

**NEW GOLD RAINY RIVER MINE  
APPENDIX N  
OMS MANUAL**

**RAINY RIVER PROJECT**

**PART I - GENERAL - OPERATION, MAINTENANCE AND  
SURVEILLANCE MANUAL WATER MANAGEMENT  
STRUCTURES**

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**Version 2020-1**

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## 1.0 INTRODUCTION

The Rainy River Mine (RRM) is located in the Rainy River District, in northwestern Ontario in Chapple Township, approximately 65 kilometers (km) northwest of Fort Frances and 420 km west of Thunder Bay. The mine includes an open pit mine, a mill, tailings management area (TMA), process water and water treatment structures. The project is currently in its third year of construction and first year of operations at the time of this Operation, Maintenance and Surveillance (OMS) manual update (to September 10, 2018).

This OMS Manual has been prepared by New Gold Inc. (NGI) for the Rainy River Mine (RRM). This document serves as a reference for the safe operation of the structures related to tailings, water management, and water diversion.

Because of the many facilities at the RRM, the OMS Manual has been separated into “Parts”, as listed below:

- Part 1: General – Tailings and Water Management Structures
- Part 2: Tailings Management Area (TMA)
- Part 3: Water Management Pond (WMP)
- Part 4: Mine Rock Pond (MRP)
- Part 5: Sediment Ponds
- Part 6: Freshwater Diversions
- Part 7: Water Treatment
- Part 8: Pinewood and Culverts
- Part 9: Emergency Preparedness Plan (EPP)

The OMS is a requirement of the Ministry of Natural Resources and Forestry (MNRF), Lakes Rivers Improvement Act (LRIA) approvals, and has been prepared in general accordance with the latest guidelines titled “Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities:” developed by the Mining Association of Canada (MAC, 2011).

New Gold is also committed to an integrated water management including water balance and water quality that applies to all mining activities undertaken and during the Rainy River Mine (RRM) operations and closure.

The goal of the OMS Manual is to provide specific guidance the operation to the Tailings, Water Management and Water Diversion dams. The objectives of this OMS are to define and describe the following:

- Roles and responsibilities of personnel assigned to the facility;
- The key components of the facility;
- Set out procedures required to operate, monitor the performance of, and maintain a facility to ensure that it functions in accordance to design, meets regulatory and corporate policy obligations, and links to emergency preparedness and response;

- Procedures and processes for managing change;
- Requirements for analysis and documentation of the performance of the facility;
- Serve as a training document for personnel that are new to the mine;
- Identify potentially unsafe conditions or indicators and provide links to emergency response procedures; and
- Satisfy the requirements of the Mining Association of Canada's (MAC) guidelines Towards Sustainable Mining (TSM) initiative.
- Meet regulatory requirements with regard to surface water quality management, monitoring and contaminant releases;
- optimize water resources on-site, to support the water balance in minimizing make up water requirements and to meet discharge criteria;
- define processes for the release of contaminants from approved discharge locations;
- define monitoring requirements to ensure any impacts are measured and potential pollution is minimized; and
- Identify contingencies for the release of contaminants in the event discharge criteria are not met.

The OMS Manual covers operations of the facility through the commissioning, operations, and closure phases of the Rainy River Mine. The tailings facilities include the equipment and operations beginning with the tailings discharge from the mine mill, pipelines, deposition equipment, tailings, water treatment and water management (seepage collection ponds) and water diversion. In addition, the OMS guides operators and staff on when to initiate the Emergency Preparedness Response Plan (EPRP).

This management plan also covers the management of surface water quality including monitoring and discharge. Groundwater is not part of the scope of this plan, except for seepage collection systems, as releases are to surface water, and monitoring for groundwater is through the groundwater monitoring plan. This plan is developed pursuant to conditions 3c and 3e of the operations ECA. Reference is made to the construction ECA discharges to allow for transition between project phases and part of the current discussions with the authorities is to merge both ECAs into one.

This document has been prepared primarily for use by the mine personnel who are responsible for the operation, maintenance and surveillance of the tailings facility. It contains information and instructions necessary to perform the above required activities. Comprehensive checklists and procedures for operation, maintenance and annual inspections are utilized by the RRM e.g., through the SAP work order system and are not reproduced herein.

Water and water quality is a significant and important resource to all Communities of Interest (COI). The RRM has a positive water balance and has been permitted to discharge, ultimately into the Pinewood River, which is a river that supports indigenous use, sport fishing and other water users. The receiving capacity of Pinewood River is variable and limited due to low summer and winter flows and high freshet and storm driven flows.

This plan has been developed as part of the site operation, maintenance and surveillance (OMS) manual and in fulfilment of Operations Environmental Compliance Approval (ECA) 5178-9TUPD9 condition 3(1)(e)&(c).

## 1.1 Regulatory Requirements and Guidelines

This document is consistent with the New Gold Tailings, Heap Leach and Waste Rock Facilities Management Policy and was prepared pursuant to the MAC guidelines for *Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities* (MAC, 2011).

There are a number of Federal and Provincial environmental approvals required to construct, operate, and eventually reclaim the mine. Key Provincial legislation related to the RRM includes the: *Ontario Water Resources Act, Environmental Protection Act, Endangered Species Act, Mining Act, Lakes and Rivers Improvement Act, Public Lands Act* and *Planning Act*. From the Federal perspective, the *Fisheries Act* and the associated Metal and Diamond Mining Effluent Regulation are the primary regulatory instruments related to the RRM.

The primary approval(s) for construction of the various hydraulic structures and associated water storage facilities are as follows:

- Work Permits from Ontario Ministry of Natural Resources and Forestry (MNR), under the *Lakes and Rivers Improvement Act (LRIA)*.
  - These permits approve the design of the dams and appurtenances, in accordance with the provided design drawings and report.
  - LRIA approvals are generally required for each annual dam raising campaign.
- Discharge of effluent (e.g. from the TMA) is governed by the Environmental Compliance Approvals (ECAs) for Industrial Sewage Works issued under the *Environmental Protection Act* by the Ontario Ministry of the Environment Conservation and Parks (MECP).
  - The ECAs dictate the quality and quantity of effluent allowed to be discharged to the environment as well as other measures intended to ensure the environment is protected; as well as the overall design of the facility.
- Permits to Take Water (PTTWs) issued under the *Ontario Water Resources Act* direct water takings associated with the Site, including dam foundation dewatering and water supply from the Pinewood River.
  - Where water takings (surface or groundwater) are required to support construction and operation, they are generally restricted by the PTTWs received from the MECP which limit the volume of water that can be taken from the environment.
- A Closure Plan has been filed with the Ministry of Energy Northern Development and Mines (ENDM) under the *Mining Act*, which describes the planned development and operation of the RRM, the proposed approach to closure of the RRM, and outlines the associated financial assurance related to closure aspects.

- This Closure Plan will be amended from time to time as required, such as any changes to the proposed operation of the TMA, or other changes to the RRM which are deemed to be material.
- The Closure Plan primarily focuses on the physical and chemical stability of the site post-closure or during a temporary shutdown scenario.
- Planning to date has assumed long term cover of the potentially acid generating (PAG) tailings to inhibit oxidation.

In addition to these and other regulatory approval requirements, a number of commitments were made regarding the RRM through the Federal and Provincial environmental assessment processes. These commitments were initially tabulated in Table 14-1 of the Rainy River Project, Final Environmental Assessment Report (AMEC, January 2014) and are maintained and tracked by the Environmental Department as the Rainy River Mine Commitments Registry. In particular, the Federal environmental assessment decision statement condition 3 states the following:

3.1 The Proponent shall minimize changes caused by the Designated Project to water levels and water flows in the Pinewood River, the Minor Creek System, and the Modified Minor Creek System in such a way as to protect fish and fish habitat, by implementing mitigation measures including, but not limited to;

- 3.1.1 recycling of water, for ore processing, from the tailings management area and ponds constructed for water management;
- 3.1.2 optimizing the timing, position and quantity of final effluent discharge between the final effluent discharge points;
- 3.1.3 filling the open pit during the decommissioning and abandonment phases in a manner which meets the flow requirements in the Pinewood River while allowing the pit to be filled as expeditiously as possible to reduce any adverse environmental effects; and
- 3.1.4 not taking water from the Pinewood River when flows are below the minimum threshold set by Ontario.

3.2 The Proponent shall, for all effluent, comply with the Metal Mining Effluent Regulations, the Fisheries Act and any site-specific water quality requirements set by Ontario. To ensure compliance, the Proponent shall implement, at a minimum, the following mitigation measures:

- 3.2.1 treat effluent prior to discharge to the environment;
- 3.2.2 treat tailings slurry to break down cyanide and precipitate heavy metals;
- 3.2.3 collect site contact water and seepage in ditches and divert to either the tailings management area or water management facilities for release via final discharge points;
- 3.2.4 install and operate a water quality control structure in the constructed wetland to prevent the release of final effluent discharge not compliant with the Regulations or requirements;

The Proponent shall control acid rock drainage and metal leaching so that all effluent and passive outflow from the Project Site comply with the Metal and Diamond Mining Effluent Regulations, any site-specific water quality requirements set by Ontario, and the Fisheries Act, as applicable at any time. To ensure compliance, the Proponent shall implement, at a minimum, the following mitigation measures:



- 3.3.1 line the former Clark Creek channel (under the east mine rock stockpile) with non potentially acid generating material;
- 3.3.2 sort waste rock into potentially acid generating and non-potentially acid generating rock stockpiles through the development and implementation of a detailed mine rock segregation program using criteria for determining potentially acid generating material set by Ontario;
- 3.3.3 design and construct the perimeter ditching around the east mine rock stockpile and low grade ore stockpile to accommodate a 100-year flood event;
- 3.3.4 use potentially acid generating material only for the purpose of constructing the tailing management dam, where saturated conditions can be maintained. Potentially acid generating material must not be used for any other construction purpose;

The following Provincial environmental assessment approval and conditions of approval are also of note, including

- Collectively and individually, the processes and water management strategies proposed for the RRP are Best Management Practices and/or Best Available Technology Economically Achievable (BATEA), and NG has committed to the use of such processes and water management strategies in the Final EA Report
- Treatment of the tailings slurry to levels equal to or less than 1 mg/L weak acid dissociable cyanide before deposition in the tailings management area (which is well below the 50 mg/L weak acid dissociable cyanide threshold criteria outlined by the International Cyanide Management Code);
- Using in-plant SO<sub>2</sub>/Air treatment for cyanide destruction and heavy metal precipitation to optimize the quality of groundwater seepage associated with the tailings management area during operations and following mine closure;
- Managing the site for ARD control, both during operations and following closure to prevent adverse water quality impacts to the Pinewood River, including that associated with any groundwater seepage;
- All final discharge points will have a point of control to immediately cease discharge. A control structure will be constructed at the discharge points to be in compliance with MDMER.
- Runoff and seepage from the TMA and stockpiles will be captured, monitored, and either released to the environment if applicable criteria are met and/or re-used in the process plant during operations.
- Open pit dewatering water will be contained and if necessary, treated before it is discharged to the environment.

Where pertinent to the operation of tailings and water management and water diversions, specific regulatory approvals have been included in this manual (Table 1-1). However, the full list of regulatory conditions has not been reproduced herein and should be reviewed, where required, including when changes to the OMS of the facilities are considered. The full list of regulations, permits and approvals associated with this OMS are available through the site environmental team who should be contacted for the most current environmental approval and regulatory requirements.

**Table 1-1 Summary of Permits and Approvals Relating to the OMS**

Legislation	Permit	OMS Component	Influence
Environmental Protection Act	Environmental Compliance Approval #0412-A2LR4V (Air)	TMA	Limits and requirements related to emissions and discharges related to air.
	Environmental Compliance Approval #5178-9TUPD9 (Industrial Sewage)	TMA, process water management and water treatment	Limits and requirements related to emissions and discharges to the environment.
Ontario Water Resources Act and O.Reg 387/04	PTTW number 8776-9W2QN3	WMP/Pinewood River	Defines water taking limits and defines reporting and monitoring requirement
	Permit to Take Water – Surface and Groundwater PTTW 0040-9VUL6B and PTTW 7430-AYEN78 TMA Infrastructure	TMA and process water management	Defines water taking limits and defines reporting and monitoring requirement
	Permit to Take Water – Surface and Groundwater PTTW 2133-9VUPVZ and PTTW 8101-AY8HT5 Construction Phase	Fresh Water Diversions and Water Treatment	Defines water taking limits and defines reporting and monitoring requirement
Lakes Rivers Improvement Act	FF-2015-02B (as amended) West Creek Diversion and Dam	Freshwater Diversions	Management, protection, preservation and use of waters and lakes. Ensure that dams are suitably located, constructed, operated and maintained.
	FF-2015-03B Clark Creek Diversion (as amended)	Freshwater Diversions	
	FF-2015-04 Tailings Management Area	TMA, Process Water Management and Water Treatment	
	FF-2015-04A (as amended March 6, 2017) Water Management 4 and 5	Process Water Management	
	FF-2015-04B (as amended March 6, 2017) Water Management Ponds 1, 2 and 3	Process Water Management	
	FF-2015-04C Tailings Management Area (Start-Up Arrangement), Haul Road 13 and TMA Start-Up Cell	Tailings Management Area	

Legislation	Permit	OMS Component	Influence
	FF-2015-05A (as amended) Mine Rock Pond	Process Water Management	
	FF-2015-07 Pinewood River Intake/Discharge Structure	Process Water/Water Treatment	Management, protection, preservation and use of waters and lakes.
	FF-2017-03 Tailings Management Area Cell 2	Tailings Management Area	Management, protection, preservation and use of waters and lakes. Ensure that dams are suitably located, constructed, operated and maintained.
Endangered Species Act	ESA Permit FF-C-001-14	All	Defines project boundaries, disturbance limits including noise and dust and reclamation
Fisheries Act	Authorization 15-HCAA- 00039	Freshwater diversions	West, Clark, Teeple, Stockpile dams and diversions
	Metal Mining Effluent Regulation (MMER) discharge notification	TMA, WMP Water Treatment and seepage	Standards/limits for quality of effluent discharged into waters frequented by fish.
Ontario Environmental Assessment Act	Provincial EA Approval Conditions	All	Conditions subject to the Approval to proceed with the planning, design, construction, operation and closure of a combination open pit and underground gold mine.
Federal Canadian Environmental Assessment Act 2012	Federal EA Approval Conditions	All	Conditions in relation to the environmental effects referred to in subsection 5(1) of CEAA 2012, with which the Proponent must comply.
Environmental Assessment (EA) Act	Environmental Assessment (EA) Commitments	All	Commitments identified in the final Environmental Assessment (EA) Report, in accordance with the Federal Environmental Impact Statement (EIS) Guidelines and Provincially approved Amended Terms of Reference (ToR).

## 1.2 Review and Update

The accountability for review and updates of the OMS Manual is with the Mill Manager (who will designate responsibility for the review) as well as the General Manager who has final site authority.

Updates to the OMS manual are required to incorporate change as facilities are constructed or change in facility design, performance, capacity, operations/closure requirements, site

management, roles and responsibilities, regulations or procedures. When updated the OMS manual will be reviewed by the Environmental Department, Engineer of Record (EOR) and annually, as part of review by the Independent Tailings Review Board (ITRB) or at their request.

The OMS will be updated prior to operating new structures. The OMS manual will be reviewed, at minimum, on an annual basis. The OMS manual will be submitted to MNRF as defined by permit conditions as part of annual updates.

Previous revisions and future proposed revisions are outlined in the revision history presented below (Table 1-2). Comments from the MNRF and ITRB are included in Appendix G. This revision history will be updated for each revision – this revision is current to August 15, 2017.

**Table 1-2 OMS Revision History**

Revision	Addition	Details	Date
<i>Pre-Production OMS Manual (3098004-000000-A1-EMA-0001):</i>			
AG	Revised Final for Pre-Production	Updated dam design criteria, instrumentation details – submitted for MNRF review and comment	August 31, 2016
AH	Revised Final for Pre-Production	Updated in response to MNRF comments – see appendix G	October 5, 2016
AI	Revised Final for Pre-Production	Removed reference to WMP filling plan	November 10, 2016
AJ	Final with West Creek Diversion updates	Required by MNRF in West Creek Diversion LRIA approval	March 31, 2017
00	For Use	WMP Filling, Clark Creek Diversion (MNRF approval April 28, 2017)	May 1, 2017
01	For Use	Updated for WMP filling above 364.7	July 2017
<i>OMS Manual for Operations (3098004-000000-A1-EMA-0002):</i>			
AC	Final draft	Including TMA Start-up Cell details submitted to MNRF	March 31, 2017
<b>OMS Manual – Current revisions</b>			
2017-08	Updated based on ITRB comments and MNRF conditions for MRP and Cell 2 and 3	ITRB comments (Appendix G) responses <ul style="list-style-type: none"> <li>• Updated sections to current project status and current to Aug 15, 2017</li> <li>• Contact list updated (s2.3)</li> <li>• Revised geology section re plastic clay tills (s3.3)</li> <li>• Included trigger levels for instrumentation and defined</li> </ul>	August 2017

Revision	Addition	Details	Date
		thresholds for event driven surveillance (Table 7.3) <ul style="list-style-type: none"> <li>States responsibility for OMS updates (s1.2 and s2.2)</li> <li>Reworded reference to MNRFS screening but submission for comment (s1.2)</li> </ul> MNRFS requirements consistent with LRIA permit conditions <ul style="list-style-type: none"> <li>Mine Rock Pond (s4.3.2 and s5.3.2)</li> <li>Cell 2 (s4.2.2. and s5.1.2)</li> <li>Cell 3 (s4.2.3 and s5.1.2)</li> </ul>	
2018-03	TMA Cell 2 completion	Including updated OMS prior to the commissioning of TMA Cell 2  Update to include the Contaminant Release, Surface Water Quality and Monitoring Plan as per MECP ECA requirements  Including as built drawings for the WMP, MRP, TMA Cell 1 and 2 and WCD consistent with LRIA permit conditions  Including a responsibility matrix, as per ITRB's recommendation	October 2018
<i>Future Planned Updates – excludes updates required as a result of unplanned changes</i>			
TBD	Water Discharge Pond and Constructed Wetland	Update OMS prior to the commissioning of these facilities	November 30, 2018 or as determined by LRIA conditions of approval
TBD	Sediment Ponds 1 and 2	Update OMS prior to the commissioning of these facilities	
TBD	Annual update 2018	Annual review and update e.g., include ITRB comments	November 2018

### 1.3 Supporting Documents

The OMS manual and supporting documents will be stored in a location accessible to those required to follow the manual i.e., RRM sharepoint site. The list of supporting documents (Table 1-3) isn't an exhaustive list and permit approvals are based on applications and supplemental information which need to be followed (see list of regulatory permits and approvals Table 1-2).

The following documents and procedures are relevant to the geotechnical site investigations, design, construction, and operation of the TMA, process water ponds, and freshwater diversion dams and channels are listed below (Table 1-3). However, additional information is provided in the facility description section of this manual (see section 4). A list of supporting drawings is provided in Appendix A. Additional details regarding pumping requirements, tailings pumping and

pipeline designs and water recirculation pumping and pipeline designs are provided in Appendix B.

Safety requirements for work at the RRM and apply to work associated with the OMS are documented on the RRM health and safety sharepoint site and include;

- Hazard Identification and Risk Management;
- Document Records and Development Control;
- Training and Competency Awareness;
- Incident Management;
- Job Hazard Analysis; and
- Emergency Preparedness and Response Plan (EPRP) for the Site (New Gold, 2017).

