Minto Mine

Closure Adaptive Management Plan

2017-01

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Minto Mine
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Minto Mine Closure Adaptive Management Plan

AMP Version History

AMP Version	Issue Date	Description and Revisions Made
2014-01	June 2014	First Issue
2016-01	August 2016	Revisions made as per requirements of WUL QZ14-031 and QML-0001
2017-01	February 2017	Revisions made to reflect finalization of closure water quality objectives, with associated updates and adjustments

2017-01 Revisions

AMP Section	Description of Revision
1	Included a description of all three closure periods. Included a recommendation to revise the AMP prior to implementation.
2.1	Included an introduction paragraph which provides context by explaining how the surface water quality AMP components are integrated. Also, included Table 2-1, which clarifies what AMP component applies to a given closure period.
2.1.1.1	Included clarification regarding what closure period the Mine Site AMP Component applies.
2.1.1.3	Revised all of the values in Table 2-2 (formerly 2-1) so that they actually represent maximum predicted concertation for the Post Closure II period. Revised Table 2-3 (formerly 2-2) to include applicable closure period to each specific threshold and revised wording to improve clarity.
2.1.2.1	Included explanation for when the CWTS AMP component applies.
2.1.2.3	Revised Table 2-5 (formerly 2-4) to include applicable closure period to each specific threshold.
2.1.3.1	Significant revisions made to describe how the Minto Creek AMP component will apply to the PCI period.
2.1.3.2	Significant revisions made to separate out risk narrative for PCI and PCII periods.
2.1.3.3	Significant revisions made to incorporate a PCI specific AMP component for Minto Creek. Includes the addition of Table 2-6 for the PCI period. Significant revisions made to the PCII specific AMP component to incorporate the finalized WQOs. Table 2-7 (formerly Table 2-5) revised with WQOs. Revisions specific threshold 1 of Table 2-8 (formerly Table 2-6). Revisions to Table 2-9 (formerly Table 2-7) to incorporate central tendency WQO, revised resample frequency in specific threshold 1 response, included applicable closure period to each specific threshold and revised specific threshold 5.
2.1.4	Significant revisions to match what is in the updated operational AMP (2016-02).
2.2.1.3	Significant revisions to match what is in the updated operational AMP (2016-02).

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1 Introduction

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.

As an outcome of the Phase V/VI mine licensing processes, Minto is required to update the mine Reclamation and Closure Plan (RCP) for the updated mine plan and with additional information outlined in its Quartz Mining License QML-0001 (QML) and Water Use Licence QZ14-031 (WUL) and approval letters. Both authorizations required the updating of the Adaptive Management Plan (AMP) for the closure and post-closure periods. AMPs are tools used to address uncertainty or conditions beyond those expected in reclamation and closure. 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.

A closure failure modes and effects analysis (FMEA) was conducted to determine both the probability and severity of postulated component failures at the Minto mine site and the associated infrastructure and environmental management systems. The FMEA was used to determine potential failure modes with the greatest risk rating, and identified components and scenarios where uncertainty and attendant risk could be reduced through adaptive management.

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 and implemented an operational Adaptive Management Plan to address uncertainty in site performance during the operational period (MEL, 2016). Uncertainty is reduced in the operational period through the development and implementation of operational management plans. Minto has developed a number of operational management plans which describe the management and response actions for expected conditions at the site during operations. 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; and
- Heritage Resources Protection Plan.

For the closure and post closure periods, planning and management of site activities are guided by the Minto Mine Reclamation and Closure Plan (RCP). This includes the identification of distinct closure periods with defined activities and performance expectations:

1. Active Closure (AC) - includes the implementation and construction of the large majority of the selected closure measures. Closure measures completed during this period include, but are not limited recontouring, soil placement, closure water conveyance construction, revegetation, construction of passive water treatment facilities and partial decommissioning of the Water Storage Dam, demobilization and demolition. Further details regarding the planned closure measures can be found in Section 7 of the RCP. During the AC period, operational water quality objectives/effluent standards and AMP will still apply and active treatment is expected to be the primary source of water treatment. The AC period is expected to span three years but may be completed sooner as closure measures are completed.
2. Post Closure I (PCI) - The PCI period is intended to provide time which allows the closure measures to establish and assessments to be completed on the performance of the chosen closure measure. During this period, maintenance on soil covers will be ongoing as vegetation begins to establish. Water conveyance features will be commissioned along with the passive treatment system. The passive treatment system is expected to take two years to reach design performance expectations. A pump back system will be established from the passive treatment system to the water treatment plant as there is potential that water quality will not meet effluent standards without active treatment. During PCI, operational water quality objectives/effluent standards will still apply. Passive treatment will be commissioned over the first two years of PCI and will become the primary water treatment system utilizing active treatment as required to meet operational water quality objectives and manage site water inventory. During the PCI period the Operational AMP and Closure AMP will both apply to specific components and are identified in this AMP.
3. Post Closure II (PCII) - is intended as a conformational period which will monitor that the closure measures continue to perform as expected. PCII is primarily a monitoring phase with maintenance activities as required. During PCII the closure water quality objectives will apply and passive treatment will be the primary water treatment onsite. The Closure AMP will be the sole AMP in PCII and will cover all of the components detailed in this plan.

This AMP is intended to provide a framework for responses to conditions beyond those expected and identified in the RCP for primarily the Post Closure I and II periods.

Given the complexities of this AMP and the duration until implementation, it is recommended that this plan be reviewed and revised as required prior to implementation.

1.1 Adaptive Management Overview

Adaptive management is an approach to environmental management that is appropriate when mitigation measures 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. Embedding adaptation into environmental plans involves thinking about how the results of monitoring will change management actions. 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. 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.

1.2 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 post closure phases of the Minto Mine life and provides an AMP framework for each. For each component the AMP describes 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.

1.2.1 Updated AMP Objectives

This 2016 version of the AMP has been updated to include the requirements of the QML and WUL.

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, which have also been addressed in the Operational AMP (the QML approval letter is non-specific as to the mine phase, so the requirements have been included in both AMPs). The QML approval letter requirements and where the items are addressed in the AMP are presented in the following concordance Table 1-1.

Table 1-1: QML Approval Letter Concordance Table

1. Adaptive Management Plan An adaptive management plan must include:	Section addressed
(a) key pathways and events that lead to uncertainty about site performance, including but not limited to:	1.3 2.1 – 2.5
○ water quality	2.1
○ physical stability	2.2
○ cover systems	2.3.1
○ water treatment, and	2.1, 2.5
○ water management	2.5
(b) detailed descriptions of effective indicators of performance, monitoring programs, triggers for adaptive management responses, and actions that will be taken for each event or pathway. Triggers and actions should be defined and described for various levels of response, initially requiring investigation of causes and proceeding to implementation of appropriate contingency measures; and	2.1 – 2.5
(c) detailed descriptions of procedures for investigating causes of adaptive management trigger exceedances, and corrective actions should be provided. These should demonstrate that actions can be taken prior to causing unacceptable effects	2.1 – 2.5

The WUL was issued August 5, 2015 and the requirements for the Closure AMP are outlined in clause 110 e) (Yukon Water Board, 2015).

Clause 110 e) details and the sections in the AMP where these are addressed are summarized in Table 1-2.

Table 1-2: QZ14-031 Concordance Table

110) The updated RCP shall include, but not necessarily be limited to, the following: e) an updated Closure AMP including, but not necessarily be limited to, the following:	Section addressed
i) numerical values of thresholds for each parameter for each specific threshold for each AMP component	all
ii) consideration of statistical trend analysis to provide future forecasting of potential exceedences;	2.1
iii) thresholds for action and responses related to potential poor performance of the Main Pit Dam; and	n/a[1]
iv) management measures to responds to changing conditions in:	2.1
• McGinty Creek	2.1.2
• water quality at internal monitoring locations	2.1.1
• pit water quality	2.1.1
• passive treatment system performance; and	2.1.1
• water levels in open pits	2.1.2

1.3 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:

[1] Main Dam is no longer part of the proposed Mine Plan

"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)

1.3.1 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, therefore, these components have been carried over into the AMP for the closure periods:

- Surface water quality;
- Groundwater quality;
- Water Management Infrastructure;
- Physical Stability; and
- General Reclamation Measures

The specific AMP framework for these components is described in Sections 2.1 through 2.5.

1.3.2 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 – outlined in the Minto RCP document.

- *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.

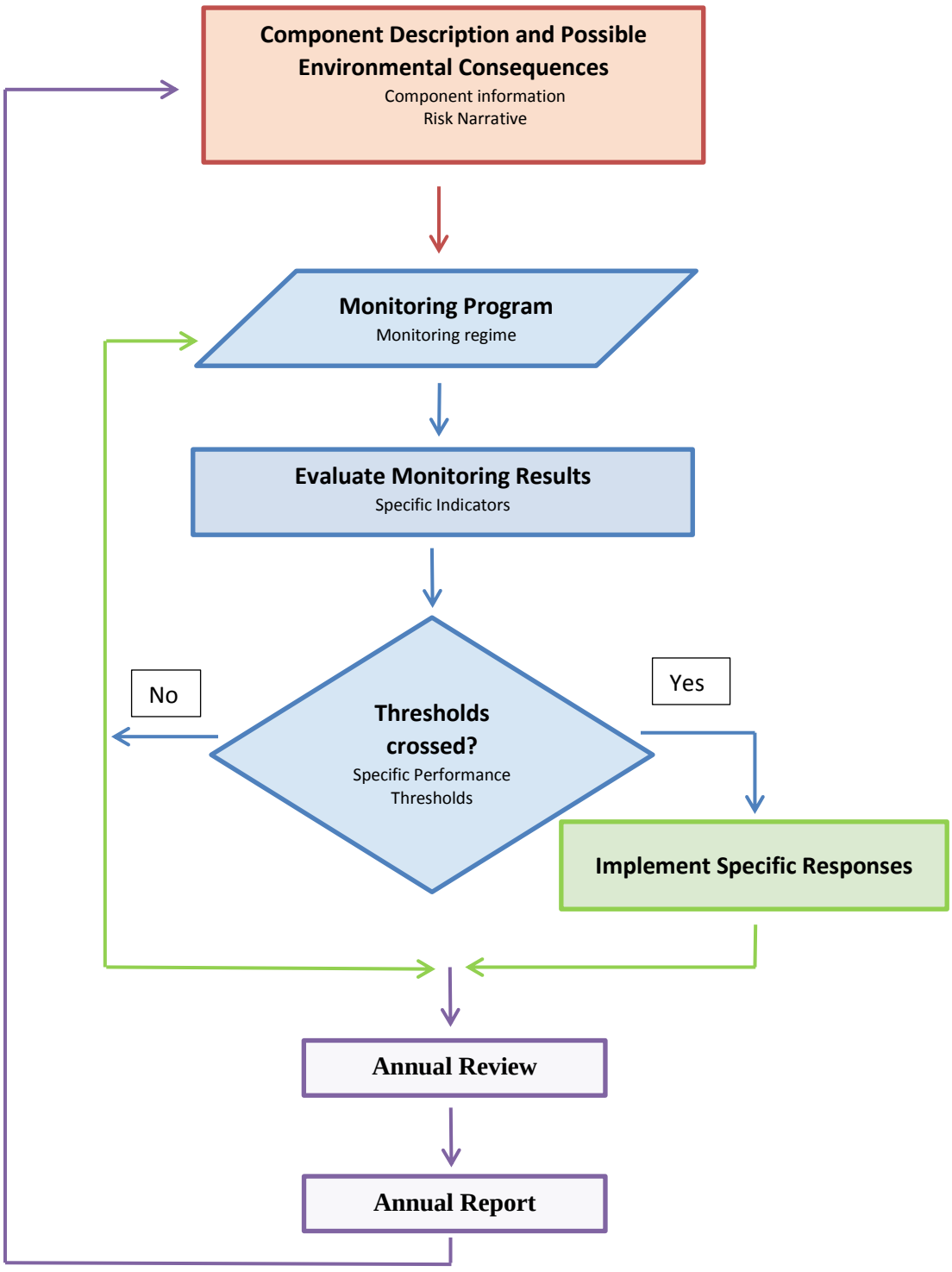

Figure 1-1: Sequential Components of the AMP (Adapted from AECOM 2010)

2 Adaptive Management Plans for Mine Components

2.1 Surface Water Quality

The Surface Water Quality section of this AMP aims to integrate the mine site (Area 2 and Main Pits) water quality with the performance of the CWTS to reach the overall goal of meeting water quality objectives (WQO) in Minto Creek's receiving environment (W2). The McGinty Creek AMP component is also included but does not have the same source control uncertainty as Minto Creek and is therefore not integrated with other AMP components. The Surface Water Quality components are intended to address the uncertainty that arise in specific closure periods and are therefore not completely inclusive of PCI and PCII closure periods. The closure periods will be identified to the corresponding components in the sections below. A summary of the closure periods and corresponding AMP components is broken down in Table 2-1 below.

