



Minto Mine

Operations Adaptive Management Plan

December 2015

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Minto Mine
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1 Introduction

1.1 Overview

Minto Explorations Ltd. (Minto), a wholly owned subsidiary of Capstone Mining Corp. (Capstone), owns and operates the Minto copper mine. Minto Mine is located within Selkirk First Nation (SFN) Category-A Settlement Land (Parcel R-6A), and is approximately 240 km northwest of Whitehorse, Yukon Territory. The Minto mine commenced commercial operations in October 2007.

The Yukon Government's Decision Document (Yukon Government, 2014) following the YESAA review of Minto's Phase V/VI project proposal (file # 2013-0100, (Minto Explorations Ltd., 2013)) required an Adaptive Management Plan (AMP) for the mine operations. As an outcome of the Phase V/VI mine licensing processes, Minto is required to update the AMP with additional information outlined in its Quartz Mining License QML-0001 (QML) and Water Licence QZ14-031 (WL).

AMPs are tools used to address uncertainty or conditions beyond those anticipated in mining operations. AMPs outline a range of possible but unexpected outcomes and the responses that will be undertaken to curb possible negative impacts associated with these unexpected situations.

Mining activities are highly managed operations, with very prescriptive and detailed management plans required for both operational control and regulatory approval. More mature mines such as Minto have management plans which benefit from the operational experience at the site, and uncertainty in the range of conditions expected is reduced through this operational experience.

Minto has developed a number of operational management plans which describe the management and response actions for expected conditions at the site. These plans currently include:

- Solid Waste Management Plan;
- Environmental Monitoring, Surveillance, Reporting Plan;
- Wildlife Protection Plan;
- Spill Contingency Plan;
- Sediment and Erosion Control Plan;
- Mine Development and Operations Plan;
- Underground Mine Development and Operations Plan;
- Mill Operations Plan;
- Water Management Plan;
- Tailings Management Plan;
- Waste Rock and Overburden Management Plan;
- Emergency Response Plan;
- Heritage Resources Protection Plan; and

- Reclamation and Closure Plan

This AMP is intended to provide a framework for responses to conditions beyond those expected and identified in these decision-based management plans. Consequently, this AMP addresses a limited range of components.

1.2 Adaptive Management Planning

Adaptive management is an approach to environmental management that is appropriate when a mitigation measure may not function as intended or when broad-scale environmental change is possible. Adaptive management plans are precautionary in nature, and provide a level of security in long term environmental planning. Adaptive management plans also allow for the inclusion of improved science into mitigation measures as they are continually revised.

Adaptive management has been evolving since its emergence in the 1970s. Adaptive approaches include an ability to incorporate knowledge into the management plan as the knowledge is gleaned and circumstances change. Eberhard et al. (Eberhard, et al., 2009) described the categories of knowledge that may trigger changes to water quality management plans; system understanding, measuring progress and anticipating changes. These categories allow for the inclusion of knowledge and adaptation of management to changed conditions. Embedding adaptation into environmental plans involves thinking about how the results of monitoring will change management actions. Adaptive management plans are a way to accept uncertainties and build a structured framework to respond to changing conditions.

Adaptive management conducts a flexible path with actions to take when specific triggers occur. AMPs are a formalization of a plan for performance monitoring and project re-evaluation in the future. The general structure of adaptive management can be described by the following steps:

1. Identify risk triggers associated with vulnerabilities or uncertainties;
2. Quantify impacts and uncertainties;
3. Evaluate strategies and define implementation path that allows for multiple options at specific triggers;
4. Monitor the performance and critical variables in the system; and
5. Implement or re-evaluate strategies when triggers are reached.

Although there are no widely used AMP terms, the steps listed above are representative of typical AMP processes. Within AMPs, triggers provide decision points in a stepwise decision-making framework that identifies how and when management action should be taken. A key characteristic of adaptive management is monitoring, which is used to advance scientific understanding and to adjust management policies in an iterative process. Adaptive management is a rigorous method for addressing uncertainties in ecosystem management.

1.3 Adaptive Management Plan Objectives

An AMP is a management tool wherein a framework is provided to make quick and effective decisions to guide responses to unforeseen events. This document identifies areas of uncertainty within the operational phase of the Minto Mine life and provides an AMP framework for each. For each component the AMP describes monitoring commitments, thresholds, triggers and responses to underperforming elements or emerging risks within the

component. The steps laid out in the AMP framework are precautionary, and therefore they provide the confidence that action will be taken before adverse environmental impacts are observed.

Response planning, and results for anticipated events are contained within site management plans while AMPs guide responses to unforeseen or contingency events. This AMP provides a framework to guide responses to unanticipated monitoring results and to potential but low probability events where uncertainty exists.

It is difficult to predict the specific environmental condition that may arise which requires a response from management and, therefore, the AMP does not provide specific detailed descriptions of responses to a situation. The AMP provides a range of possible responses to use as a guide to respond to specific environmental conditions encountered. Management should use the information provided in the AMP and undertake the appropriate response.

1.3.1 Updated AMP Objectives

This 2015 version of the AMP has been updated to include the requirements of the QML and WL.

The QML was issued December 18, 2014 and was accompanied by a letter entitled outlining the components required in an Adaptive Management Plan (Yukon Government - Energy, Mines and Resources, 2014). The AMP includes the requirements outlined in the letter with the exception of Cover Systems, as they are more appropriately addressed in the Closure Adaptive Management Plan with forms part of the Reclamation and Closure Plan.

The WL was issued August 5, 2015 and the requirements for the AMP are outlined in clause 109 (Yukon Water Board, 2015).

Clause 109 details and the sections in the AMP where these are addressed are summarized in Table 1-1.

Table 1-1: QZ14-031 Concordance table

109) The Licensee shall submit to the Board for Review and Approval an updated Operational Adaptive Management Plan. This plan shall be submitted by December 18, 2015, and shall be implemented once approved. The updated plan shall include, without limitation:	Section addressed
a) a surface water quality Adaptive Management Plan for McGinty Creek;	2.2
b) groundwater quality Adaptive Management Plans, including establishment of thresholds, for the Minto Creek and McGinty Creek watersheds;	2.3, 2.4
c) freeboard thresholds for each water storage facility;	2.5
d) WQOs, as stated in clause 8; (note: Clause 8 is presumed to be incorrect reference, and therefore W2 WQOs from licence have been included)	2.1
e) specifications for Monthly Reports that will include, but not be limited to the activities carried out under the Adaptive Management Plan, and	3.1
f) specifications for the Annual Report to include but not be limited to: i. activities undertaken in relation to the Adaptive Management Plan; ii. trend analysis and water levels in Minto and McGinty creeks; iii. proposed updates and revisions to the Adaptive Management Plan, and iv. any other revisions	3.1, 3.2

1.4 Adaptive Management Plan Approach

In addition to the conclusions drawn from research, the approach presented in this AMP follows the Environmental Code of Practice for Metal Mines, Section 4.1.17 on Adaptive Management:

“Mine owners/operators should use adaptive management methods to revise and refine the environmental management strategy. Adaptive management should consider a wide range of factors, including:

- The results of environmental audits or other evaluation activities;
- The results of environmental monitoring;
- The results of monitoring of the performance or condition of environmental infrastructure, such as containment structures, water management systems or treatment facilities;
- Technological developments; and
- Changing environmental conditions.” (Environment Canada, 2009)

In addition to the guidance provided by the Environmental Code of Practice for Metal Mines, the AMP serves to meet the Yukon Government’s Decision Document following the YESAA review of Minto’s Phase V/VI project proposal which identifies some areas that an AMP for operations should be prepared to address including “*water quality, physical stability, covers, water treatment, and water management*;”. Though some covers are anticipated to be placed as part of progressive reclamation, they are not an operational feature and therefore have not been included in this AMP.

1.4.1 AMP Components

The following AMP components have been identified as having the potential for unexpected conditions during the operational period for which the Operational Management Plans may not provide adequate mitigation against potential effects to the environment or human health and safety:

- Water management;
- Water quality;
- Physical Stability; and

The specific AMP framework for these components is described in subsequent sections.

1.4.2 AMP Framework

The AMPs for each component are laid out using a common element approach to create consistency in implementation of the AMP protocol for all components as illustrated in Figure 1-1. The common elements are:

1. Description of the component
 - *Description* - description and understanding of the component leads to risk narrative and specific performance thresholds.
 - *Risk Narrative* describe the possible environmental impacts and environmental conditions that implementation of the AMP will prevent.

