu-d, Mo-t and Zn-t) had concentrations in source water discharges (e.g. SRP-Pond and KS TSF- spillway) greater than guidelines, but the concentrations for those metals remained less than BC Water Quality Guidelines' (WQG's) in the downstream receiving environment at model nodes WQ-01 and 03.



From 2023 Annual EMA Report: Monitoring Stations at the KS TSF.

Closure Water Quality Prediction vs Current Trends

- In 2023, field turbidity, TSS, and pH levels remained within the permitted discharge limits and trigger levels at each of the relevant monitoring stations within the KS TSF area.
- Overall, while some exceedances of WQ guidelines were observed—particularly for dissolved Cu, Mo, and Zn—the 2023 data indicates that these are within expected variability and baseline patterns, rather than indicating worsening environmental conditions.
- The decreasing trend in dissolved Cu concentrations at certain stations and the lack of long-term increasing trends in other parameters suggest that current practices and discharge controls are maintaining water quality within acceptable ranges.
- Aside from dissolved Cu, dissolved Zn, and total Mo, which were greater than the guidelines in 2023 in discharge waters, the assessment found water quality conditions that met environmental quality guidelines and had generally stable or decreasing trends in most water quality indicators.



From 2022 KS Updated Goldsim Modelling.

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Slide presented by TD

Dissolved Copper: While the exceedances of the acute lethality guideline at multiple stations are concerning, the **decrease** in copper concentrations over a ten-year period at WQ-23a and WQ-25 suggests improvements in water quality. The background station data (WQ-SDDI) indicate that some of the copper concentrations could be due to natural, non-TSF-related factors.

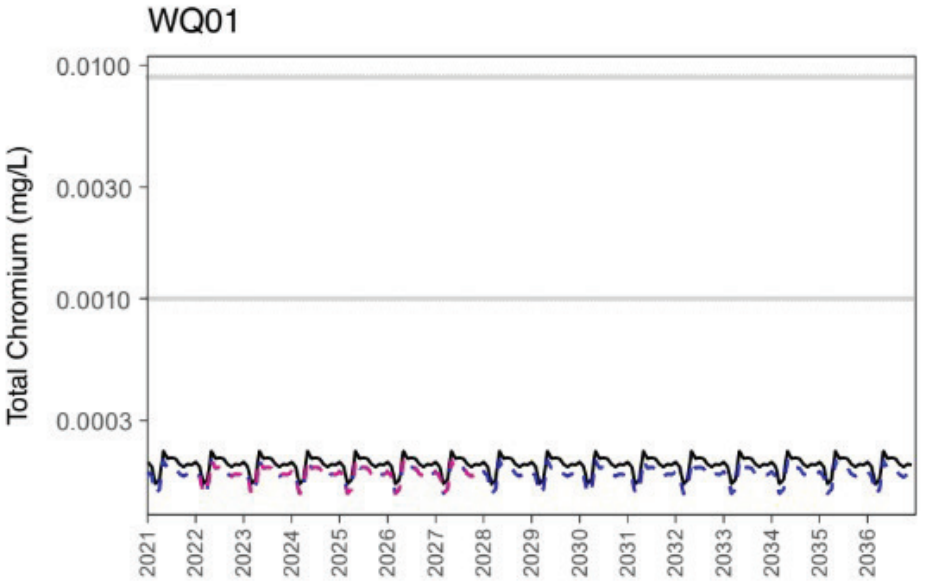
Total Molybdenum: The exceedances at WQ-25 for ruminant wildlife are within historical trends, and no new significant increases were observed. The seasonal variability and lack of long-term trends suggest that the exceedances are likely not caused by any recent changes in discharge practices or environmental conditions.

Dissolved Zinc: The increased frequency of exceedances at WQ-23a suggests some variability in zinc levels, but without a long-term upward trend, this may simply reflect natural fluctuations rather than any significant or worsening environmental impact.

