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Review of the determination of security for reclamation and closure of the Wolverine Mine

July, 2019

Yukon Department of Energy, Mines and Resources

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Per the Yukon's legislative and policy framework ("the Framework"), the Yukon Government ("the Government") holds a security for the cost of mine reclamation and closure for mines operating in the Yukon. At a minimum of every two years, mine operators must submit a reclamation and closure plan for approval by the Government. Once the Government has approved the plan, it determines the cost of reclamation and closure activities, and holds a security of that amount in the case that the mine operators cannot carry out reclamation and closure themselves.

The Wolverine Mine, operated by Yukon Zinc Company (YZC), began operations in 2011. In January 2015, it entered temporary closure due to a drop in metal prices. In March 2015, the company entered creditor protection under CCAA. When the company exited protection in October 2015, it paid the outstanding security of $2.8 million to bring the amount of security to $10.6 million. Throughout temporary closure, the costs for reclamation and closure increased substantially. At the same time, no additional security was collected. In December 2017, the total security amount was assessed at $35.5 million, leaving a $24.9 million dollar shortfall.

Our mandate

The scope of this report is to assess the following:

- Did the Government correctly implement the Framework for the determination of financial security for quartz mine site reclamation and closure for the Wolverine Mine
- Is the Framework for quartz mine site reclamation and closure effective for the circumstances encountered with the Wolverine Mine;
- Are there general improvements that could be made to the Framework to minimize the financial risk to the Government associated with mine site reclamation and closure, particularly to address circumstances similar to those encountered with the Wolverine Mine, while recognizing the need for a competitive financial security regime

Methodology

To complete this Assessment, we took the following major steps:

- Reviewed key materials and correspondence related to the Wolverine Mine
- Interviewed consultants who prepared relevant reports
- Interviewed Government staff who were involved with the Wolverine file
- Analyzed the key reasons for the security shortfall
- Prepared a report presenting our findings

Key findings

Through our review, we identified the following key issues that led to an increase in security costs:

- **Assessment of company risk**: YZC's poor financial situation was a major driver of the funding shortfall. However, the current Framework does not include an assessment of companies' financial risk or sensitivity to external factors such as metal prices.
- **Mine flooding**: The mine was flooding during temporary closure, and flooded to the top in June 2017. At this point, excess water was rerouted to the tailings storage facility (TSF), where it became much more expensive to treat.
- **Water treatment plant**: If a water treatment plant had been present onsite, underground water would not have been diverted to the TSF.

- **Internal communications practices**: Government decision-makers were not informed of the urgency of the situation at the Wolverine Mine in a timely manner. This prevented them from taking measures to limit the increase in liabilities.
- **Delays**: YZC repeatedly delayed implementation of temporary closure measures in ways that increased liabilities.
- **Spending of security**: Government decision-makers did not discuss spending of security in order to limit certain liabilities on the site, particularly with respect to water treatment.
- **Information gathering and inspections**: Site inspectors gather information about license compliance, but not on any additional risks at the site.

Policy options

We have developed the following policy options to help prevent such shortfalls in the future. In developing these options, we considered both Yukon's desire to remain competitive and the need to limit future liabilities.

1. **Risk assessment**: The Government should consider an initial risk assessment prior to granting a license to a mine operator. This risk assessment should consider:

    a. The company's financial statements
    b. The company's financial relationships to its parent company, if applicable
    c. The life of mine plan and feasibility study
    d. The sensitivity of the above to changing circumstances including metal prices

    Based on the results of the risk analysis, the Government may choose to adjust the amount of security required, including possibly requesting more than 100% of estimated closure and reclamation costs for high-risk applicants.

2. **Spending of security funds**: The Government should consider being more proactive in identification of risks that would increase liabilities at the site. In this case, it appears that the Government understood the risks present at the site, but did not enforce certain necessary actions by YZC, principally the installation of bulkheads and the building of a water treatment plant. In this case, the Government could have stepped in to prevent future increases in liabilities at the site, but did not do so. In the future, the results of the risk assessment should inform decisions around when to intervene.

3. **Communications protocol**: The Government should consider implementing a clearer communication protocol whereby risks are escalated to senior decision-makers in a timely and clear manner.

Introduction

PricewaterhouseCoopers LLP ("PwC," "we," or "us") was engaged by the Yukon Government (also referred to as "Government") to provide an independent assessment of the Department of Energy, Mines and Resources (EMR) review and approval of reclamation and closure plans (RCPs), and determination of financial security for the Wolverine Mine, Yukon ("Assessment").

Per the Yukon's legislative and policy framework (also referred to as the "Framework"), the Yukon Government holds a security for the amount of money needed for mine reclamation and closure for mines operating in the Yukon. The Yukon Government must approve an RCP before the license is issued. Periodic updates of this plan are required, at a minimum of every two years. Once the Government approves the plan, it determines the cost of reclamation and closure activities in the plan, and takes a security from the mine operator at that amount. The cost is the estimated amount that would allow the Government to carry out reclamation and closure themselves in the case that the mine operator cannot carry out such activities.

The Wolverine Mine, operated by Yukon Zinc Company (also referred to as "YZC" or the "Company"), began operations in 2011. In January 2015, it entered temporary closure due to a decline in metal prices. In March 2015, the Company entered into creditor protection under CCAA (Companies' Creditors Arrangement Act). When the Company exited CCAA protection in October 2015, it paid outstanding security of $2.8 to bring the amount of security to, $10.6 million. During the temporary closure, estimated costs for reclamation and closure increased substantially. At the same time, no additional security was collected from the Company. In December 2017, the total security amount required was estimated at $35.5 million, leaving the Government with a $24.9 million dollar shortfall.

In this context, the objective of our Assessment is to answer the following questions:

- Did the Department correctly implement the legislative and policy framework for the determination of financial security for quartz mine site reclamation and closure for the Wolverine Mine?
- Is the Framework for quartz mine site reclamation and closure effective for the circumstances encountered with the Wolverine Mine?
- Are there general improvements that could be made to the Framework to minimize the financial risk to the Yukon Government associated with mine site reclamation and closure, particularly in circumstances similar to those encountered with the Wolverine Mine, while recognizing the need for a competitive financial security regime?

Mining projects in Yukon usually require both a Quartz Mining License (QML) and a Water License (WL). The scope of this report applies only to the QML, and the financial security determination for the Wolverine Mine pursuant to the *Waters Act* is outside the scope of this review.

Unless otherwise specified, all dollar figures in this report are in Canadian dollars.

The key authors of this study are:

- Michael Dobner, National Leader, Economics Practice
- Gemma Stanton-Hagan, Senior Economist
- Manpreet Juneja, Economist

Scope of review

To prepare this assessment, we have reviewed and, where appropriate, relied upon various documents and sources of information. By general classification, these sources include the following:

- Policy and regulation documents governing mining in the Yukon
- RCP documents
- Reports by consultants hired by the Yukon Government
- Correspondence between the Yukon Government and Yukon Zinc Company
- Briefing notes prepared for Yukon Government officials
- Interviews with Yukon Government employees
- Interviews with consultants who have been hired by Yukon Government or Yukon Zinc Company

Policy and regulation framework

This section outlines elements of the current policy and regulation framework that are relevant to our Assessment.

Background

On April 1, 2003, responsibility for regulating mining projects in the Yukon was moved from the Federal government to the Yukon Government. Prior to this date, several mines in the Yukon were abandoned or under-secured. These sites are addressed for remediation purposes in the Devolution Transfer Agreement made between the Government of Canada and the Government of Yukon. The Wolverine Mine is the first case, since the Government of Yukon took over this responsibility, where a mine operator was unable to pay security obligations under its Quartz Mining License. However, prior to 2003 several mines in the Yukon were abandoned or under-secured.

