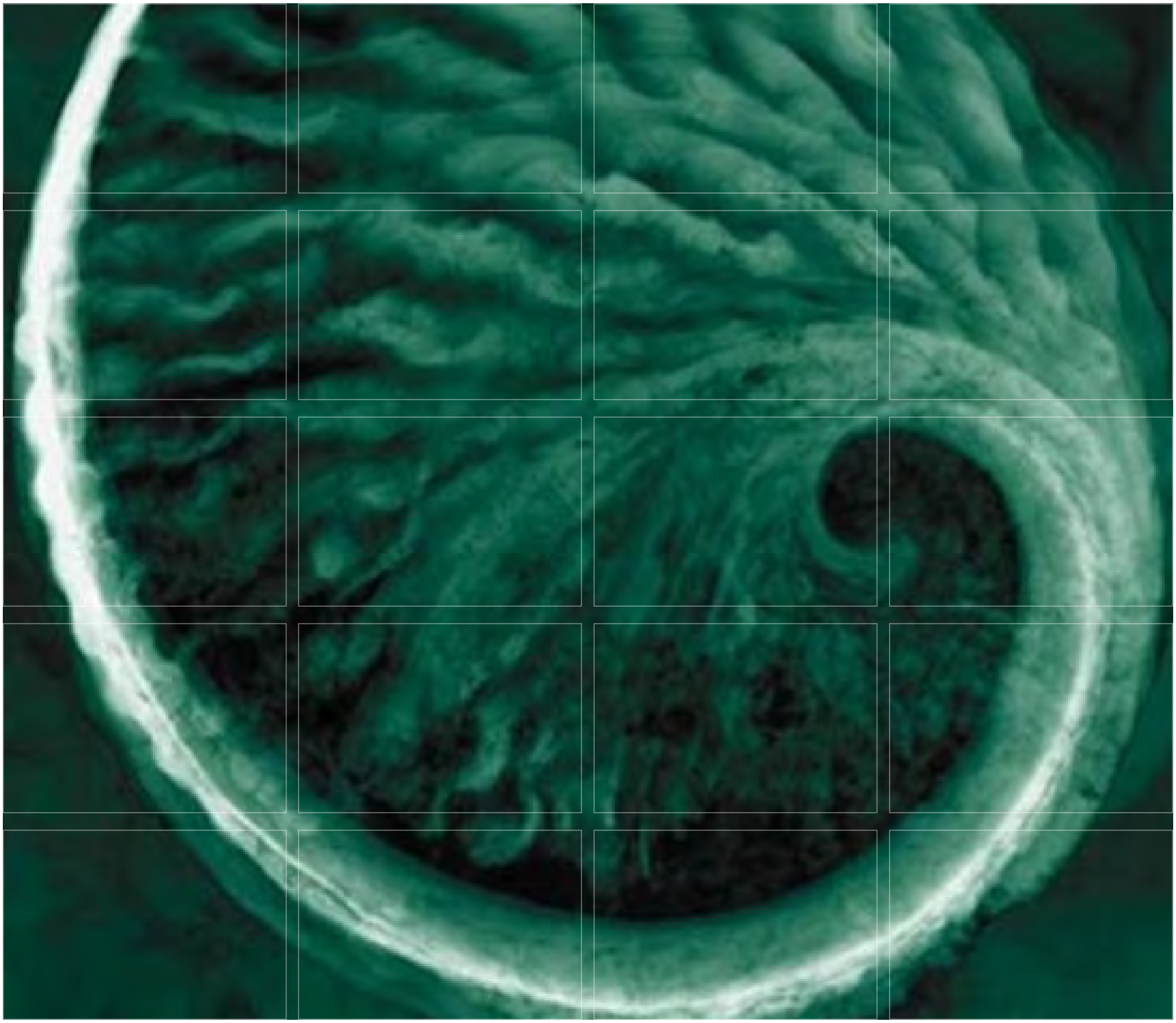

Prepared for:

CASINO

BUILDING OUR FUTURE TOGETHER

CASINO MINE PROJECT

BAT Study for Tailings and Waste Rock Management

Executive Summary

November 2018

ERM

The business of sustainability

Casino Mining Corporation

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BAT Study for Tailings and Waste Rock Management

November 2018

Project #0376359

Citation:
ERM. 2018. *Casino Mine Project: BAT Study for Tailings and Waste Rock Management*. Prepared for Casino Mining Corporation by ERM Consultants Canada Ltd.: Vancouver, British Columbia.

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ACKNOWLEDGEMENTS

Casino Mining Corp. (CMC) has undertaken this Best Available Technology (BAT) study for tailings and waste rock management with the assistance of Environmental Resources Management Ltd. (ERM) as the BAT study facilitator, and Knight Piésold Ltd. (KP) as the design engineer for the tailings management and waste rock facilities. Other consultants who have provided input into the study include Lorax Environmental Services Ltd. (Lorax) for geochemistry, Contango Strategies Ltd. for treatment wetlands, Environmental Dynamics Inc. for terrestrial ecology and wildlife, Hemmera for socio-economics and community, Marsland Environmental Associates for water quality, and Palmer Environmental Consulting Group for fisheries.

CMC established the Tailings Working Group to participate in and provided input to the study. The value of the input provided by this group cannot be understated. Among others, First Nations' representatives were involved throughout the study and provided comments and feedback, and raised questions that were instrumental in advancing the study. CMC will continue to work with this group to seek their input on refinements to the Project's mine waste management plans as the project moves forward. CMC greatly appreciates the investment of time and technical insight that has been provided by the working group throughout the study.

EXECUTIVE SUMMARY

CASINO PROJECT

Casino Mining Corporation (CMC) is proposing to develop the Casino Project (the Project), an open pit copper and gold mine located approximately 200 km west of Carmacks, and 300 km northwest of Whitehorse in Yukon, Canada. The Project includes an open pit, processing facilities, heap leach facility, temporary stockpiles, and associated infrastructure. The mine site will be accessed via a 120 km all-weather access road that will connect to the existing Freegold Road 83 km from Carmacks. The mine's water supply will be provided from the Yukon River via an approximate 17 km above-ground pipeline.

The Project is designed to process approximately 120,000 tonnes per day (t/d) of sulphide ore through a concentrator facility to produce copper and molybdenum concentrates, and to leach oxide ore to produce gold-silver doré bars over the 22-year mine life. During the life-of-mine operations, the Project will produce an estimated 956 Mt of tailings, of which 20% is classified as potentially acid generating (PAG) and 658 Mt of potentially reactive waste rock and overburden materials.

The mine site and a portion of the access road are located within the traditional territory of Selkirk First Nation (SFN). A portion of the access road is located within the traditional territory of Little Salmon/Carmacks First Nation (LSCFN), and the water supply pipeline is located within the overlapping traditional territories of Tr'ondëk Hwëch'in (TH) and SFN. The Kluane First Nation (KFN) and White River First Nation (WRFN) traditional territories are located downstream from the proposed mine and aspects of the project are within the asserted traditional territory of the WRFN.

BACKGROUND

In January 2014, CMC submitted an application to the Yukon Environmental and Socio-Economic Assessment Board (YESAB) for screening in advance of submitting applications for regulatory authorizations. In February 2016, following two rounds of information requests in 2014 and 2015, the YESAB Executive Committee determined that the Casino Project would require a panel review under the *Yukon Environmental and Socio-Economic Assessment Act* (YESAA). In citing its reasons for requiring a panel review, the Executive Committee stated that while "perpetual sub-aqueous storage of tailings and waste rock behind an engineered structure has been a generally accepted method of disposing of mine tailings", there is a "growing debate among Yukon First Nations, experts in the mining and engineering industries, governments and members of the public within and outside of Yukon on how to ensure both the geochemical stability of PAG tailings and waste rock and the physical stability of tailings dams in perpetuity"[1].

