



SEABRIDGE GOLD

Tailing Management Facility at the KSM Project Overall Perspective of the Design and Selection Process

Presentation by

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Agenda

1. KSM Project Overview
2. Regulatory Approvals
3. KSM Tailings Management Facility
Overview
4. Independent Geotechnical Review
Board
5. BAT Study
6. Conclusions of BAT Study
7. Conclusion of Dr. Dirk van Zyl Review

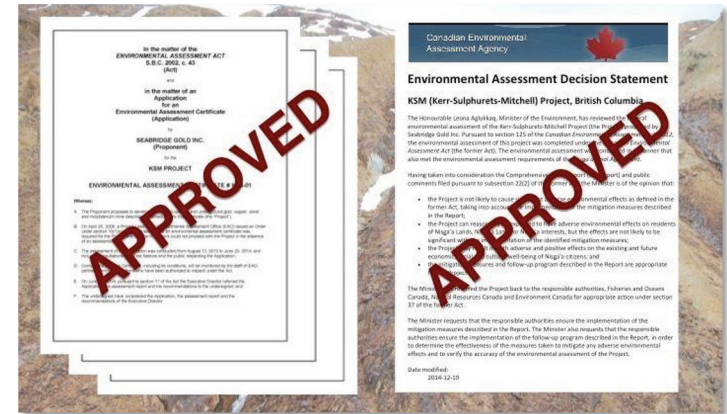
KSM Project Overview

- Located 65 km northwest of Stewart, BC
- World's Largest Undeveloped Gold and Third Largest Copper Project
- Aspects of the Project are within the territories of Nisga'a Nation, Tahltan Nation and Skii km Lax Ha
- Invested +\$1 billion to move the Project forward
- KSM Mining ULC, a subsidiary of Seabridge Gold Inc., is the holder of the KSM Project



Environmental Assessment (EA) Approvals

- Underwent one of the most comprehensive Environmental Assessments:
 - 7 years (2007-2014)
 - 36,000 pages of scientifically rigorous information compiled by over 250 independent scientists from across 20 disciplines
- BC Environmental Assessment (EA) certificate issued July 2014
- Federal Environmental approval received December 2014
- Nisga'a Final Agreement approval in December 2014
- "Substantially Started" designation from the BC Government: July 2024



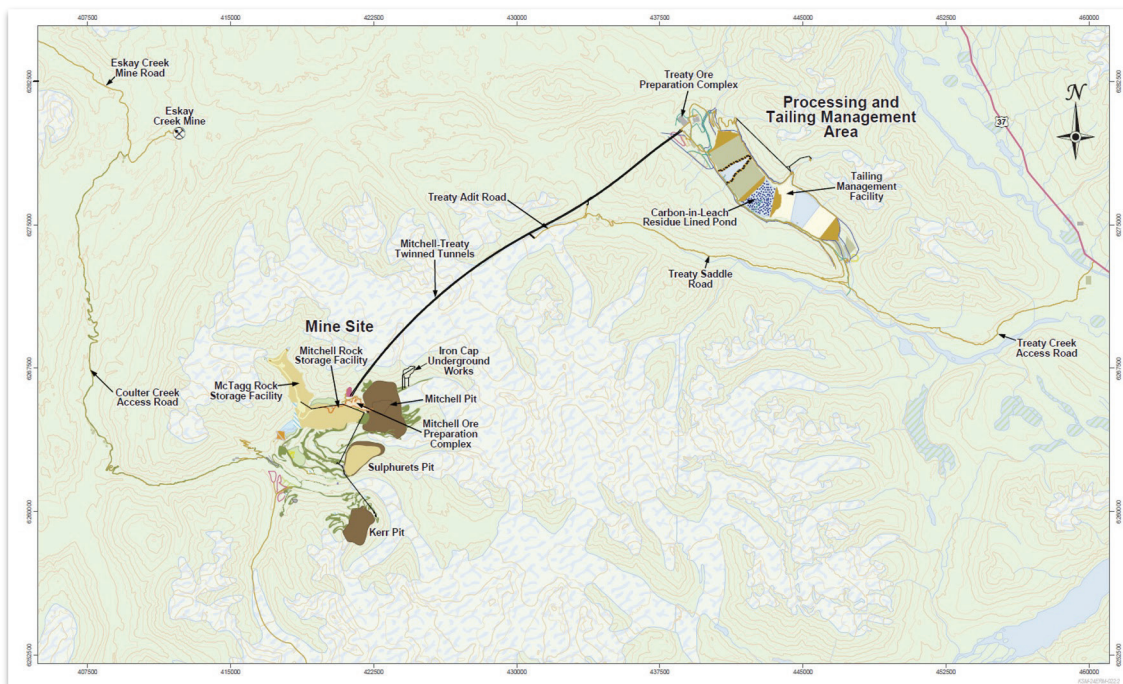
"After consideration of the findings of the Assessment Report, Project design aspects and recommended conditions of the proposed EA Certificate, Recommendations of the Executive Director, and the key considerations as outlined in section 2 of these Reasons for Ministers' Decision, and having regard to our responsibilities under the Act, we issued an EA Certificate for the Project. The EA Certificate includes legally enforceable conditions which gives us confidence to conclude that the Project will be constructed, operated and decommissioned in a way that no significant adverse effects are likely to occur."

- Hon. Mary Polak, Former BC Minister of Environment; Hon. Bill Bennett, Former BC Minister of Energy & Mines

Overall Project Layout

Guiding Design Principle: Protection of the environment including downstream waters and fish-bearing habitats.

- KSM approved on the basis that there would be no significant downstream environmental impacts, including Alaskan waters.