The current Framework aims to support sustainable development in Yukon. The security held by the Yukon Government is designed to provide funding for closure and reclamation of mines in the case that the mine operator is not able to carry out these tasks. However, the Government carrying out closure and reclamation is a worst-case scenario that all parties would want to avoid. Moreover, due to the Yukon's small population and tax base, it is less able to absorb the costs of abandoned or under-secured mines compared to other provinces in Canada.

Policy and regulation framework

This sub-section reviews relevant aspects of the legislation, policy, and guidelines framework that governs mine reclamation and closure in the Territory. It summarizes key provisions of the Framework on the topics of RCP approval and development, costing of RCPs, permissible types of security, review period, uses of security, and temporary closure.

The following regulations, policies, and guidelines govern mine reclamation and closure policy in the Territory:

Document	Date Introduced	Contents
Quartz Mining Act (QMA)	2003	The legislative requirement for licensees to reclaim and close sites and the need for financial assurance
Security Regulation	2007	The types of security that may be held and provisions for collecting and releasing security
Yukon Mine Site Reclamation and Closure Policy	January 2006	Details the requirements for RCPs and security
Yukon Mine Site Reclamation and Closure Policy Financial Guidelines	April 2014	Guidance on costing of security amount and when an RCP needs to be updated
Reclamation and Closure Planning for Quartz Mining Projects	August 2013	Plan requirements and closure costing guidance

In the remainder of this section we summarize key processes that are relevant to our Assessment, drawn from the legislation, policy, and guidelines described above.

RCP development and approval

Per the document on *Reclamation and Closure Planning for Quartz Mining Licenses*: "A Reclamation and Closure Plan describes how a quartz (hard rock) mine will be reclaimed and closed to return the mine site to an environmentally stable condition suitable for future land uses. RCPs also provide the basis for estimating the financial liability associated with a mining project."

An approved RCP is a mandatory prerequisite for approval to begin mining activities. Although each RCP is unique, they are all expected to address certain objectives and follow certain principles, as defined in the *Reclamation and Closure Planning for Quartz Mining Projects* document. As part of preparing an RCP, mine operators are expected to engage with interested parties including affected First Nations, local communities, assessment/regulatory authorities, and non-governmental organizations. Mine operator are expected to fully fund the reclamation and closure of the mine site.

The Department of Energy, Mines and Resources (EMR) is responsible for administering the Framework, some in coordination with the Water Board. According to the Framework, the process for RCP approval needs to include the following elements:

- The mine operator is responsible for preparing the proposed RCP, and may employ a third-party consultant to prepare it.
- The mine operator also submits an estimate of the funds required for security.
- EMR must approve both the RCP and the security estimate.
- EMR approval of the RCP may be subject to terms and conditions that must be followed in order to maintain the license in good standing. It may also request changes to the RCP prior to approval.
- Once EMR approves an RCP, the Government also determines the final security amount, which must be paid by the mine operator by the date set by EMR to maintain the license in good standing.

Costing of RCPs

The security amount is the estimated cost for the Yukon Government to reclaim and close a mine, were it to close at any point in time.

According to the Security Regulation for the Quartz Mining Act: "In determining the amount of security, if any, to be furnished by a licensee, an applicant for a license, or the prospective assignee of a license, the Minister[1] shall consider:

a. The degree of risk of any significant adverse environmental effects from development and production;
b. The estimated cost to implement any plan addressing reclamation of the site during and after development and production that is approved pursuant to a licence;
c. The costs that would be incurred by the Government of Yukon if it was required to reclaim the site of development and production, including costs associated with post-closure measures, monitoring and on-going maintenance to address mitigation of any significant adverse environmental effects from development and production; and
d. Any security furnished or deposited pursuant to the Waters Act or other Yukon enactment.[2]

The Quartz Mining Act also allows the Minister to consider the past performance of the applicant.[3]

[1] Minister of Energy, Mines and Resources
[2] Quartz Mining Act Security Regulation, Section 3.
[3] Quartz Mining Act Section 139(2)

The cost estimate may be prepared by a third party or the mine operator. Estimates for engineered structures and design must be sealed by a professional engineer licensed to practice in the Yukon. Parties (i.e. the Government and the mine operator) may consult other professionals for specialized work and estimates where required.

An RCP must include cost estimates for three scenarios:

1. Closure from the current state
2. Peak closure costs anticipated over the next two years
3. Closure at the end of the mine life

Prior to the guidance change in August 2013, closure costs were estimated from three starting points: Year 0, Year 2 and end of mine life. The guidance change caused a significant increase in Wolverine's security estimate as a result of new components considered in cost estimates outlined in the guidance. The largest change was the introduction of "operational" costs that had not been incurred, but were required for closure (previously omitted from costing).

Permissible types of security

Per the *Security Regulation*, the following types of security are permitted:

a. "Cash
b. A promissory note guaranteed by a bank in Canada and payable to the Government of Yukon;
c. A certified cheque or bank draft drawn on a bank in Canada and payable to the Government of Yukon;
d. A government guaranteed bond;
e. An irrevocable letter of credit from a bank in Canada;
f. A surety bond that is acceptable to the Government of Yukon; or
g. Any other form of security approved by the Minister in accordance with the act."

Yukon Mine Site Reclamation and Closure Policy Financial Guidelines provide that a pledge of assets may be used as security if there are no liens on the assets, subject to approval by the Government of Yukon and other conditions.

Review period

Security estimates must be reviewed either every 24 months or in the case of the following:

- Expansion of the mine not contemplated in the development of the existing plan
- Change in reclamation procedures identified as a result of studies or more cost effective methods
- The identification of unforeseen, significant hazards or operational changes

Revisions should take into consideration the following:

- Progressive reclamation by the mine operator or failure to meet reclamation objectives
- Changes in liability, knowledge, technology, or risk
- Costs associated with temporary closure
- Changes to the Net Present Value (NPV) of security
- Other material changes reported by the mine operator deemed by the Minister to significantly change the liability during the period covered by an approved RCP

Under the *Security Regulation,* the cost estimate may also be reviewed and amended periodically based on request from the mine operator or the Minister's own determination. For any increase in the security determination, the Minister must provide the mine operator with all documents used in this determination and accept written comments on the determination.

In the event of an increase in security, the *Security Regulation* states: "If the outstanding reclamation and closure liability increases, government may approve short term measures to address immediate site mitigation that offsets the increased liability rather than requiring additional financial security being posted by the mine operator." [4]

Uses of security

The Government may draw on the security in the case of mine closure or where permitted by the Quartz Mining Act. The Quartz Mining Act permits two uses of the security other than reclamation and closure:

- Where a mine operator does not comply with direction from the Chief,[5] or there is an unnecessary danger to persons, property, or the environment (section 146 of the QMA)
- Where an inspector believes that the site or part of the site has been abandoned by the mine operator (section 147 of the QMA)

When one of these conditions is triggered, the Government has the right under section 139 (3) and (4) of the QMA to spend the security in ways that are not necessarily laid out in the reclamation and closure plan.

Temporary closure

Temporary closure is permitted under the Framework. Per the *Reclamation and Closure Planning for Quartz Mining Projects*: "temporary closure is a closure in which mining related activities cease with the intent of resuming activities in the near future." A temporary closure is a closure lasting longer than six months and is not expected to last longer than five years. Maximum duration is often defined in the Quartz Mining License.