Recognizing the importance of safe and environmentally sound management of tailings and mine waste rock, CMC decided to defer the commencement of the panel review process, and undertook a

[1] Environmental and Socio-economic Effects Statement Guidelines. Panel of the Board Review Casino Mining Corporation Casino Mine. Yukon Environmental and Socio-economic Assessment Board (YESAB). June 20, 2016.

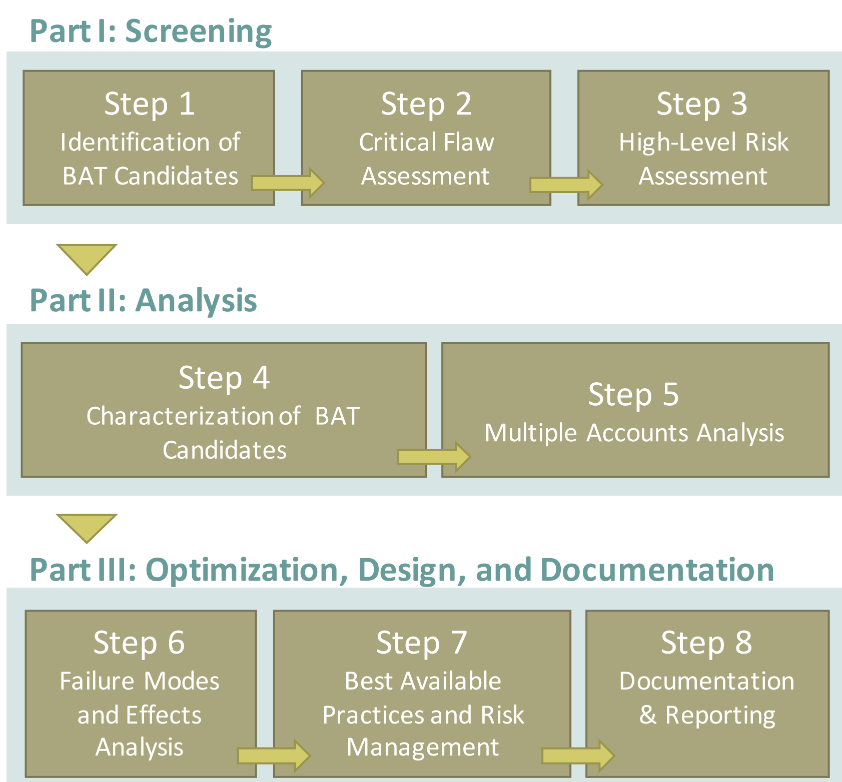
Best Available Technology (BAT) study to evaluate the design and approach for managing waste rock and flotation tailings. A BAT study considers and compares alternative locations, technologies, high level risks, and best available management practices for tailings and waste rock management.

Importantly, CMC established the Tailings Working Group (TWG) to provide input as the BAT study progressed. The TWG included representatives of First Nation governments, including their technical advisors, Yukon and federal government representatives, and a representative from YESAB. The group met in-person and by teleconference over 17 months (April 2017 to August 2018) to conduct the BAT study. The TWG reviewed the results and decisions made at each step of the study. Participation in the working group was without prejudice and does not constitute approval of the Project. The TWG functioned as an "information sharing" forum, rather than an advisory group.

METHODOLOGY

The BAT study followed the methods in Environment and Climate Change Canada's *Guidelines for the Assessment of Mine Waste Disposal* (2016), with supplemental analysis in two additional steps: 1) a high-level risk assessment, to identify lower-risk candidates; and 2) a failure modes and effects analysis, to identify and evaluate potential failure modes associated with the preferred alternative(s). Figure ES-1 identifies the steps in the BAT study.