Table 2-1: Surface water AMP components and corresponding closure period

AMP Component	Applicable Closure Period	Exceptions
Mine Site	PCII	No exceptions
Constructed Wetland Treatment Systems (CWTS)	PCI and PCII	Applies after the CWTS commissioning period only
Minto Creek	PCI and PCII	Only applies in PCI after the CWTS is preforming as expected only
McGinty Creek	PCI and PCII	No exceptions

2.1.1 Mine Site

2.1.1.1 Description

During the closure and post-closure period, the management of runoff and site water will become increasingly more passive, as described in the RCP. Attention to the quality of site runoff and surface water at some key locations will be important indicators of reclamation success of site facilities, and will provide an indication of potential water quality issues upstream of the passive treatment installation at the former water storage pond footprint. In particular, attention to the water quality in the two upstream pit outflows (Main Pit – W12, Area 2 Pit – W45) will provide site managers with indications of water quality that may lead to passive treatment performance problems, and possibly to water quality objectives not being attained further downstream in the receiving environment of Minto Creek (W2).

As active water treatment will be employed and utilized in Active Closure as well as available during the PCI period, with a high degree of certainty around effluent quality, the AMP framework for the mine site facilities below are relevant to the post closure PCII period only.

2.1.1.2 Risk Narrative

Increasing concentrations of contaminants from closed site facilities and flooded open pits lead to passive treatment challenges, exceedance of downstream water quality objectives, and/or adverse effects to aquatic resources in the receiving environment (lower Minto Creek).

2.1.1.3 Specific Indicators, Performance Thresholds and Responses

Indicators, performance thresholds and responses specific to water quality and the monitoring program are provided below in Table 2-3, and the specific thresholds are identified in Table 2-2. The monitoring results that will be evaluated and utilized in this component of the AMP are outlined in Section 7.12 of the Minto Mine RCP (2017-01).

Table 2-2: Specific Performance Thresholds for Mine Site Stations

Parameter	Worst Case Maximum Predicted Concentration for Post-Closure II Period					
	W45 (Area 2 Pit)			W12 (Main Pit)		
	May	July	Sept	May	July	Sept
Ammonia - N, mg/L	0.79	0.77	0.77	0.13	0.12	0.12
Nitrite - N, mg/L	0.55	0.54	0.54	0.12	011	0.10
Nitrate - N, mg/L	30	29	29	12	11	10
Aluminum (dissolved), mg/L	0.42	0.42	0.42	0.37	0.36	0.35
Arsenic (dissolved), mg/L	0.0029	0.0029	0.0029	0.0027	0.0026	0.0026
Cadmium (dissolved), µg/L	0.00018	0.00018	0.00018	0.00018	0.00017	0.00017
Chromium (dissolved), mg/L	0.0033	0.0032	0.0032	0.0033	0.0031	0.0031
Copper (dissolved), mg/L	0.045	0.045	0.045	0.061	0.056	0.056
Iron (dissolved), mg/L	0.85	0.85	0.84	1.3	1.2	1.2
Lead (dissolved), mg/L	0.0013	0.0013	0.0013	0.0010	0.00095	0.00094
Molybdenum (dissolved), mg/L	0.049	0.048	0.048	0.016	0.015	0.015
Nickel (dissolved), mg/L	0.0046	0.0045	0.0045	0.0045	0.0042	0.0042
Silver (dissolved), mg/L	0.00011	0.00010	0.00010	0.00013	0.00012	0.00012
Selenium (dissolved), mg/L	0.023	0.022	0.022	0.0083	0.0076	0.0075
Zinc (dissolved), mg/L	0.017	0.017	0.017	0.017	0.016	0.016

Table 2-3: Specific Indicators, Performance Thresholds and Responses for Mine Site Monitoring Locations

Specific Indicators	Specific Performance Thresholds	Stage	Specific Responses

Dissolved metal parameters in Table 2-2.	**Specific Threshold 1**
	• Worst Case Maximum water quality prediction is exceeded
	
	AND
	
	• Potential or existing challenges to passive treatment are identified as a result of pit water quality
		PCII	**Notification**
			• Minto Management
			Review
			• Follow QA/QC investigative protocol:
			  ○ Review laboratory QA/QC report
			  ○ Validate original result, or re-run sample if a laboratory error is indicated
			Evaluation
			• Compare with previous results and evaluate if concentrations are trending upwards
			
			Action
			• If result is validated, **AND**
			• concentrations are trending upwards significantly, then:
			  ○ Re-sample within one month of triggering ST1

Dissolved metal parameters in Table 2-2.	**Specific Threshold 2**
	• Subsequent exceedance of ST1 in subsequent sampling (resampled or routine) and evaluation confirms upward trend in concentrations
	
	AND
	
	• Potential or existing challenges to passive treatment are identified as a result of pit water quality
		PCII	**Notification**
			• Minto Management
			• Include in scheduled Water Use Licence reporting
			Review
			• Follow QA/QC investigative protocol:
			  ○ Review laboratory QA/QC report
			  ○ Validate original result, or re-run sample if a laboratory error is indicated
			Evaluation
			• All evaluation measures identified in ST1
			Action
			• Increase sampling frequency to monthly
			• Engage qualified professional to evaluate potential for passive treatment challenges from pit outflow concentrations
			• Retain qualified expert to develop mitigation plan, including recommendations. This could include, for example, consideration of the use of batch treatment to mitigate water quality in pits.

Dissolved metal parameters in Table 2-2.	**Specific Threshold 3**
	• Continued exceedance of ST2 in subsequent sampling
	
	AND
	
	• Potential or existing challenges to passive treatment are identified as a result of pit water quality
		PCII	**Notification**
			• Minto Management, SFN, YG Inspector
			• Include in scheduled Water Use Licence reporting
			Review
			• Follow QA/QC investigative protocol
			  ○ Review laboratory QA/QC report
			  ○ Verify original result, or re-run sample if laboratory error indicated
			Evaluation
			• All evaluation measures for ST2
			Action
			• Implement recommendations from Mitigation Plan
			• Maintain monthly sampling frequency

2.1.2 Constructed Wetland Treatment Systems

2.1.2.1 Description

The RCP describes how surface water quality will be managed during the post closure period. This includes the construction and operation of a constructed wetland treatment system (CWTS) in the footprint of the existing water storage pond. Based on site specific research, it is expected that the CWTS will take at least 2 full years before the wetland will be performing as designed. Research to date, also outlined in the RCP, on wetland performance at the Minto site suggests that a constructed wetland treatment system can be expected to mitigate certain water quality constituent loading during some months of the year, particularly during base flow summer months. Although some routine maintenance is expected for this facility, there also exists some remaining uncertainty regarding how the wetland will perform in decreasing aqueous constituent loads.

Section 2.1.1 above outlines how contributing loads from upstream sources will be managed adaptively, and section 2.3 outlines how an adaptive management approach will be used to respond to changing conditions related to the physical integrity of the CWTS as a water management infrastructure component. This section outlines how unexpected changes in the performance of the CWTS related to aqueous constituent load reduction will be identified and responded to after the expected commissioning period (two years after construction).

The CWTS AMP framework will provide a response towards continuous improvement of the system during PCI period and will address unexpected performance in PCII. The CWTS will mature as a treatment installation during the first two years of PCI – the Commissioning Period – and after it will be transitioned to the primary water treatment component for the duration of PCI (as long as Operational WQO can be met) and for the entirety of PCII. The CWTS AMP framework below applies to the third year of PCI and through the entire duration of PCII.

2.1.2.2 Risk Narrative

Aqueous constituent load reduction does not meet expectations or design criteria, resulting in downstream water quality objectives not being met, and/or adverse effects to aquatic resources in the receiving environment (lower Minto Creek).

2.1.2.3 Specific Indicators, Performance Thresholds and Responses

Indicators, performance thresholds and responses specific to performance of the CWTS are provided below in Table 2-5. Specific thresholds are identified in Table 2-4. The monitoring results that will be evaluated and utilized in this component of the AMP are outlined in the Minto Mine RCP (2017-01) (Section 7.12).

Table 2-4: Specific Performance Thresholds for Mine Site stations

Specific Indicator	Specific Threshold Value	Basis/rationale for threshold value
CWTS Soil Redox Probe reading	-100 mV	Desired range for optimal performance is -250 to -100 mV. Performance can still be expected as high as -50, so -100 as threshold is conservative
Treatment rate coefficient		
Cadmium (dissolved)	0.078 (first order)	Treatment rate coefficients should be evaluated as an annual average, based on inflow and outflow concentrations, and retention time within the CWTS (formulae are provided in CTWS Design Document, appended to Minto RCP). The threshold values here are from the design basis, based on expected performance from reclamation research to date, with an added range of 20% to allow for variation.
Copper (dissolved)	0.060 (first order)	
Selenium (dissolved)	0.00012 (zero order)	

Table 2-5: Specific Indicators, Performance Thresholds and Responses for CWTS performance.

Specific Indicators	Specific Performance Thresholds	Stage	Specific Responses
Soil Redox	**Specific Threshold 1** • average of all probes trending upwards and out of ideal range (-250 to -100) over 3 consecutive sampling events **OR** • 25% of all probes reading > -100 in any sampling event	**Year 3 of PCI and all of PCII**	**Notification** • Minto Management • Include in scheduled Water Use Licence reporting **Review** • Follow QA/QC investigative protocol: ○ Validate redox results ○ Confirm water depth around probes in question **Evaluation** • Consider installation of duplicate probes to confirm readings • Consider sampling of soil in vicinity of probes in question for total organic carbon (TOC) and nutrients (NPK). **Action** • If probe readings confirmed and TOC is low, add organic carbon as directed by qualified expert • If probe readings confirmed and soil nutrients are low, add fertilizer as directed by qualified expert • If water depths less that design amount, mitigate as recommended by qualified expert
Treatment rate coefficient	**Specific Threshold 2** • Target treatment rate coefficient for specific aqueous constituent is not achieved in any year of monitoring	**Year 3 of PCI and all of PCII**	**Notification** • Minto Management • Include in scheduled Water Use Licence reporting **Review** • Follow QA/QC investigative protocol: ○ Review laboratory QA/QC report ○ Validate original result, or re-run sample if a laboratory error is indicated **Evaluation** • Increase sampling frequency of influent/effluent to monthly (if not already implemented) • Sample between cells to isolate problem cell(s) • Consider analysis for interfering/facilitating issues (e.g. iron/Sulphur) **Action** • Retain qualified expert to develop mitigation plan, including recommendations
Treatment rate coefficient	**Specific Threshold 3** • Target treatment rate coefficient for specific aqueous constituent is not achieved for **3 consecutive years** **AND** • Applicable downstream water quality objectives have been exceeded	**Year 3 of PCI and all of PCII**	**Notification** • Minto Management, SFN, YG Inspector • Include in scheduled Water Use Licence reporting **Review** • Follow QA/QC investigative protocol ○ Review laboratory QA/QC report ○ Verify original result, or re-run sample if laboratory error indicated **Evaluation** • All evaluation measures for ST2 **Action** • Implement recommendations from Mitigation Plan

2.1.3 Minto Creek

2.1.3.1 Description

The majority of the Minto Mine footprint (with the exception of the Minto North pit) is in the headwaters of the catchment area for Minto Creek. The W2 monitoring point on lower Minto Creek near the Yukon River is beyond the final mine water discharge point (W50) 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 frameworks below compliment the closure 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.