2. Monitoring the component

- *Specific Indicators* are the environmental or physical parameters to be monitored and assessed. Specific indicators are measurable or observable, and are indicative of changes from the designed or expected condition.
- *Monitoring Requirements* describes the monitoring regime for the component including frequency, type of data required and interpretation of results.
- *Specific Performance Thresholds* define the conditions, in terms of specific indicators, when action is triggered. Performance thresholds are staged to accommodate levels of concern and a diversity of actions. To the extent possible, specific performance thresholds will include early warning thresholds.

3. Responding to unexpected conditions of the component

Specific Responses are staged according to specific performance thresholds describes the actions to be implemented if specific performance thresholds are crossed. They are provided in the following categories:

- a) Notification
- b) Review
- c) Evaluation
- d) Action

4. Annual Reporting and Review

Annual Reporting reflects annual changes made to the AMP as the site conditions change. The AMP should be modified whenever unexpected circumstances are encountered and the protocol is implemented or when additional proven science or technology becomes available. The annual review will include a review of the relevant monitored data and AMP elements. Updates, amendments, performance thresholds crossed, and trigger(s) activated will be provided to the appropriate governmental (including SFN) organizations as required and will be part of the annual report.

Additional reporting is described further in section 3.

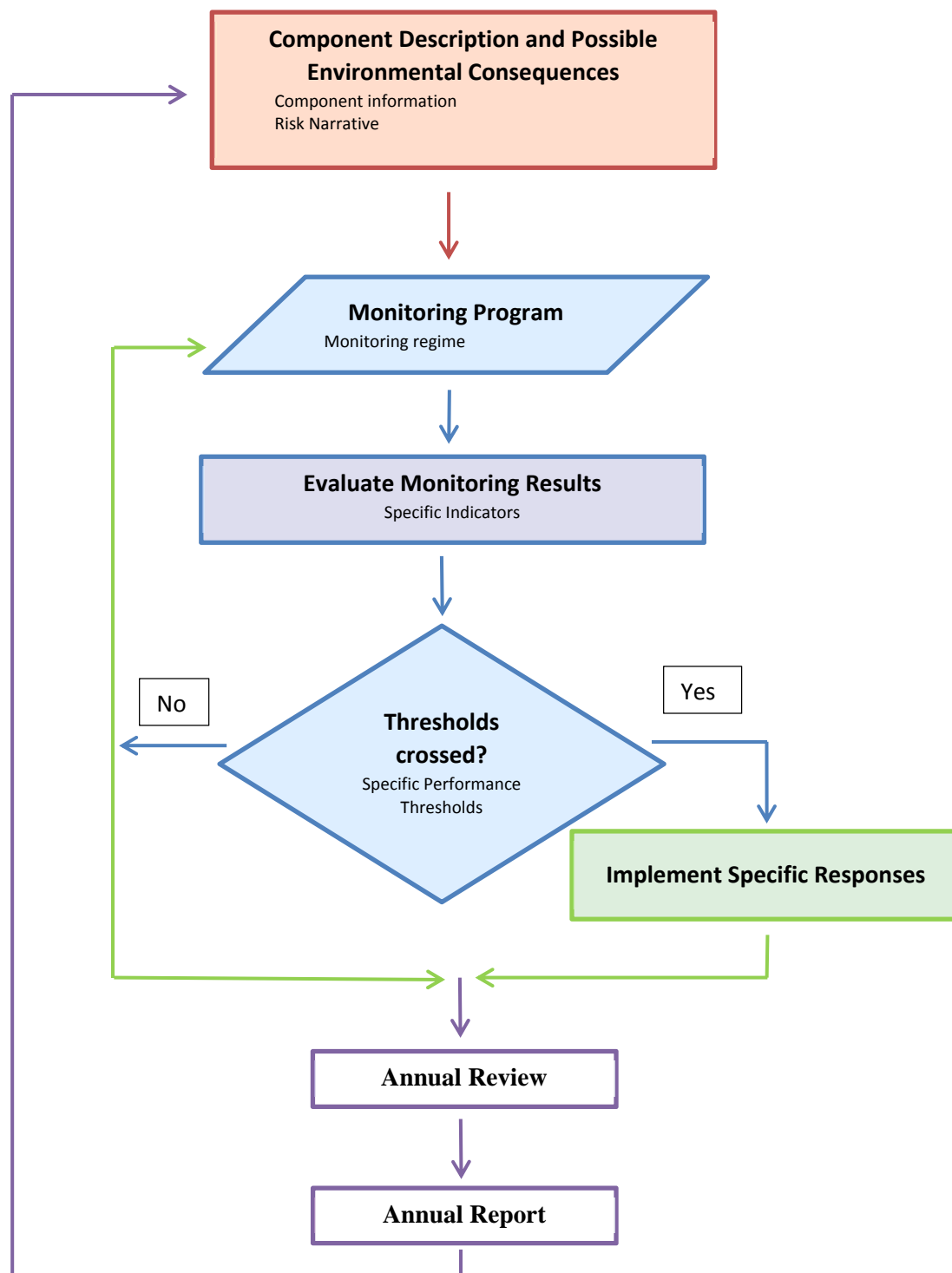


Figure 1-1: Sequential Components of the AMP (Adapted from AECOM 2010)

2 Adaptive Management Plans for Mine Components

2.1 Minto Creek Surface Water Quality

2.1.1 Description

Station W50 is considered the main control point on Minto Creek. It is also the last surface monitoring point on the mine site property and is considered a discharge compliance point under the current water licence. Additional key surface water monitoring locations upgradient of W50 and within the mine footprint are located at W16, W17, W15, W35, and W37.

As described in the Water Management Plan (Minto Explorations Ltd., 2015), Minto maintains substantial flexibility over the control and management of site runoff. The conveyance, storage and treatment systems are oriented to adequately manage site water to meet the current and proposed discharge standards at W50 (W3).

The W2 monitoring point near the Yukon River is beyond the final mine water discharge point controlled by Minto, and is subject to a broad range of influences from tributaries and catchment areas that are beyond Minto's control. However, Minto is committed to monitoring the water quality at W2 and responding to changing water quality in lower Minto Creek as appropriate. The AMP framework below compliments the operational water management plan at the mine site with a decision-based structure for ensuring that negative impacts to lower Minto Creek from mining activities are avoided.

2.1.2 Risk Narrative

Increase in contaminant concentrations from the mine causes adverse effects to aquatic resources in the receiving environment (lower Minto Creek) despite adherence to discharge standards.

2.1.3 Specific Indicators, Performance Thresholds and Responses

Indicators, performance thresholds and responses specific to water quality and the monitoring program are provided below in Table 2-1. Specific thresholds are identified in Tables 2-2. In some cases the AMP specific threshold has been refined to be based on observed conditions at the time of sampling, as opposed to a statistic from previous sampling data (i.e. dissolved cadmium WQO/threshold calculated using observed hardness.)

Table 2-1: Specific Indicators, Performance Thresholds and Responses for Surface Water Quality