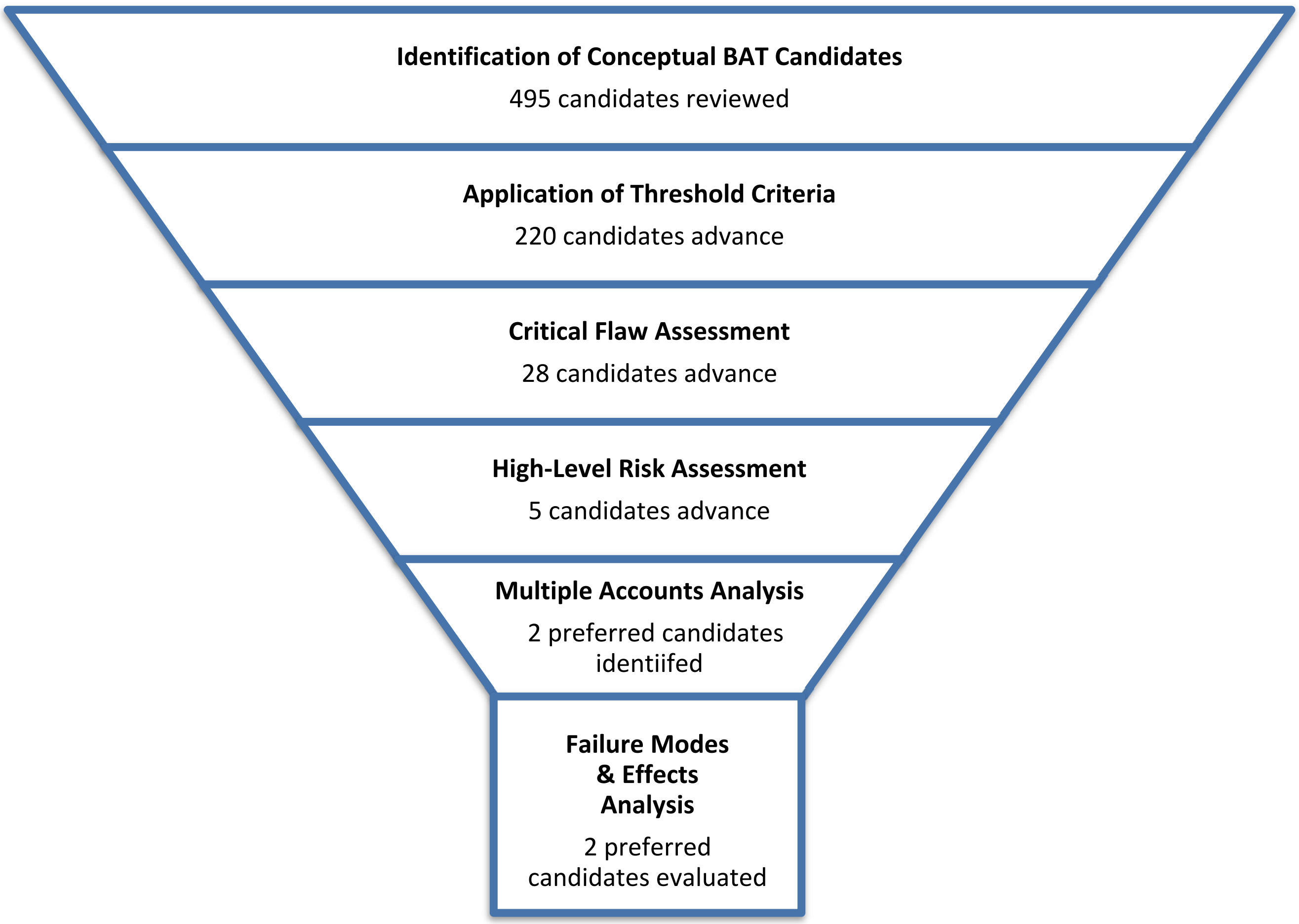
Figure ES-1. BAT Study Steps



BAT PROCESS OVERVIEW

The BAT study began in April 2017, with initial engagement of the TWG, establishment of the TWG terms of reference, and review of the planned BAT study methods. Over the course of the study, BAT candidates were systematically identified, eliminated and refined, as summarized in Figure ES-2 and described in the sections below.