Per the *Yukon Mine Site Reclamation and Closure Policy Financial Guidelines*: "Upon notice or determination of a temporary closure, the Yukon government will determine whether or not a review of the approved reclamation and closure plan, outstanding liability and adequacy of security shall be completed.

The mine operator shall conduct planning and assessments in discussion with relevant Yukon government agencies to prepare for the temporary closure.

Where a mine operator provides the Yukon government timely notice of an anticipated early closure, including a reasonable assessment of changes to liability and plans, the Yukon government may approve short-term measures that offset liability rather than requiring additional financial security for temporary closure measures.

The Yukon government may consider a mine operator's effort to anticipate and address temporary closures and associated liabilities.

Upon re-opening of a mine that has been subject to a temporary closure, security to cover incremental liabilities shall be promptly released by the Yukon government, except where a current risk assessment demonstrates an ongoing and significant risk of another temporary closure prior to the projected end-of-mine life."[6]

[4] Yukon Mine Site Reclamation and Closure Policy: Financial Guidelines, Guideline #F-14
[5] The Chief is the director of EMR, who is given this designation by the Minister.
[6] Yukon Mine Site Reclamation and Closure Policy: Financial Guidelines, Guideline #F-14

Wolverine Mine key information and timeline

This section reviews the key information about the Wolverine Mine that is relevant to our Assessment.

The Wolverine Mine is an underground mine producing zinc, silver, copper, and lead. It has a capacity of 1,700 tonnes per day and had an estimated mine life of nine years at the time of development.

The Wolverine Mine is owned by Yukon Zinc Corporation. Until December 2018, YZC was a privately held company owned by Jinduicheng Molybdenum Group Co. Ltd., a Chinese state owned enterprise that is a large molybdenum miner. YZC is the first majority Chinese-owned company to bring a mine into production in Canada. On December 4, 2018, YZC notified the Yukon government that it had closed a deal with Phoenix Global Investments and the new owner had taken possession of the company. YZC has never owned or operated owned any other mines.

The following timeline shows key events for operational, financial, and RCP-related events. Each RCP is given a version number i.e. "V1" etc. as they are updated and put in place.

Table 1: Wolverine Mine timeline

Year	Operational	Financial	RCP
Pre-2010	**2009-2010**: major site construction		**June 2006**: V1 RCP approved with financial security of $7.7 million **December 2006**: Quartz Mining License Issued **March 2008**: V2 RCP approved with financial security estimate of $9.1 million
2010			**April 2010**: V3 RCP approved with financial security estimate of $8.3 million
2011	**2011**: Wolverine mine starts production		**January, 2011**: Additional security requested due to deposit of tailings into the impoundment
2012	**March 2012**: Wolverine mine reaches 60% of capacity		**September 2012**: V4 RCP approved with financial security estimate of $10.6 million
2013	**January 2013**: Wolverine mine reaches full capacity		**July 2013**: V5 RCP approved with financial security estimate of $10.6 million

	July 2013: production reduced to 75% of capacity		
2014			
2015	**January 2015**: YZC enters temporary closure **February 2015**: YZC lays off most staff. A 5-man care and maintenance crew is on site to maintain the mill and conduct environmental monitoring	**March 2015**: YZC declares financial difficulties under CCAA due to unfavourable market conditions, mainly decreases in the price of zinc and silver. **April 2015**: Restructuring of YZC under CCAA **October 2015**: YZC exits CCAA and pays outstanding security in the amount of $2.8 million to bring the amount of security to, $10.6 million	**December 2015**: V6 RCP approved
2016			**February 2016**: V6 RCP security estimate of $21.6 million **December 2016**: YZC submits V7 RCP
2017	**June 7, 2017**: Underground workings flooded to surface		**September 2017**: YZC submits second V7 RCP **December 2017**: YZC submits third and final V7 RCP
2018	**December 2018**: request for extension of temporary closure granted		**May 2018**: V7 security set at $35.5 million

Chronology of events

This section presents key events from January 2015 to closure.

V5 RCP (March 2013)

The last RCP prior to 2015 was the "V5," approved in March 2013. The total security determination for this RCP was $10.6 million.

In June 2013, the Government required YZC to increase the security held from $7.7.8 million to $10.6 million per the V5 RCP. YZC and EMR agreed on a payment schedule, but only one payment was made and it did not meet the entire security obligation.

As noted previously, in March 2015, YZC applied for and was granted court protection under the CCAA. When YZC exited CCAA protection in October 25 2015, it paid the remaining security, bringing the security held to $10.6 million.

RCP guidance change

In August 2013, the guidance document titled "Reclamation and Closure Planning for Quartz Mining projects – Plan requirements and closure costing guidance" was updated. This document introduced the requirement to include new closure costing items, such as mobilization and demobilization, contingencies, and operational items required for closure such as a water treatment plant. For example, the V5 RCP assumes that waste rock will be put back underground during the operation of the mine. However, during temporary closure YZC could not do that because the mine was flooding, so the cost of managing and closing the waste rock at surface needed to be included as part of the security.

Temporary closure (January 2015)

In January 2015, the Wolverine Mine entered temporary closure following a decline in metal prices. Temporary closure is permitted under the Quartz Mining License as long as it is provided for in the RCP. To maintain their licence in good standing, mine operators must comply with the requirements of temporary closure as outlined in the RCP or apply to amend the licence.

The V5 RCP commits YZC to the following activities during temporary closure:

- Ensure physical and chemical stability of the site
- Monitor and maintain buildings and facilities
- Maintain the site, maintain access roads, and site security and access protocols
- Dewater the mine to prevent flooding of the underground workings and prevent uncontrolled discharge of groundwater at the portal
- Collect site runoff from the industrial complex and waste rock pad
- Operate and maintain water management structures and treatment facilities to ensure no uncontrolled discharges occur
- Store surface equipment that is not required for site activities in appropriate areas in no load condition
- Return chemicals and reagents with a short shelf life to suppliers or manufacturers or ensure proper disposal
- Empty contents from storage tanks if required

However, YZC's site manager at the time was not aware that YZC needed to take temporary closure measures, and the Company appeared unaware of its obligations with respect to temporary closure, as defined by their Quartz

Mining License. Following correspondence with the Government in January and February 2015, Mr. Lu, the CEO of Yukon Zinc Company, committed to complying with the terms of the license for temporary closure.

During the temporary closure, YZC repeatedly noted that it was looking to reopen the mine when prices improved. To this end, YZC was seeking investors, and had discussions with a number of potential buyers during the temporary closure. On December 4, 2018, YZC notified the Yukon government that it had closed a deal with Phoenix Global Investments and the new owner had taken possession of the company.

Lorax Recommendations (April and September 2015)

In April 2015, the Government received a closure risk report that it had commissioned from Lorax Environmental Services ("Lorax"). The purpose of this report was to identify and evaluate environmental risks associated with the temporary closure of the mine, focusing on conditions that may result in environmental degradation. In September 2015, Lorax submitted a second report, the purpose of which was to identify actions needed to enter permanent closure and attempting to work within the $7.7 million in security held at that time.

The April 2015 Lorax closure risk report noted the following site conditions that could create risks:

- The mine had not been dewatered since January 2015, and as of early February, water was flowing into the mine and the pumps had been shut off. Groundwater naturally flows into the mine. When the mine is operational, it is dewatered by pumps, and water is recycled for use in the mine. Without dewatering, there will eventually be uncontrolled discharge of groundwater from the portal and ventilation raise.
- There are no water treatment facilities onsite and collected runoff is put into the tailings facility.
- Waste rock is being stored on the surface in the waste rock storage facility, which was meant to act as temporary storage.