**Table 1-3 Supporting Documents**

Document Number				Document Title
RRP	GEO	MEM	001	ITRB Recommendations and Implications
RRP	GEO	MEM	002	Dam Change Effect on Constraint in Northwest
RRP	GEO	MEM	004	Supplemental Information West Creek Diversion Amendment
RRP	GEO	MEM	006	Design Criteria for TMA Dams
RRP	GEO	MEM	011	WMP Fill Plan Memo
RRP	GEO	MEM	012	West Creek Diversion Channel - Overflow Diversion Structure
RRP	GEO	MEM	013	Clark Diversion Channel - As Built Hydraulic Assessment
RRP	GEO	MEM	17A	WMP Borrow Filling (Formally WMP Level 1 Filling)
RRP	GEO	MEM	019	LRIA: Mine Rock Pond Amendment
RRP	GEO	MEM	020	WMP Borrow Filling - Supplemental Information
RRP	GEO	MEM	021	West Creek Diversion Amendment Box Culvert
RRP	GEO	MEM	025	Dam 1 Work Authorization
RRP	GEO	MEM	026	WMP Dam 1 - Geotech Investigation and Stability Analysis
RRP	GEO	MEM	030	TMA South Dam - Haul Road 13 Construction
RRP	GEO	MEM	033	Teeple Dam IDF Stability
RRP	GEO	MEM	034	West Creek Diversion Channel - Sequencing of Sediment Pond 1 Dams
RRP	GEO	MEM	037	Water Management Pond Water Intake Structure
RRP	GEO	MEM	039	Clark Creek Plans and Specifications Comments & Responses
RRP	GEO	MEM	043	TMA LRIA - TMA Start Up Cell Seepage Collection - Supplemental Information
RRP	GEO	MEM	056	Teeple Permanent Repair - Supplemental Information
RRP	GEO	MEM	063	Seismic Stability Assessment of TMA Dams
RRP	GEO	MEM	065	Permanent Seepage Collection Drawings Comments & Responses
RRP	GEO	MEM	071	Teeple Pond Diversion Channel Completion
RRP	GEO	MEM	074	Clark Pond Diversion Channel Completion
RRP	GEO	MEM	076	Addendum to WMP Dams 1,2,3 and Dam 4 and 5
RRP	GEO	MEM	080	Stockpile Pond Diversion Channel Completion
RRP	GEO	MEM	088	Clark Creek Dam Completion
RRP	GEO	MEM	089	Teeple Road Dam Completion

RRP	GEO	MEM	100	MNRF QAQC Information Request
RRP	GEO	MEM	104	Seismic Stability Assessment of MRP Dam
RRP	GEO	MEM	106	Seismic Stability Assessment of MRP Dam - ITRB Responses
RRP	GEO	MEM	108	TMA Cell 2 - Design Criteria
RRP	GEO	MEM	114	Appendix A of RRP-GEO-REP-026
RRP	GEO	MEM	115	Appendix B of RRP-GEO-REP-026
RRP	GEO	MEM	116	TMA Cell 2 - Sump Sizing
RRP	GEO	MEM	119	Stockpile Dam Completion
RRP	GEO	MEM	130	Sediment Pond Spillway Details
RRP	GEO	MEM	134A	West Creek Diversion Channel - As-built Review
RRP	GEO	MEM	134B	West Creek Diversion Channel - As-built Review
RRP	GEO	MEM	138	West Creek Dam Compliance
RRP	GEO	MEM	141	WMP Dams Final Stage Design Compliance
RRP	GEO	MEM	143	Cell 1 Borrow Deposition
RRP	GEO	MEM	144	TMA Cell 1 - Pre-Commissioning
RRP	GEO	REP	001	TMA geotechnical investigations
RRP	GEO	REP	1A	Geotechnical Investigations Report, Tailings Management Area, Volume 1 – Design Implications – Version 3
RRP	GEO	REP	1B	Geotechnical Investigations Report, Tailings Management Area, Volume 2 – Investigation and Interpretations
RRP	GEO	REP	003	West Creek Pond Dam - Design Revision and Operating Guidelines
RRP	GEO	REP	004	Stockpile Pond Dam Design Revision
RRP	GEO	REP	006	Design Update - Clark Creek Dams
RRP	GEO	REP	007	MRP Dam Design Revision Report
RRP	GEO	REP	008	Design brief TMA start up cell
RRP	GEO	REP	017	Instrumentation Plan Water Dams
RRP	GEO	REP	018	WMP Filling Plan - To Elevation 367m
RRP	GEO	REP	022	WMP Dewatering Plan
RRP	GEO	REP	024	2016 Dam Instrumentation
RRP	GEO	REP	026	TMA Cell 2 Design Brief
RRP	GEO	REP	027	Clark Diversion As-built Report
			3098004-004000-A1-ETR-0004-00	2013/2014 Geotechnical Site Investigations Report
			3098004-004400-A1-ETR-0003-00	Water Management Plan for Operations
			3098004-004400-A1-ETR-0004-00	Design Brief – Water Management Dams
			3098004-004000-A1-ETR-0012-00	Dam Instrumentation During Construction
			3098004-001100-A1-ETR-0001-00	Mine Waste Management Plan
			3098004-004400-A1-ETR-0002-00	Water Management Plan for Construction
			3098004-004000-A1-ETR-0005-AB	Tailings Deposition Plan
				Fish Habitat Offset Strategy
			3098004-004000-A1-ETR-0006-00	Design Brief – Tailings Management Dams
			3098400-004000-A1-ETR-0004-00	2013-2014 Geotechnical Field Investigations



## **1.4 Document and Records Control**

Records from shift and periodic (daily, weekly and annual) TMA and water management system inspections will be retained in a secure repository as per the requirements of the site document control system. Once documents are printed, they are uncontrolled. Document Control follows the New Gold RRM document control procedures.

All records relating this OMS manual shall be retained for a minimum period of 25 years or until decommissioning ends, whichever is longer, as per regulatory requirements in the Federal CEEA Decision Statement. This includes place, date, time of sampling, dates and types of analysis performed, analytical techniques, methods or procedures, results of analysis and the names of persons who collected, analysed each sample and documentation of their training. All records and documents shall be retained at a facility close to the RRM.

## **2.0 ROLES AND RESPONSIBILITIES**

This section identifies the individuals having responsibility for the operation, maintenance and surveillance of the tailings, process water and freshwater dams and diversion channels. Though the accountability of tailings and water management lies with the General Manager, the Mill Manager is responsible for the operation of the tailings and water management at the RRM. The Environmental Department provides environmental technical support, including monitoring, land and water management and environmental contact with regulatory agencies.

### **2.1 Definitions**

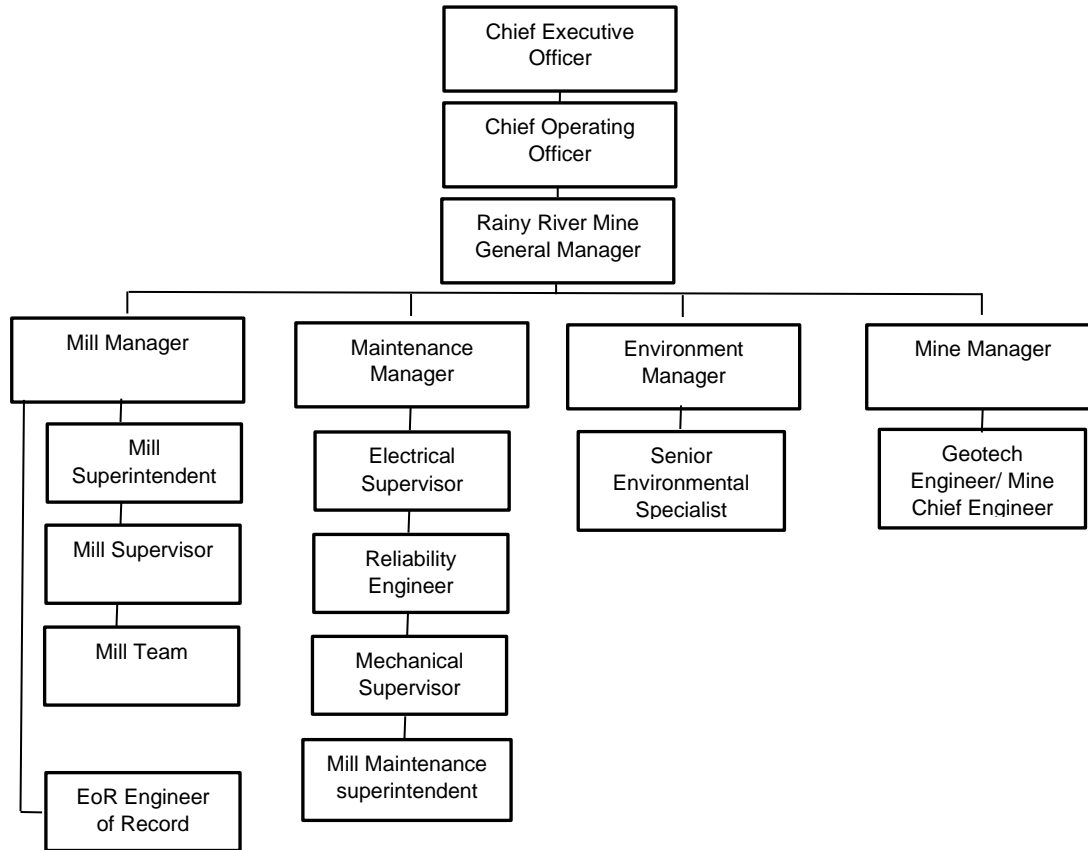
- **Surface Water**  
A collection of water above ground in the form of a lake, wetland, stream, river or impounded by a constructed structure e.g., dam, sump etc.
- **Process Water**  
Water that has been reclaimed from the TMA/WMP/MRP for use in the Mill or dust suppression
- **Mine Water**  
Water that has been pumped from the open pit or underground as part of the dewatering process
- **Communities of Interest (COI)**  
Communities that have an interest in the workings at New Afton site. Includes all stakeholders and First Nations partners.

### **2.2 Organizational Structure**

The organizational structure for the RRM, relative to the OMS, is illustrated in Figure 2-1. The RRM/New Gold personnel and contact information associated with the positions referenced within each organizational flow chart can be found in Table 2-1. The organization chart is representative of the organization of persons related to the OMS following the construction and hand over of facilities. Prior to the handover of facilities, the EOR reports through the construction management team, for those facilities under construction.



**Figure 2-1 Organisation Chart For Tailings and Water Management**



### 2.3 Roles and Responsibilities

#### Executive Vice President / Chief Operating Officer:

- Is formally responsible for all of New Gold’s operations; and
- Has responsibility for corporate “*Tailings, Heap-leach and Waste Rock Facilities Management Policy*”. (included in Appendix C)

#### General Manager:

- Has accountability for tailings management;
- Provide support for the implementation of this plan
- Ensure resources are available for the management of water quality and effluent release
- Shall ensure that all TMA, process water and freshwater structures meet Canadian Dam Association, Dam Safety Guidelines;

**Mill Manager:**

- Has responsibility for the tailings management facility and ancillary process water management structures, and water diversion structures including operation, maintenance and surveillance;
- Accountable for ensuring maintenance of the OMS Manual and conformance to the Mining Association of Canada's "Guide to Developing Operation, Maintenance and Surveillance for Tailings and Water Management Facilities";
- Ensures that manuals for the tailings and water management systems are reviewed annually, including an assessment of the effectiveness of the established system and performance against objectives, and updated as required;
- Ensures that the tailings handling and disposal operation is staffed by trained and competent persons;
- Integrates guidance from the Environment Department under the requirements of regulatory approvals and the Environmental Management System (EMS) where applicable to tailings management;
- Shall submit an annual dam safety inspection report for all dams (TMA area and others) to MECP/MNRF where required; and
- Report any potential facility design changes that could affect the facility's integrity.
- Coordination of activities with the EOR during operations; and
- Has emergency management and response roles.

**Maintenance Manager:**

- Has primary responsibility for the maintenance work and maintenance management systems including dams and water management structures; and
- Ensures records of maintenance inspections for the dams and water management structures and related activities are accurately and permanently recorded and provided to the Geotechnical Engineer and the Engineer of Record (EOR).

**Reliability Engineer, Mechanical Superintendent and Electrical Supervisors:**

- Oversees planning and execution of equipment maintenance through the work order system;
- Arranges/conducts maintenance for equipment e.g., calibration and maintains instrumentation calibration records; and
- Identifies issues and corrective actions to prevent incidents.

**Chief Mine Engineer / Geotechnical Engineer:**

- Manages dam design, construction and contracts;
- Design works and review construction to confirm permit requirements for the works are built as required
- Completing quarterly and annual inspections on TMA, process water and freshwater dams, diversion channels;

- Ensuring monitoring activities are undertaken as per schedule;
- Responding to concerns raised by operations personnel;
- Maintaining a dam raise schedule;
- Review spigotting and dam construction schedules;
- Construction oversight for major dam raise projects;
- Ensure that the OMS Manual is updated appropriately, as assigned by the Mill Manager; and
- Coordinating and managing survey.

**Mill Superintendent:**

- Responsible for ensuring daily, monthly and as-required reports with respect to all aspects of the operation, maintenance and surveillance of the tailings facilities are prepared, including all records of inspection and monitoring;
- Ensures that a system exists to implement the OMS manual procedures and requirements and the system is subjected to regular review and effectiveness checks;
- Participates in the review cycle for the OMS manual; and
- Undertakes any modifications as required to maintain a safe and effective tailings operation including adjustments to deposition plans, equipment and facilities.

**Mill Supervisor:**

- Responsible for the day-to-day operation, maintenance and surveillance of the tailings distribution system and related works including buildings, equipment, pipes, pumps, and dams;
- Verifies work order completion;
- Identifies new and revised maintenance requirements; and
- Performs visual inspection surveillance of tailings facilities including dams, pipelines, decants and other operations.

**Mill Team:**

- Responsible for operating, inspecting and maintaining dams and water pump houses;
- Responsible for security inspections during the shift, via work requests;
- Perform inspections, monitoring, audits and assessments including but not limited to;
  - Visual inspection (dams, water, spillways and pipelines);
  - Water levels;
  - Freeboard; and
  - Instrumentation.
- Ensures adequate maintenance, via work requests, of access roads, diversion ditches, emergency spill catchment areas and the reclaim water system; and

- Adjusting spigotting as directed by the supervisor.

**Engineer of Record (EOR):**

- Verifies the TMA and water diversion structures are constructed and operated as per the design intent;
- Performs Annual Dam Safety Inspections as per regulatory requirements; and
- Provides support for safe operation of the TMA and water diversion structures.

**Environmental Manager:**

- Support the Operation, Maintenance and Surveillance activities;
- Maintain contact and communication with regulatory agencies;
- Assist with environment related technical support such as inspection and evaluation of stability by an external expert;
- Ensure regulatory and other sampling, monitoring, and analyses programs are conducted as required and all analytical results and/or reports are reviewed and reported to the appropriate internal and external stakeholders;
- Ensure rehabilitation and stabilization programs are conducted for tailings in conjunction with closure plan requirements;
- Prepare Annual Reports to regulatory agencies; and
- Administer and track compliance against Permits.

**Environmental Team:**

- Conduct sampling requirements to ensure compliance and monitor against baseline and guideline data;
- Ensure employees, contractors and managers are aware of their requirements under water management;
- Monitor conformance with relevant permits for the OMS manual requirements;
- Integrate tailings operations activities into the EMS;
- Identify and assess applicable tailings related regulatory requirements including permits, licenses, authorizations;
- Support tailings/geotechnical engineering and operations in meeting permit requirements; and
- Provides environmental support to the mill area activities and parties including but not limited to: construction, earth moving, erosion and dust control and water discharges.

**Document Control**

- Provide for the communication of information and storage of records

## 2.4 Contact Information

The RRM contact information, for the positions listed in Sections 2.1 and 2.2, can be found in Table 2-1.

**Table 2-1 RRM Contact Information**

Position	Name	Phone Number	Mobile	Email
President CEO	Renaud Adams	(416) 324-6002	(416) 303-1511	<a href="mailto:Renaud.adams@newgold.com">Renaud.adams@newgold.com</a>
Executive Vice President	Robert J. Chausse	(416) 324-6001	(416) 316-5211	<a href="mailto:Rob.Chausse@newgold.com">Rob.Chausse@newgold.com</a>
Director HSE	Claude McKenzie	(807) 482-0954	(807) 708-3203	<a href="mailto:Claude.McKenzie@newgold.com">Claude.McKenzie@newgold.com</a>
General Manager	Eric Vinet	(416) 645-7283	(416) 881-7405	<a href="mailto:Eric.Vinet@newgold.com">Eric.Vinet@newgold.com</a>
Mine Manager	Darrol VanDeventer	(807) 482-0900	(807) 708-7488	<a href="mailto:Darrol.VanDeventer@newgold.com">Darrol.VanDeventer@newgold.com</a>
Mill Manager	Tyler Buckingham	(807) 482 0900	(807) 707-7241	<a href="mailto:Tyler.Buckingham@newgold.com">Tyler.Buckingham@newgold.com</a>
Environmental Manager	Sylvie St. Jean	(807) 482-0900	(807) 707-3497	<a href="mailto:Sylvie.St.Jean@newgold.com">Sylvie.St.Jean@newgold.com</a>
Maintenance Manager	Tony Lord	(807) 482-0900	(647) 456-8475	<a href="mailto:Tony.Lord@newgold.com">Tony.Lord@newgold.com</a>
Mill Superintendent	Todd Durand	(807) 482-0900	(807) 708-8408	<a href="mailto:Todd.Durand@newgold.com">Todd.Durand@newgold.com</a>
Mill Shift Supervisor	David O'Brien	(807) 482-0900		-
Mill Shift Supervisor	Ron Langdon	(807) 482-0900		<a href="mailto:Ron.Langdon@newgold.com">Ron.Langdon@newgold.com</a>
Mill Shift Supervisor	Gilbert Tougas	(807) 482-0900		<a href="mailto:Gilbert.Tougas@newgold.com">Gilbert.Tougas@newgold.com</a>
Mill Shift Supervisor	Robert Manns	(807) 482-0900		-
Mill Maintenance Supervisor	Don Ibey	(807) 482-0900		<a href="mailto:Don.Ibey@newgold.com">Don.Ibey@newgold.com</a>
Maintenance Mechanical Supervisor	Derek Nelson	(807) 482-0900		<a href="mailto:Derek.Nelson@newgold.com">Derek.Nelson@newgold.com</a>
Maintenance Mechanical Supervisor	Mitch Lemaire	(807) 482-0900		-
Maintenance Electrical Supervisor	Lewis Kempf	(807) 482-0900		<a href="mailto:Lewis.Kempf@newgold.com">Lewis.Kempf@newgold.com</a>
Maintenance Electrical Supervisor	Bill Cole	(807) 482-0900		<a href="mailto:Bill.Cole@newgold.com">Bill.Cole@newgold.com</a>
Reliability Engineer - Maintenance	Ian Strain	(807) 482-0919	(807) 707-1060	<a href="mailto:Ian.Strain@newgold.com">Ian.Strain@newgold.com</a>
Tailings Dam Engineer	Patrick Green	(807) 482-0900		<a href="mailto:Patrick.Green@newgold.com">Patrick.Green@newgold.com</a>
New Gold Environment On Call		(807) 632-6152		<a href="mailto:rainyriver.enviro@newgold.com">rainyriver.enviro@newgold.com</a>
Ministry of Natural Resources and Forestry – MNRF	Andrew Bromley	(807) 475-1368		<a href="mailto:Andrew.Bromley@ontario.ca">Andrew.Bromley@ontario.ca</a>
Ministry of Environment Conservation and Parks	Matt Hoffmeister	(807) 468-2703		<a href="mailto:Matt.Hoffmeister@ontario.ca">Matt.Hoffmeister@ontario.ca</a>
Spills Action Centre (SAC)		(800) 268-6060		-
Ministry of Energy Northern Development and Mines	Neal Bennett	(807) 475-1123		<a href="mailto:Neal.Bennett@ontario.ca">Neal.Bennett@ontario.ca</a>
Environmental Canada and Climate Change	Gordon Moore	(613) 990-9744		<a href="mailto:Adam.Scheepers@canada.ca">Adam.Scheepers@canada.ca</a>
Engineer of Record	Andre Zerwer	(705) 222-3192		<a href="mailto:AZerwer@bgcengineering.ca">AZerwer@bgcengineering.ca</a>

## 2.5 Competency and Training

Training and education will be provided to employees to enhance their performance and RRM will ensure that all personnel receive the level of training to ensure they are competent. Tailings specific training is essential in ensuring safe and effective operation of the TMA as well as correct construction. The RRM in conjunction with the Engineer of Record will provide training programs or opportunities as required and job related training covering aspects related to requirements for the specific types of equipment and operational requirements.