Ore Production

130,000 per day

Environmental Assessment Mine Life

50+ years

Tailings

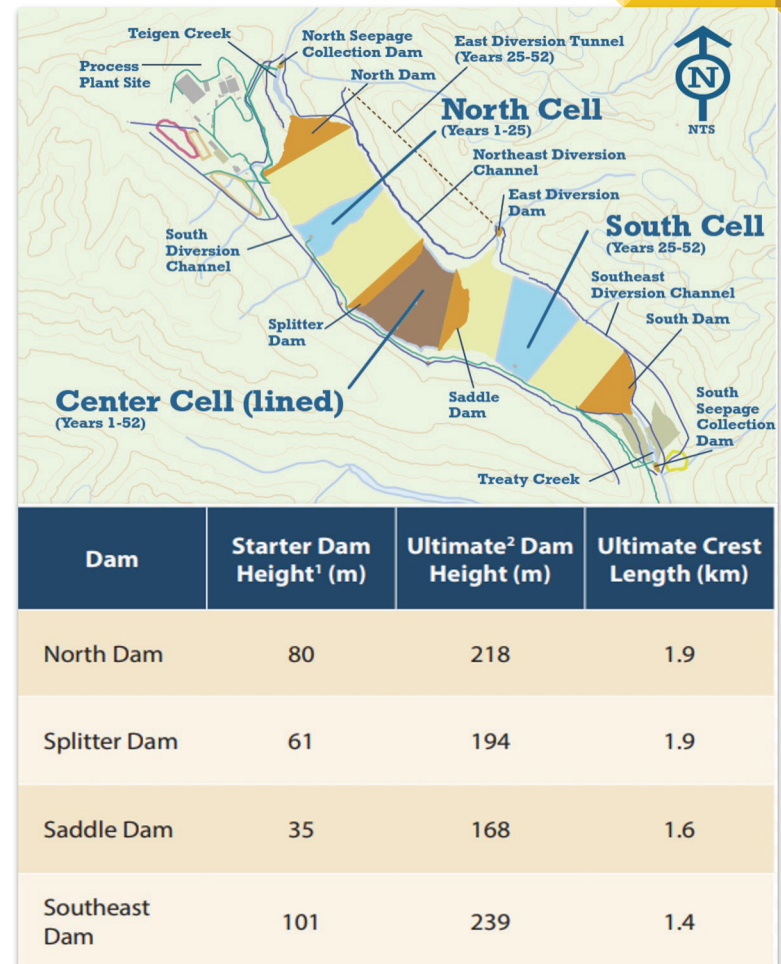
- 2.1 billion tonnes of NPAG Flotation Tailings
- 0.2 billion tonnes of PAG CIL Residue

Two Key Areas

- Mine Area
- TMF Area (23 km northeast of the Mine Area)

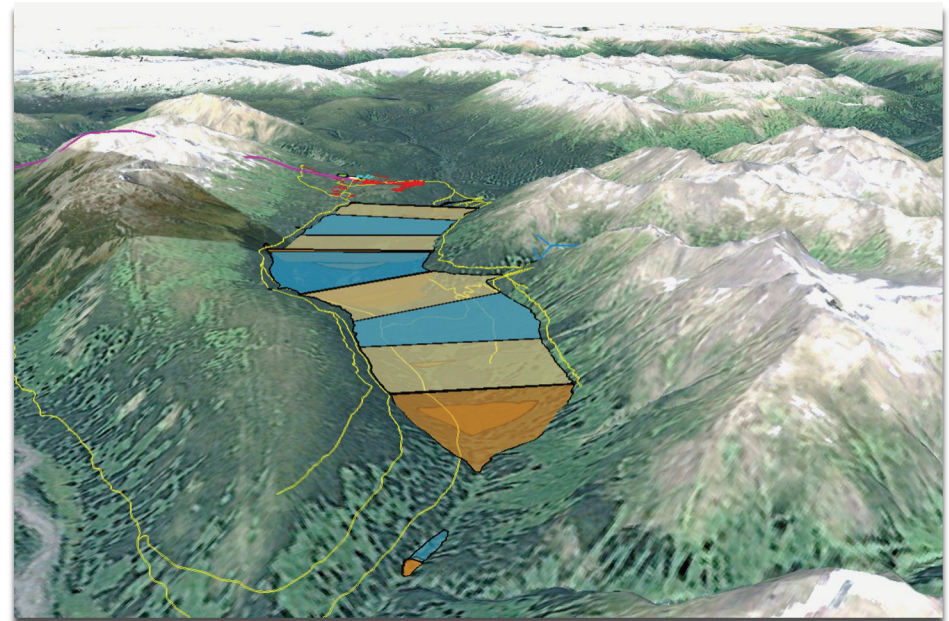
KSM Tailings Management Facility (TMF)

- **Conducted Tailings Management Alternatives Assessment (part of EA) in 2013**
 - Looked at alternative technologies (including cyclone sand, paste, and filtered)
 - Location selected after completing an extensive alternative assessment which examined 14 different sites
- **EA Approved Design - Centerline Cyclone Sand TMF**
 - The centerline design method was developed in the mid 1960's to replace upstream dam design methods and provide increased stability
- The TMF is designed to work with the shape of the valley providing natural containment
- Situated in the Canadian Nass River watershed which drains into Canadian waters



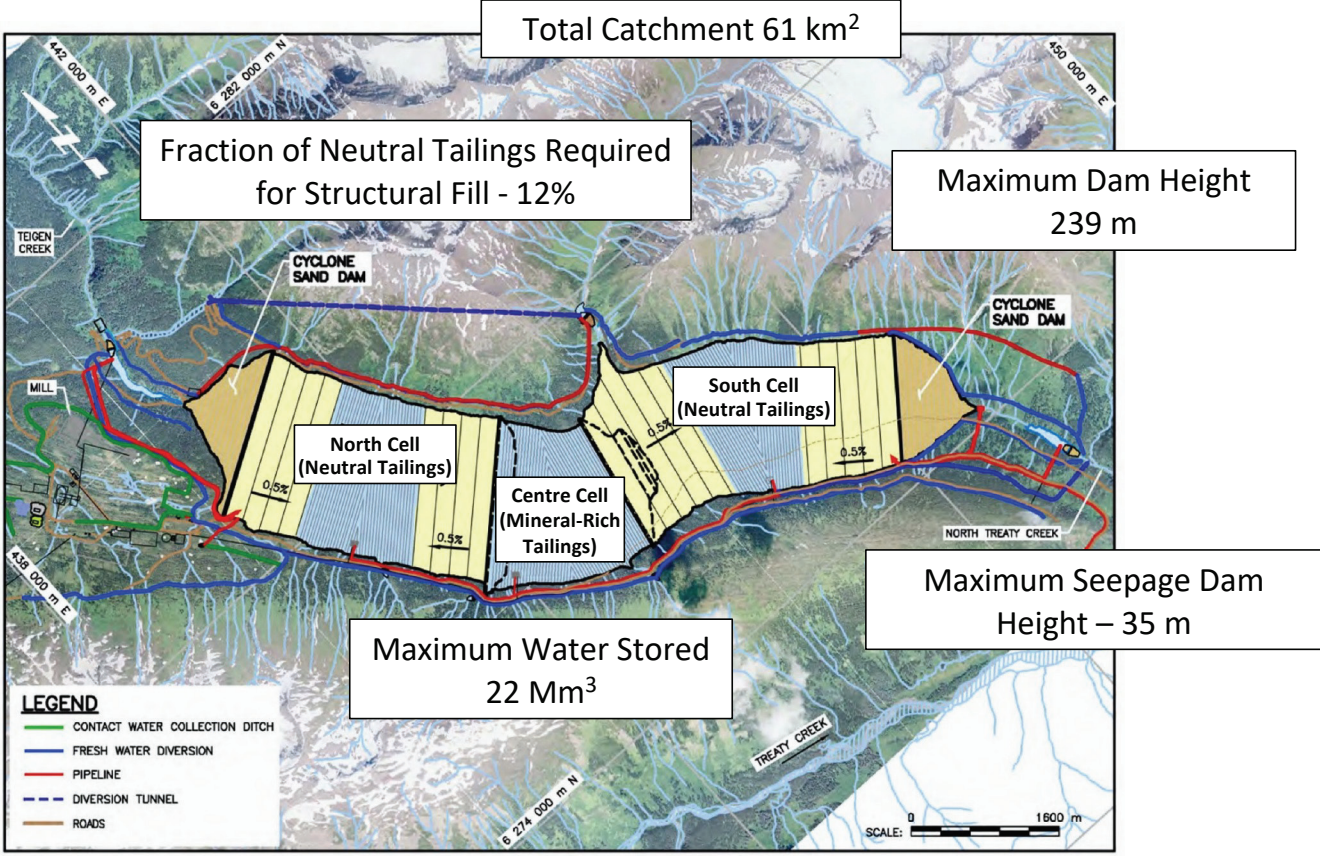
KSM Tailings Management Facility (TMF)