The report also noted that the tailings facility was performing as expected and that hazardous materials were being stored onsite in a safe manner.

Lorax made recommendations for permanent closure and reopening scenarios. Per the Framework, permanent closure from the current state must be considered as part of an RCP. The Lorax report also included a risk assessment of each scenario. It noted that a main risk factor under the permanent closure scenario was that the poor financial situation of YZC would lead them to not undertake the proper care and maintenance.

Recommendations for the permanent closure scenario included:

- Ensure that adequate staff, equipment, and supplies are on site to support care and maintenance activities
- Minimize the flow of non-contact water into the tailings storage facility to reduce water treatment requirements
- Update the RCP, which does not reflect the current (temporary closure) conditions

In the case of reopening, Lorax also recommended the following:

- Security should be recalculated and paid in full before reopening
- A water treatment plant should be complete within five months of mine operations resuming

The table below summarizes the risks identified by Lorax as "severe" and the recommended mitigation plan for each risk.

Table 2: Summary of severe risks and recommendations for mitigation, September 2015 Lorax report

Risk Description Summary based on Environmental Risk Assessment	Risk Mitigation Plan for Permanent Closure
Complete flooding of underground workings, resulting in contamination to Wolverine Creek	1. Finalize design of underground hydraulic plugs and surface cap by early 2016. 2. Ensure construction of plugs is complete in summer 2016 prior to water levels rising to installation zone elevations. 3. Cap openings to prevent access
Tailings facility discharge of contaminated water to Go Creek due to lack of operational water treatment plant	1. Following lab testing of tailings facility water, conduct *in situ* testing in winter 2015-16 and 2016-17. 2. Install water treatment infrastructure including a retention pond, and treat water until quality is suitable for discharge. Discharge over three consecutive spring summer periods 2017 to 2019.
Uncontrolled discharge from ditches and sumps during spring resulting in contamination to Go Creek and Wolverine Creek watersheds	1. Maintain adequate resources onsite to ensure frequent monitoring and water management activities are undertaken during spring 2. Decommission ditches and sumps once infrastructure is decommissioned and sites are ready for reclamation activities.
Lack of resources and funding to maintain the site in a managed state, or respond to atypical conditions (e.g., storm events)	Ensure adequate staffing resources and operational equipment in order to maintain the site in a desired state according to permit and license conditions, and to respond to emergent situations.
Mine access road breach resulting in interrupted delivery of necessary supplies and downstream environmental degradation	

V6 RCP (December 2015)

YZC submitted the "V6" RCP on July 17 2015, as required by the Quartz Mining License. After EMR received the RCP, Steve Jan[7] and Lorax/Ecowest[8] both reviewed it and provided comments on deficiencies. In particular, this RCP did not include measures to take the site from its current state into permanent closure. In this RCP, permanent closure costs were based on the assumptions that a water treatment plant would be present and that waste rock would be put back underground. However, at the time, no water treatment plant was present and waste rock could not be put underground because the mine was flooding.

In November 2015, Steve Jan completed a costing review of the V6 RCP. His recommended option would require $29.9 million in security and included an active mechanical water treatment plant. He also costed an option recommended by Lorax that included a passive (in situ) water treatment plant at $18.8 million.

[7] SteveJan Consultants is a consultant based in Campbell River, BC.
[8] EcoWest Consulting Inc. is a consulting company based in Vancouver, BC.

This RCP was finalized and approved under the Quartz Mining License on December 23, 2015. EMR determined the appropriate security amount to be $21.6 million, and communicated this to YZC in February 2016. YZC was not required to furnish this amount until the security determination was finalized.

Terms and conditions of V6 RCP approval

EMR approved the V6 RCP on December 23, 2015 subject to certain terms and conditions. These terms and conditions were informed by Lorax's recommendations earlier in 2015. Prior to this approval, on November 15, 2015 EMR shared the terms and conditions with YZC in draft form for comments. EMR extended some of the deadlines based on comments from YZC, but no conditions were removed or modified. The following is an excerpt of the terms and conditions in the approval letter, with some details omitted.

1. "Disposal of reagents and other hazardous materials
2. Installation of hydraulic plugs (bulkheads)

    a. A written workplan for the scheduling and delivery of the design, installation and construction of the hydraulic plugs (bulkheads) for the underground workings must be submitted for review and approval by the Chief no later than June 30, 2016.

3. Environmental monitoring of underground workings
4. Experimental water treatment systems[9]

    a. Pursuant to paragraph 8.6 of the License, a written plan and implementation schedule must be submitted for review and approval by the Chief before construction and implementation of any on-site biopass systems can take place.
    b. Reports detailing water quality sample results and progress made during the bio-pass test system trials must be submitted to the Chief. The first report is due May 31, 2016 and additional reports are to be submitted every four months thereafter.

5. Water treatment of tailings management facility effluent

    a. A written plan describing water quality predictions and defining the requirements for water treatment and discharge must be submitted to the Chief no later than July 17, 2017. The plan should include an updated water quality model and water balance model that predicts the chemistry of the water in the Tailings Management Facility and the time it will take to reach maximum capacity prior to discharge being required.
    b. If a water treatment plant is required, a written plan for the design, installation and operation must be submitted for review and approval by the Chief no less than 12 months prior to the requirement for discharge, as defined in a) above.
    c. All plans for discharge must meet the criteria set out in water license QZ04-065.

6. Environmental monitoring program"

YZC had requested an extension on December 17, 2015 in order to explore further cost reduction measures. EMR rejected this request because they were anxious to have an RCP that reflected the current temporary closure conditions implemented.

[9] We note that all proposed water treatment methods for groundwater were experimental. Item four above refers to a requirement to test these methods.

Government security cost determination for V6 RCP (February 2016)

The Government's security cost estimate for the V6 RCP was $21.6 million. This was communicated to YZC in draft form in February 2016, but did not need to be furnished by YZC until the security determination was finalized. YZC was not satisfied with the security estimate, arguing that it was too high.

The table below summarizes the changes in cost estimates between the V5 RCP, Steve Jan's recommended security cost, and the Yukon Government's final determination for the V6 RCP.

Table 3: Comparison of security costs, $ millions

Cost Item	Previously held security (RCP V5)	SteveJan Consultants	Yukon Government
Mine Workings	0.56	0.62	0.53
Waste Pads	-	1.15	1.15
Tailings Management System	2.11	1.24	1.24
Infrastructure	2.65	3.28	2.65
Access Roads	0.88	0.82	0.79
Remaining Land Reclamation	0.16	0.22	0.21
Supporting Studies	-	0.15	0.15
Interim Care and Maintenance	-	4.80	2.28
Site Management and Monitoring	4.41	5.80	5.55
Mobilization and Demobilization	-	0.17	0.16
Contingency Plans/ Provisions (includes Water Treatment)	-	17.88	2.84
Sub-Total	**10.76**	**37.33**	**17.56**
Indirect costs[10]	-	-	2.63 (15% of total 17.56)
Cost inflation	-	-	0.81
Total Financial Security	**10.76**	**37.33**	**21.00**

It is not unusual for the Government's final determination to vary from a third party consultant's recommended security cost. The biggest difference between Steven Jan's recommendation and the final determination was the

[10] Indirect costs account for the fees and charges in excess of the actual direct reclamation costs for activities including design, permitting and ongoing operations during planning/permitting.

water treatment plant, which accounted for $12.4 million of the $16.3 million difference. The new guidance set in 2013 (see RCP guidance change) requires a plan for closure from the current state, which means that a plan for water treatment must be included in the RCP. The Steve Jan plan assumed construction of an active water treatment plant. Steve Jan estimated the cost for an active water treatment plant at $14.7 million, based on the scale that would be needed if the mine was operational. However, the Yukon Government determined that this scale of water treatment plant was not necessary for closure, and the final determination requires a smaller active mechanical water treatment plant. We note that one of the terms and conditions of the V6 RCP approval was for YZC to submit a new design for a water treatment plant that would be appropriate for the current conditions at the site.