Table 2-1 demonstrates the training that will be provided at a minimum, to support operation of the tailings water, process water, water treatment and freshwater management structures as required.

**Table 2-1 OMS Manual Training Matrix**

<b>Training</b>	<b>TMA contractor</b>	<b>Mill Crews and Supervisor</b>	<b>Mill Supt.</b>	<b>Geotech. Engineer</b>	<b>Enviro Dept.</b>	<b>Mgmt. Team</b>
Site Orientation	X	x	x	x	x	x
Daily Inspection		x				
Quarterly Inspection			x	x	x	
OMS / General Tailings & Ponds	X	x	x	x	x	
EPRP training	X	x	x	x	x	x
Construction method of TMA raises	X			x		
Towards Sustainable Mining			x	x	x	x
Instrument Data Collection		x		x	x	

### 3.0 SITE CONDITIONS

#### 3.1 Site Location and Tenure

The site is located in the Township of Chapple, approximately 65 kilometers (km) by road northwest of Fort Frances, in northwestern Ontario. New Gold has 100% interest in the lands forming the RRM through direct ownership or option agreement, however surface rights are not owned throughout the site boundary.

The RRM is located with lands used by Indigenous Groups for traditional and ceremonial purposes including but not limited to the following groups; Rainy River First Nations, Naicatchewenin First Nation, Big Grassy River First Nation, Naotkamegwanning (Whitefish Bay) First Nation, Anishinaabeg of Naongashiing (Big Island) First Nation, Ojibways of Onigaming First Nation, and the Sunset Country Métis community (represented by Métis Nation of Ontario Region 1 Consultation Committee). New Gold has regulatory requirements and/or biparty agreements to engage with these communities.

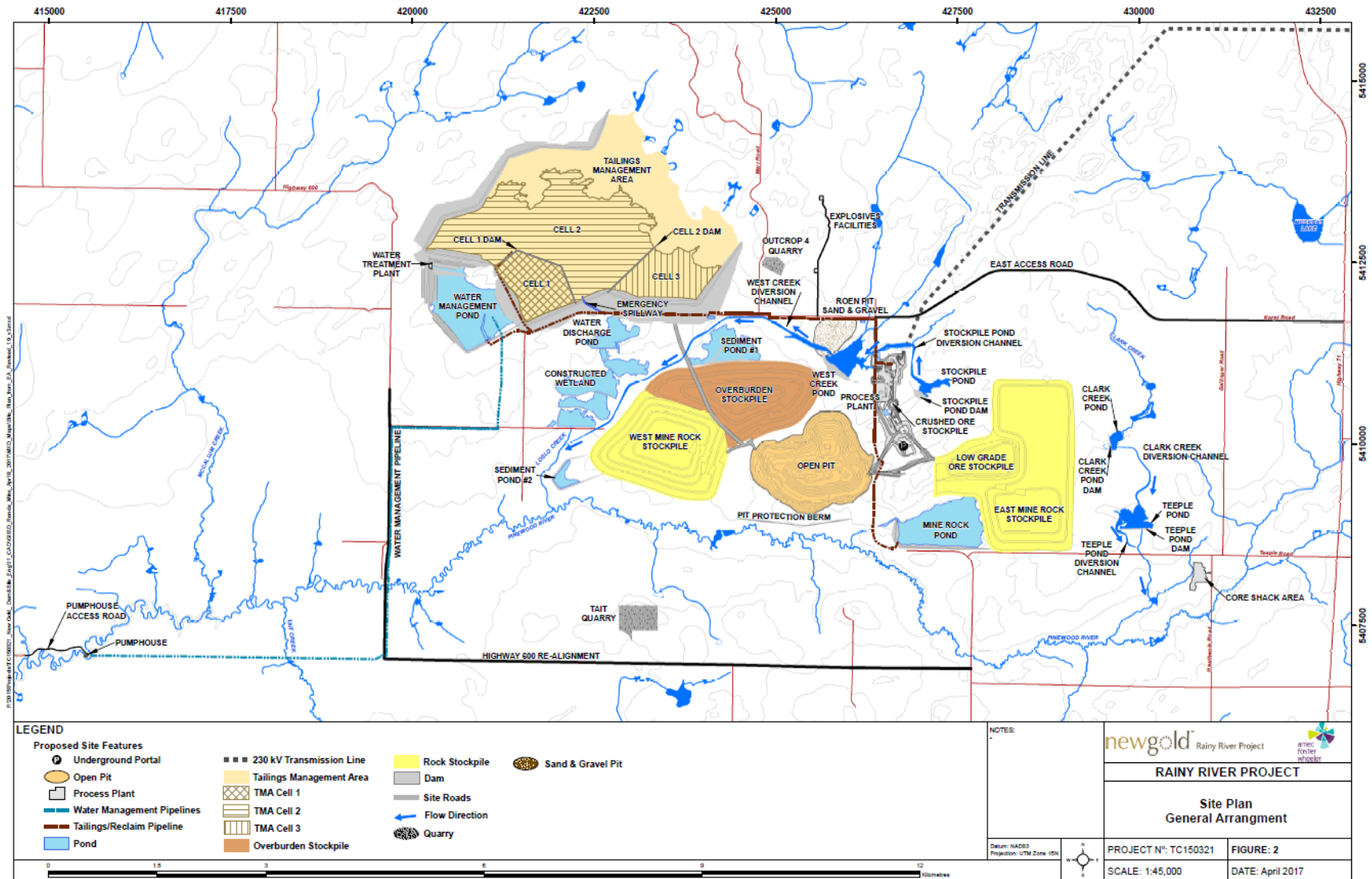
Road access to the site is by provincial Highways 600 and 71 and Korpi Road (east access road). A site location map is provided in Figure 3-1. The mine is serviced by local municipal infrastructure and is in close proximity to Fort Frances, Ontario for support and supply.

The site topography is variable with elevations ranging from 350 m to 390 m. The terrain is comprised of both forested and non-forested areas, including agricultural and wetland areas. The local drainage systems are characterized by numerous small creeks that drain into the Pinewood River. The small creeks typically originate from rocky uplands or headwater wetland systems.

The forested areas are dominated by mixed poplar and black spruce forests. Wetlands are comprised mainly of treed and open fens, together with wetland thickets and marsh areas.



Figure 3-1 Rainy River Mine Site Plan General Arrangement





### 3.2 Climate

Weather at the site is seasonal with cold winters with freezing conditions from November until March. The site receives ~700 mm of precipitation in an average year and the pond evaporation is estimated to be ~540 mm (Table 3-1). An estimated evapotranspiration of 500 mm is inferred by the difference between precipitation and runoff in the Pinewood River.

**Table 3-1; Mean Annual and 1:20 year Precipitation and Evaporation**

Barwick - 1981 to 2010 Canadian Climate Normals station data													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Average (°C)	-15	-11.6	-4.4	4.4	11.4	16.4	19	17.9	12.6	5.5	-3.4	-11.8	3.4
Rainfall (mm)	0.2	3	11	30.4	75.1	124.7	102.9	78.8	75.5	51.3	13.6	2.1	568
Snowfall (cm)	29.5	18.3	18.8	8.9	1.1	0	0	0	0.8	7.5	28.3	28.6	142
Precipitation (mm)	29.8	21.3	29.8	39.2	76.2	124.7	102.9	78.8	76.2	58.8	41.8	30.7	710
Pond Evaporation													
Pond Evaporation (mm)	0	0	0	0	109	110	129	104	63	23	0	0	538
Barwick 2018 station data													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug*	Sep	Oct	Nov	Dec	Year
Daily Average (°C)	-14.2	-15.7	-3.8	0.2	13.9	18.1	20.1	18.6					
Difference (°C)	1.1	-4.1	0.6	-4.2	2.5	1.7	1.1	0.7					
Rainfall (mm)	0	0	0	5.4	70.7	98.2	75.1	70.6					
Snowfall (cm)	21.6	27.4	6.4	10.4	0	0	0	0					
Precipitation (mm)	21.6	27.4	6.4	15.8	70.7	98.2	75.1	70.6					358.8
% Difference	-27.5	28.6	-78.5	-59.7	-7.2	-21.3	-27.0	-31.4					-45.7

Site runoff varies widely in response to the climatic conditions. In normal (50% non-exceedance) and wetter years there is surplus water available for taking for site catchments or the Pinewood River. However, the Pinewood River frequently has no flow in September, and in extreme dry years, presents a water supply risk to the project.

Further details regarding the climatic conditions and hydrology can be found in the Water Management Plan for Operations (RRP-GEO-REP-026 R1). The site and project climatic characteristics (and seismic hazard analysis) are summarized in Table 3-2.

**Table 3-2 Site Characteristics used in Geotechnical Design**

Criterion	Source or Calculation	Value	Unit
<b>Climatic Data</b>			
Monthly temperatures (Note 1)			
<i>Mean</i>	Environment Canada - Barwick Station (Stn 6020559)	3.2	°C
<i>Low (February)</i>		-15.9	°C
<i>High (August)</i>		18.8	°C
<i>Period of freezing</i>		November to	-
Precipitation (Note 2)			
<i>Mean annual precipitation</i>	Environment Canada - Barwick Station (Stn 6020559)	682.1	mm
<i>Mean annual rainfall</i>		543.7	mm
<i>Mean annual snowfall</i>		138.4	cm
Storm events (24-hour) (Note 3)			
<i>2-yr</i>	Ministry of Transportation (MTO)	51	mm
<i>5-yr</i>		51	mm
<i>10-yr</i>		93	mm
<i>25-yr</i>		102	mm
<i>100-yr</i>		129	mm
<i>Regional Flood (Timmings Storm)</i>		193	mm
<i>Probable Maximum Precipitation (PMP)</i>		586	mm
Wind velocities (for wind-wave calculations)			
<i>Average annual maximum</i>	(Note 4)	16	km/h
<i>Maximum likely</i>		80	km/h
<b>Probabilistic Seismic Hazard Analysis (Note 5)</b>			
Peak Ground Acceleration for Rock Sites (outcrops)			
<i>475</i>	Natural Resources Canada	0.009	g
<i>2,475</i>		0.036	g
<i>10,000</i>		0.096	g
Peak Ground Acceleration for Overburden Sites (20 to 30 m)			
<i>475</i>	Natural Resources Canada	0.014	g
<i>2,475</i>		0.054	g
<i>10,000</i>		0.136	g

Notes:

1. Data obtained between 1971-2000
2. Data obtained between 1979-2012
3. Data for 2 to 100 year return obtained from MTO (2010), PMP) from AES IDF values prepared by the Hydrometeorology Division, Canadian Climate Centre, Station Rainy River, ON, Station Number 6026852
4. AMEC, 2013. Rainy River Gold Project, Climate, Air Quality, and Sound Baseline Study
5. The 1:10,000 year earthquake is considered equivalent to the maximum credible earthquake. AMEC, 2012. Earthquake Ground Motion Hazard Assessment, Rainy River Gold Project, Richardson Township, Ontario

### 3.3 Surficial and Bedrock Geology

The RRM is positioned within the Achaean age Rainy River Greenstone Belt that forms part of the 900 km long, east-west trending Wabigoon Subprovince of the Canadian Shield. In general, the Rainy River Greenstone Belt is bounded by the Sabaskong Batholith in the north and the Rainy Lake Batholithic Complex in the east. It extends south into Minnesota where the Long Point Intrusive Rocks, the Baudette Intrusive Rocks (both granitoid), and the Rainy Lake – Seine River Fault, the Vermillion Fault and the Four Towns Fault constrain the belt.

The site is characterized by gently undulating topography, strongly influenced by a sequence of glaciations, which on higher ground has left bedrock exposed with little to no overburden cover. In the lower lying areas, thick overburden deposits primarily of glacial origin (e.g., till) are found.

The mine site area can be divided into two general physiographic types based on topography and frequency of bedrock outcrops. The north and east portions of the project site have numerous bedrock outcrops, with variable soil cover, where the bedrock has a significant influence on the surface topography. The southwest and central portions of the site have thicker and more extensive soil deposits, with isolated bedrock outcrops.

The surficial geology generally consists of the following stratigraphy:

- Peat/Holocene: variable thickness ranging from thin veneers to greater than 3 m in thickness;
- Glaciolacustrine clay: typically located below the peat layer (Brenna Formation) and above the Whiteshell Till (Wylie Formation). The upper unit is typically low to high plastic silty clay, with occasional sand layers. The lower unit is typically clay silt and fine sand. Both units have varved silt and clay with varying thickness typically in the millimeter scale;
- Whitemouth Lake (WML) Till: Thickest and most widespread unit on site. The till is typically medium to high plastic silty clay with trace to some sand and gravel;
- Whiteshell Till: confined under the Whitemouth Till, the Whiteshell Till is a silty sand till with some gravel and cobbles and trace clay with some boulders. It is an aquifer with artesian pressures (above the ground surface) in some locations; and
- Bedrock: underlying the Whiteshell Till.

Groundwater recharge to the deeper groundwater system (shallow bedrock and Whiteshell Till) is limited to areas where the bedrock is at surface or has limited cover of overburden, mainly to the north and east of the open pit. Very limited recharge to the deeper groundwater system is probable through the Whitemouth Lake Till on higher ground. Where glaciolacustrine clays and peat are present, recharge to the deeper groundwater system is minimal.

Note; the TMA dams have been designed assuming high pore pressures and residual strength in the clayey foundation units (Upper/Lower Glaciolacustrine and WML Till). Further details regarding the surficial geology at the site and design criteria for the TMA Dams is provided in TMA – Volume 1 – Dam Design Implications (Amec Foster Wheeler, 2016f) and Volume 2 – Investigation and Interpretations (Amec Foster Wheeler, 2016g).

### **3.4 Geochemistry**

#### **3.4.1 Mine Rock**

Static and kinetic geochemical testing representing all major lithology types of non-ore mine rock in the vicinity of the proposed pit development determined that approximately 50% of the mine rock samples were unlikely to generate acidic drainage (NPAG) in the future (neutralization potential ratio [NPR] >2). The remainder of the samples were classified as potentially acid generating (PAG) materials with NPR < 2. It's noted that NPR ratios are influenced by the low concentrations of both sulphides and carbonates.

Progressive encapsulation of the PAG rock during operations and at closure will limit precipitation infiltration and flushing of oxidation products from the mine rock. Restriction of oxygen inflow to the PAG rock may occur as a result of complete encapsulation of the pile.

The dam design includes only non-potentially acid generating (NPAG) mine rock downstream of the dam core. PAG rock is used in the completion of portions the TMA starter cell/cell 1, cell 2 dam and the upstream sections of the ultimate TMA dams.

#### **3.4.2 Tailings**

Based on geochemical testing, the tailings are PAG with an expected lag time to net acidic conditions of approximately 30 years. In addition, there is a potential risk of elevated cadmium concentrations in the TMA during operations due to leaching from the tailings.

Metal release from subaerial (beached) tailings may occur prior to acidic conditions and management of the tailings pond water may be required at this time. Metal release may occur from submerged tailings; however, subaerial tailings appear to be a greater source of loadings than submerged tailings. The milled ore is also a substantial source of loadings to the tailings pond, in some cases (e.g., cadmium) it is the dominant loading source early in mining operations.

Geochemical assessments suggest that Cd concentrations in the TMA may exceed the working site-specific value (0.001 mg/L subject to confirmation through permitting) within 1 year after mining begins. Reductions in the tailings beach areas could extend the period of time until exceedance is reached. Water treatment in the WMP is planned to be employed to support discharges from the WMP meeting discharge effluent quality targets.

### **3.5 Hydrology and Water Flow**

The collection of runoff and hydrology data for the RRM is challenged by low gradient, small systems and frequent beaver impoundment. Water Survey of Canada Station 05PC011 at the Pinewood River provides the longest and most reliable available data set. Water Survey of Canada Station 05PC023 (at Highway 617) provides a shorter period of record and is known to provide erroneous readings of up to 20 %. Table 3-3 presents mean streamflow data in the Pinewood River as presented in the EA application, which have been pro-rated where required and in winter months.

**Table 3-3; Monthly Streamflow in the Pinewood River at WSC 05PC011**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
<b>Mean</b>	0.218	0.144	0.538	9.595	7.135	5.412	3.163	1.536	1.787	2.352	1.913	0.383	194.8
<b>5<sup>th</sup> %ile</b>	0.073	0.049	0.181	3.228	2.400	1.820	1.064	0.517	0.601	0.791	0.644	0.129	65.5
<b>95 %ile</b>	0.440	0.292	1.087	19.41	14.43	10.95	6.398	3.107	3.615	4.758	3.870	0.776	394.1

The RRM site on the north side of the Pinewood River is drained by four small creek systems, which from east to west are: Clark Creek (Teeple Drain), West Creek, Marr Creek and Loslo Creek (Cowser Drain). These creek basins range in size from 7.3 km<sup>2</sup> (Marr Creek) to 16.35 km<sup>2</sup> (West Creek). Major portions of the Clark Creek, Marr Creek and Loslo Creek basins will be overprinted by RRM developments, principally the tailings management area and stockpiles. West Creek currently flows through the proposed open pit and will have to be diverted around the pit in order for the RRM to proceed.

It should be also noted that the lower approximately 3.3 km reach of Loslo Creek and 2.3 km of Clark Creek leading to the outflow into the Pinewood River have been previously designated as Municipal drains under the Drainage Act (respectively, the Cowser Drain constructed in 1980 and the Teeple Drain constructed in 1994).

### 3.6 Water Quality

Water quality in the area of the RRM is influence by the presence of clays/silts and water quality guidelines are frequently exceeded at baseline or upstream sites. There are a number of circumstances where exceedance of the Provincial Water Quality Objectives (PWQO) and Canadian Environmental Quality Guidelines (CEQG) values are common:

- Total metal values for samples showing elevated total suspended solids (TSS), especially for very common minerals such as aluminum and iron;
- Total aluminum concentrations in areas where clay / silt soils are common, as aluminum is a common clay mineral;
- Samples collected from under the ice in low volume water systems, because the process of ice formation tends to exclude ions from the ice crystal lattice, thereby concentrating the ejected ions in the underlying water column; and
- Samples collected during summer drought conditions in low volume water systems, because of ion concentration due to evaporative processes

The majority of parameters for surface waters met PWQO and CEQG for the protection of aquatic life, with the exception of common exceedances for aluminum (mainly CEQG), iron and phosphorus; frequent exceedances for cadmium (CEQG), copper (mainly CEQG) and cobalt (PWQO); and occasional, to rare, exceedances for arsenic, lead, nickel and zinc.