Figure ES-2. Candidate Refinement through the BAT Study



IDENTIFICATION OF BAT CANDIDATES

CMC identified a combined total of 495 conceptual candidates by considering 11 possible locations and 45 possible configurations for tailings and waste rock storage (i.e., thickened, paste or filtered tailings; and sub-aerial or sub-aqueous waste rock storage).

Threshold criteria, including distance (i.e., 20 km from the deposit), storage capacity (i.e., sufficient storage capacity in a single or combination of locations, for the anticipated volume of tailings and waste rock produced over the life of the mine), and site characteristics (i.e., topography, foundation conditions, terrain stability, water management, and accessibility), were used to identify realistic BAT candidates and narrow the number of conceptual candidates. Applying the threshold criteria resulted in the elimination of the Lower Dip Creek site (45 candidates) due to an unreasonably large upstream catchment area, and a further 23 configurations with paste tailings technology, as paste tailings technology was found to be incompatible with the climate in the Project area. In total, 220 candidates met the threshold criteria and advanced to the Critical Flaw Assessment step.

CRITICAL FLAW ASSESSMENT

The critical flaw assessment eliminated candidates with flaws that could not reasonably be managed or mitigated. In consultation with the working group, CMC determined that sites with discharge to the Yukon River (i.e., sites at Coffee Creek, Excelsior Creek, Canadian Creek, Lower Britannia Creek, Upper Britannia Creek, and Sunshine Creek) were unacceptable due to their proximity—and related risk of impact—to this important regional waterway. Additionally, candidates that involved filtered PAG tailings, and those with sub-aerial waste rock storage, were also eliminated. Twenty-eight candidates, comprising of 4 sites and 7 configurations, passed the critical flaw test and advanced to the high-level risk assessment.

HIGH-LEVEL RISK ASSESSMENT

The high-level risk assessment (HLRA) aimed to identify and eliminate those candidates with higher levels of risk. The risk assessment was conducted in two parts. First, a high-level comparison of the candidates was reviewed at a workshop with the TWG, which resulted in the elimination of some sites and configurations due to clear disadvantages. This included elimination of the Upper Casino Creek site as it had the highest dam and no significant advantage over the Middle Casino Creek site, and the Upper Dip Creek site was eliminated due to the larger and undisturbed catchment area, potential permafrost conditions, and higher habitat values. Two of the configuration types were also eliminated in the HLRA based on: 1) the inability to provide secondary containment of PAG tailings upstream of waste rock, to ensure that in the event of a dam failure, the PAG tailings will not be released from the TMF area; and 2) the number of acid-generating impoundments.

The second part of the HLRA involved comparing and evaluating the remaining candidates in consultation with the TWG with respect to their relative risks in terms of safety, environment, and technical execution. The conclusion of these two parts resulted in five of the lower-risk candidates being selected to advance to the multiple accounts analysis (MAA). As identified in Table ES-1, these sites included both the Middle Casino and Lower Casino sites, with either a ponded water cover or a water table cover over the waste rock and PAG tailings at closure, as well as a fifth candidate that was adjusted to include management of a portion of the NAG tailings stream as a filtered stack; this candidate was located at Lower Casino Creek, with a ponded water cover over the waste rock and PAG tailings at closure. This fifth candidate was included at the request of the TWG.