- TMF's design, construction and operation has been planned to and will meet the most rigorous applicable standards
- TMF will be constructed and monitored in compliance with -
 - Canadian Dam Safety Association; International Commission on Large Dams; International Council on Mining and Metals; GISTM; Engineers and Geoscientists BC. Regular reviews by an eight-member Independent Geotechnical Review Board
 - Will be regulated by the BC Mining Code
- Precedence of centerline cyclone sand dams include:
 - Copper Mountain, Gibraltar, Highland Valley Copper, Brenda, and Kemess South in British Columbia and numerous dams in high seismic areas such as Chile and Peru



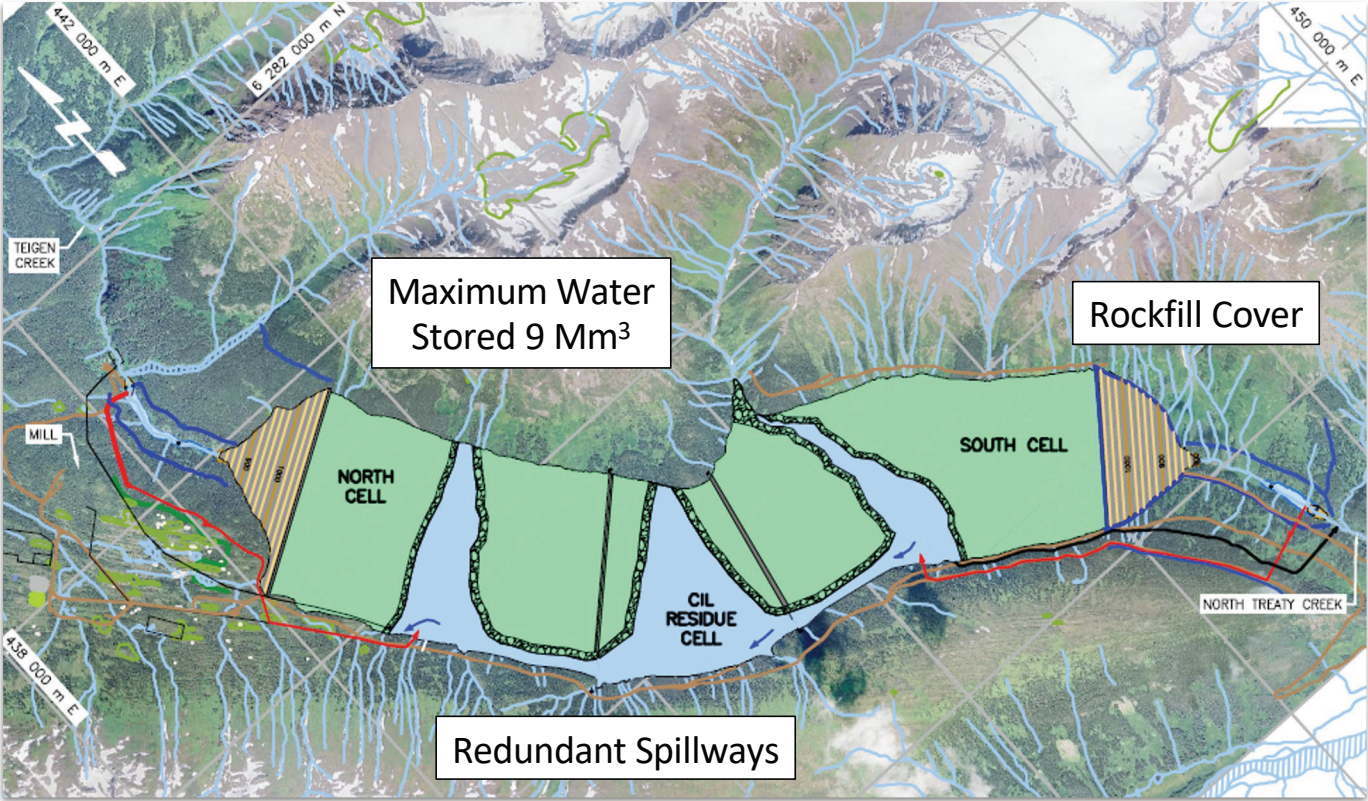
EA Approved Tieggen-Treaty Cyclone Sand TMF