### 3.7 Hydrogeology

Regional groundwater flow is generally towards the west in the Pinewood River watershed, but locally is towards the Pinewood River corridor. Horizontal gradients are relatively steep on higher ground, approaching 0.01, but become more subdued in the lower lying areas where they decrease to approximately 0.003. This change in horizontal gradient is a strong indication that,

as the groundwater flows from the higher ground to lower elevations, there is flow from the relatively impermeable shallow bedrock to the more permeable Whiteshell Till and other granular material immediately above the bedrock, referred to generically as the Pleistocene lower granular deposits (PLGD).

Groundwater in the shallow bedrock and PLGD becomes confined as it moves westwards and towards the Pinewood River beneath the lower permeability silty clays of the Whitemouth Lake Till and the glaciolacustrine deposits that largely sandwich this till (the Pleistocene Aquitard). Artesian conditions within the shallow bedrock and PLGD are common along the stream corridors with upwards gradients on the order of 0.03 to 0.1, while downwards gradients occur in the higher areas between the streams.

Groundwater quality is typical calcium magnesium-bicarbonate type water with the majority of sampling points having total dissolved solids exceeding 500 mg/L. Sampling of groundwater since 2007 has indicated metal concentrations above application guidelines e.g., arsenic, cobalt, iron, molybdenum, zinc, mercury and uranium.

### **3.8 Biological**

#### **3.8.1 Fisheries**

The fish community proximal to the RRM is dominated by baitfish and forage fish species with sportfish (e.g., Walleye and Northern Pike) in the lower Pinewood River below the Pinewood Pumphouse. Presently Marr and Loslo Creek are fish bearing and a fish relocation program is underway. West Creek and Clark Creek are former tributaries to the Pinewood River and have been offset for by the Clark Creek Diversion and West Creek Diversion. Clark Creek Diversion and West Creek Diversion are offsetting habitat and support all life history stages of baitfish and forage fish species.

The freshwater diversions are fish bearing waters and subject to protection under numerous permits and legislation e.g., *Fisheries Act*. Cowser Drain (Loslo Creek) and the Pinewood River are also fish bearing. Water quality discharges into these areas must meet MMER and ECA permit requirements. Additional studies as required by the ECA e.g., for mercury, sulphate and ammonia are ongoing, the results of which may influence operation of the TMA.

#### **3.8.2 Vegetation**

The RRM is within Ecoregion 5S (Agassiz Clay Plain) and there are no published Significant Wildlife Habitat Ecoregion Criteria Schedules for this ecoregion. Apsen-Birch hardwood forest is the dominant (46.6 %) forest type proximal to the mine, followed by coniferous swamp / wetland (29.4 %). Agricultural lands are present across 8 % of the area proximal to the mine, primarily along roads and in areas of well drained clays. No records of rare vegetation communities or rare plants were identified during the Environmental Assessment.

Based on the ecoregion, the growing season length is 180-190 days with mean annual temperatures of 1.5 to 3.0 °C. The frost free period is ~125 days from mid-May to mid/late September (Ministry of Agriculture; 1976-2005).

#### **3.8.3 Wildlife**

Key wildlife aspects influencing the OMS manual include the presence of;

- Species at risk including but not limited to Eastern Whip-poor-will and bobolink which require consideration of limits of disturbance, timing of works, noise mitigation and dust management;



- Snapping turtles, for which measures must be taken to prevent them entering the TMA, process water and water treatment facilities;
- Migratory birds requiring noise mitigation measures, reduced light pollution, timing windows on clearing, deterrents to prevent use of the TMA and monitoring for use of the TMA;
- Deer, which along with other wildlife require that a fence is to be constructed around the active tailings deposition areas; and
- Bear, which along with other wildlife need to be managed through controlling wildlife-human interactions including reporting, no harassing of wildlife, no fishing or hunting on the mine site, speed restriction and waste management to exclude wildlife.

### **3.9 Natural Hazards**

Natural hazards to the RRM are limited to weather related hazards e.g., flooding, drought, extreme cold or high winds and forest fires. Other natural hazards e.g., volcanic activity, subsidence, avalanches and landslides are not expected to affect the mine given surrounding geology and topography. Responses to natural hazards are considered as part of the site EPRP. Potential natural hazards relating to the OMS are discussed here, however further consideration on how to respond to natural hazards is considered in the maintenance and contingency sections.

- Forest Fire; there is potential for forest fire to affect operations of the mine, with the cycle in the area of the RRM being 63 to 210 years. The RRM has a fire prevention and preparedness plan (June 2017) developed with the MNRF.
- Pit Slope Failure; could be cause by flooding or slope instability. Modelling of the 1:100 year flow in the Pinewood River would result in the Pinewood River cresting adjacent to the pit at between 347-349 masl. A berm is proposed to protect the pit. This is the same mitigation proposed as for managing ice jams in the Pinewood River.
- Flooding; there is potential for flooding, and associated rainfall to affect operations of the mine. Design of the dams and diversion structures has considered these events as described in section 4 and contingencies are discussed in section 10. Results of flooding leading to a potential need to discharge additional water is offset by the increased assimilative capacity of the receiving environmental at the permitted 1:1 discharge ratio.
- Drought; drought conditions may result in a reduction in water availability for processing and discharge. Drought conditions for processing is mitigated through the design of the WMP and water storage. In the event of 5<sup>th</sup> %ile low flow fall, only 1.53 Mm<sup>3</sup> could be discharged. However, this is managed through capacity in the TMA, WMP and water treatment.
- Seismic hazard; the site is located in the Canadian Shield which is comprised of Precambrian granites and gneisses that host some of the oldest rocks in the world. No earthquakes recorded with a magnitude greater than M 4.5 have occurred within approximately 500 km of the site. The results of the probabilistic seismic hazard analysis (PSHA) are shown in Table 3-1. Further details regarding the PSHA are provided in the *2013/2014 Geotechnical Site Investigations Report* (AMEC, 2014d).

### **3.10 WATER BODIES WITH POTENTIAL FOR CONTAMINANTS**

Further details of water bodies with potential for contaminants are contained in the following sections, however, the summary here provides an overview of linkages between the water bodies with respect to water quality and influence on contaminant release.

- Tailings Management Area (TMA) Cell 1, Cell 2, Cell 3 and ultimate TMA
  - Receives treated (SO<sub>2</sub>/air) tailings from the mill, pump back from Sediment ponds 1 and 2;
  - Provides subaqueous disposal of tailings which are expected to be potentially acid generating (PAG)
  - Provides aging for effluent through planned dam raises ahead of storage needs
  - Provides consideration for cadmium management through balancing tailings beach size
  - Provides mitigation for MeHg accumulation by depositing tailings in a cellular manner supporting rapid permanent flooding of organic matter
- Water Management Pond (WMP)
  - Receives treated supernatant from TMA cell 1 during 1st 6 months of operations after which discharges to the WMP from the TMA are through a water treatment plant at up to 20,000m<sup>3</sup>/day commencing November 2018
  - Receives pump back BCR 2, constructed wetland and WDP
  - Provides freshwater make up to the plant
  - Provides aging of effluent prior to discharge toward the Pinewood River
  - Provides ammonia treatment through bubblers
- Runoff and Seepage collection systems
  - Receives run off for 1:25 year 24h events and seepage containment around the WMP, TMA and WMRS and for 1:100 year 24h event at the EMRS and LGORE
  - Seepage collection from the MRP is not required, as it is operated with minimal volume and is the seepage collection for the EMRS
  - Discharges back to the source of the seepage or any one of MRP, WMP, TMA, water discharge pond, sediment ponds 1&2
- Sumps including plant site ponds north and south, and tailings emergency dump ponds
  - Receives run off from the plant site – plant site north&south pond and polishing pond and discharges through the mill to the WMP
  - Emergency dump ponds are ultimately discharged to the MRP, WMP or TMA as appropriate.
- Temporary Sumps



- Receives runoff from the OB dump and WMRS – sumps 1&2 and provides containment for 1in2 year 24h event discharging to the Pinewood River via splashpad
- Receives surface water collection from the open pit – sump 4 and 5 – and provides containment for 1in2 year 24h event and discharges the Mine Rock Pond
- Receives dewatering from the north wells of the open pit– sump 6 – and provides containment for 1in2 year 24h event and discharges either to the MRP or to the Pinewood via a splashpad
- Constructed wetland (including water discharge pond), BCR 1 and 2, Nitrification Cell
  - Provides effluent treatment (focused on cyanide complexes, nitrates and sulphates but also residual metals/amonia) and treatment following discharge from the WMP and mitigates flow losses in the Pinewood River
  - Notwithstanding discharge limits, discharge volume from WMP into the constructed wetland is up to 20,000m<sup>3</sup>/day based on 20 day retention, however, depending on system performance this may be modified.
  - Discharges to Loslo Creek are permitted from the start of spring melt to end November at level no greater than 20% of the flow of the Pinewood and mixing ratio of 1:1
- Open Pit
  - Receives groundwater inflow and surface runoff anticipated at 3000 to 4000 m<sup>3</sup>/day on average
  - Discharges to the MRP
- Mine Rock Pond (MRP)
  - Receives runoff and seepage from the east mine rock stockpile (EMRS) and from the open pit with an MOWL of 0.5Mm<sup>3</sup> provides storage for the EDF (1.3Mm<sup>3</sup>)
  - Provides freshwater make up to the plant
  - No discharges from the MRP – water pumped to the plant or high flows divert to the open pit, or sumps 4 and 5
- Sediment ponds 1 and 2
  - Receives run off from the overburden (OB) dump and west mine rock stockpile (WMRS) which are progressively reclaimed
  - Sediment pond 1 receives storm flow >1:10 24h event from the West Creek Diversion
  - Settling and retention of 12 days for 1:25 year 24h event
  - Discharges to TMA

#### **4.0 FACILITY DESCRIPTIONS**

The components of the RRM relative to the scope of the OMS include tailings and process water management, freshwater diversions and water treatment. The site layout is shown on Figure 3-1.

While there is interconnectivity between the systems, for the purposes of the OMS they are categorised in these groupings and reference made between them where required e.g., water management pond, water discharge pond and constructed wetland.

Tailings and process water management are provided by the following;

- Tailings Management Area –TMA (including cells 1, 2 and 3 and associated pipelines);
- Mine Rock Pond - MRP.

The TMA provides long term containment for the tailings. The mill make-up water is reclaimed from the Tailings Management Area (TMA), the Water Management Pond (WMP) and/or the Mine Rock Pond (MRP) as described in Appendix A.1. The TMA dam raising schedule is divided into five stages and has been set to ensure ample pond storage is available to satisfy mill make-up water supply and effluent management requirements.

The TMA has been designed to optimize natural degradation processes, by ensuring there is sufficient time to allow for heavy metals to precipitate to low levels in the pond. The natural degradation processes are most effective during warm weather conditions when biophysical activity is optimal, and are also augmented by exposure to sunlight. A treatment plant is also planned to treat TMA water for metals before discharging into the WMP, and is scheduled to be built in the Fall of 2018.

Bubblers (10) throughout the WMP provides sufficient aeration to treat for ammonia and will keep the water over the WMP from completely freezing during the winter. Mill make-up water is provided through reclaim from the TMA and/or the transfer of contact water from the Mine Rock Pond (MRP) decided by the reclaim logic described in Appendix A.1. Treated surplus water is transferred to the WMP before it is discharged to the environment predominately via the constructed wetland. A pipeline to the Pinewood River can also discharge water during a short period in spring. The wetland will treat for nitrate and sulphates and any residual metals and will become the primary treatment plant at closure. Effluents planned for discharge to the environment will meet discharge criteria or be pumped back to the WMP for further treatment.

Freshwater diversion is provided by the following;

- Clark Creek diversion including the Clark Creek and Teeple dam and diversions; and
- West Creek diversion including the Stockpile and West Creek dam and diversions.

The freshwater diversions function to reduce inflows to the RRM and provide offsetting habitat for the loss of portions of Loslo, Marr, Clark and West creeks. Diversion of the non-contact runoff from these catchments reduces the effluent management requirements. All structures support fish habitat.

Water treatment is provided by the following;

- Water Treatment Plant, Water Discharge Pond (WDP) and the Constructed wetland – (CW); and
- Sediment ponds 1 and 2.

Sedimentation ponds have been designed to allow for the settlement of total suspended solids present in the non-contact runoff or effluent prior to discharge to the environment. Sediment Ponds #1 and #2 receive runoff and seepage from the West Mine Rock Stockpile (WMRS). The Water Discharge Pond (WDP) and Constructed Wetland receive discharge water from the WMP. The constructed wetland is the primary and priority discharge location from the WMP (to mitigate

flow reductions in the Pinewood River) ahead of discharging to the Pinewood River downstream of McCallum Creek.

#### **4.1 Design Criteria and Basis**

The basis for design of the tailings, process water, freshwater diversion and sedimentation dams are summarized in the subsequent sections. Where practically possible, the RRM has been designed to minimize effort at closure by promoting progressive reclamation opportunities including but not limited to: establishing the TMA closure cover and developing the East Mine Rock Stockpile (EMRS) and West Mine Rock Stockpile (WMRS) to closure slopes.

Results from field investigations (subsurface and groundwater conditions) have been incorporated to the design as per the documented findings from the *2013/2014 Geotechnical Site Investigations* (AMEC, 2014d) and *Geotechnical Investigations Report – TMA, Volume 1 – Design Implications* (Amec Foster Wheeler, 2016f).

**Table 4-1 Summary of Dam Design Criteria**

Dam	Hazard Potential Classification	Upstream Watershed	Maximum Operating Pond Level		Environmental Design Flood		Inflow Design Flood	Spillway design/Emergency Spillway design			Design Slopes
			Volume	Level	Storm Event	Volume		Width	Design Flow	Max. flow depth (IDF)	
-	-	-	Mm <sup>3</sup>	m	-	Mm <sup>3</sup>	-	m	m <sup>3</sup> /s	m	(_H:1V)
<b>Tailings Management Area</b>											
Cell 1	Very high	None/Tailings		369.9	100 yr 30 day	0.320	PMF	8			11
Cell 2	Very high	Loslo/Tailings		364.05	100 yr 24h	0.828	PMF	19	293.0	1.4	11
<b>Process Water Management</b>											
WMP	Very high	TMA	5.0	369.7	100 yr 30 day	0.630	PMF	8	3.7	0.50	4-9.2
MRP	Very high	EMRS	0.5	356.8	100 yr 30 day	1.0	PMF	15	64.7	1.60	11
<b>Freshwater Diversions</b>											
Clark Creek Dam	Low	Clark Creek		378.75	n/a	n/a	100-yr	20		0.30	5.5
Teeple Dam	Low			378.5	n/a	n/a	100-yr	120		0.10	6.0
Stockpile Pond Dam	Very high	West Creek	0.095 NOWL	372.2	n/a	n/a	PMF	33	79.6	2.30	6.5
West Creek Dam	Very high		0.156 NOWL	361.0	n/a	n/a	PMF	8			7.9
Notes Hazard potential classification per LRIA Spillways have been designed to pass an IDF event while satisfying minimum freeboard requirements PMF is probably maximum flood To be updated for WDP, CW and Sediment ponds 1 and 2 based on approvals											

**Table 4-2 Summary of Dam Characteristics**

Purpose & Facility	Dam Name	Type of Dam	Construction Method	Crest Elev. (m)	Max. Dam Height (m)	Dam Length (m)	Crest Width (m)	Slopes (_H : 1V)	Spillway		Normal Freeboard (m)
									Invert Elev. (m)	Width (m)	
<b>Tailings containment dams</b>											
Tailings Management Area (TMA)	TMA North	Central core	Staged centreline raises	366.5 (final 379.5)	2.5	3620	20	11.0	365.5 (emergency)	10	varies
	TMA South				11.0	3505	20				
	TMA West				7.5	1865	20				
	TMA Cell 1	Rockfill & liner	Final	371.5		1470	10	11.0	370.5 (emergency)	8	varies
<b>Process Water Management</b>											
Water Management Pond (WMP)	WMP Dam 1	Homogeneous	Final	371.5	4.2	850	10	4.0	370.5 (emergency)	8	3.6
	WMP Dam 2			371.5	9.5	800	10	5.5 *			
	WMP Dam 3			371.5	13.3	750	10	9.2 *			
	Settling Pond			371.5		550	5	4.0	n/a	3.6	
Mine Rock Pond	Mine Rock Pond	Central core	Final	360.2	13.0	1655	10	11.0	358.9 (emergency)	80	3.4
<b>Freshwater Diversion</b>											
Clark Creek Diversion	Clark Creek	Homogeneous	Final	380.0	2.0	285	6	5.5 *	379.9	6	1.3
	Teeple Road	Homogeneous	Final	379.0	5.0	465	6	6.0 *	378.7	6	0.5
West Creek Diversion	Stockpile Pond	Central core	Final	375.5	9.8	380	6	6.5 *	372.3	20	3.2
	West Creek	Central core	Final	364.9	8.9	750	10	7.9 *	360.9	8	3.9
<b>Sediment Control</b>											
Water Discharge Pond (WDP)	Water Discharge Pond	Homogeneous	Final	355.2	2.2	350	6	4.0	354.2	5	1.0
Constructed Wetlands	Pond A	Homogeneous	Final	347.5	1.5	715	5	3.0	347	50	0.5
	Pond B			349.0	2.0	840			348.5		0.5
	Pond C			350.5	2.5	1015			350		0.5
	Pond D			351.5	1.5	305			351		0.5
	Pond E			352.5	1.5	190			352		0.5
West Mine Rock Stockpile	Sediment Pond #1	Central core	Final	354.0	3.8	1750	6	4.0	353.7 (emergency)	60	0.8
	Sediment Pond #2	Homogeneous	Final	348.2	5.2	1460	6	4.0	348 (emergency)	115	2.2
	Temporary Sediment Pond	Homogeneous	Final, temporary	348.6		600	6	4.0	348.5 (emergency)	60	0.6

**Notes:**

- 1) Refer to the relevant design reports for design details.
- 2) Normal freeboard is the height between the normal pond level and dam crest
- 3) Emergency spillways are noted in parenthesis for contact water ponds that require Environmental Design Flood (EDF) containment. Otherwise, spillways are working or overflow spillway.
- 4) Inclinations with an asterisk (\*) include toe berms

## 5.0 Approved Discharges/Releases

The following table summarizes the approved discharges for the site. Approved discharges and all other contact water runoff and seepage will be managed consistent with MMER requirements. Water may be used for dust suppression or other industrial uses e.g., drilling and truck washing except from the TMA consistent with the management of water for dust suppression (December 2016).

Runoff and seepage from the plant site, EMRS, OB&WMRS, LGORE, WMP, TMA and other areas as required will be directed to one or more of the process plant, MRP, water discharge pond, TMA, WMP, sediment ponds 1 and 2 or constructed wetland. Seepage and collection systems and ditching are designed at minimum for 1:25yr 24h storm except the EMRS, which is 1:100 year 24h storm.

At all times during discharge from WMP pipeline, sediments 1&2 and wetland final discharge, except where attributable to background conditions, surface water benchmarks in Table 5 of the ECA must be achieved at SW22 and SW24.

In the event of exceedance of volume or quality, contingencies will be applied and required reporting conducted - see contingency and reporting sections. The exceedance is considered a spill.