Table ES-1. Candidates for Multiple Accounts Analysis

Candidate	Location	NAG Tailings	Closure Concept
MC-25	Middle Casino	Thickened slurry	Water Table Cover
LC-25	Lower Casino	Thickened slurry	Water Table Cover
MC-28	Middle Casino	Thickened slurry	Ponded Water Cover
LC-28	Lower Casino	Thickened slurry	Ponded Water Cover
LC-34	Lower Casino	Thickened slurry + filtered stack	Ponded Water Cover

CHARACTERIZATION OF BAT CANDIDATES

The five remaining candidates were characterized across five accounts: technical, biophysical environment, human environment, economics, and consequences of dam failure and 48 indicators across 16 sub-accounts that were identified in conjunction with the TWG (Table ES-2). These relevant and differentiating accounts, sub-accounts and indicators also provided the framework for the MAA.

Table ES-2. Summary of Accounts, Sub-Accounts and Indicators

Account	Sub-Account	Indicator
Technical	Operational risk	Complexity of mine waste transport
		Complexity of operational water management
		Complexity of closure cover
		Complexity of embankment structure
	Geochemical Stability	ARD mitigation challenges (operations)
		ARD mitigation challenges (post-closure)
		Metal leaching potential (operations)
		Metal leaching potential (post-closure)
		Adaptability of ML/ARD mitigation strategy for early closure
	Water management	Control of operational water balance
		Complexity of underdrain system
		Complexity of post-closure water management
		Ability to implement active water treatment (post-closure)
	Physical stability	Extent of foundation for dam(s)/stacks
		Enhanced stability (post-closure)
Biophysical Environment	Air quality	Fugitive dust emissions (TMF surface)
		TMF hauling distance
	Groundwater	Seepage Management (operations)
		Seepage Management (post-closure)
	Surface water quality	Degradation of downstream water quality (operations)
		Degradation of downstream water quality (post-closure)
		TMF wetland requirements (post-closure)
	Fish and aquatic habitat	Extent of fish habitat loss (direct)
		Quality of lost fish habitat (direct)
		Changes to surface water hydrology (operations)
		Diversity of directly affected fish community
		Diversity of directly affected benthic invertebrate community
	Terrestrial habitat	Direct loss of wetlands
		Risk of metals uptake to wildlife (plant-based)
		Risk of metals uptake to wildlife (water-based)

(continued)

Table ES-2. Summary of Accounts, Sub-Accounts and Indicators (completed)

Account	Sub-Account	Indicator
Human Environment	Archaeology and cultural heritage	Disturbance to known archaeological site(s)
		Disturbance to historic sites
	First Nations' Interests	Cultural and/or spiritual relationship to the environment
		First Nations' ability to pursue land use and cultural activities
		Sensory disturbance during operations
	Recreational and commercial land use	Built structures
		Sensory disturbance during operations
	End land use	Post-closure landscape
Economics	TMF Economics	Net Present Cost
Consequences of Dam Failure	Fair weather failure	Volume of water (post-closure)
		Dam factor (post-closure)
		Tailings deposition
		Secondary impact of dam failure (post-closure)
	Flood-induced failure	Volume of water (post-closure)
		Dam factor (operations)
		Dam factor (post-closure)
		Tailings deposition
		Secondary impact of dam failure (post-closure)

MULTIPLE ACCOUNTS ANALYSIS

The multiple accounts analysis includes both scoring (data-based) and weighting (value-based) elements to quantitatively calculate the weighted merit rating of each candidate. Each indicator was scored on a scale of one (worst) to six (best) based on the performance of each of the five candidates. Then, each indicator, sub-account and account was given a weighting to reflect its importance in the decision-making process (i.e., indicators within a sub-account were weighted relative to each other, sub-accounts within an account were weighted relative to each other, and accounts were weighted relative to each other). CMC developed weightings in consultation with technical consultants, and provided the opportunity to members of the TWG to also provide their own weightings so that the results could be compared.