Specific Indicators	Specific Performance Thresholds	Specific Responses
<p>Aqueous Concentrations at Station W2 for the following parameters with water quality objectives</p> <p>Parameters:</p> <ul style="list-style-type: none">NH₄-NNO₂-NNO₃-N <p>Dissolved</p> <ul style="list-style-type: none">AluminumArsenicCadmiumChromiumCopperIronLeadMolybdenumNickelSilverSeleniumZinc <p>(See Table 2-2 below for specific threshold values)</p>	<p>Specific Threshold 1</p> <ul style="list-style-type: none">Exceedance of predicted expected case maximum for dissolved concentrations at W2. (Does not apply to Arsenic, Iron, Lead, Molybdenum, Nickel, Silver, or Zinc)	<p>Notification</p> <ul style="list-style-type: none">Minto ManagementInclude in scheduled Water Use Licence monthly reporting <p>Review</p> <ul style="list-style-type: none">Follow QA/QC investigative protocol:<ul style="list-style-type: none">Review laboratory QA/QC reportValidate original result, or re-run sample if a laboratory error is indicated <p>Evaluation</p> <ul style="list-style-type: none">Compare with W3 results <p>Action</p> <ul style="list-style-type: none">If comparison with W3 result indicates mine loadings are responsible for exceedance then:<ul style="list-style-type: none">Re-sample both W2 and W3 within 24 hours of original sample result reviewActions will continue until performance thresholds are no longer exceeded.
	<p>Specific Threshold 2</p> <ul style="list-style-type: none">Exceedance of predicted expected case maximum for dissolved concentrations in 2 consecutive samples (scheduled or re-sample) where evaluation confirmed mine loading responsible for first exceedance <p>(Does not apply to Arsenic, Iron, Lead, Molybdenum, Nickel, Silver, or Zinc)</p>	<p>Notification</p> <ul style="list-style-type: none">Minto ManagementInclude in scheduled Water Use Licence reporting <p>Review</p> <ul style="list-style-type: none">Follow QA/QC investigative protocol:<ul style="list-style-type: none">Review laboratory QA/QC report <p>Validate original result, or re-run sample if a laboratory error is indicated</p> <p>Evaluation</p> <ul style="list-style-type: none">Compare with W3 results. If comparison with W3 result indicates that mine loadings are responsible for exceedance; and validation confirms original result, then:<ul style="list-style-type: none">Evaluate causes for load contributions and develop investigation plan. <p>Action</p> <ul style="list-style-type: none">Implement investigation plan, including at a minimum:<ul style="list-style-type: none">Re-sampling both W2 and W3 within 24 hours of original sample result review; andSite investigation of candidate load contributions.Review results of investigation and prepare recommendations if appropriate.Implement recommendations.Actions will continue until performance thresholds are no longer exceeded.
	<p>Specific Threshold 3</p> <ul style="list-style-type: none">Exceedance of predicted worst case maximum for dissolved concentrations <p>OR</p> <ul style="list-style-type: none">WQO exceeded at W2 in a single sample	<p>Notification</p> <ul style="list-style-type: none">Minto Management, SFN, YG InspectorInclude in scheduled Water Use Licence reporting <p>Review</p> <ul style="list-style-type: none">Follow QA/QC investigative protocol<ul style="list-style-type: none">Review laboratory QA/QC reportVerify original result, or re-run sample if laboratory error indicated <p>Evaluation</p> <ul style="list-style-type: none">Compare with W3 results. If comparison with W3 result indicates mine loadings responsible for exceedance – and verification confirms original result – then:<ul style="list-style-type: none">Evaluate candidate causes for load contributions and develop investigation plan (or review/revise as appropriate) <p>Action</p> <ul style="list-style-type: none">Maintain weekly monitoring at W2 and W3Implement investigation plan, including any reviews/revisions, and at a minimum:<ul style="list-style-type: none">Re-sampling both W2 and W3 within 24 hours of original sample result receipt; andSite investigation of candidate load contributions; andEvaluation of potential effects to aquatic resources (i.e. Compare to PNEC and apply BLM for D-Cu, invertebrate tissue for Se, compare with calculated acute guideline for D-Cd.)

Specific Indicators	Specific Performance Thresholds	Specific Responses
		<ul style="list-style-type: none">Review results of investigation and prepare recommendations if appropriateImplement recommendationsActions will continue until performance thresholds are no longer exceeded.
	Specific Threshold 4 <ul style="list-style-type: none">Exceedance of predicted worst case maximum for dissolved concentrations in 2 consecutive samples (scheduled or re-sample) where evaluation confirmed mine loading responsible for first exceedance	Notification <ul style="list-style-type: none">Minto Management, SFN, YG InspectorInclude in scheduled Water Use Licence reporting Review <ul style="list-style-type: none">Compare with W3 resultsFollow QA/QC investigative protocol Evaluation <ul style="list-style-type: none">Compare with W3 results. If comparison with W3 result indicates mine loadings responsible for exceedance; and verification confirms original result, then:<ul style="list-style-type: none">Evaluate candidate causes for load contributions and develop investigation plan (or review/revise as appropriate)Provide investigation plan to SFN/YG InspectorEvaluate potential for mine loadings to cause adverse effects to aquatic resources (i.e. redo BLM modeling) Action <ul style="list-style-type: none">Maintain weekly monitoring and collect samples at greater frequency as requiredDevelop investigation plan, including at a minimum:<ul style="list-style-type: none">Re-sampling both W2 and W3 within 24 hours of original sample result review; andSite investigation of load contributionsEvaluation of potential effects to aquatic resourcesReview results of investigation and prepare recommendationsImplement recommendations arising from investigations. <p>If threshold consistently exceeded for 2 months, then:</p> <ul style="list-style-type: none">Develop revised forecast for near-term (12 months) water quality in Minto Creek.Develop and implement any additional mitigation measures to reduce loading from mine site, if necessary, with appropriate regulatory approvals.Actions will continue until performance thresholds are no longer exceeded.
	Specific Threshold 5 <ul style="list-style-type: none">WQO or PNEC exceeded in 2 consecutive samples (scheduled or re-sample) where evaluation confirmed mine loading responsible for first exceedance	Notification <ul style="list-style-type: none">Minto Management, SFN, YG InspectorInclude in Water Use Licence reporting Review <ul style="list-style-type: none">Compare with W3 resultsFollow QA/QC investigative protocol Evaluation <ul style="list-style-type: none">All evaluation measures for ST4 and:<ul style="list-style-type: none">Consider ongoing WQ monitoring results in development of investigation planEvaluate potential for mine loadings to cause adverse effects to aquatic resources (i.e. redo BLM modeling) Action <ul style="list-style-type: none">Maintain weekly monitoring and collect samples at greater frequency as required.Develop investigation plan, including at a minimum:<ul style="list-style-type: none">Re-sampling both W2 and W3 within 24 hours of original sample result review; andSite investigation of load contributionsEvaluation of potential effects to aquatic resourcesReview results of investigation and prepare recommendationsImplement recommendations arising from investigations.Implement necessary reasonable and practical measures to reduce contaminant loading from mine to Minto Creek.Suspend discharge from the mine until water quality is appropriate for discharge.Actions will continue until performance thresholds are no longer exceeded.

Table 2-2: Specific Performance Thresholds for Surface Water Quality in Lower Minto Creek (W2)

	W2 Water Quality Objective	Expected Case Water Quality Predictions at W2 – Operational Period	Worst Case Water Quality Predictions at W2 – Operational Period
	(mg/L)	(mg/L)	(mg/L)
Ammonia - N, mg/L	0.25	0.057	0.25
Nitrite - N, mg/L	0.06	0.015*	0.057*
Nitrate - N, mg/L	9.1	1.1	5.1
Aluminum (dissolved), mg/L	0.1	0.057	0.077
Arsenic (dissolved), mg/L	0.005	**	0.0007
Cadmium (dissolved), µg/L	$e(0.736 \ln(\text{hardness}) - 4.943)$	0.000027	0.00004
Chromium (dissolved), mg/L	0.001	0.00062	0.00082
Copper (dissolved), mg/L (when [DOC] @ W2 >10 mg/L)	0.02	0.0092	0.014
Copper (dissolved), mg/L (when [DOC] @ W2 ≤10 mg/L)	0.013	0.0092	0.014
Iron (dissolved), mg/L	1.1	**	0.37
Lead (dissolved), mg/L	0.004	**	0.00044
Molybdenum (dissolved), mg/L	0.073	**	0.0015
Nickel (dissolved), mg/L	0.11	**	0.0021
Silver (dissolved), mg/L	0.0001	**	0.000042
Selenium (dissolved), mg/L	0.002	0.00055	0.00087
Zinc (dissolved), mg/L	0.03	**	0.0065

*Prediction reduced by 75% to account for expected nitrification in Minto Creek.

** While predictions exist for these parameters, as no action will be taken on expected case predictions, they have not been included in this table.

2.2 McGinty Creek Surface Water Quality

2.2.1 Description

The Minto North deposit is an extension of the mineralization being mined within the Minto Creek catchment. It is within the McGinty Creek catchment area, to the north of Minto Creek. As described in the Water Management Plan (Minto Explorations Ltd., 2015), Minto actively manages water directly impacted by open pit mining and pumps or transports it to the Main or Area 2 Pits.

Minto has been monitoring surface water quality in the McGinty Creek catchment since 2009, and the results from monitoring program (until July 2012) were presented in Phase V/VI Mine Plan supporting information in *McGinty Creek Water Quality Characterization, June 2013 (Access/Minnow, 2013)*. Additional data collected between August 2012 and July 2015 has been included in a re-characterization of the background water quality. The methodology for updating and employing these update data is described briefly in Section 2.2.3 below.