Other key increases between the V5 and V6 RCP cost determinations included:

- Updated plans for treatment of waste rock, which could not be put back underground as previously intended Addition of costs for an interim care and maintenance period of one year between the current state and permanent closure
- The design, construction, and commissioning of a water treatment plant
- Addition of indirect costs i.e. design, permitting, and operations during planning and permitting
- Inclusion of a 2% annual inflation rate, which was not previously included

Deferral of security determination

Per the Quartz Mining License, the next update to the RCP needed to be submitted by July 17, 2017. On April 29, 2016, YZC communicated its intention to update the RCP earlier to reflect current site conditions and with the goal of reducing the security determination. On June 21, 2016, EMR gave permission for this update, requesting it on or before December 2016. It was understood that the security held would remain at $10.6 million until a new RCP was approved and costed.

When EMR gave permission to update the plan, it noted certain requirements for the updated RCP including:

- A measure for permanent closure from the current state
- Plans for underground plugs
- A water treatment plant

On June 21, 2016, the Government already knew that the Company would likely not be able to pay an additional amount of security. As indicated later in this report, it appears to us that at that point in time, it may have been helpful for the Government to reject this extension and deem the Company officially out of compliance. Such a decision would have highlighted the urgency of the situation and may have led to more timely action on the part of the Government, thus mitigating some of the losses that continue to increase since that time.

Events in 2016

In May 2016, EMR granted YZC an extension on removing reagents from the site from May 31 to August 1. However, the extension would have led to a delay over the winter (October to May) due to lack of access. On August 3, YZC notified EMR that they had not yet removed the reagents and would provide an update when available. EMR notified YZC that they were out of compliance and engaged contractors, using some of the security funds, to remove the reagents. However, the YZC then stepped in and removed the reagents themselves.

As noted above, Lorax's risk assessments in 2015 recommended installation of bulkheads by fall 2016. Bulkheads are hydraulic plugs that would have prevented the flooding of the underground mine workings from reaching the surface. In the terms and conditions of its approval of the V6 RCP in December 2015, EMR requested that the Company install them by September 2016. On May 16, 2016, YZC submitted a proposed design, which EMR asked a third party (Tetra Tech) to review. On August 9, 2016, EMR informed YZC that their proposed design was unacceptable, and issued a new deadline of August 22, 2016 for an updated design. However, YZC did not submit an updated design by the deadline, and as of September, it was too late to install the plugs before winter conditions

set in. The V7 RCP submitted in December 2016 included the original bulkhead design with no changes. EMR then set further deadlines for design and installation by June and October 2017, respectively. YZC commissioned a bulkhead design from Golder Associates that was delivered in July 2017. Although this design was sound, by this time the mine workings had flooded to the surface.

V7 RCP: First version (December 2016)

On December 30, 2016, YZC submitted V7 RCP for review. In May and April 2017, EMR received reports from Lorax identifying deficiencies in this plan. Two key changes led EMR to request an updated version of the V7 RCP to be provided by September 2017:

- On June 7, 2017, the underground mine workings flooded to the surface
- On July 14, 2017, YZC requested extension of temporary closure from January 2018 to January 2020

In August and September of 2017, EMR provided additional requests to YZC to be addressed in the updated RCP. A major concern was that YZC's plans for experimental water treatment would not adequately address the key risks. EMR also requested YZC to do the following:

- Describe how predicted inflow rates now differ from those estimated in the 2015 RCP, which would have predicted that full flooding would not happen until spring 2018.
- Calculate the actual underground inflow rates using the volume of the underground workings and compare to the predicted inflow rates used in the water balance.

Inflow rates are a key metric because they determine the ultimate cost of water treatment and the speed at which the tailings storage facility will fill.

Events in 2017

In June 2017, the underground mine workings flooded to the surface. Because there was no water treatment plant in place, the water was diverted to the tailings storage facility (TSF).

In August 2017, YZC requested extension of temporary closure from January 2018 to January 2020. This request was granted by EMR on December 19, 2017, with the following terms and conditions:

1. Maintain water level below 1,310 m in TSF
2. Install a water treatment facility to be operational by August 1 2018, submit ongoing monitoring reports
3. Begin in-situ or batch treatment and discharge of underground mine water. Stop diverting underground mine water to the TSF
4. Submit a re-vegetation plan to meet the QML requirements by May 1, 2019
5. Submit an updated Wolverine Wildlife Protection Plan by March 1, 2018 to reflect the temporary and final closure changes in monitoring programs
6. Conduct a bathymetric survey by a qualified hydrologist of the TSF by June 1 2018 and submit a report
7. Develop a numerical hydrogeological model to meet the requirements of the QML by May 1, 2018
8. Repair or replace compromised groundwater monitoring wells by August 1, 2018
9. Continue sampling monitoring station T1
10. Submit a standalone Adaptive Management Plan by July 1, 2019

V7 RCP: Second version (September 2017)

On September 29, 2017, YZC submitted a second version of the V7 RCP, which was intended to address EMR's requests. EMR had the plan reviewed by Lorax to assess any deficiencies.

Lorax raised the following issues in reports dated October and November 2017:

- Lorax calculations expect the tailings storage facility (TSF) to reach capacity in June 2018 at the earliest instead of September as suggested in the RCP
- A longer period may be required to dewater the TSF
- The RCP assumes that winter water inflows would be zero, which historically has not always been true
- YZC should consider diverting water flowing from the underground mine workings to a separate reservoir rather than into the TSF, which is more expensive to treat.

Additionally, a September 2017 report from Klohn Crippen Berger[11] noted that the liner in the North End Slump (part of the TSF) should be repaired before any additional tailings were put into the TSF. However, if the pond level was managed through water treatment and proceeded to closure, there would be no need to repair the liner. The report also noted that the water level was 1309.5m and recommended a maximum water level of 1310mas long as there was no water treatment plant.

V7 RCP: Third version (November 2017)

On November 29 2017, YZC submitted a third version of the V7 RCP to address the above noted feedback and correct their proposed cost estimate. On December 12, 2017, Lorax estimated the cost of V7 RCP at $35.5 million, which included bulkhead installation and a water treatment plant.

V7 RCP: Revision of third version (December 2017)

YZC submitted a revision of the third version of the V7 RCP on December 18, 2017. This was approved by EMR on December 19, 2017, which became the final V7 RCP. EMR also granted YZC's request for an extension of the temporary closure from January 2018 to January 2020.

On March 29, 2018, EMR notified YZC that they could submit additional information relevant to their review of the security determination. EMR also requested updates on the progress of commissioning the water treatment plant for the TSF, and progress of work related to the in situ or batch treatment of underground water. EMR requested these updates to ensure that the Company was meeting the conditions of its license and addressing concerns about water management at the site.

On April 26, 2018, YZC requested an extension for implementing the conditions of the December 19, 2017 letter due to lack of funding. This was the first time that YZC explicitly acknowledged that a lack of funds would prevent them from carrying out the required activities during temporary closure.