During Operations



EA Approved Tiegen-Treaty Cyclone Sand TMF

Closure



TMF Design Improvements During EA

Lined Central CIL Residue Cell

Added to store CIL residue under saturated conditions to prevent ARD

Relocated Access Road

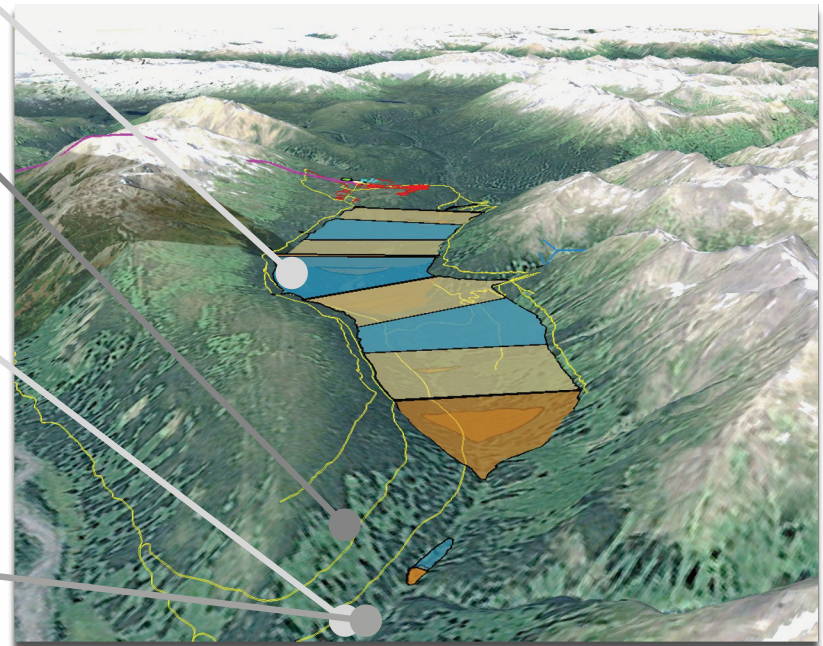
Moved from the Teigen Creek Valley to the Treaty Creek Valley to eliminate potential impacts to high value salmon habitat in Teigen Creek

Relocated Discharge Location

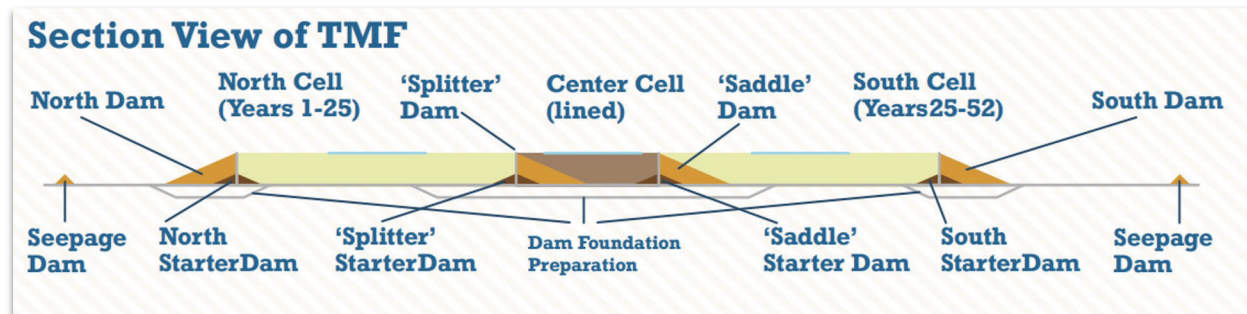
For excess water from the TMF moved from South Teigen Creek to Treaty Creek to mitigate potential water quality impacts on high value salmon habitat in Teigen Creek

Refined Discharge Strategy

To mimic natural seasonal flows



TMF Key Features



- Meets or exceeds CDA (2014) and Ministry of Mines (HSRC for Mines in British Columbia, 2017) requirements
- Extreme flood storage management design exceeds regulatory requirements by 100%
- 90% of tailings will be non acid/neutral generating sandy silt
- 10% of tailings will be potentially acid generating material - deposited in the lined center cell, stored underwater and isolated from the natural environment and the rest of the TMF to mitigate acid generation
- Seepage is collected by seepage dams and recycled to TMF
- Annual discharge of water into nearby receiving water courses will meet regulated water discharge criteria
 - Water treatment is not anticipated
- Instrumentation will be installed to monitor performance from initial construction through to post-closure (settlement, pore pressure, seepage flow, water quality)

Independent Geotechnical Review Board (IGRB)



Purpose – To provide independent, expert oversight, opinion and advice on the design, construction, operational management and ultimate closure of the Tailings Management Facility (TMF) and Water Storage Dam. Established January 2015

Expertise - The IGRB members combined have over 300 years of experience investigating designing, constructing, and closing mine waste management facilities

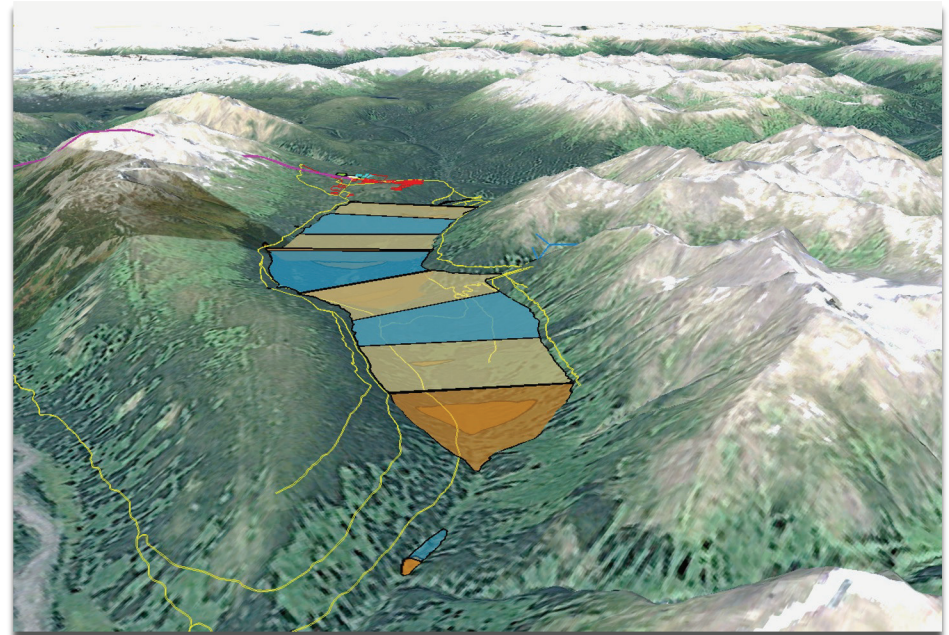
IGRB Conclusion - “The layout and type of structures, the tailings management approach, runoff and seepage control measures, and the closure plans are appropriate for the site conditions and intended purposes.”