Station MN-4.5 is the monitoring station on the lower main stem of McGinty Creek near the confluence with the Yukon River. The YESAB Environmental Effects assessment supported Minto's conclusion of no anticipated significant adverse effects to aquatic resources, on the basis of the comparison of predicted surface water quality in lower McGinty Creek to water quality guidelines (or site-specific water quality objectives) for the protection of aquatic life, as evaluated at monitoring station MN-4.5. Surface water quality at the MN-4.5 monitoring point is subject to a broad range of influences from tributaries and catchment area that are beyond Minto's control (i.e. downgradient of the Minto North Pit). However, Minto is committed to monitoring the water quality at MN-4.5 and responding to changing water quality in lower McGinty Creek as appropriate. The AMP framework below complements the operational water management plan at the mine site with a decision-based structure for ensuring that negative impacts to lower McGinty Creek from mining activities are avoided.

2.2.2 Risk Narrative

Increase in contaminant concentrations from Minto North mining activities causes adverse effects to aquatic resources in the receiving environment (lower McGinty Creek).

2.2.3 Specific Indicators, Performance Thresholds and Responses

Indicators, performance thresholds and responses specific to water quality and the monitoring program are provided below in Table 2-8. The specific indicators are contaminant (nitrogen species and metals/metalloids) concentrations for parameters identified in the Water Use Licence QZ14-031 Table 2 – Water Quality Objectives. Thresholds are all based on a proposed water quality objective (WQO). In its submission to the Yukon Water Board at the Public Hearing, Minto committed to updating WQOs for McGinty Creek. The approach to selecting WQOs for this AMP section is identical to the approach utilized in the YESAB evaluation for the Phase V/VI Project Proposal. That approach considered a background water quality dataset from monthly monitoring conducted from 2009 – 2012. Monthly monitoring has continued in the McGinty Creek catchment, and the background dataset has been updated to include all monitoring data until July 2015 (stripping of the Minto North Pit began in August 2015.) For indicators which do not exceed Canadian Water Quality Guidelines (CWQGs) at a frequency of greater than 10% in background monitoring, the CWQG has been adopted as the WQO. Indicators which do exceed the CWQG at a frequency of >10% use the 95th percentile of the background dataset (at station MN-4.5) as the WQO. The information used in the selection of the WQO (and therefore the specific thresholds) is summarized in Table 2-5, and the actual threshold values are presented in Table 2-6.

Table 2-3: Specific Indicators, Performance Thresholds and Responses for Surface Water Quality in McGinty Creek

Specific Indicators	Specific Performance Thresholds	Specific Responses
<p>Aqueous Concentrations at Stations MN-4.5 for the following parameters:</p> <ul style="list-style-type: none">• Ammonia-N• Nitrate-N• Nitrite-N• Aluminum (total)• Arsenic (total)• Cadmium (total)• Chromium (total)• Copper (total)• Iron (total)• Lead (total)• Molybdenum (total)• Nickel (total)• Silver (total)• Selenium (total)• Zinc (total) <p>(See Error! Not a valid result for table. below for Water Quality Objective values and calculations.)</p>	<p>Specific Threshold 1</p> <ul style="list-style-type: none">• Exceedance of 80% of the WQO in two consecutive samples (scheduled or re-sample) at MN-4.5	<p>Notification</p> <ul style="list-style-type: none">• Minto Management• Include in scheduled Water Use Licence reporting <p>Review</p> <ul style="list-style-type: none">• Follow QA/QC investigative protocol:<ul style="list-style-type: none">○ Review laboratory QA/QC report○ Validate original result, or re-run sample if a laboratory error is indicated <p>Evaluation</p> <ul style="list-style-type: none">• Compare with MN-1.5, MN-2.5 and MN-0.5 results <p>Action</p> <ul style="list-style-type: none">• If comparison with other results suggests that Minto North operations may be responsible for exceedance then:<ul style="list-style-type: none">○ Evaluate causes for load contributions, with particular focus on any sediment sources○ Re-sample both MN-4.5 and MN-1.5 within 48 hours of original sample result review○ Actions will continue until performance thresholds are no longer exceeded.
	<p>Specific Threshold 2</p> <ul style="list-style-type: none">• Exceedance of the WQO at MN-4.5	<p>Notification</p> <ul style="list-style-type: none">• Minto Management• Include in scheduled Water Use Licence reporting <p>Review</p> <ul style="list-style-type: none">• Follow QA/QC investigative protocol:<ul style="list-style-type: none">○ Review laboratory QA/QC report○ Validate original result, or re-run sample if a laboratory error is indicated <p>Evaluation</p> <ul style="list-style-type: none">• Compare with MN-1.5, MN-2.5 and MN-0.5 results• Evaluate potential effects to aquatic resources <p>Action</p> <ul style="list-style-type: none">• If comparison with results suggests that Minto North loadings are responsible for exceedance and validation confirms original result, then:<ul style="list-style-type: none">○ Evaluate causes for load contributions, with particular focus on any sediment sources○ Increase monitoring frequency to weekly.○ Re-sample both MN-4.5 and MN-1.5 within 48 hours of original sample result review; and○ Where reasonable and practical, implement additional sediment and erosion control measures outlined in Minto’s Erosion and Sediment Control Plan.○ If source of loading from Minto North is not sediment-related, develop a mitigation strategy with recommendations.• Actions will continue until performance thresholds are no longer exceeded.
	<p>Specific Threshold 3</p> <ul style="list-style-type: none">• Exceedance of the WQO at MN-4.5 in 2 consecutive samples (scheduled or re-sample) where evaluation confirmed mine loading responsible for first exceedance	<p>Notification</p> <ul style="list-style-type: none">• Notify management, SFN and YG• include in scheduled Water Use Licence reporting <p>Review</p> <ul style="list-style-type: none">• Follow QA/QC investigative protocol:<ul style="list-style-type: none">○ Review laboratory QA/QC report○ Validate original result, or re-run sample if a laboratory error is indicated

Specific Indicators	Specific Performance Thresholds	Specific Responses
		<p>Evaluation</p> <ul style="list-style-type: none">• Compare with MN-1.5, MN-2.5 and MN-0.5 results.• Consider conducting a trend analysis on observed water quality concentrations and revising water quality predictions• Evaluate potential effects to aquatic resources <p>Action</p> <ul style="list-style-type: none">• If comparison with results (evaluation, above) suggests that Minto North loadings are STILL responsible for exceedance; and validation confirms original result, then:<ul style="list-style-type: none">◦ If not already implemented, increase monitoring frequency to weekly.• If evaluation above also suggests that Minto North loadings are contributing to a potential for significant adverse effects to aquatic resources, then:<ul style="list-style-type: none">◦ Implement recommendations from mitigation strategy (threshold 2 response)• Actions will continue until performance thresholds are no longer exceeded.

Table 2-4: Information utilized in the selection of Water Quality Objectives for use at Station MN-4.5.

Water Quality Parameter	Units	95 th Percentile at MN-4.5 (2009 – 2015)	Canadian Water Quality Guideline
N-NH3	mg/L	0.114	0.197
N-NO2	mg/L	0.025	0.06
N-NO3	mg/L	0.222	3
Al-T	µg/L	2834	5 µg/L if pH < 6.5 100 µg/L if pH ≥ 6.5
As-T	µg/L	1.95	5
Cd-T	µg/L	0.101	0.04 µg/L if hardness (as CaCO₃) < 17 mg/L $10^{(0.83(\log[\text{hardness}]) - 2.46)}$ if hardness ≥ 17 mg/L and ≤ 280 mg/L 0.37 µg/L if hardness > 280 mg/L
Cr-T	µg/L	5.5	1
Cu-T	µg/L	12.67	2 µg/L if hardness (as CaCO ₃) ≤ 82 mg/L or unknown $0.2 * e^{(0.8545[\ln(\text{hardness})] - 1.465)}$ if hardness ≥ 82 mg/L and ≤ 180 mg/L 4 µg/L if hardness > 180 mg/L
Fe-T	µg/L	4937	300
Pb-T	µg/L	2.12	1 µg/L if hardness (as CaCO₃) ≤ 60 mg/L or unknown $e^{(1.273[\ln(\text{hardness})] - 4.705)}$ if hardness > 60 mg/L and ≤ 180 mg/L 7 µg/L if hardness > 180 mg/L
Mo-T	µg/L	1.1	73
Ni-T	µg/L	8.0	25 µg/L if hardness (as CaCO₃) ≤ 60 mg/L or unknown $e^{(0.76[\ln(\text{hardness})] + 1.06)}$ if hardness > 60 mg/L and ≤ 180 mg/L 150 µg/L if hardness > 180 mg/L
Se-T	µg/L	0.22	1
Ag-T	µg/L	0.04	0.25
Zn-T	µg/L	29.5	30

* Cd-T CCME guideline is the long term guideline

**Shaded and bolded cells indicate values used as WQOs

Table 2-6: Threshold values for AMP use at Station MN-4.5.