The monitoring results that will be evaluated and utilized in this component of the AMP are outlined in section 7.12 of the Minto Mine RCP (2017-01). The Operational Water Quality Objectives will continue to be employed in the Active Closure and PCI periods. As such, the Minto Mine Operational AMP is relevant and will be utilized during the Active Closure and PCI periods. To address the uncertainty of meeting the post closure water quality objectives (PC-WQO) within the expected 5 year duration of the PCI period, a PCI AMP framework has been developed for Minto Creek and is intended to be used as a supplement to the Operational AMP.

The PCI period AMP framework was developed to guide continuous improvement towards meeting PC-WQO after the CTWS has reached the expected performance and will only apply during the PCI period. The portion of the Minto Creek AMP that applies to the PCII period is intended to respond to uncertainty regarding meeting both non-degradation and 50% of assimilative capacity WQOs.

In the sections below, the PCI period AMP framework and the PCII period AMP framework for Minto Creek have been separated to simplify what AMP frameworks apply to what closure period.

2.1.3.2 Risk Narrative

Post Closure I Period

The CWTS performs as designed, however, the water quality in the receiving environment is not trending towards meeting PC-WQO by the end of the expected PCI period.

Post Closure II Period

Increase in contaminant concentrations from the mine causes exceedance of the PC-WQO in the receiving environment (lower Minto Creek).

2.1.3.3 Indicator, Specific Performance Thresholds and Responses

Post Closure I Period

The indicator, performance thresholds and responses specific to continuous improvement of water quality during the PCI period are provided in Table 2-6. The AMP framework for the PCI period applies to the receiving environment of Minto Creek (W2) and utilizes the results of trend analysis of routine monitoring to guide responses to improving water quality towards meeting the post closure water quality objectives prior to the expected completion of the PCI period (5 years total). Specifically this AMP only applies after the CWTS has met the designed performance for a period of one year and water quality at W2 is not meeting post closure water quality objectives.

Table 2-6: Continuous improvement for water quality at W2 during the PCI period.

Indicator	Specific Performance Threshold	Stage	Specific Responses
Complete an annual Trend Analysis of receiving environment water quality data (Minto Creek Station W2) to determine if water quality meets or is trending towards meeting PC-WQOs. To be initiated after successful establishment of the CWTS (PCI Years 3,4,5 at minimum)	Trending towards meeting PC-WQO and will likely meet them before end of PCI.	**PCI**	**Action:** • Re-evaluate in subsequent years and confirm or repudiate previous year's results
	Trending towards meeting PC-WQO but will likely not meet before end of PCI.	**PCI**	**Notification:** • Minto Management **Review:** • Follow QA/QC investigative protocol: - Review laboratory QA/QC report - Validate original result, or re-run sample if a laboratory error is indicated **Evaluation:** • Review site water quality results - e.g. does pit water quality exceed expected concentrations? • Compare with W3 and/or CWTS results. If comparison indicates elevated site concentrations are responsible for exceedance; and validation confirms original result, then: - Engage qualified expert(s) to develop mitigation plan **Action:** • Review results of investigations/evaluations and implement recommendations if appropriate. • Re-evaluate in subsequent years and confirm or repudiate previous year's results
	Water quality stable, neither trending towards nor away from PC-WQO	**PCI**	**Notification**: • Minto Management, SFN, YG Inspector • Include in scheduled Water Use Licence reporting **Review:** • Follow QA/QC investigative protocol: - Review laboratory QA/QC report - Validate original result, or re-run sample if a laboratory error is indicated **Evaluation:** • Review site water quality results - e.g. does pit water quality exceed expected concentrations? • Compare with W3 and/or CWTS results. If comparison indicates elevated site concentrations are responsible for exceedance; and validation confirms original result, then: - Engage qualified expert(s) to develop mitigation plan **Action:** • Review results of investigations/evaluations and prepare recommendations if appropriate. • Engage SFN and Regulators • Re-evaluate in subsequent years and confirm or repudiate previous year's results
	Trending away from meeting PC-WQO	**PCI**	**Notification:** • Minto Management, SFN, YG Inspector • Include in scheduled Water Use Licence reporting **Review:** • Follow QA/QC investigative protocol: - Review laboratory QA/QC report - Validate original result, or re-run sample if a laboratory error is indicated **Evaluation:** • Review site water quality results - e.g. does pit water quality exceed expected concentrations? • Compare with W3 and/or CWTS results. If comparison indicates elevated site concentrations are responsible for exceedance; and validation confirms original result, then: - Engage qualified expert(s) to develop mitigation plan **Action:** • Review results of investigations/evaluations and prepare recommendations if appropriate. • Engage SFN and Regulators • Reassess Passive treatment option • Re-evaluate in subsequent years and confirm or repudiate previous year's results

Post Closure II Period

Indicators, performance thresholds and responses specific to water quality and the monitoring program are provided below in Table 2-8. Specific thresholds for the PCII period AMP framework are identified in Table 2-7. This portion of closure AMP for Minto Creek water quality utilizes the post closure water quality objectives (WQOs) at station W2 as the basis for specific thresholds.

To apply these WQOs as the basis of specific performance thresholds in this plan, the following abbreviations, definitions and assumptions are being used:

BGWQ: Background Water Quality, as compiled and outlined in Appendix F of the RCP (Minnow, 2016).

ND: Non-degradation of water quality, statistically unchanged from BGWQ

NDIDPE-WQO: Non-degradation Maximum water quality objective, as defined by the 95th percentile of the BGWQ data set

NDCT-WQO: Non-degradation Central Tendency water quality objective, as defined as the 95th percentile of the annual medians of the BGWQ data set.

50IDPE-WQO: 50% of assimilative capacity Individual Data Point Evaluator water quality objective, as calculated using the 95th percentile of background concentrations and the Post Closure WQO formula outlined in Section 3.1.3.1 of RCP 2017-01.

50CT-WQO: 50% of assimilative capacity Central Tendency water quality objective, as calculated using the NDCT-WQO as background and the Post Closure WQO formula outlined in Section 3.1.3.1 of RCP 2017-01.

75%-STI: Specific Threshold One value, as calculated using 75 percent of the 50IDPE-WQO and is intended to be an early warning threshold for the 50% of assimilative capacity WQO.

Table 2-7: Specific Performance Thresholds for Surface Water Quality in Lower Minto Creek (W2)

Parameter	Non-Degradation - Individual Data Point Evaluator	Non-Degradation - Central Tendency	75% of 50% Assimilative Capacity Individual Data Point Evaluator	50% Assimilative Capacity - Individual Data Point Evaluator	50% Assimilative Capacity - Central Tendency
	Water Quality Objective	Water Quality Objective	STP-1	Water Quality Objective	Water Quality Objective
	(NDIDPE-WQO)	(NDCT-WQO)	Table 2-7	(50IDPE-WQO)	(50CT-WQO)
Ammonia - N, mg/L	0.12	0.06	0.14	0.18	0.13
Nitrite - N, mg/L	0.04	0.03	0.04	0.05	0.04
Nitrate - N, mg/L	0.22	0.15	3.5	4.7	4.6
Aluminum (dissolved), mg/L	0.053	0.032	0.058	0.077	0.066
Arsenic (dissolved), mg/L	0.0011	0.0009	0.0023	0.0031	0.0029
Cadmium[1] (dissolved), µg/L	0.00005	0.000044	0.00017	0.00022	0.00019
Chromium (dissolved), mg/L	0.0011	0.0010	0.0008	0.0011	0.0010
Copper (dissolved), mg/L (when [DOC] @ W2 >10 mg/L)	0.0054	0.0029	0.010	0.013	0.011
Copper (dissolved), mg/L (when [DOC] @ W2 ≤10 mg/L)	0.0054	0.0029	0.0069	0.0092	0.0079
Iron (dissolved), mg/L	0.91	0.57	0.75	1.0	0.84
Lead (dissolved), mg/L	0.00025	0.00014	0.0016	0.0021	0.0021
Molybdenum (dissolved), mg/L	0.0015	0.0011	0.028	0.037	0.037
Nickel (dissolved), mg/L	0.0020	0.0016	0.042	0.056	0.056
Selenium (dissolved), mg/L	0.00050	0.00046	0.0010	0.0013	0.0012
Silver (dissolved), mg/L	0.00001	0.00001	0.000041	0.000055	0.000055
Zinc (dissolved), mg/L	0.008	0.005	0.014	0.019	0.017

[1]Cadmium value calculated using 95th percentile hardness (225.2 mg/L) in Operational Stage WQO calculation. Actual objective for comparison with monitoring results will be calculated with observed hardness.

Table 2-8 below presents the specific thresholds and actions proposed to respond to changing water quality, i.e. deviation from a non-degradation condition, in lower Minto Creek, as measured at water quality station W2.

Table 2-8: Specific Indicators, Performance Thresholds and Responses for Surface Water Quality at Station W2 in lower Minto Creek during Post Closure II, using Non-Degradation Water Quality Objectives.

Specific Indicators	Specific Performance Thresholds	Specific Responses
Aqueous Concentrations at Station W2 for parameters with water quality objectives (See Table **2-5** above for specific threshold values)	**Specific Threshold 1** • Exceedance of 2 consecutive NDIDPE-WQOs **OR** • Exceedance of NDCT-WQO once	**Notification** • Minto Management • Include in scheduled Water Use Licence reporting **Review** • Follow QA/QC investigative protocol: o Review laboratory QA/QC report o Validate original result, or re-run sample if a laboratory error is indicated **Evaluation** • Review site water quality results – e.g. does pit water quality exceed expected concentrations? • Compare with W3 and/or CWTS results. If comparison indicates either elevated site concentrations or poor CWTS performance are responsible for exceedance; and validation confirms original result, then: o Engage qualified expert(s) to develop mitigation plan **Action** • Review results of investigations/evaluations and prepare recommendations if appropriate. This could include a recommendation that certain parameters be immediately subject to the AMP framework in Table 2-9 – 50%AC-WQOs if concentrations are determined by a qualified expert are unlikely to achieve ND-WQOs. • Actions will continue until performance thresholds are no longer exceeded.
	Specific Threshold 2 • Continued Exceedance of Threshold 1 in subsequent sampling	**Notification** • Minto Management, SFN • Include in scheduled Water Use Licence reporting **Review** • All review measures for ST1 **Evaluation** All evaluation measures from ST1 **Action** • Implement recommendations from mitigation plan • Actions will continue until performance thresholds are no longer exceeded.
	Specific Threshold 3 • Continued exceedance of Threshold 1 for 3 years	**Notification** • Minto Management, SFN, YG Inspector • Include in scheduled Water Use Licence reporting **Review** • All review measures for ST2 **Evaluation** • All evaluation measures for ST2 **Action** • If all results are confirmed, then non-degradation is declared unattainable, and the specific indicator (i.e. parameter) is then subject to the AMP framework in Table 2-7 (50%AC-WQOs).

In the case of the non-degradation condition being declared unattainable for any given specific indicator through the decision framework above, that parameter will be subject only to the following AMP framework which applies the 50% of assimilative capacity water quality objectives. Until such time, the specific indicators will be subject to both frameworks to ensure that actions are implemented in the case where 50% assimilative capacity WQOs are approached or exceeded early in the post closure period. The definition of attainment, of the closure WQOs are detailed in the RCP 2017-01 and is used as the basis for specific threshold 4 in Table 2-9, below. Specifically, as outlined in greater detail in the RCP, attainment is considered to be achieved if specific threshold 4 is not triggered.