Approved Discharge	Description	Quality	Quantity	ECA	MDMER	Comment
Process Plant wastewater treatment	Cyanide destruction SO <sub>2</sub> /air circuit with parallel 1,402m <sup>3</sup> reactors and 90min retention time	<1mg/L WAD	1,580m <sup>3</sup> /h max capacity	Ops	N/A	Provincial EA commitments also apply
TMA	Total ultimate storage capacity 104Mt with 17.5M <sup>3</sup> of water over 527ha, 25-30m dam height			Ops	N/A	
Constructed wetland	Five ponds created by dams	Table 2 ops ECA	1:1 combined, with effluent not exceeding natural flow	Ops	Notice given	Preferentially used ahead of pipeline – no discharge during winter
WMP Water Discharge Pipeline to the	10km 24inch HDPE pipe discharging to the Pinewood River with a	Table 2 ops ECA		Ops	Not submitted	No discharge during winter – preferentially

Pinewood River						use the wetland
Sediment pond 1	560,000m <sup>3</sup> pond over 54ha with ~3.1m high dam. Treats OB stockpile discharging to the West Creek Diversion	Table 3 ops ECA	1:5 to WCD (<16.7% of flow)	Ops	Notice given	If effluent limits in ECA Tables 3 or 4 exceeded, pump to WMP/TMA; Designed for 1in25year 24h event with 12 days residence time
Sediment pond 2	356,000m <sup>3</sup> pond over 17ha with ~3.5m high dam. Treats OB stockpile and WMRS discharging via ditching to the Pinewood River	Table 4 ops ECA	1:10 to Pinewood River (<9.1%)	Ops		
Domestic Sewage Treatment Plant	As designed/approved			Ops		
Oil/Water Separator	As designed/approved			Ops		
Preliminary Phase MRP inc OB pile	Temporary discharge until MRP completed	Table 3 con ECA		Con	Yes – PRF1	MMER Discharge location 48°49'42" N 94°00'01" W. No discharge in operation
In pit sumps 3&4	Built to convey water to MRP or WMP or discharge to the Pinewood River	Table 3 con ECA		Con	Yes – PRF2&3	One MRP completed – cease discharge from sumps
OB and WMRS – sumps 1&2	Receiving 280ha of runoff with storage capacity of 50,000m <sup>3</sup> ; 12 day retention of 1in2 year 24h event	Table 3 con ECA		Con	Yes – PRF9	Used in conjunction with perimeter ditching around south stockpile area
WMRS temp sediment pond	Storage capacity of 49,200m <sup>3</sup> within the WMRS	Table 3 con ECA		Con	As per PRF-9	Permit to construct expires May 2018

Plant site Ponds N&S and polishing pond	Temporary discharge until completion of Mine Rock Pond			Con	Yes – PRF6-8	
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## 6.0 Water Quality Treatment Plans

To meet water quality objectives and regulatory limits the following strategies are implemented;

- Diversion of non-contact water to reduce the volume of water to be managed. This includes the Clark and West Creek Diversions.
- Maximizing water recycling to limit make up water requirements and overall water volume to be managed
- Compact footprint to reduce area of distance and contact water to be managed
- Collecting site contact water and seepage in ditches and divert to either the tailings management area or water management facilities for release via final discharge points
- Mine rock segregation and ML/ARD management with PAG material not used in construction except for where it will remain subaqueously covered and an engineered cover over the EMRS
- Treating tailings slurry for cyanide destruction and precipitate heavy metals
- Constructing and operating a water treatment plant in the WMP
- Conducting dam raises in sufficient time to PAG rock is inundated prior to the anticipated onset of acid production and allow for supernatant aging prior to discharge to the WMP and ultimately to the Pinewood River

For specific parameters the following water quality treatments are applied;

- TSS
  - Limit areas of disturbance and constructing timing
  - Progressive reclamation of disturbed areas and stockpiles e.g., design criteria for sediment ponds 1 and 2 assumes three years of active work area exposed
  - Use of sediment and erosion control measures, as required, prioritizing erosion prevention ahead of controlling sediment laden runoff
- Cyanide
  - Limit cyanide use in the processing plant to what is consumed in the process
  - Process plant waste water treatment (SO<sub>2</sub>/air) to reduce free cyanide concentration to 1 mg/l in the tailings supernatant
  - Retention/aging of tailings supernatant in the TMA to allow for photodegradation
  - See ammonia
- Ammonia
  - Use of emulsion to reduce ammonia residuals
  - Scheduling dam raises to allow storage / aging of effluent



- Aging effluent in the TMA before seasonal (June to August nominally) discharge to the WMP for overwintering ahead of discharge through the constructed wetland the following year
- Drawing down the WMP after winter and by the end of May to allow capacity for filling from the TMA
- Limiting discharge timing to the constructed wetland to between freshet and the end of November or additional limits based on system performance
- Where required, use of phosphate in the WMP/wetland to increase the rate of ammonia uptake and aeration in the WMP/wetland to support uptake/volatilization
- Cadmium
  - Tailings beach management to minimize mobilization of cadmium
  - Water treatment plant consisting of lime neutralization with possible ferric sulphate coagulant addition for heavy metal removal (with alkali effluent water being neutralized before discharge to the WMP)
- Sulphate
  - Reduce rates of generation through mine rock segregation, using NPAG in construction, limiting SO<sub>2</sub> use in CN destruction circuit to what is consumed by the process, progressive reclamation and subaqueous disposal of tailings
  - Reducing releases to the receiving environment include having higher dilution ratios that approved and taking water from the Pinewood River through operations (subject to permit approval) to prevent buildup of sulphate in the recycled water.
  - If required, apply additional treatment following investigation and sampling of tailings during early operations (Years 1&2)
- Mercury – methylmercury (MeHg)
  - Recycling water from WMP/TMA through the plant which will result in mercury removal in the processing plant
  - Discharge of supernatant from Cell 1 into the WMP to increase sulphide concentration above optimum conditions for methylation
  - Tailings deposition plan is cellular to rapidly flood organic material therefore reducing the opportunity for methylation to occur
  - Tailings deposition to rapidly flood deep organic soils in the former Loslo and Marr Creek channels, where possible
  - Limit water level fluctuations in newly flooded areas to the extent possible i.e., once covered remain covered
  - Stripping of organic soils from the MRP, where feasible
  - Divert run off from NPAG stockpile (EMRS) and MRP to the plant

Water quality plans for the sewage treatment plant and oil/water separator will be developed at the time of approval or concurrent with the start of operation of those works.

## **7.0 Release Plan for Approved Discharges**

The section applies to the WMP pipeline discharge, constructed wetland final effluent, sediment pond 1&2. Temporary sumps are addressed through the attached document (Temporary Sump Management Plan). Release plans for the sewage treatment plant and oil/water separator will be developed at the time of approval or concurrent with the start of operation of those works.

#### Determining receiving environment capacity (flow monitoring)

- A hydrometric station has been established in the Pinewood River and will be used to calculate discharge limits in the Pinewood River at Loslo Creek and at the WMP pipeline discharge
- An additional hydrometric station or equivalent flow measuring device will be established in the West Creek Diversion proximal to the Sediment Pond 1 outlet
- Based on the flow in the Pinewood or West Creek Diversion, in a 24h period for the proceeding 48h, a daily (24h) discharge rate will be established

#### Determining suitability for release

- This is based on water quality results as required by permit conditions, or additional internal sampling and visual observation i.e., absence of film/sheen/foam.

#### Controlling and measuring release volume

- Flow will be released from a control structure e.g., flow control gate at the respective effluent release locations. The flow control gate will be sized to control flows over the anticipated discharge range and permitted mixing ratios
- Released volumes will be adjusted at least daily to match the receiving environment capacity
- Measuring releases will be conducted by an annually calibrated flow meter with an accuracy no less than +/-15% and capable of operating under winter conditions
- Volumes will be recorded from the flow meter automatically or via manually on discharge checklists/discharge records.
- In the event of discharges not being suitable for discharge the release control structure will be closed and contingencies applied (see contingency section), specifically pump back to TMA/WMP.

Once finalized the contaminant release plan will be submitted to MECP for approval, prior to any discharges from the WMP/WDP/CW, Sediment ponds 1 & 2, or the Pinewood River pipeline.

## **8.0 Monitoring Requirements**

Water quality monitoring requirements are defined in the ECA. The purpose of monitoring is to inform operation of the works and areas of site that may influence water quality and meet permit requirements. Monitoring includes;

#### Surface Water Quality

- Following provincially approved protocols – see section 7(4) of the ECA;
- Developing a TSS/NTU relationship within 6 weeks of discharges from the sediment ponds;
- Visual inspection of the works to ensure they are free from floating and settleable solids and no visible film/sheen or foam;
- Sampling in locations and with the frequency specified in Table 6 for pipeline discharges, sediment pond 1 and 2 discharges, constructed wetland final pond and oil/water separator; and
- Sampling in locations and with the frequency specified in Table 7&8 for the receiving environment.

#### Flow monitoring

- Continuous flow monitoring for WMP pipeline discharge, constructed wetland final discharge and sediment ponds 1 and 2 with an accuracy of +/-15% calibrated annually with winter operational capability
- Calculate the daily flow rate for each stream

#### Long term monitoring

- Follow the Pinewood River Biological Effects Monitoring Plan and monitoring requirements for the MMER
- Mercury monitoring plan as defined in the study plan terms of reference
- Sulphate monitoring plan as defined in the study plan terms of reference

#### Internal monitoring

- Additional monitoring locations maybe added to support understanding of the water quality plan and inform mitigation. Sampling protocols and parameter lists maybe varied as required e.g., isotope sampling for source water determination. Sampling locations may include;
  - TMA supernatant particularly during year 1 to determine sulphate and cadmium concentrations;
  - WMP pond;
  - Seepage ponds;
  - Constructed wetland upstream of the final effluent;
  - Sediment pond 1&2; and
  - Additional receiving environment locations based on feedback or request.

## 9.0 Contingencies

Immediate response for effluent not meeting criteria is consistent with steps taken in spill response;

- Stop the release of the contaminant e.g., shut the release control structure
- Treat for the exceedance e.g., addition of flocculants
- Divert or cease inflows into the works where possible
- Reclaim/pumpback to containment e.g., WMP/TMA

Two contingency plans have been developed as part of MECP approvals for water treatment;

- Pinewood River Quality Contingency Plan, Version 1 August 2016; and
- Groundwater and Surface Water Contingency Plan, Version 2 October 2015.

In summary contingency options outlined in these plans include limiting discharges, acceleration of TMA dam raises, add water quality treatment, additional monitoring, and provision of water to affected areas and increased mixing ratios/improved mixing. The trigger for implementation of contingency in surface water is if protection of aquatic life criteria are not achieved 90 % of the time.

**RAINY RIVER PROJECT**

**PART II - TAILINGS MANAGEMENT AREA - OPERATION,  
MAINTENANCE AND SURVEILLANCE MANUAL**

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**Version 2020-1**

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## 1.0 Regulatory Requirements

This document is consistent with the New Gold Tailings, Heap Leach and Waste Rock Facilities Management Policy and was prepared pursuant to the MAC guidelines for *Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities* (MAC, 2011).

The following is a list of permits that this section of the OMS complies with:

- LRIA-FF-2017-03: TMA Cell2 and Culvert C17
- LRIA-FF-2015-04C: TMA south starter dam, north starter dam and the TMA Starter cell

## 2.0 FACILITY DESCRIPTIONS

The components of the RRM relative to the scope of the OMS include tailings and process water management, freshwater diversions and water treatment. The site layout is shown on Figure 3-1. While there is interconnectivity between the systems, for the purposes of the OMS they are categorised in these groupings and reference made between them where required e.g., water management pond, water discharge pond and constructed wetland.

Tailings and process water management are provided by the following;

- Tailings Management Area –TMA (including cells 1, 2 and 3 and associated pipelines);
- Mine Rock Pond - MRP.

The TMA provides long term containment for the tailings. The mill make-up water is reclaimed from the Tailings Management Area (TMA), the Water Management Pond (WMP) and/or the Mine Rock Pond (MRP) as described in Appendix A.1. The TMA dam raising schedule is divided into five stages and has been set to ensure ample pond storage is available to satisfy mill make-up water supply and effluent management requirements.

The TMA has been designed to optimize natural degradation processes, by ensuring there is sufficient time to allow for heavy metals to precipitate to low levels in the pond. The natural degradation processes are most effective during warm weather conditions when biophysical activity is optimal, and are also augmented by exposure to sunlight. A treatment plant is also planned to treat TMA water for metals before discharging into the WMP, and is scheduled to be built in the Fall of 2018.

## 3.0 Tailings Management Area

Design criteria, including mill throughput, used in the design of the TMA dams is summarised in the follow table. Subsequent sections describe tailings cells 1, 2 and 3 and associated seepage collection systems and supporting infrastructure.

Testing carried out in 2012 for the feasibility study determined that the tailings are non-plastic, predominantly silt sized particles, with 71% of the particles passing the 0.075 mm sieve. The specific gravity is 2.82. Column settling tests (undrained and drained) support a deposited void ratio of 1.0 for deposition planning purposes, inferring a dry density of about 1.4 t/m<sup>3</sup>. This is quite

typical for hard rock gold tailings. A much more conservative dry density of 1.1 t/m<sup>3</sup> was adopted for the design of the initial start-up cell due to the small footprint and relatively rapid filling.

**Table 3-1 Mill and Tailings Operating Data used for design**

Revision G		Symbol	Source	Total	Years 1 - 4	Years 4 - 14	Units (metric)
				Total	Total	Total	
<b>Operating data provided (design criteria)</b>							
<b>Ore production</b>							
Resource - Open Pit		A	New Gold	100.1	53.4	46.7	Mt
- underground		B	New Gold	4.2	0.5	3.7	Mt
Design production rate ( <i>while operating</i> )		C	BBA		21,739	21,739	t/day
Mill availability ( <i>% of the time the Mill operates</i> )		D	BBA	92			%
Nominal production rate*		E	C x D		24,000	24,000	t/day
<b>Tailings production</b>							
Tailings / ore ratio		F	BBA	1.0			
Slurry density in the Mill		s <sub>o</sub>	BBA		50.0	50.0	% solids
Discharge slurry percent solids ( <i>mass of solids / total mass</i> )		s <sub>d</sub>	BBA		46.7	46.7	% solids
<b>Tailings properties</b>							
Specific gravity of solid tailings particles		G <sub>s</sub>	AMEC		2.82	2.82	-
Void ratio of deposited tailings ( <i>vol. of voids / vol. of solids</i> )		e	AMEC		1.0	1.0	-
<b>Flows affecting the Mill water balance</b>							
- Moisture content of the ore entering the Mill ( <i>mass of water/mass of solids</i> )		G	New Gold	3.0			%
- Freshwater for glands & reagent mixing ( <i>per ton of ore</i> )		H	AMEC M&M	0.08			m <sup>3</sup> / t
- Evaporation and spillage losses in the Mill ( <i>per ton of ore</i> )		I	assumed	0.02			m <sup>3</sup> /t
<b>Calculated data (design parameters)</b>							
Project design life		J	(A) / (E x 365)	13.5	7.0	6.6	years
<b>Tailings production</b>							
- Nominal tailings production	daily	K	E x F		24,000	24,000	t/d
	monthly		E x F x 30		720,000	720,000	t/mo
	annual		E x 365		8,760,000	8,760,000	t/y
	total		E x 365 x J	103.8	61.4	57.8	Mt
<b>Deposited tailings</b>							
- Dry density		r <sub>d</sub>	G <sub>s</sub> / (1+e)		1.41	1.41	t/m <sup>3</sup>
- Volume	daily	L	K / r <sub>d</sub>		17,021	17,021	m <sup>3</sup> /d
	monthly				510,630	510,630	m <sup>3</sup> /mo
	annual				6,212,665	6,212,665	m <sup>3</sup> /y
	total		A+B/r <sub>d</sub>	73.96	43.5	41.0	M-m <sup>3</sup>
- Water content (at 100% saturation) ( <i>mass of water/mass of solids</i> )		w	e / G <sub>s</sub> x 100		35.5	35.5	%

- Water retained in voids	daily	M	K x w	8,520	8,250	m <sup>3</sup> /d
	monthly			255,600	255,600	m <sup>3</sup> /mo
	annual			3,109,800	3,109,800	m <sup>3</sup> /y
<b>Mill water balance</b>						
- Water in ore entering the Mill		N	E x G x 30	21,600	21,600	m <sup>3</sup> /mo
- Freshwater for glands and reagent mixing		O	K x H	57,600	57,600	m <sup>3</sup> /mo
- Water leaving the Mill with the tailings		P	(K / s) - K	821,755	821,755	m <sup>3</sup> /mo
- Losses in the Mill		Q	K x I	14,400	14,400	m <sup>3</sup> /mo
- Make-up water required to balance the Mill		R	P + Q - N - O	756,955	756,955	m <sup>3</sup> /mo

\* assumes maximum capacity of 21 000 + 20%

### 3.1.1 TMA Cell 1

The purpose of Cell 1 is to allow for the deposition of tailings, outside of fish bearing waters i.e., no MMR Schedule 2 requirement. Cell 1 has been designed to contain 3.3 Mm<sup>3</sup> of tailings, or 4.5 months storage capacity. The dam has a 'very high' hazard potential classification equivalent to extreme hazard classification by the CDA. The design information for Cell 1 is within RRP-GEO-LRIA-004C August, 2016 and the design brief is RRP-GEO-REP-008 R2. A summary of design characteristics is provided in the table below. The IDF for spillway and design is the 24h PMF (516 mm) and the EDF is the 100 year 30 day event. The facility creates a ring dam therefore reducing inflows and water management requirements. As the TMA is raised in stages over the life of mine the cell will become encapsulated within the ultimate TMA facility requiring no change to the closure plan.

The Cell 1 will have a crest elevation of 371.5 masl, and consists of (also see Table 4-4):

- a continuous raise of the TMA south starter dam from elevation 366.5 masl to 371.5 masl between stations 0+000 to 0+800;
- a raise of the TMA west dam (WMP dam 4) from 366.5 masl to 371.5 masl between stations 1+000 to 1+900; and
- a standalone internal containment dam also built to elevation 371.5 masl.

**Table 3-2 Summary of Cell 1 Dam Characteristics**

	Spillway Invert Elevation (m)	Dam Crest Elevation (m)	Minimum Ground Elevation <sup>1</sup> (m <sup>3</sup> )	Maximum Height (m)	Length (m)	Dam Fill Volume (incremental) (Mm <sup>3</sup> )
TMA Start-Up Cell Dam	370.5	371.5	360.0	11.5	1,500	1.17
TMA South Dam - Stage 1		371.5	365.0	6.5	800	0.24
TMA West Dam - Stage 1		371.5	363.0	8.5	700	0.19

Notes:

<sup>1</sup> Minimum ground elevation noted is original ground

The TMA start-up cell will have a maximum operating water level (MOWL) of approximately 369.90 masl, which corresponds to the operational pond volume of 200,000 m<sup>3</sup>. Once the water level reaches the MOWL it must be pumped from the TMA start-up cell to the Mill Process Water Tank (MPWT), to maintain sufficient capacity to contain the EDF event. Due to the limited storage in the TMA start-up cell at this point in mine operations, no operating range can be allowed (i.e.,

any water above the MOWL must be pumped immediately). The TMA Cell 1 spillway has an invert elevation of 370.5 m and a base width of 8 m. The spillway discharges north into TMA Cell 2.

The primary dam construction materials are mine waste rock and select clay (overburden) obtained from a local borrow or from open pit development. The TMA South and West Dam have a clay core with select or processed sand filter/drain zones provided downstream of the core and above the foundation to inhibit the migration (piping) of fine-grained soils under seepage forces. The TMA Start-Up Cell Dam has an upstream bituminous liner to minimize seepage.