On May 3, 2018, EMR notified YZC of an increase in the security amount to $35.5 million, and requested payment by May 18, 2018. Since then, the additional security amount has not been paid and conditions of the December 19 approval have not been met.

The key reason for the increase in the security amount between the V6 RCP and the V7 RCP was the flooding of the underground mine workings. After the mine flooded, water was diverted to the TSF. This substantially increased the cost to treat this water. Additionally, there was substantially more water to be treated, mainly because the bulkheads had not been installed earlier.

Cost to install the bulkheads has also increased substantially since the mine flooded, because dewatering needs to take place before plugs can be designed and installed.

[11] Klohn Crippen Berger is a geoscience engineering company based in Vancouver and the Engineer of Record for the TSF.

Key findings

This section outlines what we have identified as the key issues that led to the ultimate shortfall of security funds, as described in previous sections.

Company risk profile

The root cause of the funding shortfall for the Government was YZC's financial conditions and cash flow sensitivity to changing economic conditions. This issue was present from the time of approving V1 RCP and throughout all subsequent RCPs.[12] However; the Framework does not include evaluation of mine operators based on financial risk. EMR does not review financial risk and does not have access to financial information or the life of mine plan of mine operators.[13] Rather, under the Framework, the role of EMR is to approve the RCP, assess the correct security amount, and ensure that the proponent is in compliance with their license.

In particular, the Yukon Government was not aware of the extent to which the Wolverine Mine was sensitive to changes in metal prices. In addition, the Government did not have any information on the extent to which YZC's parent company in China was financially committed to the Wolverine Mine. The parent company funded the initial mine construction and restructuring, but was clearly not willing to provide the additional security required.

During mine construction (2009-2011), YZC had both operational and financial difficulties. Operational difficulties led to costs that were higher than anticipated. There were also two fatalities during construction that led to delays and cost increases. Overall costs were high because high metal prices had led to competition for mining contractors. A drop in metal prices then led to temporary closure in 2015. Staff at EMR were surprised by the closure.

YZC's financial distress became obvious when it entered CCAA in 2015. Although the Government received the full security in October of that year, it was clear that the Company was in financial trouble. In that year, the Government commissioned reports by Lorax on the state of the mine and the risks during closure. As part of this study, Lorax noted the risk that financial distress would lead YZC to not fulfil its obligations during temporary or permanent closure. It is not typical for these reports to assess financial distress, but in this case, the risk was very clear, given the CCAA protection.

Starting in 2015, EMR should have become aware that the Company was in financial trouble and could have realized that it may not meet its obligations. However, this realization did not manifest itself into actions that would have limited losses to the Government in that case. Although the site was fully secured in accordance with the Framework, liabilities were increasing and the Company was not taking action to address that. The Government was aware that this situation was leading to an increase in the required security that the Company would likely not pay. Given that the obvious consequence of this situation was that the Government would be liable for any shortfall, the Government should have considered the possibility of stepping in to limit liabilities.

Mine flooding

Mine flooding was one of the key reasons that closure costs increased so dramatically from $21.6 million in 2016 to $35.5 million in 2017. We understand that installation of bulkheads would have prevented the flooding of underground mine workings from reaching the surface, but it was repeatedly delayed. Once the mine was flooded to the surface, installing the bulkheads became more difficult and expensive because the portion of the mine from the

[12] Throughout temporary closure, YZC did not explicitly indicate that its financial distress would lead it to not comply with its obligations. However, in April 2018, a letter from YZC where it acknowledged that its financial difficulties are limiting its ability to comply with its obligations.
[13] Life of Mine Plan is the long-term plan for a mine as approved by a company board. It includes a forecast of the mine revenues and costs as well as the underlying assumption (e.g. future price of the mineral)

portal to the location of the bulkheads would require dewatering and structural rehabilitation before the bulkheads could be safely installed.

The mine began flooding shortly after temporary closure began in January 2015. In April 2015, the Environmental Risk Assessment by Lorax recommended that the main portal and ventilation raise should be sealed, and additional bulkheads should be installed on the ramp. The report also noted that site-specific knowledge would be necessary for detailed designs. Bulkheads could not be installed in the winter when the site was not accessible.

Two key issues led to the flooding of the mine:

- Underestimation of the water inflow rate
- Delays in installing bulkheads

The RCP V6 that YZC submitted in July 2015 had an estimate of infill at 150 m^3 per day. This was much lower than the 279 m^3 per day estimated by Lorax in its Environmental Risk Assessment. The assumption of a lower inflow rate would lead to much less urgency with respect to installing the bulkheads and developing a plan for water treatment. Indeed, Government staff were surprised when the site flooded to the top in June 2017. However, that date was in line with Lorax's predicted inflow rate.

As noted elsewhere in this report, there was significant "back and forth" on the design of the bulkheads that led to delays. Ultimately, the bulkheads were not installed before the mine workings flooded to the surface. YZC seemed reluctant to go ahead with bulkhead design and installation because they claimed that they were planning to restart the mine. However, we understand that bulkheads could have been removed quickly in that case. YZC also initially objected to EMR's requests for updated designs because of the additional costs. These repeated delays meant that the bulkheads were ultimately not installed before the mine flooded to the surface.

Once the mine flooded, groundwater from the mine had to be diverted to the TSF because there was no water treatment plant onsite. Because the contents of the TSF were contaminated, this diversion made the groundwater much more difficult to manage and expensive to treat, compared to if it had been treated separately.

Water treatment plant

A water treatment plant was always required to close the site. However, it was not included in the initial RCP because it was assumed that the water treatment plant would be built as part of normal operations. The original plan was for a plant to be built during operations in 2015. This was consistent with the Framework in place until August 2013.

Starting with the V5 RCP in 2015, RCPs for the Wolverine Mine were subject to the new guidance instituted in August 2013. Under this new guidance, closure costs need to be estimated from the current state, meaning that they did need to include a water treatment plant. If the plant were constructed as part of operations, it would be removed from the closure cost estimate. The Government understood from the beginning that a water treatment plant would be needed at some point in time.

We note that a water treatment plant must be designed and tested for the individual site and contaminants. It can take months or years to build. In the case of the Wolverine Mine, a design had to be approved by EMR prior to beginning construction.

Throughout temporary closure, YZC was looking into various design options. A treatment plant had been approved per the water license, but the license did not specify when it had to be put in place. YZC also had the option of finding a different treatment method and amending the water license.

The absence of a water treatment plant is one reason that closure and reclamation costs increased between the V6 and V7 RCPs. If there had been a water treatment plant in place, water from the mine workings would not have

been diverted to the TSF once the mine workings flooded in summer 2017. It is at that point that the situation became urgent, because water from the tailings facility cannot be discharged without being treated first. Although the cost to install the plant has not increased, the amount of water to be treated has increased substantially. Much of this water could be treated more easily: more than half of the water flowing into the TSF was from the mine workings, and this water can be treated more easily if it is not part of the tailings pond. As noted previously, a 2017 report from Lorax recommended diverting this water to a separate reservoir.

Internal communication practices

Based on our understanding, beginning in 2015 EMR had all the information it needed to properly manage the risks at the Wolverine Mine. However, not all this information was clearly communicated to senior management. Moreover, the severity and potential consequences of the situation were not properly reflected in the communications.

In 2015, reports from Lorax raised the issue of mine flooding and water treatment at the site. EMR acted on these recommendations by including terms and conditions for YZC in its December 2015 approval of the V6 RCP. However, the urgency of these issues does not seem to have been fully communicated to senior management.

Throughout the temporary closure, there was substantial "back and forth" between EMR and YZC that may have obscured the real risks. There was an apparent lack of understanding of the urgency of issues such as installing bulkheads.