Figures ES-3 and ES-4 illustrate the merit ratings for each candidate based on the weightings developed by CMC. The results indicate that both candidates at the Middle Casino (MC) site have significantly higher ratings than the candidates at the Lower Casino (LC) site. Candidates without a closure pond also have higher merit ratings. Overall, MC-25 (Middle Casino, water table cover) has the highest rating, followed by MC-28 (Middle Casino, ponded water cover).

Figure ES-3. Multiple Accounts Analysis – Results by Candidate (CMC's Weightings)

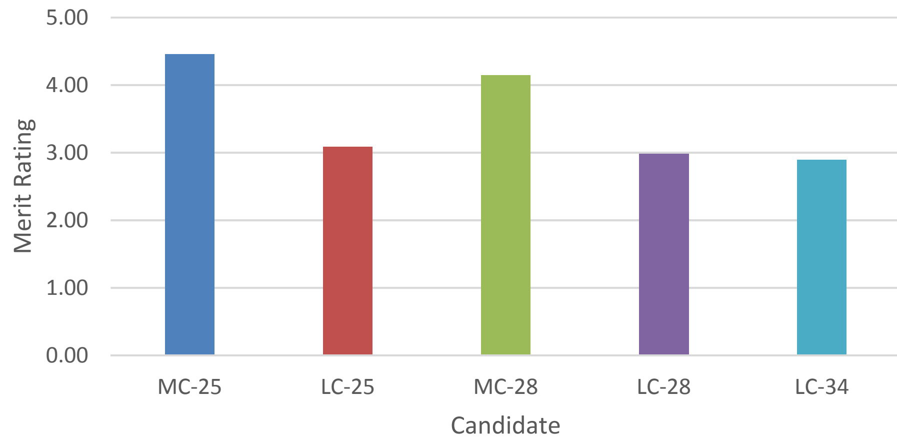


Figure ES-4. Multiple Accounts Analysis – Results by Sub-Account (CMC's Weightings)

Note: Higher account merit rating indicates higher preference.

CMC reviewed the MAA results with the TWG. The group recognized that the difference between the two highest-rated candidates is the type of closure cover, and thus recommended that both MC-25 and MC-28 be evaluated in the failure modes and effects analysis (FMEA).

FAILURE MODES AND EFFECTS ANALYSIS

CMC held several meetings with the TWG to conduct the FMEA, which included both the identification of potential failure modes, and the evaluation of the risk posed by each failure mode. In total, 88 potential failure modes were identified and discussed, and a risk rating was calculated for each failure mode (Table ES-3). Results of the FMEA highlighted the difference in closure cover between MC-25 and MC-28. Risks associated with the water table closure concept (MC-25) relate to the ability to maintain saturation and avoid oxidation of PAG materials in the post-closure phase, whereas risks identified for the closure pond concept (MC-28) include those related to long-term embankment stability and seepage management.

Table ES-3. FMEA Risk Ratings

	Number of Failure Modes			
Risk Rating	MC-25 and MC-28	Specific to MC-25	Specific to MC-28	Totals
Very Low	7	0	0	7
Low	23	3	4	30
Medium	19	9	10	38
High	8	4	1	13
Very High	0	0	0	0
Totals	**57**	**16**	**15**	**88**

CONCLUSIONS AND NEXT STEPS

The BAT study has identified two preferred candidates, MC-25 and MC-28. Both candidates involve zoned storage of thickened NAG and PAG tailings, and waste rock stored behind a cyclone sand embankment located in one facility at the Middle Casino Creek site. The preferred design concept is waste rock located upstream of the NAG tailings, and PAG tailings located within a defined cell within the waste rock storage area.

The candidates differ in terms of closure, and both Ponded Water Cover (MC-28) and a Water Table Cover (MC-25) are identified as viable closure alternatives. Both MC-28 and MC-25 have been evaluated in the FMEA, and the risks identified in the FMEA will be further investigated and mitigated during final design.

Following the results of the BAT Study, CMC will continue to engage with the Tailings Working Group through the advancement of the engineering of the MC-25 and MC-28 options.