### **3.1.2 TMA Cell 2**

The purpose of Cell 2, is to allow for continued operations and tailings deposition, following filling of Cell 1, as the ultimate TMA dams are constructed. TMA Cell 2 has been designed to provide containment for approximately 12 months of tailings deposition at maximum production rate based on the design criteria provided in this section (Table 4-1). The dam has a 'very high' hazard potential classification equivalent to extreme hazard classification by the CDA. The Design brief for Cell 2 dam is within RRP-GEO-REP-026 R1 Design Brief, April 28, 2017. A summary of dam characteristics is provided in the table below (Table 4-5). The IDF for spillway and design is the 24h PMF (516 mm) and the EDF is the 1:100 year 24h (127 mm) for containment below the spillway. The 19 m wide spillway with an invert of 364.70 is located in the north starter dam.

The TMA Cell 2 Dam has a crest elevation of 366.5 m which is equal to the crest elevation of the TMA Starter Dams and north starter dam forms part of the containment for tailings deposition. The cell provides containment for approximately 5.5 Mm<sup>3</sup> of tailings. The facility is bounded by natural topography (high ground) in the north and by impoundment dams along the remaining perimeter. The facility will be encapsulated during the life of mine when the TMA Stage 2 raise (elevation 371.5 m) is constructed.

The dam section is a central clay core embankment with rockfill shells and a crest elevation of 366.5 m. Sand filter and transition zones are provided downstream of the clay core and a partial blanket beneath the downstream shell. The dam section requires shallow side slopes due to the characteristics of the foundation soils. Clean (NPAG) rockfill is required for construction of the downstream shell. Any rockfill (NPAG or PAG) may be used for construction of the upstream shell (outside Loslo Creek). Given the Schedule 2 approval schedule, 2x1600 mm culverts will be placed in Loslo Creek until the approval is received, then these will be grouted and sheet piling used to close the dam.

Work on the dam is scheduled between approval (August) and December for clay placement, and sheet piling across Loslo Creek to be completed in 1Q2018, pending MMER Schedule 2 approval.

**Table 3-3 Summary of Dam Characteristics for Cell 2**

Tailings Management Area Dam	Spillway Invert Elevation (m)	Dam Crest Elevation (m)	Minimum Ground Elevation <sup>1</sup> (m <sup>3</sup> )	Maximum Height (m)	Length (m)	Dam Fill Volume <sup>2</sup> (Mm <sup>3</sup> )
Start-Up Cell Dam (Cell 1 Dam)	364.7	371.5	360.0	11.5	1,500	-
North Dam – Stage 1		366.5	363.5	3.0	1,100	-
West Dam (0+000 to 1+000)		366.5	363.5	3.0	600	-
West Dam (1+000 to 1+900)		371.5	363.0	8.5	650	-
South Dam (0+000 to 0+800)		371.5	365.0	6.5	800	-
South Dam (0+800 to 1+250)		366.5	364.5	2.0	300	-
Cell 2 Dam		366.5	356.0	10.5	900	0.47

- Notes:  
 1 Minimum ground elevation noted is original ground.  
 2 Incremental fill volume to currently permitted structure.

### 3.1.3 TMA Cell 3

TMA cell 3 is a component of the ultimate TMA bounded by the TMA south starter dam and the Cell 2 dam. Cell 3 will provide containment for tailings/water for approximately 6 month (April to October 2019 prior to adjoining with Cell 2 through a spillway as part of the overall TMA.

The TMA south starter dam is will be built to 366.5 m and has a ‘very high’ hazard potential classification equivalent to extreme hazard classification by the CDA. The design brief for TMA dams is within Detailed Design Brief Design Brief - Tailings Management Dams 3098004-004000-A1-ETR-0006-00, July, 2014. This was revised following review by the ITRB and, for the starter dams, little design change was required to the 10:1 downstream slopes and the 4:1 upstream slopes (RRP-GEO-MEM-006 Rev 1). A summary of design characteristics is provided in design brief and in the summary table in this section. The IDF for spillway and design is the 24h PMF (516 mm) and the EDF is the 1:100 year 30 day event for containment below the spillway.

When full containment in the TMA is available (i.e. TMA South Dam is constructed to elevation 366.5 m), tailings will be discharged from the north side of the TMA South Dam (upstream slope).

An overflow spillway will connect TMA Cell 2 and 3 to allow for water reclaim during this period of operation. As tailings are discharged from the TMA South Dam, starting in April 2019 (approx.) the pond level in the cell will continue to increase until the water begins to passively overflow at elevation 364.5 m into TMA Cell 2. The TMA Cell 3 Overflow Spillway has an invert elevation of 364.5 m and a base width of 19 m. The spillway will allow TMA Cells 2 and 3 to act as one pond above this invert elevation.

### 3.1.4 Seepage Collection System

Seepage collection systems have been designed consistent with permitting requirements (MECP ECA #5178-9TUPD9) to contain seepage and a 1:25 yr 24h storm event (102 mm). However, seepage and runoff reporting to the MRP, from the EMRS and LGOS, is through ditching designed for a 1:100 yr 24h storm event, also consistent with the ECA approval. There is no requirement for seepage collection from the MRP, however, as noted elsewhere in this manual (section 5) the MRP will be managed with a minimum water level to reduce seepage and dewatered in winter to 5,000 m<sup>3</sup>.

Seepage collection systems may be modified during construction, however the design criteria will not be reduced.

### 3.1.4.1 Cell 1

Cell 1 seepage collection is based on continuous ditches reporting to sumps and pump back. Cell 1 seepage details are outlined in RRP-GEO-MEM-043-R1. Seepage to the south east (through WMP Dam 4) is part of inflows to the WMP and managed as part of the WMP water.

Three sumps are proposed with the base of the sump 1 to 2 m below grade to allow for the incoming ditch invert. Combined seepage flow to these sumps is 29 m<sup>3</sup>/day and final dimensions are being field fitted. Where required, the downstream side of the ditches will be raised to 362.0 m to prevent back flooding from Loslo Creek. Pumping sizing is intended to drain the sumps within 5 days.

**Table 3-4 TMA Cell 1 Seepage Collection Sumps**

Parameter	Sump 1	Sump 2	Sump 3
Location	North side of cell 1	East side of cell 1	South of TMA south dam
Seepage flow (m <sup>3</sup> /day)	12	7	10
Runoff (m <sup>3</sup> /day)	9,321	4,113	5,257
Ditch steady flow (m <sup>3</sup> /day)	200	117	173
Storage volume required (m <sup>3</sup> )	9,532	4,237	5,440
Pump capacity (m <sup>3</sup> /day)	2,500	1,000	1,500

### 3.1.4.2 Cell 2

Seepage from cell 2 dam has been estimated to be approximately 9.2 m<sup>3</sup>/day when the cell is at capacity (364.7 m). Until the TMA south dam is completed i.e., Marr and Loslo Creek are impounded, this seepage will be collected and pumped back into Cell 2, as such Cell 2 seepage management is temporary. Sumps and ditching have been designed for a 1:25 year event, consistent with seepage collection commitments;

- Seepage collection sump will be built with ~8,000 m<sup>3</sup> of live storage (NWL 354.0, MOWL 355.5)
- Minimum pumping capacity 1,600 m<sup>3</sup>/day to dewater sump in 5 days

Seepage from the north starter dam, is estimated at 0.02 to 0.03 m<sup>3</sup>/day/m per metre run of dam which will be captured in WMP sump 3.

### 3.1.4.3 Cell 3

Cell 3 is not anticipated to impound tailings until April 2019 and as such seepage is not anticipated until after this time. Seepage from the south starter dam, is estimated at 0.02 to 0.03 m<sup>3</sup>/day/m per meter run of dam which will be directed via ditching to the water discharge pond, or if necessary pumped back.



#### **3.1.4.4 Pipelines**

There are five pipeline corridors used to transfer tailings, fresh water, and reclaim water on site. Drawing 100126-4500-DD10-PIP-0001.001 shows the key plan of the tailings and reclaim pipelines that interact with the plant site. Drawing 100126-6200-DD10-PIP-0001.001 shows the key plan of the Pinewood Pipeline used for effluent discharge (see Appendix B).

- Tailings Pipeline: the tailings pipelines are 4,000 m in length between the Mill and the TMA and are used to transfer tailings to the TMA for discharge. The tailings line is contained within a lined corridor with six emergency dump ponds. The line is within additional containment over West Creek and its tributaries.
- TMA Reclaim Pipeline: the TMA reclaim pipeline is 4,000 m in length between the TMA and the Mill and is used to transfer mill make-up water. The reclaim line is contained within a lined corridor with six emergency dump ponds. The line is within additional containment over West Creek and its tributaries.
- MRP Reclaim Pipeline: The MRP reclaim pipeline is 1,750 m in length between the MRP and the Mill and is used to transfer mill make-up water.
- Open Pit Pipeline: The Open Pit pipeline is 1,400 m in length between the Open Pit and the MRP and used to transfer pit dewatering to the MRP.
- TMA Transfer Pipeline: The TMA transfer pipeline is 2,300 m in length between the TMA and the WMP and are used to transfer TMA surplus water to the WMP.
- WMP Freshwater Pipeline: The WMP freshwater pipeline is 4,000 m in length between the WMP and the plant site and used to transfer freshwater to plant site infrastructure and the Mill (if required).
- Pinewood Pipeline: The Pinewood pipeline is 10,300 m in length between the WMP and the Pinewood Pump house. It is used to discharge WMP effluent into the Pinewood River.

#### **3.1.4.5 Utilities**

The following utilities are used on site:

- Power to the plant site is provided by 230 kV transmission lines that are connected to Hydro One northwest of the site at a Switching Station;
- The main 230 kV substation is located near the concentrator building to provide power to the process equipment via underground supply lines. Power to the remainder of the site is provided by a network of overhead power lines fed from the main substation; and
- Site telecommunications and Process Control are distributed via fiber optic lines.

#### **3.1.4.6 Tailings Distribution Systems**

Mill tailings are produced and detoxified in a cyanide destruction circuit as shown on the process flow diagram 100126-3200-DC00-PFD-0017 (Appendix B). Pipelines to the TMA are shown on the process flow diagram 100126-3200-DC00-PFD-0022 (Appendix B). Tailings are beached from the TMA dams. A wide beach against the dams enhances safety and reduces seepage.

### 3.1.4.7 Water Circulation Systems

Appendix B contains supporting information for the pumping requirements and design of pumps and pipelines. Mill make-up water is provided from the TMA, WMP and/or MRP. The TMA reclaim recirculates water from the mill after the tailings solids have settled in the TMA. The WMP reclaim pumps treated water from the mill. The MRP reclaim pumps water collected from the EMRS and Open Pit/future underground mine. Mill make-up water will be preferentially pumped from the MRP with the TMA and WMP supplying the remainder of make-up water as described in the Appendix A.1.

Freshwater pipelines transfer water to the Plant site for the freshwater requirements at the Mill, as well as to provide water to the truck filling station, truck shop, truck wash facility, and fire water tank. Surplus water in the WMP may also be pumped to the Pinewood Discharge Structure for discharge into the Pinewood River. Details on effluent discharge via the Pinewood Pipeline are described in Section 4.4.

### 3.1.4.8 Mill Make-up Water Supply

Mill make-up water is provided by reclaim from the WMP, TMA cells and MRP. The reclaim water from the TMA is pumped from the central pond using the following three pumps:

**Table 3-5 Make up water supply pump ID and capacity**

Equipment ID	Name	Capacity
4520-PU-0023	Process Plant Pump	1,350 m <sup>3</sup> /hr
4520-PU-0024	Process Plant Pump (Standby)	1,350 m <sup>3</sup> /hr
4520-PU-0035	WMP Pump (Standby)	1,350 m <sup>3</sup> /hr
4520-PU-0036	WMP Pump	1,350 m <sup>3</sup> /hr

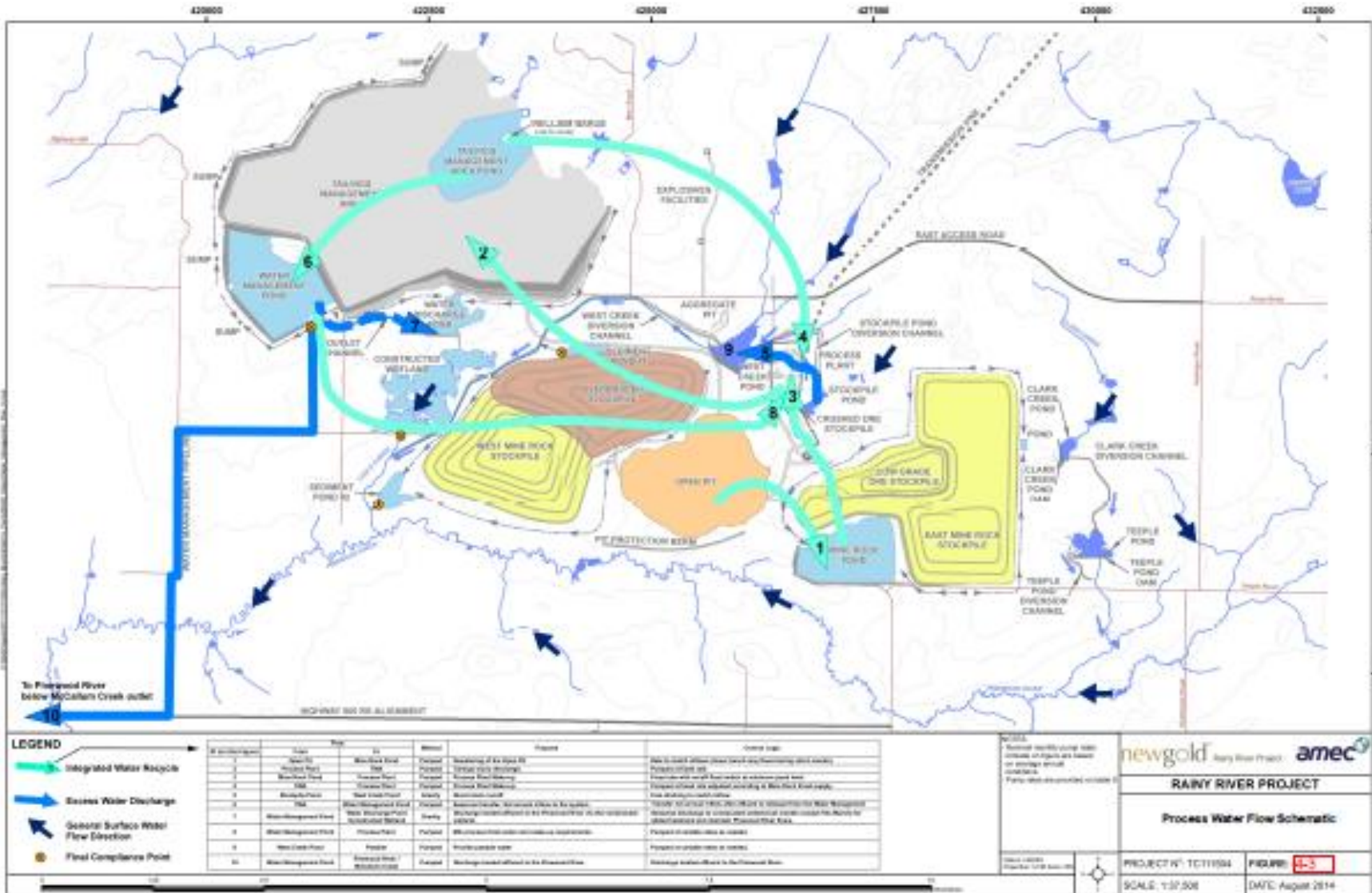
Reclaim water from the MRP is pumped using the following two pumps.

Equipment ID	Name	Capacity
2590-PU-0030	Mine Rock Pond Water Pump	680 m <sup>3</sup> /hr
2590-PU-0031	Mine Rock Pond Water Pump	680 m <sup>3</sup> /hr

## 3.2 Process Water and Water Management

Summary of the process water is shown in Figure 4-1 – process flow diagram water flow sheet. Appendix B includes process flow diagrams. Appendix E includes the process water balance for the TMA and WMP includes TMA cells 1, 2 and 3.

**Figure 3-1 Process Water Flow Schematic**



### 3.3 Instrumentation

#### 3.3.1 Dam Safety

Instrumentation has been and will be installed during construction. Instrumentation will include instrumented dam sections that will monitor dam foundation and clay fill pore pressures to infer consolidation characteristics, as well as monitor any movement of dam fill due to deformation. Each dam instrumentation section will include: standpipe(s), a settlement plate, slope inclinometer(s), survey pins/monuments, and a terminal arrangement with data logger and vibrating wire piezometers.

Following construction, the instrumentation will remain for dam monitoring purposes. A detailed report containing the proposed locations, usage, and analysis of all instrumentation is provided in the *Geotechnical Monitoring Plan* (Amec Foster Wheeler, 2016b). The design details for the installed or proposed dam instrumentation is summarized in Table 4-14. The design information provided in Table 4-14 will be confirmed and updated as may be required following development of the As-Built drawings.

**Table 3-6; Dam Instrumentation Summary**

Facility	Section (Sta.)	Dam Instrumentation							Pond Level Gauge (type)
		Slope Stability			Foundation Consolidation		Phreatic Level and Seepage		
		Slope Inclinometers (no.)	Survey Pins (no.)	Survey Monuments (no.)	Vibrating Wire Piezometers (no.)	Settlement Plates (no.)	Vibrating Wire Piezometers (no.)	Standpipe Piezometers (no.)	
TMA North	3+300	0		0	2	1	1	2	TBD
	Mass array				142				
	1+000				2				
	1+380				2	1	1	1	
	1+450	2		2	4	2	1	2	
	1+600	1			4	2	1	1	
	2+200	2		2	4	2	1	2	
	2+350	1			4	2	1	1	
TMA South	Mass array				176				
	0+300			0	1		1		
	0+460	2		0	5		2	1	
	1+450	0	35	0	0	1		0	
	1+500	2		0	4	0	3	0	
	Mass array				82				
TMA West	0+400				2				TBD
	1+000				2				
	Mass array				88				
WMP Dam 1			16					- Staff gauge	
WMP Dam 2	0+950	1	34	0	2	0	2	2	- Survey stakes
WMP Dam 3	0+300	0		0	1	0	1	2	
	0+500	1	17	0	2	1	4	1	
Mine Rock Pond	0+220	1		2	2	1	1	4	- Staff gauge
Clark Creek									- Staff gauge
Teepie Road									- Staff gauge
Stockpile Pond	0+125	1	8	0	1	0	1	2	- Staff gauge
West Creek	0+291				2			2	
	0+320	2	2						- Staff gauge
	0+340	2	2		2	1	1		
Water Discharge Pond									TBD
Constructed Wetlands									
- Pond A									TBD
- Pond B									TBD
- Pond C									TBD
- Pond D									TBD
- Pond E									TBD
Sediment Pond #1									TBD
Sediment Pond #2									TBD
Temporary Sediment Pond									TBD

**Notes:**

- 1) Survey pins installed at 100 m centres along 3-5 lengthwise lines (crest, toes, etc.) Quantities are total for each dam
- 2) TMA Dams feature mass array of WVP instruments installed in grids within the dam foundation. Installation of these instruments is currently on-going

In addition to the instrumentation described above, the TMA dams are equipped with an additional suite of vibrating wire piezometers (VWPs) to provide enhanced monitoring resolution during construction. A total of 524 VWPs were installed in the TMA dam foundations, arranged in a grid pattern, and managed with a remote wireless data acquisition and management system.