Best Available Technologies (BAT) Study of KSM's TMF

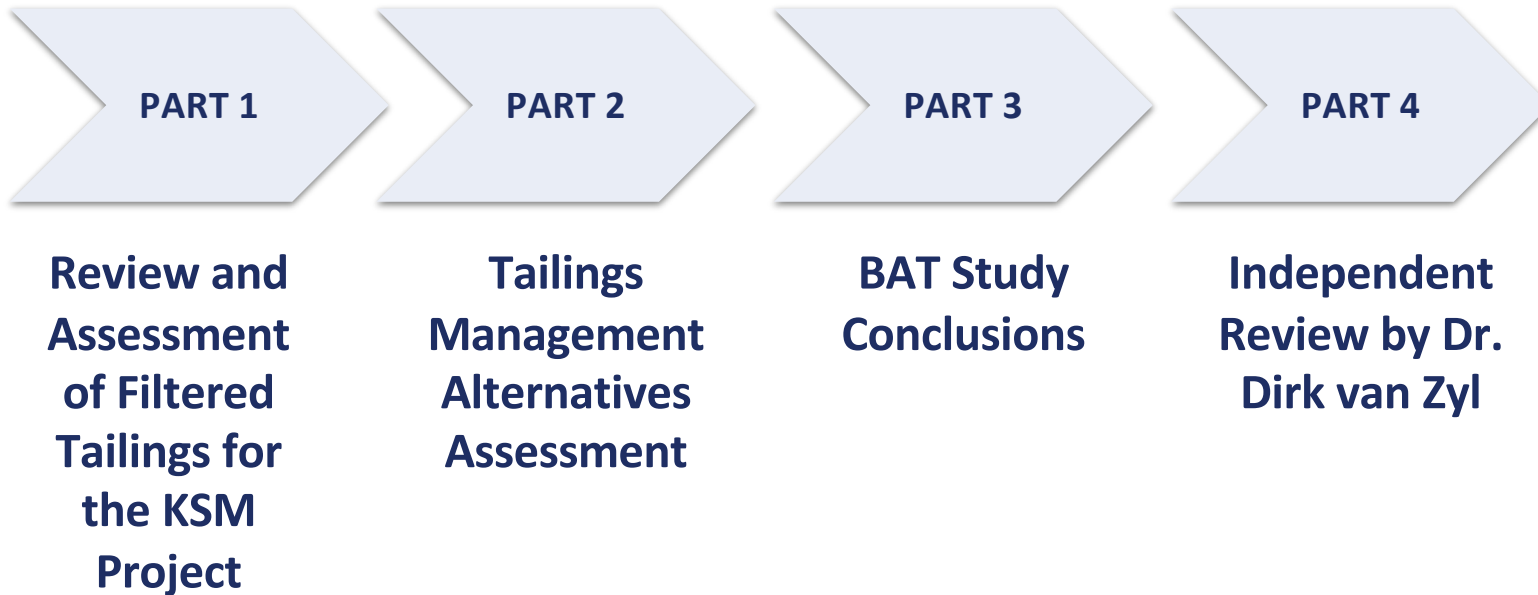
- The independent review panel that investigated the unfortunate breach of Mount Polley dam in 2014 recommended –
 - Best Available Technologies (BAT)
 - Best Available Practices (BAP)
 - Filtered tailings as “a prime candidate”
- BC mandated that all projects undergoing EA need to provide a BAT assessment

In spite of receiving EA approvals that approved the existing TMF design in 2014, **Seabridge voluntarily initiated the BAT study in 2015 to -**

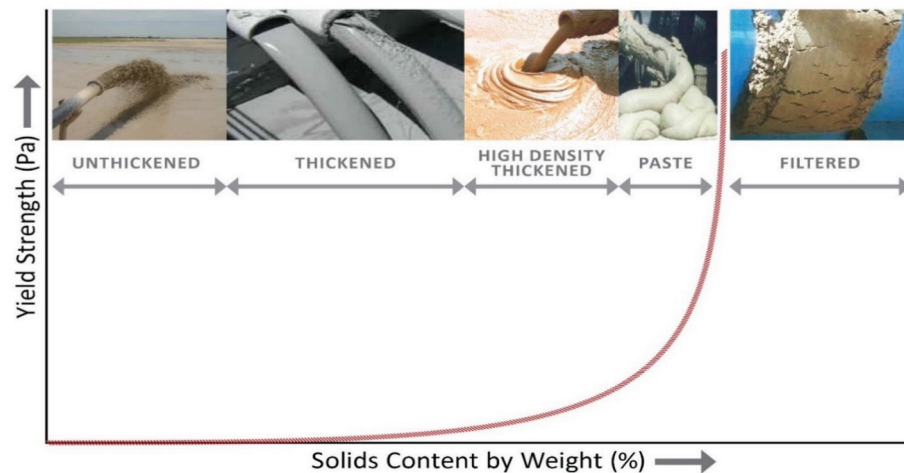
- Further review the EA-approved tailing management strategy;
- To confirm that the current plan is the most appropriate strategy to minimize physical, geochemical, biophysical, and social and community risks over the life of the tailing facility.



BAT Assessment Framework



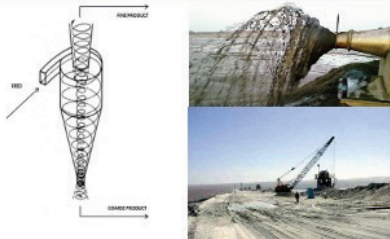
Part 1 - Tailings Dewatering Technologies



Dewatered State	Yield Stress Range (Pa)	Process Equipment	Degree of Saturation During Transportation	Transport Method
Unthickened	~0	None - product of the processing plant with no additional de-watering effort	> 100%	Pumped in slurry pipeline using centrifugal pumps
Thickened	<30	Conventional or high rate thickeners and flocculants	> 100%	Pumped in slurry pipeline using centrifugal pumps
High Density Thickened	<100	High density or high compression thickeners and flocculants	> 100%	Pumped in slurry pipeline using centrifugal pumps
Paste	>100	Deep cone thickener or a combination of thickening and filtering	>= 100%	Pumped in slurry pipeline using positive displacement pumps
Filtered	Not applicable – acts as a solid	Vacuum or pressure filters	< 95%	Trucks or conveyors

Part 1 - Particle Segregation Technologies

Cyclones



- Uses water and cyclone to separate the sand-sized particles
- Have been built in a wide variety of climates, most often for larger copper mines that have tailing containing coarse particles
- Provides robust stability, even in seismic areas with high levels of precipitation, and have been used around the world for over 50 years
- **Main advantages –**
 - Coarse sand recovered can be further dewatered and used in dam construction
 - With the removal of the coarse particles, the volume of tailing requiring storage in the facility is reduced