Table 2-9: Specific Indicators, Performance Thresholds and Responses for Surface Water Quality at Station W2 in Minto Creek, using the 50% Assimilative Capacity Water Quality Objectives.

Specific Indicators	Specific Performance Thresholds	Stage	Specific Responses
Aqueous Concentrations at Station W2 for parameters with water quality objectives (See Table **2-7** above for specific threshold values)	**Specific Threshold 1** • Exceedance of SPT1 from Table 2-7	**PCII**	**Notification** • Minto Management • Include in scheduled Water Use Licence reporting **Review** • Follow QA/QC investigative protocol: o Review laboratory QA/QC report o Validate original result, or re-run sample if a laboratory error is indicated **Evaluation** • Compare with W3/CWTS results **Action** • On next scheduled sampling event, ensure sampling conducted at mine site stations W12 and W45 (open pits) if not already scheduled.
	Specific Threshold 2 • Exceedance of SPT1 in **2 consecutive samples at W2** where evaluation confirmed mine loading responsible for first exceedance	**PCII**	**Notification** • Minto Management • Include in scheduled Water Use Licence reporting **Review** • Follow QA/QC investigative protocol: o Review laboratory QA/QC report o Validate original result, or re-run sample if a laboratory error is indicated **Evaluation** • Compare with W3 results. If comparison with W3 result indicates that mine loadings are responsible for exceedance; and validation confirms original result, then: o Evaluate causes for load contributions and develop investigation plan; and o A trend analysis will be conducted by a qualified person. **Action** • Implement investigation plan, including at a minimum: o Re-sampling both W2 and W3 within **one month** of original sample result review; and o Site investigation of candidate load contributions. • Review results of investigation and prepare recommendations if appropriate. • If trend analysis suggests WQO exceedance within one year, then initiate actions for Specific Threshold 3.
	Specific Threshold 3 • 50IDPE-WQO exceeded at W2 in a single sample where evaluation confirms that mine loading is responsible for exceedance.	**PCII**	**Notification** • Minto Management, SFN, YG Inspector • Include in scheduled Water Use Licence reporting **Review** • Follow QA/QC investigative protocol o Review laboratory QA/QC report o Verify original result, or re-run sample if laboratory error indicated **Evaluation** • Compare with W3 results. If comparison with W3 result indicates mine loadings responsible for exceedance – and verification confirms original result – then: o Evaluate candidate causes for load contributions and develop investigation plan (or review/revise as appropriate) **Action** • Implement investigation plan, including any reviews/revisions, and at a minimum: o Re-sampling both W2 and W3 within **two weeks** of original sample result review; and o Site investigation of candidate load contributions • Review results of investigation and prepare recommendations if not already prepared from ST2. • Implement recommendations from above.
	Specific Threshold 4 • Exceedance of 50IDPE-WQO in **2 consecutive samples (scheduled or re-sample) at W2 or twice in one year** where	**PCII**	**Notification** • Minto Management, SFN, YG Inspector • Include in scheduled Water Use Licence reporting **Review**

Specific Indicators	Specific Performance Thresholds	Stage	Specific Responses
	evaluation confirmed mine loading responsible for first exceedance **Or** • 50CT-WQO exceeded at W2 by a 3 year rolling average value (ST-4 = Attainment as defined in the RCP 2017-01)		• Compare with W3 results • Follow QA/QC investigative protocol **Evaluation** • Compare with W3 results. If comparison with W3 result indicates mine loadings responsible for exceedance; and verification confirms original result, then: o Evaluate candidate causes for load contributions and develop investigation plan (or review/revise as appropriate) o Provide investigation plan to SFN/YG Inspector • Engage a qualified individual for the evaluation of potential effects to aquatic resources (i.e. Compare to Predicted No Effect Concentration (PNEC) and apply Biotic Ligand Model (BLM) for D-Cu, invertebrate tissue for Se, compare with calculated acute guideline for D-Cd.) This may include but not be limited to the evaluation of existing data and results from effluent toxicity, surface water toxicity, sediment chemistry, sediment toxicity, benthic invertebrate community structure and fish health testing/programs. **Action** • Implement monthly monitoring at W2 and W3/CWTS if recommended by qualified individual evaluating for the potential for effects at aquatic resources. • Revise investigation plan, including at a minimum: o Re-sampling both W2 and W3 within **one week** of original sample result review; and o Additional site investigation of load contributions • Review results of investigation and prepare additional recommendations • Implement recommendations arising from investigations.
	Specific Threshold 5 • 50IDPE-WQO exceeded in **3 consecutive samples (scheduled or re-sample) at W2** where evaluation confirmed mine loading responsible for exceedances	**PCII**	**Notification** • Minto Management, SFN, YG Inspector • Include in Water Use Licence reporting **Review** • Compare with W3/CWTS results and any other WQ data as appropriate • Follow QA/QC investigative protocol **Evaluation** • All evaluation measures for ST4 **Action** • Maintain monthly monitoring and collect samples at greater frequency as required. • Review and revise mitigation plans with qualified individuals, and Implement necessary reasonable and practical measures to reduce contaminant loading from mine to Minto Creek. This could include consideration of: additional passive treatment installations. • Actions will continue until performance thresholds are no longer exceeded.

2.1.4 McGinty Creek

2.1.4.1 Description

The Minto North deposit is an extension of the mineralized corridor being mined within the Minto Creek catchment. It is within the McGinty Creek catchment area, to the north of Minto Creek. Minto has been monitoring surface water quality in the McGinty Creek catchment since 2009, and the results from monitoring program (until the end of 2015) are presented in McGinty Creek Water Quality Characterization, July 2016 (AEG, 2016).

As described in the Water Management Plan (Minto Explorations Ltd., 2015), during the recently completed active mining of Minto North, Minto actively managed water directly impacted by open pit mining with pump trucks. With surface mining in Minto North now complete, there is no active water management, with runoff and meteoric water now allowed to accumulate in the pit.

The AMP framework below provides a decision-based structure with the goal of avoiding changes to background water quality in lower McGinty Creek that result from completed mining activities at Minto North. Station MN-4.5 is the monitoring station on the lower main stem of McGinty Creek, after the north and south tributaries converge, and near the confluence of McGinty Creek with the Yukon River. Surface water quality at the MN-4.5 monitoring point is subject to periodic TSS influences from catchment area that are beyond Minto's control, so dissolved metals concentrations will be used to track influences from the Minto North development.

2.1.4.2 Risk Narrative

Increase in contaminant concentrations from completed Minto North mining activities causes unacceptable changes to surface water quality in McGinty Creek.

2.1.4.3 Specific Indicators, Performance Thresholds and Responses

Indicators, performance thresholds and responses specific to water quality and the monitoring program are provided below in Table 2-11. The specific indicators are total suspended solids and contaminant (nitrogen species and dissolved 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), and the specific indicators station, as identified above, is MN-4.5. The discussion below applies to data collected from this station. The selection of this indicator station, along with other aspects of the AMP framework, is consistent with the approach taken for closure water quality objective development in Minto Creek (i.e. downstream indicator station, non-degradation water quality objectives, and a focus on dissolved metal concentrations.)

Essentially, Minto has adopted the statistical definitions of non-degradation (from the discussions and agreement with SFN regarding Minto Creek closure water quality objectives) as the basis of developing these revised McGinty Creek Water Quality Objectives. Monthly monitoring has continued in the McGinty Creek catchment, and the background dataset has been updated to include all monitoring data from initiation of the program in May 2009 until July 2015 (stripping of the Minto North Pit began in August 2015.) Similar to the data treatment used in Minto Creek, data from monitoring stations were collapsed into monthly results (most monitoring has been undertaken monthly anyway, and this was only required for May 2009 when sampling was weekly.) All monthly

data were then used to calculate the 95th percentile, for use as the maximum water quality objective, or individual data point evaluator (IDPE). The monthly data were then also grouped by year, and the annual medians were calculated. The 95th percentile of these annual medians was calculated for each station to generate the central tendency evaluator (CTE).

These objectives form the basis of the AMP thresholds. Values lower than the WQOs have been selected as early warning thresholds (ST 1) prior to the WQOs themselves forming the higher level specific thresholds (ST2 and ST3). For these thresholds, the 85th percentile of the same data selected. Utilizing a statistic such as this is more effective and reliable than using a percentage (e.g. 75%) of maximum value, as it considers the actual statistical distribution of the background data.

The actual calculated threshold values are presented in Table 2-10.

The monitoring results that are evaluated and utilized for this component of the AMP are a requirement of the Surface Water Surveillance Program of the EMSRP (Minto Explorations Ltd., 2016). The monitoring data will be compared to the specific performance thresholds monthly (by the end of the month following the month in which samples were collected) - this corresponds to the existing monthly reporting schedule.

Table 2-10: Specific Thresholds for McGinty Creek, Station MN-4.5

Analytes	Specific Threshold 1 (85th percentile)	Water Quality Objectives (Specific Thresholds 2 and 3)	
		Individual Data Point Evaluator (95^{th} percentile)	Central Tendency Evaluator (95th percentile of annual medians)
Total Suspended Solids (mg/L)	52.0	269	32.0
Ammonia (mg/L)	0.040	0.12	0.046
Nitrite (mg/L)	0.006	0.05	0.005
Nitrate (mg/L)	0.200	0.232	0.083
Dissolved Aluminum (µg/L)	48.6	135.0	47.0
Dissolved Arsenic (µg/L)	0.55	0.61	0.54
Dissolved Cadmium (µg/L)	0.026	0.041	0.015
Dissolved Chromium (µg/L)	1.0	1.0	1.0
Dissolved Copper (µg/L)	2.9	3.5	2.8
Dissolved Iron (µg/L)	334	403	358
Dissolved Lead (µg/L)	0.20	0.20	0.20
Dissolved Molybdenum (µg/L)	1.0	1.0	1.0
Dissolved Nickel (µg/L)	1.6	1.8	1.6
Dissolved Selenium (µg/L)	0.17	0.20	0.16
Dissolved Silver (µg/L)	0.020	0.020	0.020
Dissolved Zinc (µg/L)	5.0	5.2	5.0

Table 2-11: Specific Indicators, Performance Thresholds and Responses for Surface Water Quality in McGinty Creek

Specific Indicators	Specific Performance Thresholds	Specific Responses
Aqueous Concentrations at Station MN-4.5 for parameters with Water Quality Objectives. (See Table 2-10 above for Water Quality Objective and threshold values.)	**Specific Threshold 1** • Exceedance of ST1 value in two consecutive samples **(scheduled or re-sample)**	**Notification** • Minto Management • Include in scheduled Water Use Licence reporting **Review** • Follow QA/QC investigative protocol: o Review laboratory QA/QC report o Validate original result, or re-run sample if a laboratory error is indicated **Evaluation** • Compare with MN-1.5 results • A trend analysis will be conducted by Minto's senior level environmental personnel. **Action** • If comparison with other results suggests that Minto North loading may be responsible for exceedance and validation confirms original result, then: o Evaluate causes for load contributions, and o If trend analysis suggests WQO exceedance within one year, then initiate actions for threshold 2.
	Specific Threshold 2 • Exceedance of the IDPE-WQO (grab vs. IDPE, or annual average vs. CTE)	**Notification** • Minto Management • Include in scheduled Water Use Licence reporting **Review** • Follow QA/QC investigative protocol: o Review laboratory QA/QC report o Validate original result, or re-run sample if a laboratory error is indicated **Evaluation** • Measures from ST1, and • Engage a qualified professional to evaluate potential effects to aquatic resources • A trend analysis will be conducted by Minto's senior level environmental personnel. **Action** • If comparison with results suggests that Minto North loadings are responsible for exceedance and validation confirms original result, then: o Re-sample MN-1.5 and MN-4.5 within **two weeks** of original sample result review; and o Evaluate causes for load contributions o Develop a mitigation strategy with recommendations based on the findings of the potential effects to aquatic resources evaluation • Actions will continue until performance thresholds are no longer exceeded.
	Specific Threshold 3 • Exceedance of the IDPE-WQO (as defined above) in **2 consecutive samples (scheduled or re-sample)** where evaluation confirmed mine loading responsible for first exceedance	**Notification** • Notify management, SFN and YG • include in scheduled Water Use Licence reporting **Review** • Follow QA/QC investigative protocol: o Review laboratory QA/QC report o Validate original result, or re-run sample if a laboratory error is indicated **Evaluation** • Measures from ST2 **Action** • If comparison with results (evaluation, above) suggests that Minto North loadings are STILL responsible for exceedance; and validation confirms original result, then: o If not already implemented, increase monitoring frequency. o Implement recommendations from mitigation strategy (threshold 2 response). This could include batch water treatment in the Minto North pit if determined feasible and appropriate. o Actions will continue until performance thresholds are no longer exceeded.