Water Quality Parameter	Units	80% of Water Quality Objective	Water Quality Objective
N-NH3	mg/L	0.158	0.197
N-NO2	mg/L	0.025	0.06
N-NO3	mg/L	0.222	3
Al-T	mg/L	2.26	2.83
As-T	mg/L	0.004	0.005
Cd-T	µg/L	0.8*(CWQG @ observed hardness)	0.04 µg/L if hardness (as CaCO ₃) < 17 mg/L $10^{(0.83(\log[\text{hardness}]) - 2.46)}$ if hardness ≥ 17 mg/L and ≤ 280 mg/L 0.37 µg/L if hardness > 280 mg/L
Cr-T	mg/L	0.0044	0.0055
Cu-T	mg/L	0.0102	0.0127
Fe-T	mg/L	3.95	4.94
Pb-T	µg/L	0.8*(CWQG @ observed hardness)	1 µg/L if hardness (as CaCO ₃) ≤ 60 mg/L or unknown $e^{\{1.273[\ln(\text{hardness})] - 4.705\}}$ if hardness > 60 mg/L and ≤ 180 mg/L 7 µg/L if hardness > 180 mg/L
Mo-T	mg/L	0.058	0.073
Ni-T	µg/L	0.8*(CWQG @ observed hardness)	25 µg/L if hardness (as CaCO ₃) ≤ 60 mg/L or unknown $e^{\{0.76[\ln(\text{hardness})] + 1.06\}}$ if hardness > 60 mg/L and ≤ 180 mg/L 150 µg/L if hardness > 180 mg/L
Se-T	mg/L	0.0008	0.001
Ag-T	mg/L	0.0020	0.0025
Zn-T	mg/L	0.024	0.030

2.3 Groundwater Quality in Minto Creek Watershed

2.3.1 Description

Groundwater quality has the potential to be important in terms of contributions to surface water quality. Groundwater contributes to streamflow as baseflow, which is typically most important during the autumn/winter low flow season when surface water flows are minimal.

All mine workings and waste facilities within in the Minto Creek catchment are located upgradient (and west) of the Water Storage Pond (WSP). Groundwater is monitored both upgradient (west) and downgradient (east) of the WSP- upgradient monitoring is carried out via a multi-level monitoring well at MW12-06, and downgradient monitoring is carried out via a multi-level monitoring well at MW12-05. Surface water downgradient of the WSP is monitored at several stations including station W3, which is located immediately adjacent to MW12-05.

As described in the 2015 Groundwater Model Update (SRK 2015a), groundwater coming from the mine area (the western and highest elevation portion of the Minto Creek catchment) is expected to discharge to surface water in the vicinity of the Water Storage Pond. Minimal groundwater from the mine area is expected to discharge to Minto Creek down gradient of the Water Storage Pond. MW12-05 and MW12-06 are optimally located to monitor expected groundwater flow paths.

The W2 monitoring point near the Yukon River is beyond the final mine water discharge point controlled by Minto, and is subject to influences from groundwater outside the mine area that is beyond Minto's control. Minto is committed to monitoring groundwater well up gradient of W2, and the water quality at W2, and responding to changing water quality in groundwater and lower Minto Creek as appropriate.

The AMP framework below complements the operational water management plan at the mine site with a decision-based structure for ensuring that negative impacts to lower Minto Creek from mining activities are avoided.

2.3.2 Risk Narrative

Flux of geochemical load from the mine via groundwater pathways causes surface water quality objectives to be exceeded in Minto Creek at station W2.

2.3.3 Specific Indicators, Performance Thresholds and Responses

Indicators, performance thresholds and responses specific to groundwater quality in Minto Creek watershed are provided in Table 2-5. Specific thresholds are identified in Table 2-6. Groundwater thresholds are defined for all metals and metalloids identified in Table 2 of Water Use Licence QZ14-031.

Groundwater concentration specific threshold values have been defined as being equal to the surface WQOs for lower Minto Creek at station W2. While the WQOs are for surface water, and therefore have not been defined specifically for groundwater, they provide a conservative threshold for action before any significant effect would be observed in surface water.

The conservative and protective nature of adopting surface water WQOs for groundwater concentration thresholds was confirmed by conducting a mass loading calculation to determine the groundwater concentrations that would be necessary to cause exceedance of WQOs in lower Minto Creek. The mass loading calculation was

structured to represent a low-flow period when all surface flows in lower Minto Creek originate from groundwater discharge to the creek. The calculation was done using the following formula:

$$C_{\text{gw-mine_max}} = ((Q_{\text{W2}} \times C_{\text{W2-WQO}}) - (Q_{\text{gw-bgrnd}} \times C_{\text{gw-bgrnd}})) / Q_{\text{gw-mine}}$$

Where:

- $C_{\text{gw-mine_max}}$ = the maximum parameter concentration of groundwater from the mine needed to reach the WQO at the compliance point
- Q_{W2} = the combined groundwater flow discharging to Minto Creek (total groundwater discharge to Minto Creek from the 2015 groundwater model update) during low flow periods
- $C_{\text{W2-WQO}}$ = the WQO parameter concentration for surface water at W2
- $Q_{\text{gw-bgrnd}}$ = background groundwater flow discharging to Minto Creek (groundwater discharge down gradient of the Water Storage Pond from the 2015 groundwater model update) during low flow periods
- $C_{\text{gw-bgrnd}}$ = background groundwater concentration (based on average values from MW12-05 and MW12-06)
- $Q_{\text{gw-mine}}$ = the estimated groundwater flow from the mine at the Water Storage Pond (from the 2015 groundwater model update)

For all specific indicators, the calculated groundwater concentrations necessary to reach the WQO for Minto Creek during low flow conditions are 3 to 5 times higher than the WQO (see Table 2-6), and as such the adoption of the WQO concentration as a specific threshold is conservative and protective. Further details are available in SRK (2015b).

Table 2-5: Specific Indicators, Performance Thresholds and Responses for Groundwater Quality in Minto Creek

Specific Indicators	Specific Performance Thresholds	Specific Responses
<p>Aqueous concentrations in samples collected from multi-level groundwater monitoring wells MW12-05 or MW12-06 for the following parameters with water quality objectives:</p> <ul style="list-style-type: none">Dissolved AluminumDissolved ArsenicDissolved CadmiumDissolved ChromiumDissolved CopperDissolved IronDissolved LeadDissolved MolybdenumDissolved NickelDissolved SilverDissolved SeleniumDissolved Zinc	<p>Specific Threshold</p> <ul style="list-style-type: none">Exceedance of W2 surface WQO for dissolved concentrations at any monitoring port in MW12-05 or MW12-06.	<p>Notification</p> <ul style="list-style-type: none">Minto ManagementInclude in scheduled Water Use Licence reporting <p>Review</p> <ul style="list-style-type: none">Follow QA/QC investigative protocol:<ul style="list-style-type: none">Review laboratory QA/QC reportValidate original result, or re-run sample if a laboratory error is indicated <p>Evaluation</p> <ul style="list-style-type: none">Review of groundwater monitoring data to be undertaken by qualified professional, and appropriate recommendations to be developed<ul style="list-style-type: none">Review must consider the risk narrative (i.e. exceedance of surface water quality objectives as a result of groundwater flux) <p>Action</p> <ul style="list-style-type: none">Follow recommendations arising from review undertaken by qualified professional

Table 2-6: Mine-area groundwater concentrations that would be necessary to cause exceedance of WQOs in lower Minto Creek

Minto Creek	Concentrations (mg/L)												
	Model Flow (L/s) ¹	Al-D	Cr-d	Cd-D	Cu-D	Se-D	As-D	Fe-D	Pb-D	Mo-D	Ni-D	Ag-D	Zn-D
W2-WQO ²	15	0.10	0.001	0.0012	0.013	0.002	0.005	1.1	0.004	0.073	0.11	0.0001	0.03
GWbgrnd ³	12	0.01	0.0005	0.00002	0.001	0.0002	0.001	0.65	0.0001	0.003	0.001	0.00001	0.01
GWmine-max (calculated) ⁴	3	0.47	0.003	0.006	0.06	0.01	0.02	2.9	0.02	0.35	0.55	0.0005	0.1
multiplier (GWmine-max/WQO)		4.7	3.1	4.9	4.8	4.7	4.5	2.6	4.9	4.8	5.0	4.6	4.3

Notes:

- 1: Model flows based on 2015 Groundwater Model Update. 15 L/s is the total groundwater discharging to Minto Creek. 3 L/s is the estimated groundwater flow from the Minto Creek catchment up gradient of the Water Storage Pond.
- 2: WQO for surface water at W2 (for dissolved copper, the WQO for DOC < 10mg/L is used; for cadmium, the WQO for the November to March period is used (baseflow period, with assumed hardness of 180 mg/L))
- 3: GWbgrnd is background groundwater concentration calculated as the average of concentrations observed at groundwater monitoring well MW12-05
- 4: GWmine-max is the calculated concentration that all groundwater from the mine must attain to reach the WQO at W2.