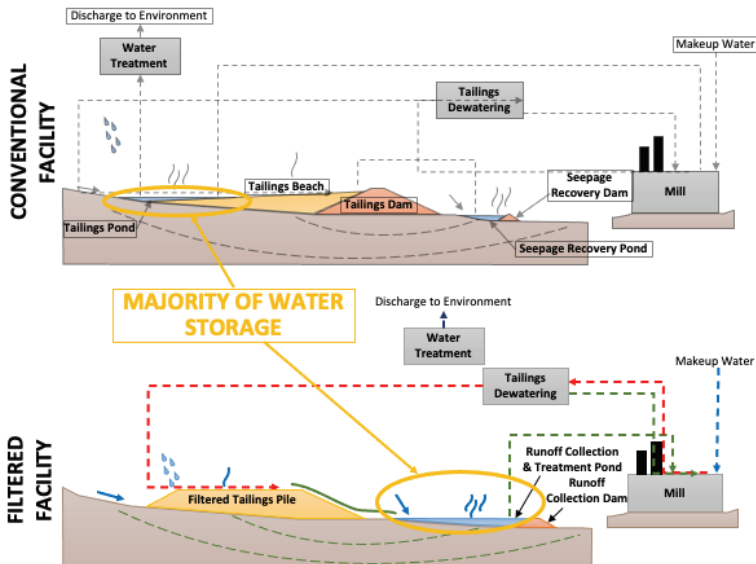
Flotation



- Use of gravity and/or chemicals to separate particles with different properties
- Minimizes the amount of tailing that requires special management, and results in better control of acid-generating material, reducing environmental risk.

- Both technologies can be use with conventional and dewatered tailings
- KSM uses both of these technologies

Part 1 - Types of Tailings Facilities

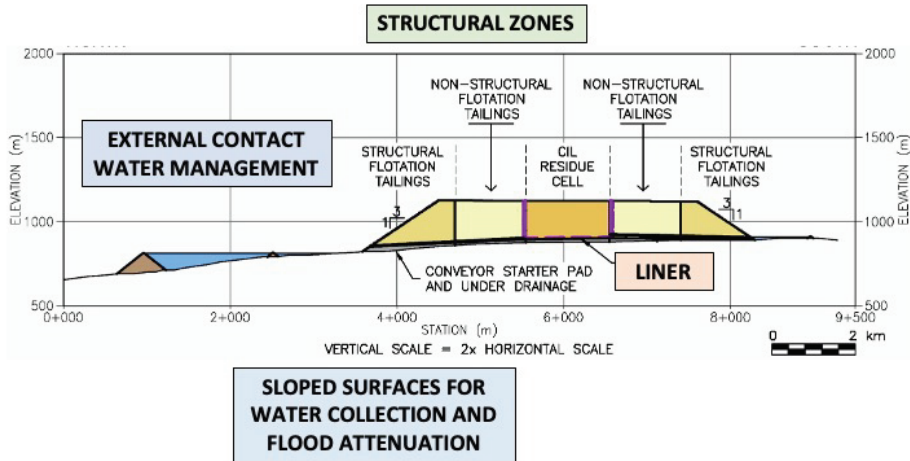


****MOVING
RISK OF
CONTACT
WATER
STORAGE****

Most people believe (or understand) using filtered tailings removes all risk, this is incorrect. Moving risk of contact water storage. Not eliminating it.

Conventional – deposited tailings with a reclaim pond
 Filtered facility – placed tailings with an external reclaim pond

Part 1 - Assessment of Filtered Tailings for KSM



Such a facility for this mine would include:

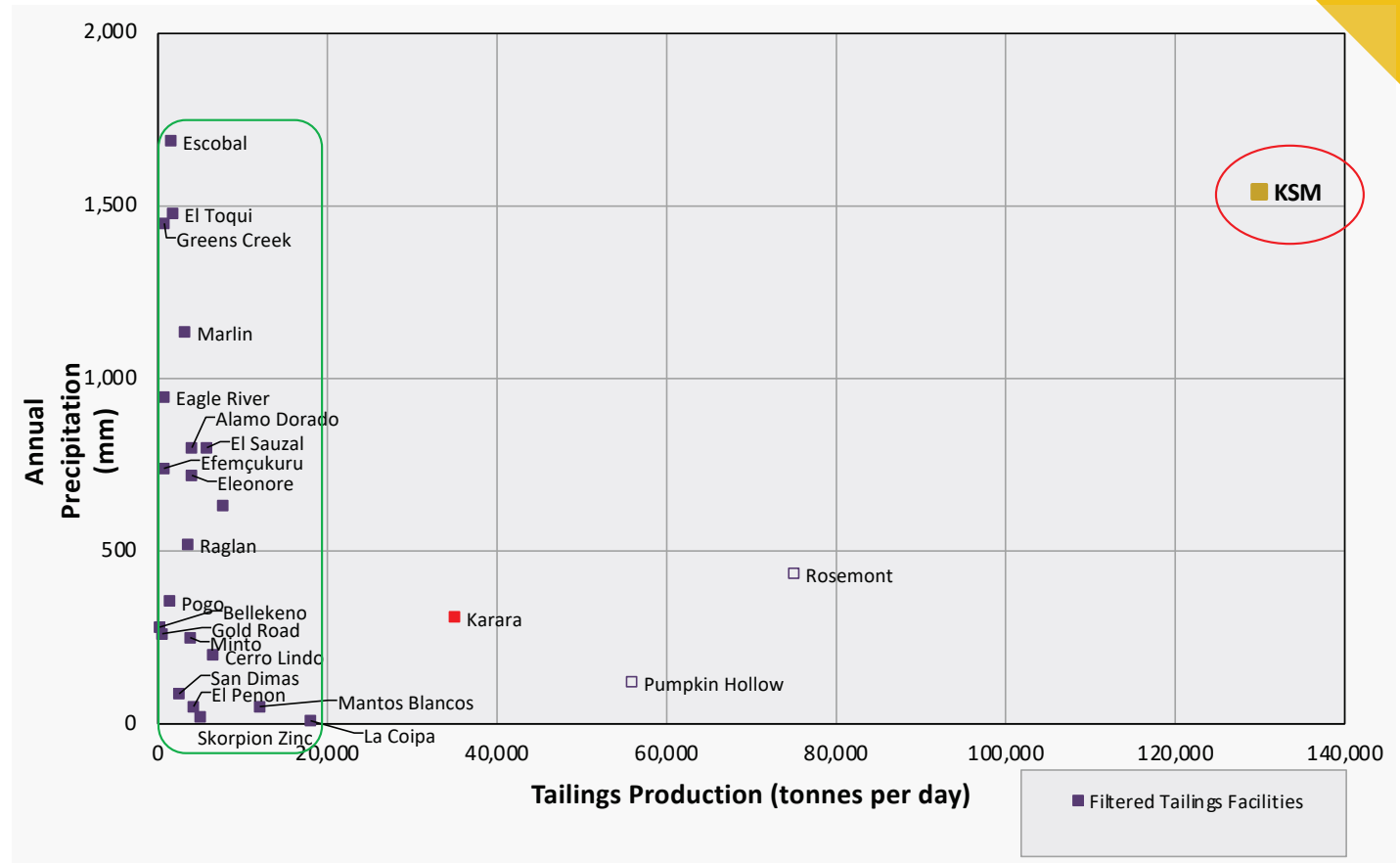
- This many filters – 130 filters
- This many conveyors – Over 10 conveyors operating at the same time
- This many equipment operators – Over ?? Dozers and ?? compactors