For example, a briefing note in spring 2016 noted the following: "Under the current requirements, Yukon Zinc is fully secured and continues to undertake work to clean up the mine site and reduce its liabilities." Although this was true, it does not communicate the potential financial inability of YZC to undertake that work, or the potential of costs to increase dramatically if such work is not undertaken.

Another factor that may have contributed to a lack of urgency in the treatment of this situation was the possibility of the mine being sold and re-started. Over this period, the Yukon Government was in discussions with several potential buyers. In the case that the mine was bought and re-started, the new owner would need to update and fully secure the RCP, solving the funding shortfall. Our understanding from conversations with staff is that this possibility may have led to there being less urgency to take action on the Wolverine Mine. However, it is difficult to say to what degree this affected how staff handled the case.

Based on our Assessment, we found that staff followed processes for sharing information. However, there is not a defined protocol on which issues constitute serious risks and how those should be handled.

Delays

Throughout the RCP process, there were repeated delays that led to problems not being addressed. In April 2016, EMR agreed to let YZC submit a new RCP and did not try to collect the increased $21.6 million in security. At the time, EMR staff thought it unlikely that YZC would have been able to pay the increased security. However, if they had tried to collect it at that time the urgency of the situation may have been more apparent to senior management. Additionally, if the RCP had been updated and YZC would not have provided the additional security, YZC would have faced fines for being out of compliance with the license.

YZC claimed that they could take actions to lower the security, but we understand that this was not realistic. In addition, certain measures that YZC failed to take during the temporary closure should have been part of the RCP because they were needed in order to secure the site. The delays led to an increase in the liabilities because YZC was not managing the site properly, as described in other key issues.

We understand from talking with EMR staff that delays of the magnitude experienced with YZC is not typical. Nevertheless, EMR should have considered the possibilities of such delays. As noted previously, one reason that

EMR staff allowed these delays may have been the hope that the mine would be bought and restarted. In that case, the new owner would have to update the RCP and pay the security in full before restarting.

Spending of security

As noted elsewhere in this report, the Yukon Government may draw on the security in the case of mine closure or where permitted by the Quartz Mining Act. Section 139 (3) and (4) of the Quartz Mining Act permits two uses other than reclamation and closure:

- Where a mine operator does not comply with direction from the Chief, or there is an unnecessary danger to persons, property, or the environment (section 146 of the QMA)
- Where an inspector believes that the site or part of the site has been abandoned by the mine operator (section 147 of the QMA)

When one of these conditions is triggered, the Government has the right under section 139 (3) and (4) of the QMA to spend the security in ways that are not necessarily laid out in the reclamation and closure plan.

Making a decision to spend the security under this provision requires the Inspector and the Chief (Director of EMR).

Under this provision, EMR was moving ahead with hiring contractors to remove reagents from the site. However, EMR did not take any action towards using the security for installing bulkheads or a water treatment plant. As noted here, presence of a water treatment plant earlier on would have stopped the closure cost from increasing so dramatically. Building a water treatment plant is a major undertaking and would require time to commission and build. Such a large item may also require additional approvals from the Yukon Government. Therefore, these discussions would need to begin early in the process. There is no evidence that EMR contemplated this possibility.

Information gathering and inspections

As per the Framework, the Compliance Monitoring and Inspection (CMI) branch within EMR conducts regular inspections to ensure that companies are complying with the water license and Quartz Mining License. Inspectors do not have a formal reporting procedure with the Mineral Resources Branch, but they are responsive to questions..

The inspectors' main task is to ensure compliance with licenses, but they are not required to report on potential risks at the site, other than direct environmental risks. During most of the temporary closure, YZC was compliant with their licenses. However, conditions were worsening and key issues were not being addressed.

In this case, inspectors complied with their mandate. However, they were in a position to collect additional information that would have been useful to government decision-makers. This information includes the following:

- The mood among workers at the site prior to closure, which may have alerted the Government that the Company's financial situation was poor
- Insight into whether the Company was on track to meet its obligations under the QML
- The impact of the above on the likelihood of environmental risks developing

EMR staff were aware of the above information through informal channels; however, formal reporting from CMI would have highlighted its importance and allowed for timely tracking.

Policy options

Considerations

We note that a more conservative way to estimate securities may have averted the situation. However, Yukon already requires higher reclamation and closure securities compared to other provinces and a general increase in security level will result in a disincentive for mining development, particularly for smaller companies. On the other hand, situations such as Wolverine Mine are costly for the Yukon Government. Our policy options aim to address both these issues. We note that the options are somewhat interdependent.

Option 1: Risk assessment

Currently, the policy framework does not require any type of risk assessment. However, in retrospect a number of factors made YZC a higher risk company: it was a small, private company, its parent company was not Canadian, it was experiencing higher than expected costs from the beginning, and its profitability was highly sensitive to metal prices.

The Framework requires that a mine operator provide 100% security for reclamation and closure, but this requirement does not fully address the inherent risks in every case. The estimated costs for reclamation and closure evolve over the life of the mine, which is why updates to the QML are required at least every two years. In the case of the Wolverine Mine, the Company allowed liabilities to increase at the site, a decision that was influenced by their financial difficulties and lack of accountability to shareholders.

It is ultimately up to the Yukon Government to determine the exact structure of the risk assessment. Below we provide an illustration of what such an assessment might look like.

The Yukon Government should conduct a holistic risk assessment prior to granting a license, taking into account the following:

- The company's financial statements
- The company's financial relationships to its parent company, if applicable
- The life of mine plan and feasibility study
- The sensitivity of the above to changing circumstances including metal prices
- If applicable, the company's history of operations

Providing this information must be a pre-condition of licence approval. Although some companies may not want to provide this information, the risk is otherwise too high for the government. We also suggest that EMR should have the right to deny a license based on the findings of the risk assessment in order to limit their potential liabilities.[14]

This risk assessment should be ongoing and conducted periodically (for example, every year or every two years along with the RCP review). Inspectors may also be required to collect information they observe during site inspections that may indicate business distress (e.g. comments from employees, lack of activity) and report on their observations directly to EMR management. In the case of the Wolverine Mine, YZC's financial situation evolved and considerably worsened between the initial granting of the license and the temporary closure. EMR eventually became aware of this, but as time elapsed, the Government's ability to mitigate liabilities became more limited.

[14] This would require an amendment to the current legislation.

Based on the information collected, the Yukon Government would provide a risk classification to an applicant that would determine the amount of security to be collected. The following is an illustration of what this classification might look like:

Risk level	Meaning	Implications for security
Low risk	The applicant carries lower than normal risk of allowing liabilities to increase or being unable to pay the closure and reclamation cost	Yukon Government may consider holding less than 100% security
Normal risk	The applicant carries a normal risk of allowing liabilities to increase or being unable to pay the closure and reclamation cost	Yukon Government may follow its current policy of holding 100% of the security
High risk	The applicant carries higher than normal risk of allowing liabilities to increase or being unable to pay the closure and reclamation cost	Yukon Government may consider holding more than 100% of the security, which could be done through various models (see below)
Unacceptable risk	The risk is too high for the Yukon Government, compared to the potential benefits	If risk is determined to be too high, the Yukon Government should not grant a license

Currently, no other provincial or territorial governments in Canada require a risk assessment such as this one. However, in Ontario the amount of security held is linked to company risk. Mining companies that pass a "financial strength" test, which is based on ratings from certain credit agencies, are exempt from providing a security for reclamation and closure funds. If the company drops below the required credit rating, it is then required to provide 100% security. We further note that robust models were developed and are used by private sector to assess the likelihood of future financial distress. The Yukon Government may consider the possibility of using such model.