2.4 Groundwater Quality in McGinty Creek Watershed

2.4.1 Description

The mine workings in the McGinty Creek catchment are limited to the Minto North Pit- the pit and the overall catchment are described in Section 2.2.1. The catchment area of the Minto North Pit is roughly 15 ha and the catchment area of the McGinty Creek watershed is roughly 3400 ha (SRK 2013). While a groundwater model encompassing the full extent of the McGinty Creek catchment has not been developed, it is clear that only a very small proportion of the groundwater in the McGinty Creek watershed can be affected by the Minto North Pit.

Groundwater in the McGinty Creek catchment downgradient of the Minto North Pit is monitored at multi-level monitoring well MW09-03.

2.4.2 Risk Narrative

Flux of geochemical load from the mine via groundwater pathways causes surface water quality objectives to be exceeded in McGinty Creek at station MN4.5.

2.4.3 Specific Indicators, Performance Thresholds and Responses

Indicators, performance thresholds and responses specific to groundwater quality in McGinty Creek watershed are provided below in Table 2-7. Groundwater thresholds are defined for all metals and metalloids identified in Table 2-4.

Three specific groundwater thresholds have been defined for the McGinty Creek watershed- all three are conservative given the small proportion of catchment groundwater that will be influenced by the mine workings. Rationale for development of the two specific thresholds is as follows:

- Specific Threshold 1: Four consecutive exceedances of surface WQO in a single monitoring port
 - The groundwater baseline monitoring at MW09-03 has shown that pre-mining groundwater concentrations for certain parameters exceed the surface WQOs on occasion, with both cadmium and iron returning multiple individual concentrations that exceed the surface water quality objective.
 - The specification of four consecutive exceedances is intended to avoid triggering the AMP unnecessarily, but to ensure that any sustained increase from baseline conditions receives appropriate scrutiny.
 - Specific Threshold 1 will not apply to dissolved iron concentrations in MW09-03-02- Specific Threshold 3 has been developed for that specific case.
- Specific Threshold 2: A single result that exceeds the surface WQO by a factor of ten in a single monitoring port
 - This specific threshold was developed to address a condition characterized by a large and rapid increase in dissolved concentrations.
 - Specific Threshold 2 will not apply to dissolved iron concentrations in MW09-03-02- Specific Threshold 3 has been developed for that specific case.

- Specific Threshold 3: Two consecutive dissolved iron concentration results for MW09-03-02 that exceed 47.6 mg/L
 - This specific threshold was developed to address the elevated baseline dissolved iron concentrations in MW09-03-02 (baseline monitoring results for this zone were routinely 3 to 5 times higher than surface WQOs for McGinty Creek)
 - The specific threshold value of 47.6 mg/L was selected as two times the maximum observed baseline concentration of 23.8 mg/L. This value will limit the chance of triggering the AMP due to variability in the baseline condition in this zone, while ensuring that conditions that may indicate a departure from baseline conditions receive appropriate scrutiny.

Table 2-7: Specific Indicators, Performance Thresholds and Responses for Groundwater Quality in McGinty Creek

Specific Indicators	Specific Performance Thresholds	Specific Responses
Aqueous concentrations in samples collected from multi-level groundwater monitoring well MW09-03 for the following parameters: <ul style="list-style-type: none">Dissolved AluminumDissolved ArsenicDissolved CadmiumDissolved ChromiumDissolved CopperDissolved IronDissolved LeadDissolved MolybdenumDissolved NickelDissolved SilverDissolved SeleniumDissolved Zinc	Specific Threshold 1 <ul style="list-style-type: none">Four consecutive exceedances of MN4.5 surface WQO¹ in routine monitoring results from a single monitoring port in MW09-03. <p>(See Error! Not a valid result for table. for Water Quality Objective values)</p>	Notification <ul style="list-style-type: none">Minto ManagementInclude in scheduled Water Use Licence reporting Review <ul style="list-style-type: none">Follow QA/QC investigative protocol:<ul style="list-style-type: none">Review laboratory QA/QC reportValidate original result, or re-run sample if a laboratory error is indicated Evaluation <ul style="list-style-type: none">Review of groundwater monitoring data to be undertaken by qualified professional, and appropriate recommendations to be developed<ul style="list-style-type: none">Review must consider the risk narrative (i.e. exceedance of surface water quality objectives as a result of groundwater flux) Action <ul style="list-style-type: none">Follow recommendations arising from review undertaken by qualified professional
	Specific Threshold 2 <ul style="list-style-type: none">A single result exceeding 10 times MN4.5 surface WQO¹ in routine monitoring results from a single monitoring port in MW09-03. <p>(See Error! Not a valid result for table. for Water Quality Objective values)</p>	
Aqueous concentrations in samples collected from MW09-03-02 for: <ul style="list-style-type: none">Dissolved Iron	Specific Threshold 3 <ul style="list-style-type: none">Two consecutive dissolved iron results exceeding 47.6 mg/L (2 times the maximum value observed in baseline monitoring) in MW09-03-02 (Zone 2).	

Notes:

1: McGinty Creek WQOs are established as total concentrations; for AMP purposes, dissolved concentrations from groundwater monitoring will be compared to the WQOs expressed as total concentrations.

2.5 Water Management

2.5.1 Description

The Minto Mine site has a positive water balance. Therefore, it is necessary to release water from site from time to time to prevent accumulation of excess water. The primary objective of Minto's water management strategy is to ensure that water can be released from site in a way that protects the water quality in Minto Creek. Details concerning water management for Phase V/VI are provided in the Minto Mine Phase V/VI Water Management Plan as amended from time to time (Minto Explorations Ltd., 2015).

The strategy can be summarized as follows:

- Runoff from developed mine areas (mine water) will be collected and stored in the Main Pit Tailings Management Facility (MPTMF) and the Area 2 Pit Tailings Management Facility (A2PTMF). Mine water will be used for ore processing.
- The site water balance will be used to define mine water inventory targets and targets for volumes to be released to Minto Creek. Inventory targets will be defined on an annual basis and reported in the annual water balance update.
- To the extent possible, water will be released from site by collecting and diverting discharge-compliant (clean) runoff to the water storage pond (WSP) and from there to Minto Creek.
- If collection, diversion and release of clean water does not move enough water off site then Minto has the option of treating and releasing mine water.

The water management strategy is able to deal with most foreseeable conditions that may be encountered though the mine development. However, certain unforeseen conditions may require an adaptive response as described below.

2.5.2 Risk Narrative

The existing water treatment plant is not able to treat and discharge enough mine water, and as a result the mine water inventory exceeds the target.

2.5.3 Specific Indicators, Performance Thresholds and Responses

Indicators, performance thresholds and responses specific to water management are provided below in Table 2-8.