Part 1 - Key Factors In Selecting Suitable Tailings Technologies

Two Key Factors

- Climate in the mine's location
- Tailings production rates

No projects at the scale of the KSM Project (up to 130,000 tonnes per day) have used filtered tailing strategies in wet, cold environments.



Part 2 - Preliminary Alternatives And Screening of TMF

- **Environment Canada 2013** “Guidelines for the Assessment of Alternatives for Mine Waste Disposal”
- **Potential sites for an unthickened tailing facility using cyclone sand technology were explored** in the Alternatives Study prepared as part of the Project’s Application in 2013
- **EA approved Teigen-Treaty Cyclone Sand TMF**
- **Reviewed 13 sites with additional technologies or strategies:** high density thickened, paste, filtered, co-disposal with mine rock, and conventional (for storing CIL residue only)
- **8 sites were eliminated:** fish bearing lake, insufficient capacity, accessibility, sterilizing mineral deposits, and no perceivable advantage of re-evaluating the site with a new technology
- **Progressed to next step:** 31 alternatives at six locations

TMF sites and technologies considered in 2013 Alternatives Study and current BAT study

Site Selection	Technology Selection								
	Cyclone Sand Tailing (Conventional Facility)	High Density Thickened Tailing	Paste Tailing	Filtered Tailing	In-pit Disposal	Backfilling	Lake Disposal	Ocean Disposal	Co-disposal
Potential TMF Sites									
Unuk Valley	●			●					
Unuk Valley Terrace				●					
Tom Mackay Lake Terrace				●					
South Unuk Valley				●					
Ted Morris Valley	◇			●					
McTagg Valley	◇			●					
Sulphurets Creek Valley	◇			●					
West Teigen Lake	●			●					
Teigen-Treaty Valley	●	●	●	●					
Upper Treaty Valley	●			●					
Knipple Lake	◇			●					
Bowser Lake							◇		
Scott Creek Valley	●			●					
Burroughs Bay								◇	
KSM - Mitchell Pit					◇				
KSM - Underground Mine							◇		
KSM - Rock Storage Facilities									●

● Evaluated in the 2013 Alternatives Study - Preferred option.
 ● Evaluated in the 2013 Alternatives Study - Feasible.
 ◇ Evaluated in the 2013 Alternatives Study - Not feasible.
 ● Evaluated in this BAT study.

Part 2 – Critical Flaw Assessment

- Assessing the potential for implementing the five remaining tailing technologies—unthickened, thickened, paste, filtered, and co-disposal—at six different locations was assessed
- A critical flaw was defined as “a flaw so unfavourable that it alone is sufficient to eliminate the option from further consideration in the context of the KSM Project
- The potential for implementing paste disposal at Teigen-Treaty Valley was screened out due to the unacceptable risk of slope failure posed by the use of large paste slopes
- It was also found that capacity at the Project’s Rock Storage Facilities is not sufficient to allow for co-disposal of tailing with waste rock

Results of Critical Flaw Assessment

Site Selection	Technology Selection				
	Cyclone Sand Tailing (Conventional Facility)	High Density Thickened Tailing	Paste Tailing	Filtered Tailing	Co-disposal
Potential TMF Sites					
Unuk Valley Terrace				●	
McTagg Valley	●			●	
Teigen-Treaty Valley	●	●	◇	●	
Upper Treaty Valley				●	
Scott Creek Valley				●	
KSM - Rock Storage Facilities					◇

● Alternatives passed critical flaw assessment.
 ◇ Alternatives did not pass critical flaw assessment.

Part 2 – Preliminary Alternatives Screening

- Remaining alternatives were screened for undesirable aspects that increase the risk of embankment failure, tailing release, environmental impact, or health and safety hazards, relative to other options
- Where the site had had multiple feasible alternatives, the most favourable option was selected to advance to the next stage of analysis, provided the other alternatives did not have significant benefits over the selected option

Result for Alternatives Screening	
Site Selection	Technology Selection
	Cyclone Sand Tailing (Conventional Facility) High Density Thickened Tailing Filtered Tailing
Potential TMF Sites	
Unuk Valley Terrace	— — ●
McTagg Valley	◇ — ◇
Teigen-Treaty Valley	● ◇ ●
Upper Treaty Valley	— — ●
Scott Creek Valley	— — ●

● Potential preferred alternative.
 ◇ Alternative not carried forward.