2.2 Groundwater Quality

2.2.1 Minto Creek Watershed

2.2.1.1 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). During final closure the WSP will be decommissioned and a passive treatment system (wetlands) established within its footprint.

The groundwater monitoring supporting the Closure AMP framework is defined and described in the Monitoring and Maintenance program, which is included in Section 7.12 of the RCP. The monitoring requirements build on those of the Groundwater Monitoring Program of the Environmental Monitoring, Surveillance and Reporting Plan (EMSRP) (Minto Explorations Ltd., 2016) implemented in the mine operations phase. The purpose of the operational groundwater monitoring program is to provide information to better understand the potential for off-site migration of contamination and to better understand and define source terms and conditions of waste emplacement, for comparison to source terms used in the predictive Water Balance and Water Quality model. An additional objective of the operational groundwater monitoring plan is to provide for the development of baseline hydrogeological conditions in areas where future mine components are being planned.

The WUL requires additional groundwater monitoring components be installed within the Minto Creek catchment are both upgradient of existing and proposed mine components and downgradient of the WSP. A multi-level monitoring well MW16-08 is to be installed upgradient of all mine components and MW16-12 is to be installed at the downstream extent of the Minto lease boundary in the Minto Creek catchment, Currently, groundwater monitoring is carried out both upgradient and downgradient of the WSP via multi-level monitoring wells at MW12-06 and MW12-05 (MW12-05 is located downgradient of the proposed MW16-12. Once the groundwater quality from MW16-12 becomes available, the groundwater quality at MW12-05 and MW16-12 will be compared by a qualified professional to assess if the use of MW12-05 should be discontinued).

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 WSP (i.e. up-gradient of monitoring well MW16-12). Minimal groundwater from the mine area is expected to discharge to Minto Creek down gradient of the WSP. Surface water downgradient of the WSP is monitored at several stations including station W2 located near the Yukon River. W2 is 6 km downstream of the Minto lease boundary and water reporting to W2 is subject to influences from groundwater and surface water outside the mine area.

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

2.2.1.2 Risk Narrative

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

2.2.1.3 Specific Indicators, Performance Thresholds and Responses

Indicators, performance thresholds and responses specific to groundwater quality in Minto Creek watershed are provided in Table 2-12. Specific Performance Thresholds (SPTs) are defined for each of the Effluent Standards (ES) parameters identified in Clause 9 (a), Table 1 of Water Use Licence QZ14-031, with the exception of pH, oil and grease, iron and nitrite (as discussed later in this section). Additionally, although it is not specified in Clause 9(a), sulphate has been included in the SPTs. Table 2-13 compiles the concentration of background groundwater for each Specific Indicator and the Specific Performance Threshold values.

The concentrations of the background groundwater are based on the respective median parameter concentrations at monitoring well MW09-03 (including all monitoring ports). At present (January 2017), the MW09-03 monitoring record is considered to be the most representative indicator of the baseline groundwater conditions for the entire project site. MW09-03 was installed in 2009 and monitored to collect baseline data downgradient of the Minto North ore body- this well is located near the southern limit of the McGinty Creek catchment close to the surface water divide with Minto Creek. Pre-mining groundwater concentrations for certain parameters such as cadmium and iron have been relatively high, likely due to the adjacent highly mineralized zone. Mining of this ore body began in Q3 2015 and as such the monitoring record prior for the 2009-2015 period reflects baseline conditions. Another groundwater well (nominally MW16-08, likely MW2017-08 when completed) will be installed in 2017 to allow groundwater quality monitoring within the Minto Creek catchment upgradient of any mine disturbances. Once an adequate record of the groundwater quality from MW16-08 becomes available, the groundwater quality at MW09-03 and MW16-08 will be compared by a qualified professional to verify and assess if background groundwater concentrations used in the current operational AMP remain appropriate. Minto expects that an adequate record will be available after 3 years of monitoring. Other new wells that are planned for installation in 2017 will be monitored in accordance with Minto's EMSRP, but will not be included in the AMP.

Iron and nitrite have been excluded from the Specific Indicators for groundwater quality because of the magnitude of the natural variability observed in groundwater at Minto. In addition, pH as also been excluded as a Specific Indicator for groundwater quality because it is not as useful an early warning indicator as sulphate and metal/ metalloid concentrations, and Oil & Grease has been excluded because it is not relevant as a specific indicator for groundwater. Although iron, nitrite and pH are excluded from the Specific Indicator list, these three constituents are monitored and would be included in the review of groundwater quality if an SPT was exceeded.

Three SPTs have been defined for the Minto Creek watershed. Rationale for development of the SPTs is as follows:

- SPT-1 corresponds to a trend-based assessment designed to flag a potential rapid increase in groundwater loadings that has not yet exceeded concentration-based thresholds. The assessment is structured to determine if an indicator has increased significantly compared to the last sampling event. The assessment will be performed as followed:

  $$((C_n - C_{n-1})/(C_{SPT-2} – C_n) > 0.2$$

  Where:

  - C_n = the parameter concentration of groundwater from the latest sampling event;

- C_{n-1} = the parameter concentration of groundwater from the last sampling event ;
- C_{SPT-2} = the parameter concentration for the SPT-2;

The SPT-1 provides a conservative threshold considering that it is weighted against the concentration for the SPT-2. The SPT-1 will be increasingly sensitive to change in concentrations between two sampling events as groundwater approaches the SPT-2, since the size of the denominator decreases as the SPT-2 value is approached.

- SPT-2 generally corresponds to the EQS concentrations defined in Clause 9 (a), Table 1 of Water Use License QZ14-031 (with four exceptions (Cr-D, Cu-D, Ni-D and sulphate) as indicated in the notes to Table 2-12). The EQS are defined for surface water discharge, and the mine is not permitted to discharge water that exceeds any EQS guidelines to surface water. As SPT-2 applies to groundwater (not surface water) concentrations in single zone, this is a highly conservative threshold.Table 26). The EQS are defined for surface water discharge, and the mine is not permitted to discharge water that exceeds any EQS guidelines to surface water. As SPT-2 applies to groundwater (not surface water) concentrations in single zone, this is a highly conservative threshold.Table 26). The EQS are defined for surface water discharge, and the mine is not permitted to discharge water that exceeds any EQS guidelines to surface water. As SPT-2 applies to groundwater (not surface water) concentrations in single zone, this is a highly conservative threshold.Table 26). The EQS are defined for surface water discharge, and the mine is not permitted to discharge water that exceeds any EQS guidelines to surface water. As SPT-2 applies to groundwater (not surface water) concentrations in single zone, this is a highly conservative threshold.
- SPT-3 generally corresponds to the estimated concentrations in groundwater that would be necessary to cause exceedance of the Water Quality Objectives in lower Minto Creek, at W2, under long term steady state conditions (exceptions are listed in the notes to Table 2-12). These concentrations were determined by conducting a mass loading calculation to determine the groundwater concentrations that would be necessary to cause exceedance of WQOs in lower Minto Creek during low flow periods where all streamflow is derived from groundwater discharge. 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:Table 26). These concentrations were determined by conducting a mass loading calculation to determine the groundwater concentrations that would be necessary to cause exceedance of WQOs in lower Minto Creek during low flow periods where all streamflow is derived from groundwater discharge. 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:

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

Where:

- $C_{gw\text{-}mine\_max}$ = the indicator parameter concentration of all groundwater upgradient of MW12-05 that reports to Minto Creek that would be required to cause surface water to exceed the WQO at station W2.
- 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
- $C_{W2\text{-}WQO}$ = the WQO parameter concentration for surface water at W2

- $Q_{gw\text{-}bgrnd}$ = 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
- $C_{gw\text{-}bgrnd}$ = background groundwater concentration (based on median concentrations from the 2009-2015 baseline monitoring period in MW09-03)
- $Q_{gw\text{-}mine}$ = the estimated groundwater flow from the mine at the Water Storage Pond (from the 2015 groundwater model update)

If groundwater concentration of one indicator reached the SPT-3 in an individual port, the quality of the lower Minto Creek at W2 would not yet exceed the Water Quality Objective due to the contribution of groundwater from un-impacted areas of the Minto Creek watershed and the fact that groundwater concentrations at a specific monitoring well port represents only a portion of the flow and not the whole groundwater flow field. The SPT-3 provides therefore a conservative threshold for action before any significant effect would be observed in surface water.

The monitoring results that are evaluated and utilized for this component of the AMP are a requirement of the Groundwater Monitoring Program of the EMSRP (Minto Explorations Ltd., 2016). The monitoring data will be compared to the specific performance thresholds monthly (by the end of the month following the month in which samples were collected) - this corresponds to the existing monthly reporting schedule.

Examples of actions that may arise from recommendations include:

- Continuation of monitoring;
- Continuation monitoring with an increase in monitoring frequency;
- Development of additional monitoring points and monitoring of those newly-established monitoring locations;
- Completion of appropriate risk assessment;
- Development and execution of a focused study to better understand the cause of exceedance.

Table 2-12: Specific Indicators, Performance Thresholds and Responses for Groundwater Quality in Minto Creek

Specific Indicators	Specific Performance Thresholds	Stage	Specific Responses
Aqueous concentrations in samples collected from multi-level groundwater monitoring wells MW12-05 or MW12-06 for the following parameters with water quality objectives: • Dissolved Aluminum • Dissolved Arsenic • Dissolved Cadmium • Dissolved Chromium • Dissolved Copper • Dissolved Iron • Dissolved Lead • Dissolved Molybdenum • Dissolved Nickel • Dissolved Silver • Dissolved Selenium • Dissolved Zinc • NH_4-N • NO_3-N • Sulphate	**SPT-1** • Exceedance of SPT-1 for any sample collected during routine monitoring from multilevel groundwater monitoring wells MW12-05 or MW12-06.	**All Stages**	**Notification** • Minto Management • Include in scheduled Water Use Licence monthly reporting **Review** • Follow QA/QC investigative protocol: o Review laboratory QA/QC report o Validate original result, or re-run sample if a laboratory error is indicated o Timing: initiate within 1 week of triggering SPT **Evaluation** • Review of groundwater monitoring data (trend analysis included) to be undertaken by qualified professional, and appropriate recommendations to be developed o Review must consider the risk narrative (i.e. exceedance of surface water quality objectives as a result of groundwater flux) • Submit recommendations to regulator for review and approval o Timing: submit within 1 week of receipt of recommendations **Action** • Follow recommendations arising from review undertaken by qualified professional. Include the trend analysis in scheduled reporting o Timing: initiate implementation of recommendations within 1 month of receipt of approval from regulator
	SPT-2 • Exceedance of SPT-2 concentrations in 2 consecutive samples (scheduled or re-sampled) collected during routine monitoring from multilevel groundwater monitoring wells MW12-05 or MW12-06.	**All Stages**	**Notification** • Minto Management • Include in scheduled Water Use Licence monthly reporting **Review** • Follow QA/QC investigative protocol: o Review laboratory QA/QC report o Validate original result, or re-run sample if a laboratory error is indicated o Timing: initiate within 1 week of triggering SPT **Evaluation** • Review of groundwater monitoring data (including trend analysis) to be undertaken by qualified professional, and appropriate recommendations to be developed o Review must consider the risk narrative (i.e. exceedance of surface water quality objectives as a result of groundwater flux) o Timing: initiate within 1 week of QA/QC review validating original results • Submit recommendations to regulator for review and approval o Timing: submit within 1 week of receipt of recommendations **Action** • Follow recommendations arising from review undertaken by qualified professional. o Timing: initiate implementation of recommendations within 1 month of receipt of approval from regulator