Table 2-8: Specific Indicators, Performance Thresholds and Responses for Water Management

Specific Indicators	Specific Performance Thresholds	Specific Responses
Water inventory in the Main Pit Tailings Management Facility or the Area 2 Pit Management Facility exceeds target inventory	Specific Threshold 1 <ul style="list-style-type: none">Water inventory target is exceeded for a period of three months. The water storage capacity still exceeds 1,000,000 m³.	Notification <ul style="list-style-type: none">Minto ManagementInclude in monthly report Review <ul style="list-style-type: none">Review site water balanceReview recent water management and water treatment practices Evaluation <ul style="list-style-type: none">Evaluate the water inventory targets. For example, how much water can be stored in the pits for how long? Can the inventory target safely be changed to accommodate the excess volume of water? Action <ul style="list-style-type: none">Develop plan to address the water excess inventory such that the target can be met within 6 months. The plan may include:<ul style="list-style-type: none">An adjustment of the target inventory,Diverting more clean water to the WSP,Modifying or expanding water treatment.
	Specific Threshold 2 <ul style="list-style-type: none">The water storage capacity is less than 1,000,000 m³.	Notification <ul style="list-style-type: none">Minto Management, SFN and YG Inspector.Include in scheduled Water Use Licence reporting. Review <ul style="list-style-type: none">Review site water balance.Review recent water management and water treatment practices. Evaluation <ul style="list-style-type: none">Evaluate the water inventory targets. For example, how much water can be stored in the pits for how long? Can the inventory target safely be changed to accommodate the excess volume of water?Evaluate treatment requirements and determine if the exiting water treatment plant has sufficient capacity to meet the requirements. Action <ul style="list-style-type: none">Immediately develop and implement a plan to address the lack of storage capacity such that the capacity can be restored prior to subsequent freshet.<ul style="list-style-type: none">The plan may include, modifying or expanding the water treatment plant.Plans to bring mobile treatment equipment to site may be considered.
	Specific Threshold 3 <ul style="list-style-type: none">The water storage capacity is less than 500,000 m³.	Notification <ul style="list-style-type: none">Minto Management, SFN, YG Inspector and Regulators.Include in Water Use Licence reporting. Review <ul style="list-style-type: none">Review site water balance.Review recent water management and water treatment practices. Evaluation <ul style="list-style-type: none">Evaluate treatment requirements and determine if the existing water treatment plant has sufficient capacity to meet the requirements. Action <ul style="list-style-type: none">Immediately make plans to bring mobile treatment equipment to site, if existing plant does not have sufficient capacity.

2.5.4 Freeboard Thresholds for Water Storage Facilities

The water storage facilities authorized under the WL include the Water Storage Pond, the Mill Water Pond, the Ridgetop North Pit, the Main Pit and the Area 2 Pit. With the exception of the Ridgetop North Pit, all of these facilities have documents associated with their design.

Storage Facility	Freeboard limit (m) from spill elevation
Water Storage Pond	1
Main Pit Tailings Management Facility	2
Area 2 Pit Tailings Management Facility	5

All of the water storage facilities water levels and volumes are managed through permanent pumping and piping systems.

The mill water pond contains an overflow culvert and does not require a freeboard limit.

As the Ridgetop North Pit has not excavated, there is not adequate detailed design to have a freeboard limit at this time, however this will be addressed in future iterations of this plan, should the pit be developed.

2.6 Physical Stability

2.6.1 Description

The physical stability of the waste rock, tailings and water storage facilities are monitored according to the Physical Monitoring Plan, which forms part of the Environmental Monitoring, Surveillance and Reporting Plan (Minto Explorations Ltd., 2015). The document describes the inspection and instrumentation data collection frequencies, instrument locations, installation details, as well as the data collection procedures.

The purpose of the monitoring program is to identify physical changes to the conditions of the facilities which may lead to future instability and to allow the mine mitigate these conditions prior to any occurrence of instability. The facilities have been separated into two sets of geotechnical thresholds and response criteria (Table 2-9). The Water Storage Dam has been excluded from the operational AMP as the facility is to be managed according to its Operation, Maintenance and Surveillance (OMS) Manual (Tetra Tech EBA, 2014).

Table 2-9: Physical Stability Categories

Category	Facility
1	<ul style="list-style-type: none"> • Dry Stack Tailings Storage Facility and Mill Valley Fill Extension (Stage 1 and 2) • Southwest Waste Dump • South Wall Buttress / Main Pit Dump
2	<ul style="list-style-type: none"> • Main Waste Dump and Main Waste Dump Extension • Reclamation Overburden Dump • Ice-Rich Overburden Dump

Category	Facility
1	<ul style="list-style-type: none"> • Dry Stack Tailings Storage Facility and Mill Valley Fill Extension (Stage 1 and 2) • Southwest Waste Dump • South Wall Buttress / Main Pit Dump
	<ul style="list-style-type: none"> • Ridgetop Waste Dump • Ridgetop South Backfill Dump • Area 118 Backfill Dump • Main Pit Dump

Category 1 facilities are founded in areas of ice-rich periglacial foundations that have previously experienced deep seated foundation movement. The Mill Valley Fill Extension (MVFE) and South Wall Buttress (SWB) are designed to mitigate movements in the Dry Stack Tailings Storage Facility (DSTS) and Main Pit South Wall areas, respectively, and the Main Pit Dump provides further stabilization to the Main Pit South Wall area. Additional monitoring inspection and response requirements for the DSTS are detailed in the Operations, Maintenance, and Surveillance Manual (OMS) for the facility (Tetra Tech EBA, 2014).

Category 2 facilities consist of all the remaining waste rock dumps and the Main Dam. These waste dumps are located in areas with good foundation conditions that avoid areas underlain by ice-rich overburden. The Main Dam design is currently in progress and subject to further operational evaluation. The southern portion of the dam is also founded on ice-rich overburden similar to the Category 1 facilities and some deformation is expected during the operational period due to thaw settlement. Additional monitoring inspection and monitoring requirements may be required for the dam, this will be addressed in the OMS manual to be completed as part of the Main Dam final design.

2.6.2 Risk Narrative

A mass failure of one of the waste facilities has the potential to endanger the health and safety of site employees or visitors, or lead to an increase in contaminant loadings from the mine and subsequent adverse effects to aquatic resources in the receiving environment (lower Minto Creek).

2.6.3 Specific Indicators, Performance Thresholds and Responses

Indicators, performance thresholds and responses specific to Category 1 and Category 2 Facilities are provided in Table 2-10 and Table 2-11, respectively.

Table 2-10: Specific Indicators, Performance Thresholds and Responses for Category 1 Facilities

Specific Indicators	Specific Performance Thresholds	Specific Responses
<ul style="list-style-type: none">• Mass movement indicated by monitoring of geotechnical instrumentation• Visual observations of physical damage• Visual observations of evidence that could suggest mass movement• Occurrence of seismic events	Specific Threshold 1 <ul style="list-style-type: none">• Observation of unusual occurrence including:<ul style="list-style-type: none">• tension cracks, settlement, or sloughing;• a seismic event that exceeds the 1:475 return period event¹;• abnormal seepage from any area of the slopes;• increased turbidity from seepage;• physical damage.	Notification <ul style="list-style-type: none">• Mine Manager• Geotechnical Engineer• Include in annual report Review <ul style="list-style-type: none">• Review previous inspection reports, existing instrumentation including piezometer, temperature, inclinometer, and survey data. Evaluation <ul style="list-style-type: none">• Geotechnical Engineer to compare recent monitoring results against older results for additional evidence of instability. Action <ul style="list-style-type: none">• Inspect the area for any other signs of instability.• Follow any recommendations of the Geotechnical Engineer. At a minimum, the Engineer will consider the need for:<ul style="list-style-type: none">○ An increase in the frequency of routine inspections and monitoring.○ Additional inspection, instrumentation, monitoring, or analyses
	Specific Threshold 2 <ul style="list-style-type: none">• One survey hub or inclinometer reading indicating acceleration of movement greater than the long-term trend and outside range of instrumentation error	Notification <ul style="list-style-type: none">• Site Geotechnical Engineer Review <ul style="list-style-type: none">• Review existing instrumentation data. Evaluation <ul style="list-style-type: none">• Site Geotechnical Engineer to compare recent monitoring results against older results. Action <ul style="list-style-type: none">• Retake reading.• If the reading was accurate, increase the survey hub or inclinometer frequency.
	Specific Threshold 3 <ul style="list-style-type: none">• For DSTSF and MVFE piezometers 13-DSP-05a, 13-DSP-06, 15-DSP-07, and	Notification <ul style="list-style-type: none">• Mine Manager• Geotechnical Engineer• Include in annual report Review

¹ This size of a seismic event would be felt by most people on site. It would shake buildings, and rattle or break dishes, hanging objects, etc. Earthquake information may also be found online at: <http://www.earthquakescanada.nrcan.gc.ca/index-eng.php>