Comparison of TMF Alternatives					
Alternative Details	Teigen-Treaty Cyclone Sand TMF	Teigen-Treaty Filtered TMF (Options 1 and 2)	Upper Treaty Filtered TMF	Scott Creek Filtered TMF	Unuk Valley Terrace Filtered TMF
	Tailing storage capacity (% of Project requirement)	100	100	100	100
Potential for expansion?	Yes	Yes	Yes	Yes	Yes
Embankment height (metres)	239	301	339	291	329
Flotation tailing structural fill (%)	12	32	27	27	73
Total catchment area (square kilometres)	60.7	37.9	114.8	76.9	28.6
Footprint area (square kilometres)	13.5	8.8	9.2	10.8	9.8

Part 2 – Evaluation- MAA

Site & Disposal Method

Account	Account Score (and Rank)					
	Teigen-Treaty Cyclone Sand TMF	Teigen-Treaty Filtered TMF Option 1	Teigen-Treaty Filtered TMF Option 2	Upper Treaty Filtered TMF	Scott Creek Filtered TMF	Unuk Valley Terrace Filtered TMF
Environment	144.6 (1)	97.5 (3)	102.4 (2)	95.7 (4)	92.6 (5)	83.7 (6)
Risks and Potential Impacts	104.4 (1)	72.9 (3)	76.9 (2)	70.9 (4)	69.2 (5)	68.4 (6)
Socio-economics	91.5 (1)	78.9 (2)	75.9 (3)	59.9 (5)	46.8 (6)	66.1 (4)
Technical	119.6 (1)	62.7 (3)	68.7 (2)	48.3 (6)	59.7 (4)	53.6 (5)
Project Economics	5.4 (1)	1.6 (3)	1.9 (2)	1.6 (3)	1.2 (5)	1.0 (6)
Account weighting	Total Score (and Rank)					
Equal account weighting	24.5 (1)	14.6 (3)	15.4 (2)	13.0 (4)	12.3 (5)	12.3 (5)
Standard account weighting	84.8 (1)	54.5 (3)	57.1 (2)	49.2 (4)	47.4 (5)	47.0 (6)
No Project Economics Account weighting	76.7 (1)	52.1 (3)	54.2 (2)	46.8 (4)	45.6 (5)	45.5 (6)
No Risks and Potential Impacts Account weighting	65.8 (1)	41.2 (3)	43.1 (2)	36.3 (4)	34.8 (5)	34.6 (6)

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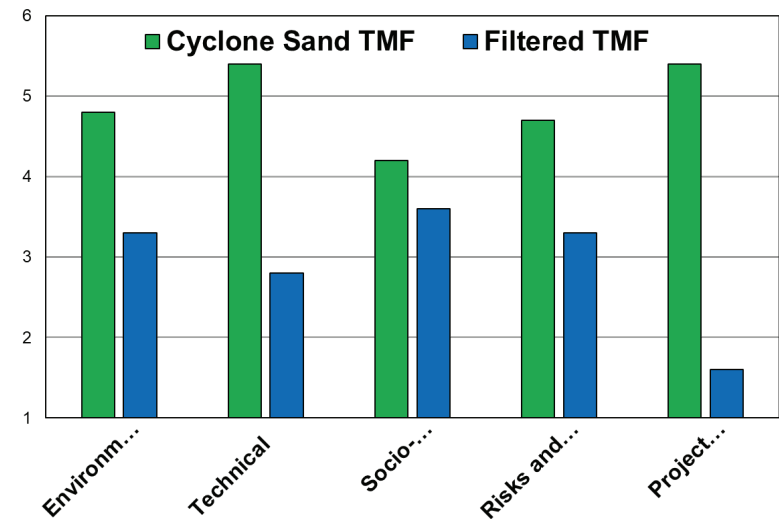
Part 3 - Conclusions of the BAT Study of KSM's TMF

- **The Teigen-Treaty site is the preferred TMF site**
 - More favorable foundation conditions and hydrogeological containment; small upstream catchment; less high value and sensitive fisheries and terrestrial habitat; fewer geohazards; and more favorable storage to structural fill ratios.
- **A filtered TMF is not practical for the KSM Project**
 - Reasons include the climate of the Project area is not well-suited to this tailing method and the scale of the filter plant needed for a project of this size is unprecedented and would likely have major challenges achieving design targets.

Challenges of Filtered Tailing

- Environmental (water management, CIL residue, increased land disturbance)
 - Winter Reliability at Production Rates
 - Long Term Stability of the Pile
- **The Teigen-Treaty Cyclone Sand TMF is the preferred management strategy for the KSM Project tailing**
 - The Teigen-Treaty Cyclone Sand TMF scored the highest for every account in the **Multiple Accounts Analysis (MMA)**; lowest impact on environmental considerations; most technically feasible to construct; fewest socio-economic concerns and least amount of risks and potential impacts.

Result of Multiple Accounts Analysis



Part 3 - Tiegen-Treaty Cyclone Sand TMF - BAT

Site Selection

- Small catchment
- Favorable foundation
- Good storage capacity
- Fewer geohazards
- No high value fish habitat

Design Features Providing Geochemical Stability

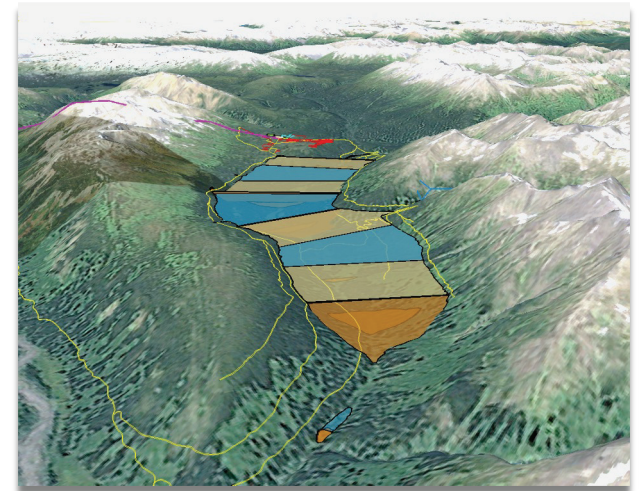
- Sulphide segregation
- PAG CIL residue submerged in lined central cell
- Glacial till core keeps majority of flotation tailings saturated minimizing oxidation of minor amounts of sulphides

Design Features Providing Physical Stability

- Resistance to seismic liquefaction (NPAG, dense, well-drained cyclone sand dams)
- Precedence for design
- Stability exceeds CDA Factors of Safety
- Design not prone to piping
- Long beaches and lots of flood storage (decrease likelihood of overtopping)

Closure

- Redundant spillways cut into rock
- Increased flood storage and beach lengths (by lowering spillway invert)
- Flow patterns returned to pre-mine conditions
- Rock cover on slopes
- PAG CIL residue covered and kept below water table
- Majority of flotation tailings kept saturated



Part 4 - Conclusion of Dr. Dirk van Zyl Review

- Commissioned an **independent review of the BAT report by Dr. Dirk van Zyl**, a world-recognized expert in tailings, mined earth structures and sustainability with more than 40 years of experience. He also sat on the Mount Polley Independent Expert Review Panel

Dr. van Zyl concluded:

“I support the overall conclusions of the KSM BAT report.”

- ***The existing KSM TMF design (EA approved) was determined to be the best for ensuring geochemical and geotechnical stability and minimizing overall environmental impacts***



More Information



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