Models for collecting more than 100% security

As noted above, holding 100% security can still carry risks because the estimated cost of reclamation and closure can increase unexpectedly. There are multiple options for scaling security to risk. In this context, we suggest using them to collect more than 100% security for mines deemed to be "high risk."

Option 1: Scaled contingency funding

Additional funding could be tied to conditions that create risk. Saskatchewan has a form of this option, whereby it requires a higher share of security when the site has tailings or engineered structures. This could also include site-specific issues such as the water treatment plant at the Wolverine Mine.

Option 2: Contingency funding

The current framework has some contingency funding built in. However, the Yukon Government may opt to increase the required contingency for "high risk" mines. This option would take the form of a simple percentage of overall funding, in contrast to the previous option.

Option 3: Pooled funding

Under this option, operators of high-risk mines are required to pay into a pool that the government would be able to access in the case of a funding shortfall. This option acts as a type of insurance against any one mine experiencing a funding shortfall. We note that this option may be unpopular among responsible mine operators because they do not want to have to pay for others' irresponsible behaviour. There is also a risk that, if not planned properly, a pool would create "moral hazard" whereby certain operators would become less careful in maintaining sites, knowing that the government would step in if there was a funding shortfall.

Option 2: Spending of security funds

According to the Quartz Mining Act, the Yukon Government has the right to spend security funds in situations other than reclamation and closure. For example, when "[the mine operator] has contravened a condition of an approved operating plan or of a license, or any provision of this Part or the regulations, whether or not the condition or provision relates to termination or abandonment." In this case, the Government may spend security in ways that are not necessarily laid out in the reclamation and closure plan, per sections 139 (3) and (4) of the QMA. Such a situation occurred once already in the case of the Wolverine Mine: the Government was ready to spend security funds to remove reagents from the site. However, other spending of security by the Government could have prevented future substantial increases in the security costs.

The Government should consider being more proactive in identification of risks that would increase the security owed. In this case, it appears that the Government understood the risks present at the site, but were not able to enforce certain necessary actions by YZC, principally the installation of bulkheads and the building of a water treatment plant. The Government requested that YZC take these and other measures by including them as terms and conditions of the RCP approval. However, this approach was not effective in this case. By the time it became clear that YZC was not going to take these measures, they would have been less effective at reducing the overall liability.

The Government may consider developing contingency plans on a case-by-case basis for requirements that are deemed critical for maintaining the adequacy of the security. These contingency plans could be triggered once certain pre-determined deadlines are not met. For example in the Wolverine Mine case, it could have translated to installing the bulkheads or constructing the water treatment plant by the Government. For example, in December 2015 the V6 RCP approval letter included the requirement for bulkhead designs to be submitted by July 30, 2016 and for the bulkheads to be installed no later than September 2016. The Yukon Government could have set this deadline as a trigger for serious consideration of spending security funds if the bulkheads were not yet installed.

Option 3: Communications protocol

Senior staff should be notified of potential major risks immediately. As noted previously, in the case of the Wolverine Mine, it appears that senior staff did not have a full understanding of the urgency of the situation. In 2015, consultant reports indicated that site liabilities would increase significantly if YZC did not properly manage the temporary closure. At that time, the Government also knew that that YZC was dealing with financial distress. Together these factors should have triggered an immediate clear communication as to the situation and the potential consequences to the Government finances.

An expanded scope of investigation for CMI may also help Government decision-makers to have a full picture of conditions and risks. We suggest this include tracking of whether a company is in line to meet their obligations under the QML, and impressions of the general mood and conditions at the site.

The Government should consider implementing a clearer communication protocol whereby risks are escalated to senior decision-makers in a timely and clear manner.

Conclusion

The scope of this report was to assess three factors:

- The ability of the Framework to address situations such as the Wolverine Mine
- The implementation of the Framework in the case of the Wolverine Mine
- Potential improvements to the Framework that would allow it to address situations similar to the Wolverine mine in the future

The following summarizes our conclusions on these topics.

Implementation of legislative and policy framework

Overall, Government staff adhered to the legislative and policy. However, some aspects of the Framework require judgement calls. In these matters, staff did not address all the risks present in the case of the Wolverine Mine.

In 2015, EMR understood the required actions at the site during temporary closure and the consequences if these actions were not taken. However, the possibility of YZC not fulfilling its obligations and the potential consequences of this were not sufficiently considered and/or were not communicated to decision makers. The Framework enables the Government to spend the security in order to reduce an increase in liability, if the mine operator does not take certain actions necessary to contain the liability.[15] Nonetheless, staff did not exercise this option.

Legislative and policy framework

We have identified two key deficiencies in the legislative and policy framework that limited the ability of EMR to address the situation of the Wolverine Mine:

- The Framework does not require a risk-benefit assessment prior to a license being granted or in an ongoing way
- Inspectors do not have the mandate of identifying risks and reporting them, other than direct environmental risks

A risk assessment prior to granting a license would allow the Government to understand the mine operator's risk profile and the likelihood of financial distress. Such an assessment would allow the Government to make more informed decisions as to whether to grant a license or increase the security amount in order to compensate for the risk. A risk assessment should be updated periodically based on feedback from inspectors and review of financial information provided periodically by the mine operator. The implications of the risk assessment for the RCP should be discussed regularly and escalated if needed.

Policy options

This report provides several options that would allow the Yukon Government to avert a similar situation in the future, while maintaining its competitiveness as a mining jurisdiction. These options are:

- **Risk assessment**: the Government should conduct a risk assessment based on the financial documents of the company and its life of mine plans. Sensitivity analysis in regards to metal prices and other factors should be considered. Risks should be assessed on an ongoing basis and used to inform decisions regarding RCPs.

[15] Quartz Mining Act Section 147(1)

- **Spending of security funds**: the Government should take a more expansive view in considering where security funds should be spent to limit overall liabilities. Risks should be assessed proactively and escalated where needed.
- **Communications protocol**: the Government should implement a clear communications protocol for which issues should be escalated to senior management and how this will be done.

Appendix A: Limitations

Receipt of new data or facts: PwC reserves the right at its discretion to withdraw or make revisions to this report should we receive additional data or be made aware of facts existing at the date of the report that were not known to us when we prepared this report. The findings are as of May 2019 and PwC is under no obligation to advise any person of any change or matter brought to its attention after such date, which would affect our findings.

Use limitations: This report has been prepared solely for the use and benefit of, and pursuant to a client relationship exclusively with the Yukon Government. We understand that the Yukon Government may share our report with third parties. The Yukon Government may release this report to third parties only in its entirety and any commentary or interpretation in relation to this report that the Yukon Government intends to release to the public either requires PwC's written consent or has to be clearly identified as the Yukon Government's own interpretation of the report. PwC accepts no duty of care, obligation or liability, if any, suffered by the Yukon Government or any third party as a result of an interpretation made by the Yukon government of this report.

Further, no other person or entity shall place any reliance upon the accuracy or completeness of the statements made herein. In no event shall PwC have any liability for damages, costs or losses suffered by reason of any reliance upon the contents of this report by any person other than the Yukon Government.

This report and related analysis must be considered as a whole: Selecting only portions of the analysis or the factors considered by us, without considering all factors and analysis together, could create a misleading view of our findings. The preparation of our analysis is a complex process and is not necessarily susceptible to partial analysis or summary description. Any attempt to do so could lead to undue emphasis on any particular factor or analysis.