Specific Indicators	Specific Performance Thresholds	Stage	Specific Responses
	SPT-3 • Exceedance of SPT-3 in 2 consecutive samples (Scheduled or re-sampled) collected during routine monitoring from multilevel groundwater monitoring wells MW12-05 or MW12-06.	**All Stages**	**Notification** • Minto Management • Include in scheduled Water Use Licence monthly reporting **Review** • Follow QA/QC investigative protocol: o Review laboratory QA/QC report o Validate original result, or re-run sample if a laboratory error is indicated o Timing: initiate within 1 week of triggering SPT **Evaluation** • Review of groundwater monitoring data (including a trend analysis)to be undertaken by qualified professional, and appropriate recommendations to be developed o Review must consider the risk narrative (i.e. exceedance of surface water quality objectives as a result of groundwater flux) o Timing: initiate within 1 week of QA/QC review validating original results • Submit recommendations to regulator for review and approval o Timing: submit within 1 week of receipt of recommendations **Action** • Follow recommendations arising from review undertaken by qualified professional. o Timing: initiate implementation of recommendations within 1 month of receipt of approval from regulator • Increase monitoring frequency to monthly sampling of all monitored zones in the affected multi-level well for a period to be defined by qualified professional.

Table 2-13: Background concentrations and SPTs for the groundwater monitoring in the Minto Creek watershed

Minto Creek	***Concentrations (mg/L)***													
	Ag-D	Al-D	As-D	Cd-D	Cr-D	Cu-D	Pb-D	Mo-D	Ni-D	Se-D	Zn-D	N-NO3	Ammonia	Sulphate[2]
SPT-3 [1]	0.00046	0.48	0.025	0.0060	0.0030	0.060	0.020	0.34	0.33	0.0093	0.13	45	1.0	4951
SPT-2	0.00030	0.30	0.015	0.0030	0.0015[4]	0.030 [4]	0.012	0.22	0.165[4]	0.0060	0.090	27	0.75	1000
Background Groundwater[3]	0.00001	0.0045	0.0001	0.00002	0.00050	0.0014	0.0001	0.006	0.001	0.0002	0.006	0.07	0.051	12

Notes:

1: For most Specific Indicators, SPT-3 is the calculated concentration that all groundwater from the mine catchment must attain to reach the Operational Water Quality Objectives at W2. Model flows were 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. The exceptions are dissolved chromium, dissolved copper and dissolved nickel, for which SPT-3 is equal to the Effluent Quality Standard value that applies to surface water discharge from the mine site.

2: There is no Effluent Quality Standard for sulphate. For the SPT-2, the guideline for Aquatic Life from the Contaminated Site Regulation Schedule 3 was used as a replacement.

3: The background concentration in groundwater is calculated as the median of concentrations observed at groundwater monitoring well MW09-03.

4: SPT-2 for dissolved copper, dissolved chromium and dissolved nickel set at one-half (50%) of Effluent Quality Standard (SPT-2 for all remaining parameters (other than sulphate) is equal to (100% of) the Effluent Quality Standard).

2.2.2 McGinty Creek Watershed

2.2.2.1 Description

The mine workings in the McGinty Creek catchment are limited to the Minto North Pit. 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); in other words, the Minto North Pit catchment is roughly 0.4% of the total McGinty Creek catchment area. 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.

The monitoring supporting the closure AMP framework is defined and described in the Post-Closure Monitoring Plan of the RCP. The monitoring requirements build on those of the operational Groundwater Monitoring Plan (part of the EMSRP ((Minto Explorations Ltd., 2016)). Groundwater in the McGinty Creek catchment downgradient of the Minto North Pit is currently monitored at multi-level monitoring well MW09-03. MW09-03 was installed in 2009 and monitored to collect baseline at the Minto North ore body. Mining of this ore body began in Q3 2015 and as such the monitoring record prior for the 2009-2015 period reflects baseline conditions. An additional multi-level groundwater well MW16-11 is to be installed downgradient of the Minto North Pit to fulfill WUL requirements.

2.2.2.2 Risk Narrative

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

2.2.2.3 Specific Indicators, Performance Thresholds and Responses

Indicators, performance thresholds and responses specific to groundwater quality in McGinty Creek watershed are provided below in Table 2-14. SPTs are defined for each of the Effluent Standards (ES) parameters identified in Clause 9 (a), Table 1 of Water Use License QZ14-031, with the exception of pH, Oil & Grease, iron and nitrite (for reasons described in the Minto Creek groundwater section (Section 2.2.1). Additionally, although it is not specified in Clause 9(a), sulphate has been included in the SPTs. The concentration of background groundwater and the Specific Performance Threshold values for each Specific Indicator and each zone (i.e. individual well port) of MW09-03 are compiled in Table 2-15. The monitoring record for MW09-03 for the 2009-2015 period reflects baseline conditions (prior to the development of the open pit). Pre-mining groundwater concentrations for certain parameters such as cadmium and iron have been relatively high, likely due to the adjacent highly mineralized zone.

Two Specific Performance Thresholds have been defined for McGinty Creek watershed groundwater- both are conservative given the application of the thresholds at individual ports, the small proportion of catchment groundwater that will be influenced by the mine workings and the expected slow rates of groundwater movement. Rationale for development of the two specific performance thresholds is as follows:

- SPT-1: Three consecutive exceedances of the 75th percentile background level in a single monitoring port.
    - The specification of three consecutive exceedances is intended to avoid triggering the AMP unnecessarily, but to ensure that any sustained increase from baseline conditions receives appropriate scrutiny.
- SPT-2: Three consecutive exceedances of the 95th percentile background level in a single monitoring port.

- The specification of three consecutive exceedances is intended to avoid triggering the AMP unnecessarily, but to ensure that any sustained increase from baseline conditions receives appropriate scrutiny.

The monitoring results that are evaluated and utilized for this component of the AMP are a requirement of the operational Groundwater Monitoring Program of the EMSRP (Minto Explorations Ltd., 2016) and the Post-Closure Monitoring Plan of the RCP.

Table 2-14: Specific Indicators, Performance Thresholds and Responses for Groundwater Quality in McGinty Creek

Specific Indicators	Specific Performance Thresholds	Stage	Specific Responses
Aqueous concentrations in samples collected from multi-level groundwater monitoring well MW09-03 for the following parameters: • Dissolved Aluminum • Dissolved Arsenic • Dissolved Cadmium • Dissolved Chromium • Dissolved Copper • Dissolved Lead • Dissolved Molybdenum • Dissolved Nickel • Dissolved Silver • Dissolved Selenium • Dissolved Zinc • NH_4-N • NO_3-N • Sulphate	**Specific Threshold 1** • Three consecutive exceedances of the 75th percentile value* from the baseline period (2009-2015) in routine monitoring results from a single monitoring port in MW09-03. *values provided in Table 2-13	**All Stages**	**Notification** • Mine/Project Manager • Include in scheduled Water Use Licence reporting **Review** • Follow QA/QC investigative protocol: ○ Review laboratory QA/QC report ○ Validate original results, or re-run samples if a laboratory error is indicated **Evaluation** • Review of groundwater monitoring data to be undertaken by qualified professional, and appropriate recommendations to be developed ○ Review must consider the risk narrative (i.e. exceedance of surface water quality objectives as a result of groundwater flux) **Action** • Follow recommendations arising from review undertaken by qualified professional.
	Specific Threshold 2 • Three consecutive exceedances of the 95th percentile value* from the baseline period (2009-2015) in routine monitoring results from a single monitoring port in MW09-03. *values provided in Table 2-13	**All Stages**	**Notification** • Mine/Project Manager • Include in scheduled Water Use Licence reporting **Review** • Follow QA/QC investigative protocol: ○ Review laboratory QA/QC report ○ Validate original results, or re-run samples if a laboratory error is indicated **Evaluation** • Review of groundwater monitoring data to be undertaken by a qualified professional, and appropriate recommendations to be developed ○ Review must consider the risk narrative (i.e. exceedance of surface water quality objectives as a result of groundwater flux) **Action** • Follow recommendations arising from review undertaken by qualified professional. • Increase monitoring frequency of all monitored zones in the affected multi-level well for a period to be defined by qualified professional.

Table 2-15: Background Concentrations and SPTs for the Groundwater Monitoring in the McGinty Creek Watershed

Minto Creek		*Concentrations (mg/L)*[1]													
		Ag-D[3]	Al-D	As-D	Cd-D	Cr-D[3]	Cu-D	Pb-D[3]	Mo-D	Ni-D	Se-D	Zn-D	N-NO3	NH_4-N	Sulphate
MW09-03-01	95th Percentile	0.000016	0.0101	0.00081	0.000272	0.000575	0.00625	0.0003	0.026	0.0060	0.0015	0.022	0.28	0.133	38
	75th Percentile	0.000010	0.0065	0.00011	0.000075	0.000500	0.00155	0.0001	0.005	0.0021	0.0001	0.013	0.13	0.067	24
	Median[2]	0.000010	0.0045	0.00005	0.000022	0.000500	0.00031	0.0001	0.004	0.0015	0.0001	0.006	0.07	0.045	22
MW09-03-02	95th Percentile	0.000034	0.0095	0.00092	0.000272	0.000796	0.01080	0.0002	0.062	0.0026	0.0040	0.015	0.07	0.282	67
	75th Percentile	0.000018	0.0073	0.00074	0.000031	0.000500	0.00263	0.0001	0.018	0.0009	0.0005	0.010	0.03	0.230	7
	Median[2]	0.000010	0.0062	0.00067	0.000026	0.000500	0.00122	0.0001	0.017	0.0005	0.0002	0.008	0.01	0.210	1
MW09-03-03	95th Percentile	0.000010	0.0075	0.00014	0.000069	0.000500	0.00500	0.0003	0.018	0.0011	0.0004	0.011	0.54	0.058	13
	75th Percentile	0.000010	0.0047	0.00005	0.000023	0.000500	0.00247	0.0001	0.006	0.0005	0.0004	0.008	0.50	0.020	12
	Median[2]	0.000010	0.0025	0.00005	0.000015	0.000500	0.00174	0.0001	0.005	0.0005	0.0003	0.003	0.48	0.012	11

Notes:

1: For monitoring results where concentrations were below the analytical detection limits, a concentration of half the detection limit was adopted for calculation purposes.

2: For AMP purposes, the background concentration in groundwater at MW09-03 is defined as the median concentration observed in each port over the 2009-2015 baseline monitoring period.

3: For Ag-D, Cr-D and Pb-D, most 2009-2015 concentrations were at the limit of analytical detection, and as such the calculated 75th and 95th percentile values are skewed low.

2.3 Water Management Infrastructure

2.3.1 Description

The closure water conveyance infrastructure is a network of channels, erosion protection features, and energy dissipation structures that convey surface water from the mine surface to Minto Creek. The network of channels is designed to collect, intercept, and convey water through the mine in its closed state. In addition to the conveyance system, three reservoirs will be present into active closure and post closure phases. Two of the reservoirs, the Main Pit Lake and the Area 2 Pit Lake will remain in perpetuity, while the third one, the WSP, will be decommissioned and the dam deconstructed. The Water Storage Dam has been excluded from the closure AMP as the facility is to be managed according to its Operation, Maintenance and Surveillance (OMS) Manual (Tetra Tech EBA, 2014) until it is decommissioned. A Constructed Wetland Treatment System (CWTS) is to be constructed within the footprint currently occupied by the WSP as part of mine closure works at Minto Mine.