Instrumentation associated with the management of the dams is being managed through a software system that includes integration with data loggers and data storage and is configured such that alarms for alert levels are defined and available. The software routinely generates reports and if trigger levels are exceeded sends out alarm notifications.

### **3.3.2 Other instrumentation**

Additional instrumentation to support the OMS manual and management of water includes;

- Densometer on the tailings pipeline;
- Flow meters on the water management pipelines including from the Pinewood River, tailings reclaim lines, MPR line and freshwater line from the WMP and
- Pressure transducers in the WMP, Clark/Teeple Ponds.

This instrumentation provides continuous recording, which is collected during routine inspections and included.

### **3.4 Regulatory Requirements**

Regulatory requirements, permits and authorizations are summarized in section 1.1. Key approvals include the Federal and Provincial Environmental Assessment conditions and commitments and permits including those issued pursuant to the LRIA and EPA. Additional legislation to be considered in implementing the OMS manual includes the MMER and various Ontario regulations including waste management.

No direct discharges are intended from any of the structures described in this section except the WMP which is described in sections 4 and 5. Seepage will be collected and pumped back from the WMP and TMA cells. Subsequent to this revision and LRIA approvals, additional details for the WDP, CW and sediment ponds discharges will be developed.



## 4.0 OPERATIONS

The overall operational objectives of the TMA and associated dams and facilities are to dispose and store the tailings and to manage all site water in a safe, economical and environmentally responsible manner. This section defines operating standards in accordance with design criteria and regulatory requirements specified in section 4.

### 4.1 Water Balance

### 4.2 Tailings transport and deposition

The RRM mill was commissioned in the fall of 2017 with a design throughput of 24,000 tpd. As discussed in further detail in Section 4, final expected effluent quality results indicate that a high-quality effluent approaching ECA permit values can be achieved through a combination of in-plant cyanide destruction using the SO<sub>2</sub>/Air process combined with natural aging in the TMA and the WMP.

#### 4.2.1 Tailings Transport

Tailings will be pumped from the tailings pump box in the mill to the TMA and deposited as outlined in the tailings deposition plans (section 5.1.2) and Appendix D. The tailings and reclaim lines are HDPE pipe and are within lined containment and held in place with clay anchors. The lined containment drains to one of six emergency dump ponds located along the tailings corridor.

#### 4.2.2 Tailings Deposition

The life of mine tailings deposition report (Document 3098004-004000-A1-ETR-0005) is being updated to reflect the operation of Cells 1 and 2. The deposition plan described here is based on the planned revisions. The tailings deposition plan involves discharging tailings from the crest of the dams to produce wide tailings beaches to enhance dam stability and inhibit seepage. In the non-winter months, spigotting will be carried out, with pipeline end-discharge in the winter once suitable beaches are present.

##### 4.2.2.1 TMA Cell 1

Deposition will commence in the start-up cell (TMA Cell 1), which is planned for a total period of six months (October 1, 2017 to March 31, 2018 approx). During this period, supernatant water will be continuously pumped to the WMP. Table 5-1 provides an overview of the tailings deposition volumes and elevations. Tailings deposition for cell 1 is discussed in more detail in the LRIA application (RRP-GEO-LRIA-004C R1 Comments and Responses).

**Table 4-1; Cell 1 Tailings Deposition**

Time Elapsed	Tailings		Water	
	Volume	Discharge Elev.	Volume	Pond Elev.
(months)	(m <sup>3</sup> )	(m)	(m <sup>3</sup> )	(m)
<1	350,000	362.0	140,000	<362.0
1	980,000	366.0	400,000	365.0
4.5	4,500,000	371.4	1,800,000	369.9

Notes: Supernatant and water will be transferred to the WMP daily by pumping, recirculation to the processing plant via WMP intake pumps

Tailings pipelines will follow the TMA South Dam alignment and branch off to the TMA Start-up Cell Dam and West Dam. Spiggotting of tailings into the TMA Start-up Cell (TMA Cell 1) will occur from the TMA South, West, and Start-up Cell Dams, forming a beach upstream of these dams and a central pond that will be pumped into the WMP from the north end of the cell.

Spiggotting will initially occur into a borrow area not exceeding 362 m i.e., below the toe of the start up cell dams. The tailings discharge rate is 5,000 m<sup>3</sup>/day to 9,000 m<sup>3</sup>/day into the borrow, and will be measured by a flow meter on the tailings line reporting to the borrow. This initial volume of tailings will backfill Borrow Area B6 within the footprint of the start-up cell and will not exceed 130,000 m<sup>3</sup>, and will remain below elevation 362.0m. The top of tailings surface will not contact any of the toes of the TMA dams forming the start-up cell until approval to operate the TMA / Start-up Cell has been granted by the MNRF.

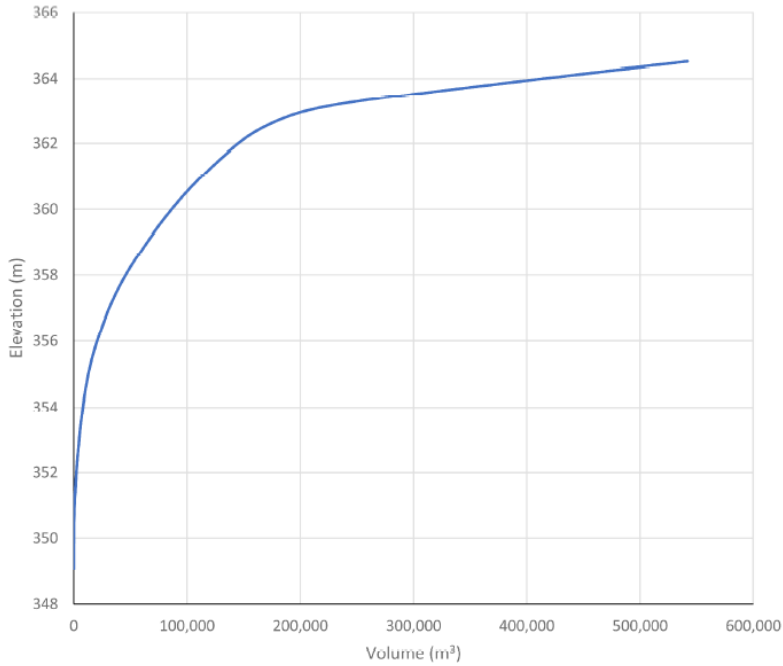
For operation of the borrow, the normal operating pond volume is 10,000 m<sup>3</sup>. The maximum operating water level is 361.9 m. If the MOWL is exceeded tailings discharge will cease and the pond drawn down by pumping to the WMP (e.g., 2 tractor pumps at a combined capacity of 40,000 m<sup>3</sup>/day). A staff gauge will be installed in the SW corner of the borrow (furthest from the tailings discharge), which will be monitored twice per 24h period (every 12h approx.). Within the borrow the volume of storage is 80,343 m<sup>3</sup>, 104,276 m<sup>3</sup> and 164,005 m<sup>3</sup> at elevation 360.0, 361.0 and 362.0 respectively.

Upon regulatory approval for tailings deposition into Cell 1, tailings will be discharged from an elevation of 366.0 m. Areas where the ground elevation is higher than 366.0 m will not discharge tailings (i.e. the high ground around the dam abutments). By month 6 of deposition, the discharge elevation will be moved up to 371.4 m and spiggots will discharge from the south, west, and east sides of the cell. Provisions will be made, as required, to facilitate ongoing construction while discharging tailings.

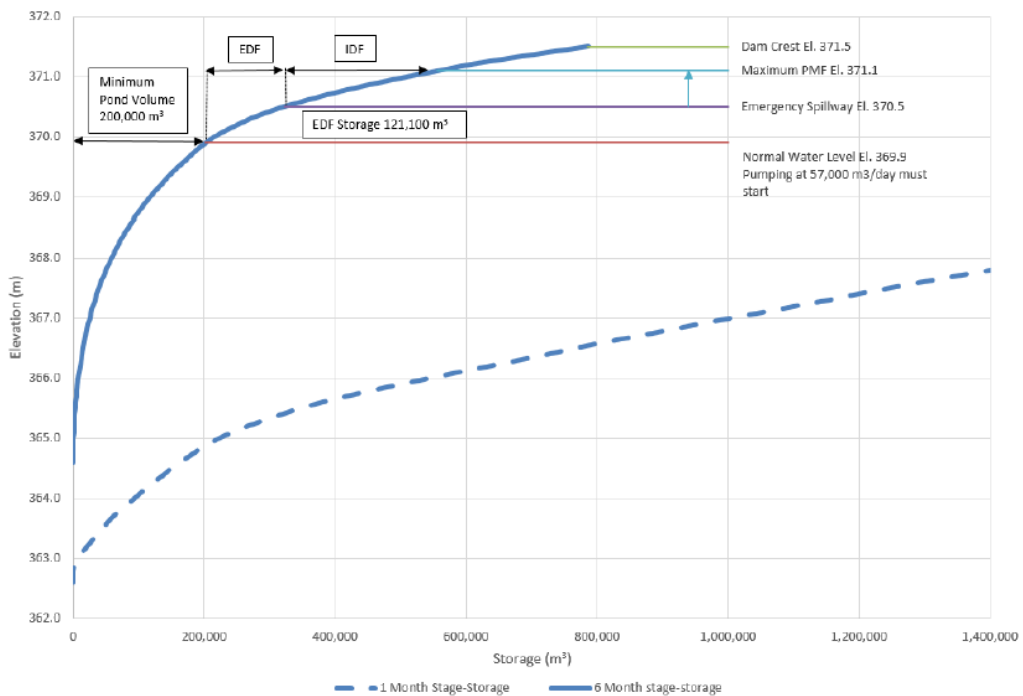
Cell 1 will not discharge to the environment and there is no reclaim direct to the mill, for dam safety and emergency spillway to the north at elevation 370.5 has been constructed. The TMA start-up cell will have a maximum operating water level (MOWL) of approximately 369.90 masl at the conclusion of six months of production, which corresponds to the operational pond volume of 200,000 m<sup>3</sup>. Once the water level reaches above the MOWL of 369.90 m, it will be pumped to the Mill Process Water Tank to contain the EDF event. Due to the limited storage in the TMA start-up cell at this point in mine operations, no operating range can be allowed (i.e., any water above the MOWL must be pumped immediately). During operation of Cell 2, cell 1 will passively overflow into Cell 2.



**Figure 4-1; TMA Cell 1 Borrow Stage - Storage Relationship**



**Figure 4-2; TMA Cell 1 Stage Storage Relationship**



#### 4.2.2.2 Future Tailings Deposition – Cell 2 and Cell 3

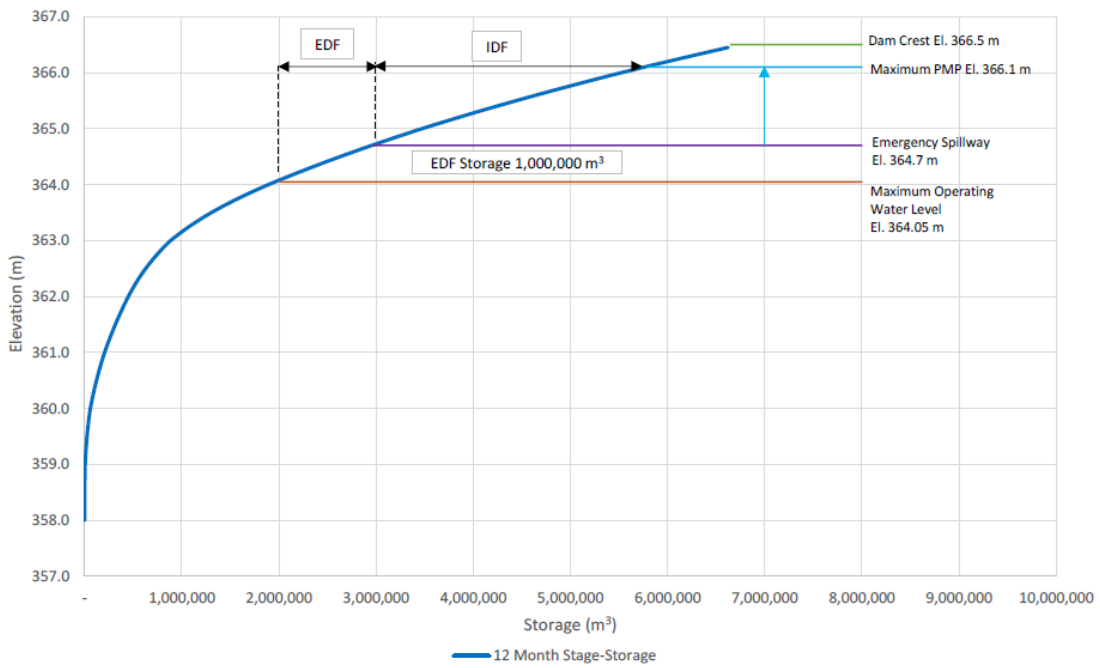
Cell 2 provides for 12 months (April 2018 to April 2019 approx.) of tailings deposition (5.5 Mm<sup>3</sup> of tailings) with a crest elevation of 366.5 m. 12 months is the maximum permitted operating duration for cell 2. Following completion of this dam, and approval from MNRF, Cell 2 will operate as described here based on RRP-GEO-REP-026 R1, April 28, 2017 or as updated in the as-built report. A stage storage relationship is provided below.

- Tailings will be discharged from the northwest side of the dam (upstream slope) for 6 months. This will be followed by discharging from the downstream slope of the TMA Cell 1 Dam for an additional 6 months (or until the TMA South Dam is completed to elevation 366.5 m).
- Surplus water from TMA Cell 1 will overflow by gravity into TMA Cell 2 through the existing emergency spillway. A pond will form in the northwest end of TMA Cell 2 and be reclaimed to the mill via the reclaim line or transferred into the WMP.
- The MOWL of Cell 2 is 364.05 m providing 1 Mm<sup>3</sup> of storage below the 19 m wide north dam spillway invert (364.7 m) to contain the 828,200 m<sup>3</sup> EDF. This will be maintained at all times.
- The spillway will provide 0.39 m of freeboard from the maximum still pond IDF level (366.11 m) to the dam crest (366.5 m)
- Water reclaim to the mill from TMA cell 2 is to occur once water levels in the WMP are below 1.0 Mm<sup>3</sup>. At minimum pumping will commence once Cell 2 pond volume increases to within approx. 800,000 m<sup>3</sup> of the MOWL and will continue until water levels are 1.2 Mm<sup>3</sup> below the MOWL.
- Pumping capacity of 40,000 m<sup>3</sup>/day between TMA Cell 2 to Cell 3. As contingency, pumping will be considered from the WMP to TMA Cell 3 to reduce WMP volumes below 1.0 Mm<sup>3</sup> prior to discharge from the WTP.

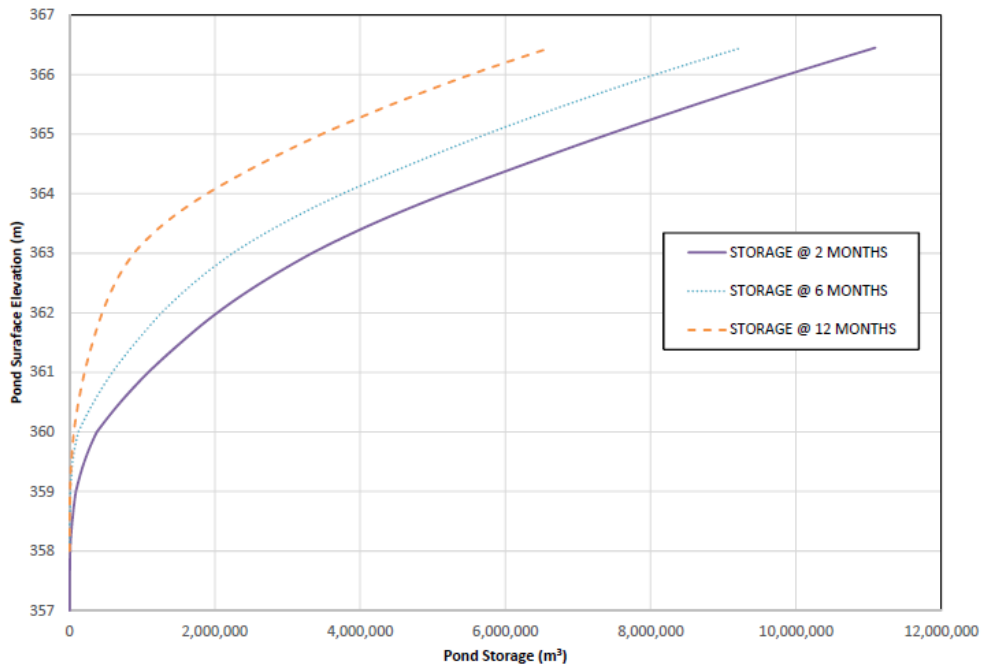
When full containment in the TMA is available (i.e. TMA South Dam is constructed to elevation 366.5 m), tailings will be discharged from the north side of the TMA South Dam (upstream slope) into an area referred to in this report as TMA Cell 3. Cell 3 will be constructed for completion in June 2018, at which time it will be used to manage excess water from cell 2 and the water impounded in the WMP (as described in this manual).

An overflow spillway is detailed for construction at the left abutment of the TMA Cell 2 Dam once the TMA South Dam is constructed to elevation 366.5. This overflow spillway (at 364.5) will provide a conduit to connect the TMA Cell 3 pond with the TMA Cell 2 pond and ultimately with the reclaim/transfer pumps. It's anticipated tailings deposition will occur for 6 months until this occurs.

**Figure 4-3 TMA Cell 2 Stage Storage and Design Pond Levels**



**Figure 4-4 Cell 2 TMA Pond Stage-Storage**



## **Dam Raising**

The dams will be raised to maintain discharge availability and sufficient pond storage capacity to contain the Environmental Design Flood (EDF).

### **4.3 Seepage Collection System**

Seepage collection systems, as described in section 4, are in place and required for the WMP and TMA only. The design criteria of 1:25 yr 24h rainfall results in seepage systems (sumps, pumps and ditches) as described in section 4 (including MOWL) and summated here;

- Cell 1 seepage is not expected to exceed 29 m<sup>3</sup>/day. Three sumps will be pumped back to Cell 1. Sumps 1 and 2 pumping will cease once Loslo Creek is impounded by the TMA south dam (June 2018 approx);
- Cell 2 seepage is expected to not exceed 9.2 m<sup>3</sup>/day and a sump of 8,000 m<sup>3</sup> will be pumped back to Cell 2 until Loslo Creek is impounded by the TMA south dam (June 2018 approx);
- Cell 3 seepage is intercepted and routed by ditch into the water discharge pond, and isn't expected to occur until June 2018 (approx.); and
- WMP includes 3 sumps, including a sump shared with the north starter dam and will be pumped back to the TMA, capacity of the sumps is 18,200, 11,800 and 20,000 m<sup>3</sup> for sumps 1, 2 and 3 respectively.

### **4.4 Progressive Reclamation and Closure**

Some progressive reclamation with respect to the TMA is proposed as part of mine operations. By the end of the operations phase a low permeability overburden cover of approximately 150 m in width will be placed on the upstream side of the TMA dam. The overburden cover will cover approximately two thirds of the ultimate perimeter, with the remaining approximately one third of the length to be reclaimed at closure. This cover is intended to prevent the tailings permanent water cover from coming into contact with the TMA dams, and will also serve a secondary function of limiting oxygen diffusion into the uppermost portion of the tailings underneath. The overburden cover will be seeded or hydroseeded with a native seed mix or equivalent, and will be armoured with NPAG rock at the transition zone of the cover with the tailings to prevent suspension and oxidation of solids.