Specific Indicators	Specific Performance Thresholds	Specific Responses
	<p>15-DSP-08, an increase in pore water pressures such that Ru^2 exceeds 0.4^3.</p> <ul style="list-style-type: none">For MVFE2 piezometers 15-DSP-09 and 15-DSP-10, an increase in pore water pressures such that the water elevation is 1 m above the original ground surface. <p>Or</p> <ul style="list-style-type: none">Temperature greater than zero at a depth of 2 m below original ground (<i>all SWD ground temperature cables, and DSTSF ground temperature cables DST-10, DST-11, and DST-14 only</i>)	<ul style="list-style-type: none">Review previous inspection reports, existing instrumentation including piezometer, temperature, inclinometer, and survey data. <p>Evaluation</p> <ul style="list-style-type: none">Geotechnical Engineer to compare recent monitoring results against older results for additional evidence of instability. <p>Action</p> <ul style="list-style-type: none">Inspect the area for any other signs of instability.If pore water pressure threshold exceeded: immediately increase frequency to semi-weekly or as directed by the Engineer until determined unnecessary.Follow any additional recommendations of the Geotechnical Engineer.
	<p>Specific Threshold 4</p> <ul style="list-style-type: none">For DSTSF and MVFE piezometers 13-DSP-05, 13-DSP-06, 15-DSP-07, and 15-DSP-08, an increase in pore water pressures such that Ru exceeds 0.6.For MVFE2 piezometers 15-DSP-09 and 15-DSP-10, an increase in pore water pressures such that the water elevation is 3 m above the original ground surface.	<p>Notification</p> <ul style="list-style-type: none">Mine ManagerGeotechnical EngineerInclude in annual report <p>Review</p> <ul style="list-style-type: none">Review previous inspection reports, existing instrumentation including piezometer, temperature, inclinometer, and survey data. <p>Evaluation</p> <ul style="list-style-type: none">Geotechnical Engineer to compare recent monitoring results against older results for additional evidence of instability. <p>Action</p> <ul style="list-style-type: none">Inspect the area for any other signs of instability.Immediately increase pore water pressure monitoring and data review frequency to daily or as directed by the Engineer until determined unnecessary.Follow any additional recommendations of the Geotechnical Engineer. At a minimum, , the Engineer will consider the need for:<ul style="list-style-type: none">An increase in the frequency of routine inspections and monitoring.Additional inspection, instrumentation, monitoring, or analyses.Modifications to the waste placement/construction practices.

² Ru is the pore water pressure coefficient which is the ratio of pore water pressure to the overburden pressure. A pore water pressure ratio of 0.5 would be similar to the effect of a groundwater table at surface.

³ Piezometer 13-DSP-5b exceeded this trigger on April 2015. A review of the data and stability analysis was completed and documented in the 2015 annual geotechnical inspection report (SRK 2015a) and found no stability issue and recommended continued monthly monitoring.

Specific Indicators	Specific Performance Thresholds	Specific Responses
	<p>Specific Threshold 5</p> <ul style="list-style-type: none">Three consecutive survey hub or inclinometer readings indicating acceleration of movement greater than the long-term trend. <p>Or</p> <ul style="list-style-type: none">Three consecutive survey hub readings indicating a change in horizontal direction of movement greater than 15 degrees from the long term trend.	<p>Notification</p> <ul style="list-style-type: none">Mine ManagerGeotechnical EngineerInclude in annual report <p>Review</p> <ul style="list-style-type: none">Review previous inspection reports, existing instrumentation including piezometer, temperature, inclinometer, and survey data. <p>Evaluation</p> <ul style="list-style-type: none">Geotechnical Engineer to compare recent monitoring results against older results for additional evidence of instability. <p>Action</p> <ul style="list-style-type: none">Inspect the area for any other signs of instability.Complete a ground survey of the area of interest to monitor any future displacement.Immediately increase monitoring and data review frequency to weekly or as directed by the Engineer until determined unnecessary.Follow any additional recommendations of the Geotechnical Engineer. At a minimum, the Engineer will consider the need for:<ul style="list-style-type: none">An increase in the frequency of routine inspections and monitoring.Additional inspection, instrumentation, monitoring, or analysesModifications to the waste placement/construction practices.

Table 2-11: Specific Indicators, Performance Thresholds and Responses for Category 2 Facilities

Specific Indicators	Specific Performance Thresholds	Specific Responses
<ul style="list-style-type: none">• Mass movement indicated by monitoring of geotechnical instrumentation• Visual observations of physical damage• Visual observations of evidence that could suggest mass movement• Occurrence of seismic events	Specific Threshold 1 <ul style="list-style-type: none">• Observation of unusual occurrence including:<ul style="list-style-type: none">• tension cracks, settlement, or sloughing;• a seismic event that exceeds the 1:475 return period event;• abnormal seepage from any area of the slopes;• increased turbidity from seepage;• physical damage.	Notification <ul style="list-style-type: none">• Mine Manager• Geotechnical Engineer• Include in annual report Review <ul style="list-style-type: none">• Review previous inspection reports, existing instrumentation including piezometer, temperature, inclinometer, and survey data. Evaluation <ul style="list-style-type: none">• Geotechnical Engineer to compare recent monitoring results against older results for additional evidence of instability. Action <ul style="list-style-type: none">• Inspect the area for any other signs of instability.• Follow any recommendations of the Geotechnical Engineer. At a minimum, the Engineer will consider the need for:<ul style="list-style-type: none">○ An increase in the frequency of routine inspections and monitoring.○ Additional inspection, instrumentation, monitoring, or analyses.
	Specific Threshold 2 <ul style="list-style-type: none">• Survey hub cumulative displacements between 150 mm and 500 mm; Or <ul style="list-style-type: none">• Increase in pore water pressures such that Ru exceeds 0.2.	Notification <ul style="list-style-type: none">• Mine Manager• Geotechnical Engineer• Include in annual report Review <ul style="list-style-type: none">• Review previous inspection reports, existing instrumentation including piezometer, temperature, inclinometer, and survey data. Evaluation <ul style="list-style-type: none">• Geotechnical Engineer to compare recent monitoring results against older results for additional evidence of instability. Action <ul style="list-style-type: none">• Inspect the area for any signs of instability.• Immediately Increase monitoring and data review frequency until determined unnecessary:<ul style="list-style-type: none">○ If survey hub threshold exceeded: increase frequency to bi-weekly or as directed by the Engineer.○ If pore water pressure threshold exceeded: increase frequency to semi-weekly or as directed by the Engineer.• Follow any additional recommendations of the Geotechnical Engineer.

Specific Indicators	Specific Performance Thresholds	Specific Responses
	<p>Specific Threshold 3</p> <ul style="list-style-type: none">Survey hub cumulative displacements greater than 500 mm. <p>Or</p> <ul style="list-style-type: none">Increase in pore water pressures such that Ru exceeds 0.4.	<p>Notification</p> <ul style="list-style-type: none">Mine ManagerGeotechnical EngineerInclude in annual report <p>Review</p> <ul style="list-style-type: none">Review previous inspection reports, existing instrumentation including piezometer, temperature, inclinometer, and survey data. <p>Evaluation</p> <ul style="list-style-type: none">Geotechnical Engineer to compare recent monitoring results against older results for additional evidence of instability. <p>Action</p> <ul style="list-style-type: none">Inspect the area for any other signs of instability.Complete a ground survey of the area of interest to allow for a stability assessment to be completed (if required by the Engineer), and to monitor any future displacement.Immediately increase monitoring and data review frequency until determined unnecessary:<ul style="list-style-type: none">If survey hub threshold exceeded: increase frequency to semi-weekly or as directed by the Engineer.If pore water pressure threshold exceeded: increase frequency to daily or as directed by the Engineer.Follow any additional recommendations of the Geotechnical Engineer. At a minimum, , the Engineer will consider the need for:<ul style="list-style-type: none">An increase in the frequency of routine inspections and monitoring.Additional inspection, instrumentation, monitoring, or analysesModifications to the waste placement/construction practices.

3 Reporting and Review

Reporting and review represent an essential part of the Adaptive Management Framework, as described in section 1.4.2, and reporting on adaptive management is included in the notification component of all specific responses described in section 2.

3.1 Monthly and Annual Reporting

Monthly reports are required to be submitted to the Yukon Water Board under Water Licence QZ14-031, and annual reports are required for submission under both the Water Licence and the Quartz Mining License. Both licenses require reporting on adaptive management.

Monthly reporting includes all activities carried out under the Adaptive Management Plan.

Annual reporting will include summaries of all activities carried out under the Adaptive Management Plan, including monitoring results compared to thresholds and any actions taken.

3.2 Annual Review

The AMP may be modified when unexpected circumstances are encountered and the protocol is implemented or when additional understanding becomes available. An annual review of the AMP will take place prior to annual reporting, and Annual Reports will include a summary of proposed updates and revisions to the Adaptive Management Plan and include a revised Adaptive Management Plan, if warranted.

4 References

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