Conveyance and collection structures and reservoirs are used to convey drainage from the major waste infrastructure to treatment systems prior to release. As discussed in the Section 7.7.1 of the RCP the water treatment plant used during operations will remain in operational until WUL criteria can be achieved consistently without its utilization.

The design criteria for the water conveyance system is described in the Section 3 of the Minto Mine – Closure Water Conveyance System Design Update Report (Appendix G2, Minto Mine RCP). Design details specific to each of the five conveyance channels are provided in Section 5 of the design report.

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

2.3.2 Risk Narrative

A mass failure of one of the conveyance and collection 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).

2.3.3 Specific Indicators, Performance Thresholds and Responses

Indicators, performance thresholds and responses specific to water management are provided below in Table 2-16. The monitoring results that are evaluated and utilized for this component of the AMP are a requirement of the Post-Closure Monitoring Program.

Table 2-16: Specific Indicators, Performance Thresholds and Responses for Water Management Infrastructure

Specific Indicators	Specific Performance Thresholds	Stage	Specific Responses

• Failure or blockage of conveyance structures resulting in changed flow paths and/or overtopping of drainage ditches
• Failure of upstream diversions leads to excessive infiltration into upgradient base of DSTF, resulting in increased flows and/or metal loads and unacceptable water quality conditions downstream.
• Occurrence of a major precipitation event
• Increased sediment load in ditch flow and or downstream (increased TSS)
• Pit wall failure
	Specific Threshold 1
	• Observation of unusual occurrence including:
	  • Partial blockage;
	  • Physical damage;
	  • Turbulent flow where laminar flow is expected or is normal;
	  • Cracks, settlement of sloughing;
	  • Downstream movement of channel bedding material (rip rap or liner);
	  • Erosion channels or flowing water outside of the designed structures;
	  • Abnormal seepage;
	  • Rainfall event that exceeds the design criteria;
	  • Increase turbidity of flow.
		All Stages	**Notification**
			• Mine/Project Manager
			• Geotechnical Engineer
			• Include in scheduled WUL reporting
			Review
			• Review previous inspection reports, survey data and precipitation records
			Evaluation
			• Geotechnical Engineer to compare recent monitoring results against older results for additional evidence of the need for design modifications
			Action
			• Inspect area to determine source of blockage and potential for repeated occurrence
			• Develop plan to address the need for repairs or modifications.
			• Increase frequency of monitoring as recommended by a qualified professional

	Specific Threshold 2
	• Observation of unusual occurrence including:
	  • Complete blockage;
	  • Substantial physical damage;
	  • overtopping of drainage ditches;
	  • Downstream water quality exceeds TSS criteria.
		All Stages	**Notification**
			• Mine/Project Manager
			• Geotechnical Engineer
			• Include in scheduled WUL reporting
			Review
			• Review previous inspection reports, survey data and precipitation records.
			Evaluation
			• Geotechnical Engineer to compare recent monitoring results against older results for additional evidence of the need for design modifications
			Action
			• Inspect area to determine source of blockage and potential for repeated occurrence
			• Immediately develop and implement a plan to address the need for repairs or modifications
			• Increase frequency of monitoring as recommended by a qualified professional

Specific Indicators	Specific Performance Thresholds	Stage	Specific Responses
	Specific Threshold 3 • Complete compromise of functionality.	**All Stages**	**Notification** • Mine/Project Manager, SFN and YG • Geotechnical Engineer • Include in scheduled WUL reporting **Review** • Review previous inspection reports, survey data and precipitation records. **Evaluation** • Engage a qualified professional to evaluate potential effects to aquatic resources. **Action** • Inspect the area for any other signs of instability. • Complete a ground survey of the area accommodate modifications/repairs. • Follow any additional recommendations of the Geotechnical Engineer. At a minimum, the Engineer will consider the need for modifications to the conveyance and retention structures and the need for an increased frequency of monitoring.

2.4 Physical Stability of Waste Rock, Overburden and Tailings Storage Facilities

2.4.1 Description

The physical stability of the site, during Post Closure I and II periods, will be monitored according to the Monitoring and Maintenance section (7.12) of the Minto Mine RCP. During active closure the physical stability of the waste rock, overburden dumps, tailings and water storage facilities are will be monitored according to the Physical Monitoring Plan, which forms part of the Environmental Monitoring, Surveillance and Reporting Plan (Minto Explorations Ltd., 2016). These monitoring plans describe 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 Minto to mitigate these conditions prior to any occurrence of instability. The facilities have been separated into two sets of geotechnical thresholds and response criteria (Table 2-17). Soil cover performance and stability is addressed under Section 2.5 General Reclamation Measures of this plan.

Table 2-17: Physical Stability Categories

Category	Facility
1	• Dry Stack Tailings Storage Facility and Mill Valley Fill Extension (Stage 1 and 2) • Southwest Waste Dump • South Wall Buttress of the Main Pit Dump
2	• Main Waste Dump and Main Waste Dump Extension • Reclamation Overburden Dump • Ice-Rich Overburden Dump • Main Pit Dump (except the South Wall Buttress) • Area 118 Backfill 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 (DSTSF) 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 DSTSF are detailed in the Operations, Maintenance, and Surveillance Manual (OMS) for the facility (Minto Explorations Ltd., 2014).

Category 2 facilities consist of all the remaining waste rock dumps. These waste dumps are located in areas with good foundation conditions that avoid areas underlain by ice-rich overburden.

2.4.2 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).

2.4.3 Specific Indicators, Performance Thresholds and Responses

Indicators, performance thresholds and responses specific to Category 1 and Category 2 Facilities are provided in Table 2-18 and Table 2-19, respectively. The responses are dependent on the phase of closure as indicated in the tables. The monitoring results that are evaluated and utilized for this component of the AMP are a requirement of the Physical Monitoring Program of the EMSRP (Minto Explorations Ltd., 2016) and the Monitoring and Maintenance section (7.12) of the Minto RCP.

Table 2-18: Specific Indicators, Performance Thresholds and Responses for Category 1 Facilities

Specific Indicators	Specific Performance Thresholds	Stage	Specific Responses

• 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
	• Observation of unusual occurrence including:
	  • tension cracks, settlement, or sloughing;
	  • a seismic event that exceeds the 1:475 return period event[2];
	  • abnormal seepage from any area of the slopes;
	  • increased turbidity from seepage;
	  • physical damage.
		All Stages	**Notification**
			• Mine/Project Manager
			• Geotechnical Engineer
			• Include in scheduled WUL reporting
			Review
			• Review previous inspection reports, existing instrumentation including piezometer, temperature, inclinometer, and survey data.
			Evaluation
			• Geotechnical Engineer to compare recent monitoring results against older results for additional evidence of instability.
			Action
			• 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:
			  ○ An increase in the frequency of routine inspections and monitoring.
			  ○ Additional inspection, instrumentation, monitoring, or analyses
			• If the results of the analysis indicate there is a stability concern, the mine inspector and Selkirk First Nation will be notified immediately.

	Specific Threshold 2 • One survey hub or inclinometer reading indicating acceleration of movement greater than the long-term trend and outside range of instrumentation error	**All Stages**	**Notification** • Geotechnical Engineer **Review** • Review existing instrumentation data. **Evaluation** • Geotechnical Engineer to compare recent monitoring results against older results. **Action** • Retake reading. • If the reading was accurate, increase the survey hub or inclinometer frequency. • If the results of the analysis indicate there is a stability concern, the mine inspector and Selkirk First Nation will be notified immediately.
	Specific Threshold 3 • For DSTSF and MVFE piezometers 13-DSP-05a, 13-DSP-06, 15-DSP-07, and 15-DSP-08, an increase in pore water pressures such that Ru[3] exceeds 0.4[4]. • For MVFE2 piezometer 15-DSP-10, an increase in pore water pressures such that the water elevation is 1 m above the original ground surface. Or • Temperature greater than zero at a depth of 2 m below original ground *(all SWD ground temperature cables, and DSTSF ground temperature cables DST-10, DST-11, and DST-14 only)*	**Active** **Closure**	**Notification** • Mine Manager • Geotechnical Engineer • Include in scheduled WUL reporting **Review** • Review previous inspection reports, existing instrumentation including piezometer, temperature, inclinometer, and survey data. **Evaluation** • Geotechnical Engineer to compare recent monitoring results against older results for additional evidence of instability. **Action** • Inspect the area for any other signs of instability. • If pore water pressure threshold exceeded, increase frequency as directed by the Engineer until determined unnecessary. • Follow any additional recommendations of the Geotechnical Engineer. • If the results of the analysis indicate there is a stability concern, the mine inspector and Selkirk First Nation will be notified immediately.

[2] 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

[3] 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.

[4] 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	Stage	Specific Responses
		Post Closure I, Post Closure II	**Notification** • Project Manager • Geotechnical Engineer • Include in scheduled WUL reporting **Review** • Review previous inspection reports, existing instrumentation including piezometer, temperature, inclinometer, and survey data. **Evaluation** • Geotechnical Engineer to compare recent monitoring results against older results for additional evidence of instability. **Action** • Inspect the area for any other signs of instability. • If pore water pressure threshold exceeded, increase frequency as directed by the Engineer until determined unnecessary. • Follow any additional recommendations of the Geotechnical Engineer. • If the results of the analysis indicate there is a stability concern, the mine inspector and Selkirk First Nation will be notified immediately.

	Specific Threshold 4
	• 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 piezometer 15-DSP-10, an increase in pore water pressures such that the water elevation is 3 m above the original ground surface.
		Active Closure	**Notification**
			• Mine Manager
			• Geotechnical Engineer
			• Include in scheduled WUL reporting
			Review
			• Review previous inspection reports, existing instrumentation including piezometer, temperature, inclinometer, and survey data.
			Evaluation
			• Geotechnical Engineer to compare recent monitoring results against older results for additional evidence of instability.
			Action
			• Inspect the area for any other signs of instability.
			• Increase pore water pressure monitoring and data review frequency 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:
			  ○ An increase in the frequency of routine inspections and monitoring.
			  ○ Additional inspection, instrumentation, monitoring, or analyses.
			  ○ Modifications to the waste placement/construction practices.
			• If the results of the analysis indicate there is a stability concern, the mine inspector and Selkirk First Nation will be notified immediately.

		Post Closure I, Post Closure II	**Notification**
			• Project Manager
			• Geotechnical Engineer
			• Include in scheduled WUL reporting
			Review
			• Review previous inspection reports, existing instrumentation including piezometer, temperature, inclinometer, and survey data.
			Evaluation
			• Geotechnical Engineer to compare recent monitoring results against older results for additional evidence of instability.
			Action
			• Inspect the area for any other signs of instability.
			• Increase pore water pressure monitoring and data review frequency 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:
			  ○ An increase in the frequency of routine inspections and monitoring.
			  ○ Additional inspection, instrumentation, monitoring, or analyses.
			  ○ Modifications to the waste placement/construction practices.