Closure Water Quality Prediction vs Current Trends

- The observed increases in alkalinity, Cr, and Co at WQ-23a are not of significant concern, as they remain below applicable WQG's and are attributed to changes in analytical detection limits rather than actual increases in metal concentrations.
- Alkalinity trends in mine discharges indicate a geochemically stable system consistent with TSF performance expectations.
- The toxicology monitoring confirms that the mine's discharges are not causing toxicity to aquatic life, and the broader ecological impacts on Kemess Creek remain minimal.

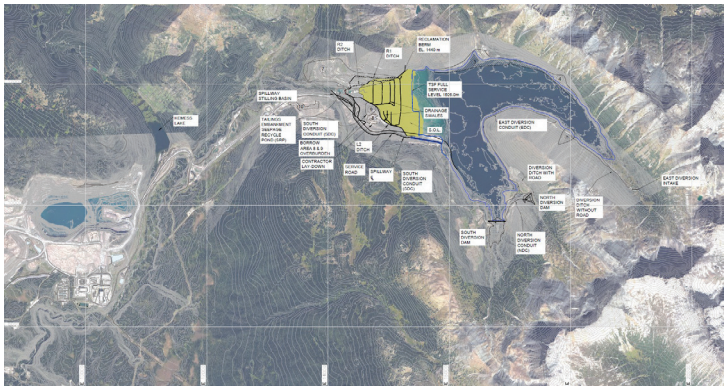
Overall, the monitoring data confirm that the Kemess TSF is operating effectively in line with its closure and environmental management plans, and there are no new risks to water quality or aquatic life associated with mine activities.



From 2022 KS Updated Goldsim Modelling.

TSF Closure Design Criteria, and Care and Maintenance Operation

- The Kemess South TSF closure design meets CDA "very high" consequence guidelines, featuring zero surface discharge and Maximum Credible Earthquake (MCE) design for seismic resilience.
- The facility will have permanently flooded tailings with a NAG tailings beach to reduce acid generation at closure.
- Key components include an earthen dam, seepage pond, sediment retention pond, and a diversion system to manage water and protect downstream fisheries.
- The closure spillway is designed to manage extreme flood events and controlled discharge, including during freshet.
- The design ensures geochemical stability and minimal environmental impact, as confirmed by the Fish and Aquatic Effects Management Plan (FAEMP).



From 2023 Dam Safety Inspection Report.

Slide presented by AT

Zero surface discharge of process water from the TSF during C&M and active closure periods;
A closure spillway design what would allow attenuate the inflow design flood (IDF) a maximum flood level with controlled discharge, on top average freshet.
A number of operational procedures and structures are in place to ensure the above criteria are met.
A diversion system around the south and east portion of the TSF to limit run-on into the TSF during the operation to reduce contact water. This diversion system also maintains a fresh water supply during the low flow periods for support of downstream fisheries resources in Kemess Creek during operation.

Transition to C&M

- During mining operations, all seepage and supernatant water was collected, recycled, and had zero surface discharge, continuing into early C&M until water quality met authorized limits, enabling passive discharge.
- The 20-month transition period used recycling and freshwater input to reduce concentrations, after which the seepage pond (SP) was connected to the sediment retention pond (SRP) for controlled discharge.
- TSF dam safety fully complies with CDA guidelines, with regular inspections by the engineer-of-record (EOR), reviews by the independent technical review board (ITRB), and oversight by qualified personnel (QP) and resident tailings personnel (RTP).
- A monitoring program tracks dam performance, with ongoing reclamation and revegetation efforts to reduce surface erosion and minimize total suspended solids (TSS).

Figure 3.8: Runoff Diversion Ditches (white arrows). Photo taken May 2010.

From 2010 KS RCP.

Conclusion

- The Kemess TSF was designed with closure in mind, using ARD/ML testing during operations to optimize tailings management and enable two-stage cycloned tailings to reinforce the dam and reduce storage requirement.
- A detailed waste management plan ensured PAG waste was placed below the final closure level for submergence, while water quality and long-term water balance predictions guide closure targets.
- The ongoing monitoring network tracks performance against model predictions, supporting adaptive management if risks are identified.
- A collaborative approach with testing and dedicated resources during care and maintenance ensures continuous monitoring and updates, with full-time site inspections to maintain TSF performance.