Specific Indicators	Specific Performance Thresholds	Stage	Specific Responses
			• If the results of the analysis indicate there is a stability concern, the mine inspector and Selkirk First Nation will be notified immediately.
	Specific Threshold 5 • Three consecutive survey hub or inclinometer readings indicating acceleration of movement greater than the long-term trend. Or • Three consecutive survey hub readings indicating a change in horizontal direction of movement greater than 15 degrees from the long term trend.	**Active Closure**	**Notification** • Mine Manager • Geotechnical Engineer • Include in scheduled WUL reporting **Review** • Review previous inspection reports, existing instrumentation including piezometer, temperature, inclinometer, and survey data. **Evaluation** • Geotechnical Engineer to compare recent monitoring results against older results for additional evidence of instability. **Action** • Inspect the area for any other signs of instability. • Complete a ground survey of the area of interest to monitor any future displacement. • Increase monitoring and data review frequency 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: o An increase in the frequency of routine inspections and monitoring. o Additional inspection, instrumentation, monitoring, or analyses o Modifications to the waste placement/construction practices, including discontinuation of loading. • If the results of the analysis indicate there is a stability concern, the mine inspector and Selkirk First Nation will be notified immediately.
		Post Closure I, Post Closure II	**Notification** • Project Manager • Geotechnical Engineer • In Include in scheduled WUL reporting **Review** • Review previous inspection reports, existing instrumentation including piezometer, temperature, inclinometer, and survey data. **Evaluation** • Geotechnical Engineer to compare recent monitoring results against older results for additional evidence of instability. **Action** • Inspect the area for any other signs of instability. • Complete a ground survey of the area of interest to monitor any future displacement. • Increase monitoring and data review frequency 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: o An increase in the frequency of routine inspections and monitoring. o Additional inspection, instrumentation, monitoring, or analyses o Modifications to the waste placement/construction practices, including discontinuation of loading. • If the results of the analysis indicate there is a stability concern, the mine inspector and Selkirk First Nation will be notified immediately

Table 2-19: Specific Indicators, Performance Thresholds and Responses for Category 2 Facilities

Specific Indicators	Specific Performance Thresholds	Stage	Specific Responses

• 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
	
	• Observation of unusual occurrence including:
	  • 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.
		All Stages	**Notification**
			• Mine/Project Manager
			• Geotechnical Engineer
			• Include in scheduled WUL reporting
			Review
			• Review previous inspection reports, existing instrumentation including piezometer, temperature, inclinometer, and survey data.
			Evaluation
			• Geotechnical Engineer to compare recent monitoring results against older results for additional evidence of instability.
			Action
			• 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:
			  ○ An increase in the frequency of routine inspections and monitoring.
			  ○ Additional inspection, instrumentation, monitoring, or analyses.
			• If the results of the analysis indicate there is a stability concern, the mine inspector and Selkirk First Nation will be notified immediately.

	Specific Threshold 2
	
	• Survey hub cumulative displacements between 150 mm and 500 mm;
	
	Or
	
	• Increase in pore water pressures such that Ru exceeds 0.2.
		Active Closure	**Notification**
			• Mine Manager
			• Geotechnical Engineer
			• Include in scheduled WUL reporting
			Review
			• Review previous inspection reports, existing instrumentation including piezometer, temperature, inclinometer, and survey data.
			Evaluation
			• Geotechnical Engineer to compare recent monitoring results against older results for additional evidence of instability.
			Action
			• Inspect the area for any signs of instability.
			• Immediately Increase monitoring and data review frequency until determined unnecessary:
			  ○ If survey hub threshold exceeded, increase frequency as directed by the Engineer.
			  ○ If pore water pressure threshold exceeded, increase frequency as directed by the Engineer.
			• Follow any additional recommendations of the Geotechnical Engineer.
			• If the results of the analysis indicates there is a stability concern, the mine inspector and Selkirk First Nation will be notified immediately.

		Post Closure I, Post Closure II	**Notification** • Project Manager • Geotechnical Engineer • Include in scheduled WUL reporting **Review** • Review previous inspection reports, existing instrumentation including piezometer, temperature, inclinometer, and survey data. **Evaluation** • Geotechnical Engineer to compare recent monitoring results against older results for additional evidence of instability. **Action** • Inspect the area for any signs of instability. • Increase monitoring and data review frequency until determined unnecessary: ○ If survey hub threshold exceeded, increase frequency as directed by the Engineer.

Specific Indicators	Specific Performance Thresholds	Stage	Specific Responses
			○ If pore water pressure threshold exceeded, increase frequency as directed by the Engineer. • Follow any additional recommendations of the Geotechnical Engineer. • If the results of the analysis indicates there is a stability concern, the mine inspector and Selkirk First Nation will be notified immediately.
	Specific Threshold 3 • Survey hub cumulative displacements greater than 500 mm. Or • Increase in pore water pressures such that Ru exceeds 0.4.	**Active Closure**	**Notification** • Mine Manager • Geotechnical Engineer • Include in scheduled WUL reporting **Review** • Review previous inspection reports, existing instrumentation including piezometer, temperature, inclinometer, and survey data. **Evaluation** • Geotechnical Engineer to compare recent monitoring results against older results for additional evidence of instability. **Action** • 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. • Increase monitoring and data review frequency until determined unnecessary: ○ If survey hub threshold exceeded, increase frequency as directed by the Engineer. ○ If pore water pressure threshold exceeded, increase frequency as directed by the Engineer. • Follow any additional recommendations of the Geotechnical Engineer. At a minimum, the Engineer will consider the need for: ○ An increase in the frequency of routine inspections and monitoring. ○ Additional inspection, instrumentation, monitoring, or analyses ○ Modifications to the waste placement/construction practices, including discontinuation of loading. • If the results of the analysis indicate there is a stability concern, the mine inspector and Selkirk First Nation will be notified immediately.
		Post Closure I, Post Closure II	**Notification** • Project Manager • Geotechnical Engineer • Include in annual report **Review** • Review previous inspection reports, existing instrumentation including piezometer, temperature, inclinometer, and survey data. **Evaluation** • Geotechnical Engineer to compare recent monitoring results against older results for additional evidence of instability. **Action** • 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. • Increase monitoring and data review frequency until determined unnecessary: ○ If survey hub threshold exceeded, increase frequency as directed by the Engineer. ○ If pore water pressure threshold exceeded, increase frequency as directed by the Engineer. • Follow any additional recommendations of the Geotechnical Engineer. At a minimum, the Engineer will consider the need for: ○ An increase in the frequency of routine inspections and monitoring. ○ Additional inspection, instrumentation, monitoring, or analyses ○ Modifications to the waste placement/construction practices, including discontinuation of loading. • If the results of the analysis indicate there is a stability concern, the mine inspector and Selkirk First Nation will be notified immediately.

2.5 General Reclamation Measures

2.5.1 Soil Cover Performance

2.5.1.1 Description

Soil covers are to be placed over the dry stacked tailings storage facility (DSTSF) and the waste rock storage facilities. Various waste rock storage facilities exist across the site including the Main Waste Dump (MWD), Main Waste Dump Expansion (MWDE), the Main Pit Dump (MPD), the Southwest Waste Dump (SWD), the High Grade Waste (HGW), the Area 118 Dump, and the Mill Valley Fill (MVF). An infiltration reduction soil cover is to be placed on these features either as part of the progressive reclamation program or during final closure activities. The cover on the HGW is to include a very low infiltration cover system incorporating a geosynthetic membrane. The primary cover functions are to:

- Minimize infiltration to the extent practical using locally available material;
- Ensure a stable landform that will promote establishment of natural vegetation endemic to the area; and
- Minimize ponding and surface erosion on the final landform.

The design criteria for the site is described in the Section 2.2 of the preliminary cover design report (SRK 2016). Design details specific to the DSTSF and each of the waste rock storage facilities are provided in Sections 5 thru 10 of the design report.

2.5.1.2 Risk Narrative

- Covers do not perform as designed resulting in unacceptable water quality conditions downstream of the site.
- Cover on a steeper slope becomes over saturated and slumps.

2.5.1.3 Specific Indicators, Performance Thresholds and Responses

Indicators, performance thresholds and responses specific to water management are provided below in Table 2-20. The monitoring results that are evaluated and utilized for this component of the AMP are a requirement of the Post-Closure Geotechnical Monitoring Program.

Table 2-20: Specific Indicators, Performance Thresholds and Responses for Cover Performance

Specific Indicators	Specific Performance Thresholds	Stage	Specific Responses

• Visual observations of physical damage
• Visual observation of ponding water
• Visual observation of surface erosion
	Specific Threshold 1
	• Observation of unusual occurrence including:
	  • settlement, or sloughing;
	  • abnormal seepage from any area of the slopes;
	  • increased turbidity from seepage;
	  • isolated pockets of vegetation stress;
	  • physical damage.
		All Stages	**Notification**
			• Mine/Project Manager
			• Geotechnical Engineer
			• Include in scheduled WUL reporting
			Review
			• Review previous inspection reports, existing instrumentation including piezometer, temperature, inclinometer, and survey data.
			Evaluation
			• Geotechnical Engineer to compare recent monitoring results against older results for additional evidence of instability.
			Action
			• Inspect the area for any other signs of instability.
			• Repair the cover to adhere to design specifications.
			• Follow any recommendations of the Geotechnical Engineer. At a minimum, the Engineer will consider the need for:
			  ○ An increase in the frequency of routine inspections and monitoring.
			  ○ Additional inspection, instrumentation, monitoring, or analyses.
			• If the results of the analysis indicates there is a stability concern, the mine inspector and Selkirk First Nation will be notified immediately.

	Specific Threshold 2 • Erosion of cover; • Large scale vegetation stress	**All Stages**	**Notification** • Mine Manager • Geotechnical Engineer • Include in scheduled WUL reporting **Review** • Review previous inspection reports, existing instrumentation including piezometer, temperature, inclinometer, and survey data. **Evaluation** • Geotechnical Engineer to compare recent monitoring results against older results for additional evidence of instability. **Action** • Inspect the area for any signs of instability. • Immediately increase monitoring and data review frequency as directed by the Engineer until determined unnecessary. • Follow recommendations of the Geotechnical Engineer to repair the cover. • If the results of the analysis indicate there is a stability concern, the mine inspector and Selkirk First Nation will be notified immediately.

2.5.2 Revegetation

The primary objective is the minimization of erosion (and corresponding sediment delivery) from sloped cover areas. Revegetation treatments at Minto are designed to achieve restoration and land-use objectives, while achieving the protection objective of maintaining surficial substrate stability and erosion control where necessary.

2.5.2.1 Risk Narrative

- Vegetation does not establish fast enough to prevent rill erosions on covers
- Deep rooted vegetation not established before a forest fire.

2.5.2.2 Specific Indicators, Performance Thresholds and Responses

Indicators, performance thresholds and responses specific to water management are provided below in Table 2-21. The monitoring results that are evaluated and utilized for this component of the AMP are a requirement of the Monitoring and Maintenance program of this RCP.

Table 2-21: Specific Indicators, Performance Thresholds and Responses for Vegetation Performance

Specific Indicators	Specific Performance Thresholds	Stage	Specific Responses
• Visual observations of failure of vegetation to establish • Visual observation of failure of native species to establish. • Visual observation of stressed vegetation.	**Specific Threshold 1** • Observation of isolated pockets of stressed vegetation.	**All Stages**	**Notification** • Mine/Project Manager • Include in scheduled WUL reporting **Review** • Review previous inspection reports. **Evaluation** • Compare recent monitoring results against older results for additional evidence of vegetation stress. • Evaluate cover integrity. **Action** • Follow any recommendations of a qualified professional to determine is a reapplication of seeds and fertilizer is required. • Repair covers as recommended by a Geotechnical Engineer
	Specific Threshold 2 • Large scale stressed vegetation. • Failure of vegetation to establish in erosion-control areas.	**All Stages**	**Notification** • Mine Manager • Geotechnical Engineer • Include in scheduled WUL reporting **Review** • Review previous inspection reports and precipitation data. **Evaluation** • Compare recent monitoring results against older results for additional evidence of vegetation stress. • E valuate cover integrity **Action** • Inspect the area for any signs of a source of contamination. • Immediately increase monitoring and data review frequency as directed by a qualified professional until determined unnecessary. • Follow recommendations of a qualified professional to restore vegetation to the area. • Repair covers as recommended by a Geotechnical Engineer. • If the results of the analysis indicate there is a stability concern, the mine inspector and Selkirk First Nation will be notified immediately.

3 Reporting and Review

Reporting and review represent an essential part of the Adaptive Management Framework, as described in section 1.3.2, 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 and will be continued throughout active closure but will reduce frequency to annually for PCI and PCII.

Annual reporting will include summaries of all activities carried out under the Closure 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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