Closure of the RRM in respect to tailings, process water and freshwater management will include but is not limited to the following:

- Flooding of the TMA with a 2 m or deeper water cover;
- A perimeter zone of tailings beach will be maintained to keep the central pond away from the dams, this zone will be covered with a low permeability cover;
- NPAG rock will be placed at the TMA transition zone with the tailings to prevent erosion and suspension and oxidation of solids;
- Dam structures containing the TMA have been designed with adequate safety factors to provide overall long term safety and stability;
- The water management pond dams will be breached to prevent retention of water; upstream dam faces that become exposed will be revegetated;

- The water discharge pond dam will be breached once it no longer has a water management function;
- The constructed wetland will be left in place as this system is designed to operate passively, and will have stabilized as a wetland complex during operations;
- At closure the MRP will collect runoff and seepage from the EMRS which will then be directed to the Open Pit to help flooding;
- Clark Creek Pond, West Creek Pond, Teeple Pond, Stockpile Pond, West Creek Diversion Channel, Clark Creek Diversion Channel, Teeple Pond Diversion Channel and Stockpile Pond Diversion Channel support the creation of fish habitat for compensation purposes as such they will remain in place at closure; and
- Sediment Ponds #1 and #2 will be maintained until such time as the site (or if applicable individual site components) become a recognized closed mine such that monitoring associated with the Metal Mining Effluent Regulation is no longer required, at such a time, pond impoundment structures will be breached and the residual pond sites will be stabilized and restored.

#### **4.5 Safety and Security**

The site safety and security will be following the RRM Health and Safety Management System including but not limited to the following:

- The site will be gated with restricted access to authorized personnel only;
- The TMA will be fenced along portions of the old highway 600 and access will be restricted to authorized personnel only;
- No public access;
- Construction Management provided security measures; and
- Onsite health and safety policies for working around bodies of water, working alone or crossing ice.

#### **4.6 Environmental Protection**

The Environmental Department has oversight over the EMS which contains tailings operations related environmental aspects including:

- Fugitive and point source dust emissions;
- Hydrocarbon Spills and Leaks;
- Pipeline Rupture and Leaks;
- Surface and ground water quantity and quality; and
- Wildlife management (including species at risk).

An environmental aspect register is a comprehensive inventory of tailings operations activities, environment aspects, assessment of risk and identification of controls. Tailings personnel have responsibility to implement and maintain the controls including monitoring and inspection. Refer to the Environment Department for the environmental aspect register (in prep) and environmental related procedures.

As outlined in orientation training, it is every RRM employee’s responsibility to report a suspected spill or uncontrolled release event to their supervisor. This includes suspicious flows of water out of the area, escaping tailings, etc. The sooner appropriate persons can begin to correct a situation, the less likely it is that severe impacts will follow.

Table 5-3 provides a summary of the MECP effluent discharge limits that must be met to discharge from the WMP.

**Table 4-2; MECP Effluent Discharge Limits from the WMP**

<b>Constructed Wetland Final Discharge and Water Management Pond Pipeline Discharge (to the Pinewood River) as stated in MECP ECA 5178-9TUPD9</b>		
<b>Effluent Parameter</b>	<b>Daily Maximum Concentration (mg/l)</b>	<b>Monthly Average (mg/l)</b>
Cadmium	-	0.0010
Cobalt	-	0.0044
CBOD5	-	25.0
E.coli	-	100/100ml geometric mean density
Total Suspended Solids	30	15
Total Phosphorus	-	0.10
Cyanide (total)	0.1	0.05
Cyanide (free)	0.02	0.01
Total Arsenic	0.034	0.017
Total Copper*	0.028	0.014
Total Nickel	0.094	0.047
Total Lead*	0.030	0.015
Total Zinc*	0.348	0.174
Un-ionized Ammonia	0.08	0.04
Acute Toxicity (Rainbow Trout and Daphnia Magna)	Non-acutely lethal (not greater than 50% mortality in undiluted effluent)	
pH of the effluent maintained between 6.0 to 9.5, inclusive, at all times		
<b>Notes:</b>		
<ol style="list-style-type: none"> <li>*Proposed effluent criteria for Total Copper, Total Lead, and Total Zinc are based on a hardness of 200 mg/L CaCO<sub>3</sub>. In the event that water quality sampling indicates that 75<sup>th</sup> percentile hardness concentrations are less than 200 mg/L CaCO<sub>3</sub>, the effluent limits may be changed by the District Manager in writing, consistent with achieving no impairment for receiving waters.</li> <li>Additional effluent limits for sediments 1&amp;2 are stated in MECP ECA 5178-9TUPD9</li> <li>The effluent discharge rate from the Constructed Wetland Final Discharge and the Water Management Pond Pipeline Discharge such that at all times the ratio of the combined flow rate of these effluents to the flow rate of the receiving surface water (Pinewood River) is less than or equal to 1:1 (i.e. the cumulative flow rate of the effluent must be less than or equal to the flow rate of the receiving surface water).</li> <li>Prior to commencing Operations Phase discharges (Constructed Wetland Final Discharge, Water Management Pond Pipeline Discharge, Sediment Pond #1, and Sediment Pond #2), the method for determining daily effluent to receiver flow mixing ratios shall be approved by the District Manager.</li> <li>For sampling frequencies and full parameter list refer to MECP ECA 5178-9TUPD9; sampling frequency varies from thrice weekly to quarterly depending on the parameter</li> </ol>		

#### **4.7 Reporting Requirements**

Reporting is sub-divided as routine, planned reports of defined frequency, and those that are non-routine i.e., event driven.

##### **Routine**

- Submission of asbuilts within 3 months of construction for WMP, TMA, MRP and sediment ponds 1 and 2
- Monthly monitoring report including a summary of all monitoring data collective, all non routine calibration/maintenance procedures, tabulation and description of any bypass/upset conditions
- Annual reporting to MECP on March 31 for the previous year, a works performance report and a surface water monitoring report
- Quarterly electronic effluent monitoring reports to ECCC
- Annual electronic effluent monitoring report and environmental effects monitoring reports to ECCC by March 31

##### **Non-routine**

- Report all spills as defined in the Environmental Protection Act immediately to spills action centre SAC, follow New Gold Incident Reporting Guidelines and follow up in writing to MECP within 10 days describing the cause and discovery of the spill or loss, clean-up and recovery measures taken, preventative measures to be taken and schedule of implementation
- Any observation of sheen/foam/settable solids within the works report immediately to (SAC) immediately and written reporting within 7 days
- Any exceedance of effluent limits report to SAC immediately, written confirmation to MECP within 7 days
- If acute toxicity tests fail, within 15 days report in writing to MECP with the cause and remedial actions proposed/implemented
- Notify ECCC immediate if MMER Sch 4 limits are exceeded, pH is outside 6-9.5 range or if the effluent is acutely lethal with a written report within 30 days

Records are retained consistent with CEAA condition 11 for a minimum of 25 years or until decommissioning ends, whichever is longer and kept locally. This exceeds the ECA permit requirement of 3 years. Records include place/date/time of sampling, dates and analysis performed, analytical techniques used, names of persons collected/analyzing sampling and results of analysis.

An Operations Report will be prepared by the Mill Manager or designate. The report will include metrics and information collected as part of normal operation. Examples of information contained in the Operations report include:

- Total monthly tailings deposition tonnage and slurry water volume;



- Total monthly reclaim volume;
- Pond level and freeboard;
- Updated water balance;
- Water quality results; and
- Intake / Discharge quantities.

Each of the regulatory approval requirements related to the construction, operation and eventual reclamation of the Site have specific compliance reporting requirements with defined deadlines or reporting periodicity. In general, the reporting includes:

- Operation, Maintenance and Surveillance Plan(s) for dams, water management (water quality) and air/noise emissions;
- Emergency Preparedness Plan(s);
- As-Built Drawings and related Construction Reports;
- Dam Safety Inspection and Review Reports
- Environmental Monitoring Plans; and
- Environmental Monitoring and Performance Reports.

The environmental approvals and permits received from the government that are maintained by the New Gold Environmental Department should be referred to for details of monitoring, inspection and reporting requirements.

In addition, the New Gold Environmental Department should be notified of any proposed major modification to RRM facilities, in order that they can liaise with the appropriate government ministries to determine if additional approvals or amendments to existing approvals are required.

## **5.0 MAINTENANCE**

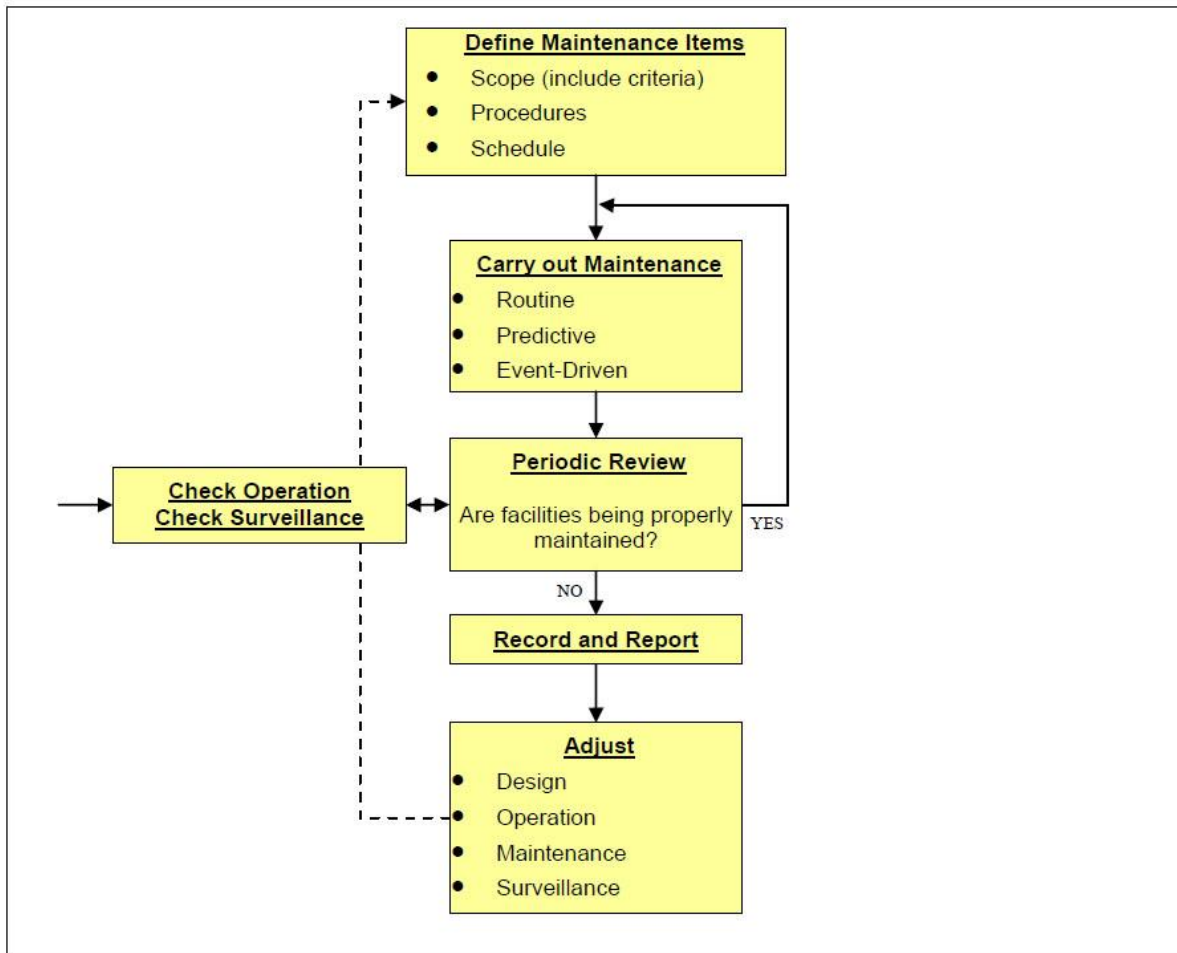
The following periodic maintenance is required:

1. Maintain the tailings and reclaim pumps and associated lines and containment;
2. Clear debris, snow and ice which may block flow through the decant facility or emergency spillways;
3. Maintain water management structures including spillways, ditches and diversions;
4. Maintain equipment, power and water lines, and instrumentation;
5. Repair any deficiencies as noted in the Dam Safety Inspections (DSI); and
6. Reconstruct the support for tailings discharge pipelines wherever washouts occur.

Maintenance records are retained by maintenance personnel performing the work in accordance with the procedures described in this document. Timing of maintenance actions for unusual conditions should be based on specific recommendations from surveillance findings. Scope and time frames for routine maintenance activities are determined and scheduled by the Maintenance Department and based on manufacturer's recommendations and best practices.

The maintenance flowchart is illustrated in Figure 5-1.

**Figure 5-1 Maintenance Flow Chart**



### 5.1 Routine and Predictive Maintenance

Routine and predictive maintenance includes removal of vegetation, beaver dams, ice blockage or sediment accumulation that would otherwise affect the performance of a structure when required.

### 5.2 Maintenance and Emergency Preparedness

A weekly table-top exercise will be conducted with the pump management team to ensure that crews are intimately familiar with the operational strategies for a broad range of operating and emergency scenarios. These table tops will be documented and New Gold management

will ensure that any ongoing lessons learned from day-to-day operation are captured including the updating of any corresponding plans, maps, flowsheets or procedures.

The maintenance of pumps is the responsibility of New Gold and maintenance records are required to be maintained. Each installation requires to be equipped with spill pan, spill kits and the necessary signage. Changes to pumping configurations, ditching, piping or operating parameters need to be approved by the New Gold Mill Manager, the New Gold Maintenance Manager and the New Gold Environmental Manager, during normal working hours. This is particularly the case if splash pads need to be altered in any way. In an emergency call out (after hours), the Managers or their alternate, will provide direction in consultation with the New Gold Environmental Department.

During depositing of tailings the above-mentioned crews are required to complete their inspections daily. Reporting is to be escalated to hourly observations if a rainfall event is escalating and the Cell 2 level is within 200 mm of the intermediate fill elevation of 363.2 masl. The general manager can then decide whether to provide additional surveillance resources in the case where additional duties including maintenance and operation of the Cell 2 dewatering pumps is required to be performed by the allocated crews.

A summary report titled " TMA Cell 2 Water Levels " is circulated each morning at 9 a.m. to summarize the measured water and tailings levels as of 4 p.m. the day prior. This report is prepared and circulated by the mill superintendent or his alternate. The purpose of the report is to highlight trend data for Cell 2.

Fundamental to the successful operation of the ponds and pumping strategy is a timely reaction to rainfall events, and ensuring that pumps come 'on line' or are taken 'off line' as design trigger levels are reached.

### **5.2.1 Dams**

The following are examples of specific maintenance activities:

- Regularly check diversion ditches, spillways and culverts for accumulation of debris or sediment, or any other form of blockage including ice, and remove if required;
- Visually inspect diversions, spillways, seepage collection sumps, dams and all ditches for cracking, bulging, slumping, and any other indications of slope movement (note, any indications of slope movement shall be reported to a qualified geotechnical engineer);
- Re-grade the dam crest, as required, to prevent local ponding and direct surface runoff towards the pond;
- Repair erosion gullies, local slumps or slides in the dam face, diversion ditches or spillway channels; and
- Regularly check diversion ditches for accumulation of debris or sediment, or any other forms of blockage, and remove if required.

- If annual survey determines necessary, correct dam crest, overflow spill way and diversion channel invert irregularities to avoid concentrated runoff.

### **5.2.2 Geotechnical and Water Monitoring Instrumentation**

Instrumentation is calibrated by the manufacturer prior to shipment. Calibration certificates will be maintained by maintenance department. Following instrument installation, initial reading procedures will be followed. Subsequent calibration will follow manufacturer's recommendations.

Malfunctioning or damaged instruments may require repair or replacement per manufacturer guidelines or approved procedure. In the event of replacement of dam instrumentation, several overlapping readings of the old and new instrument are required to ensure continuity of the data records.

### **5.2.3 Pumping Systems and Pipelines**

Maintenance of the tailing delivery, water recirculation systems and seepage pumps will include:

- Perform regular performance tests of the Pinewood Pumphouse pumps and inspections of pump fish screens to remove any debris;
- Perform regular performance tests on seepage pond pumps
- Perform annual calibration and maintenance as required on flow meters;
- Perform regular non-destructive testing appropriate for components of the tailings delivery system, including for example, periodic measurement of pipeline thickness to identify areas of wear and to schedule pipeline replacement if necessary and repair liners as required;
- Replace pipe work, bends and fitting components as required;
- Remove accumulated debris from valves, reducers and off takes;
- Carry out maintenance as recommended by fitting and valve suppliers;
- Regularly inspect major wear components;
- Maintain emergency dump ponds in a dewatered/empty state; and
- Maintain and replace system instrumentation as required.

### **5.2.4 Mobile Equipment**

Mobile equipment is maintained on the basis of a planned reliability program and as otherwise required. Equipment in question includes:

- Dozers;
- Excavators;
- Water truck;
- Pickup trucks;
- Mobile crane;
- Flatbed and picker truck; and
- Replacement of mobile equipment as required.

### **5.3 Event-Driven Maintenance**

In the event of unusual conditions or incidents that require immediate maintenance actions but are not considered an emergency, repairs and replacement of facility components are made as required and activities are documented. RRM staff will provide a means to assess event driven maintenance needs through response action planning. Response planning is based on risk prioritization, maintenance crew mobilization or “call out” procedures, required repairs and replacement material availability. Event driven maintenance actions will follow applicable safety and performance procedures. Normal documentation and maintenance records will be maintained as a result of any event driven maintenance actions. Unusual conditions that require maintenance are also communicated to maintenance staff as they occur.

#### **5.3.1 Pipeline Leaks or Breaks**

In the event of a pipeline leak or break the system in question is de-energized and repaired as follows:

- Inspect entire pipeline;
- Repair or replace affected components;
- Perform opportune and scheduled maintenance;
- Repair any collateral damage caused by a leak or break;
- Collect any released tailings and place in the tailings impoundment;
- Reclaim any disturbed areas; and
- Follow any spill reporting that may be required pending type of spill and following documentation procedures.

#### **5.3.2 Earthquake Occurrence**

Following an earthquake, the following are undertaken:

- Inspect dam and beach areas for sign of distress due to deformation;
- Inspect dam for signs of liquefaction (e.g., local sand boils, etc.);
- Measure freeboard for compliance with design requirements;
- Inspect toe area of dam for signs of deformation or piping of fines;
- Inspect diversions, ditches and spillways for sign of slumping or changes in geometry;
- Inspect seepage collection areas; and
- Collect instrumentation data and submit to EOR for analysis.

#### **5.3.3 Flood Event**

Following extreme storms (as defined in section 7) the following are undertaken:

- Measure freeboard for compliance with design requirements;
- Inspect dam, diversions, ditches, spillways and diversions for signs of excessive erosion and repair if required;
- Inspect seepage return system for adequacy; and

- Implement appropriate response based on observations/measurements as defined in this manual.

#### **5.4 Reporting Requirements**

Maintenance information will be communicated internally through formal and informal meetings, interaction between various levels of the organization (department and/or crew meetings), through information posted at the site and through this OMS Manual.

Communications with applicable contractors involved in tailings management will be conducted daily and weekly during tailings activity meetings, as appropriate. All employees and contractors are encouraged to communicate openly with site management about operational conditions requiring maintenance and reporting any significant observations such as event-driven maintenance or any maintenance requirements that exceed expected norms.

Equipment logs and manuals will be maintained for reference and use by responsible staff.

Maintenance diaries and logs shall be maintained and accessible for review by other parties.

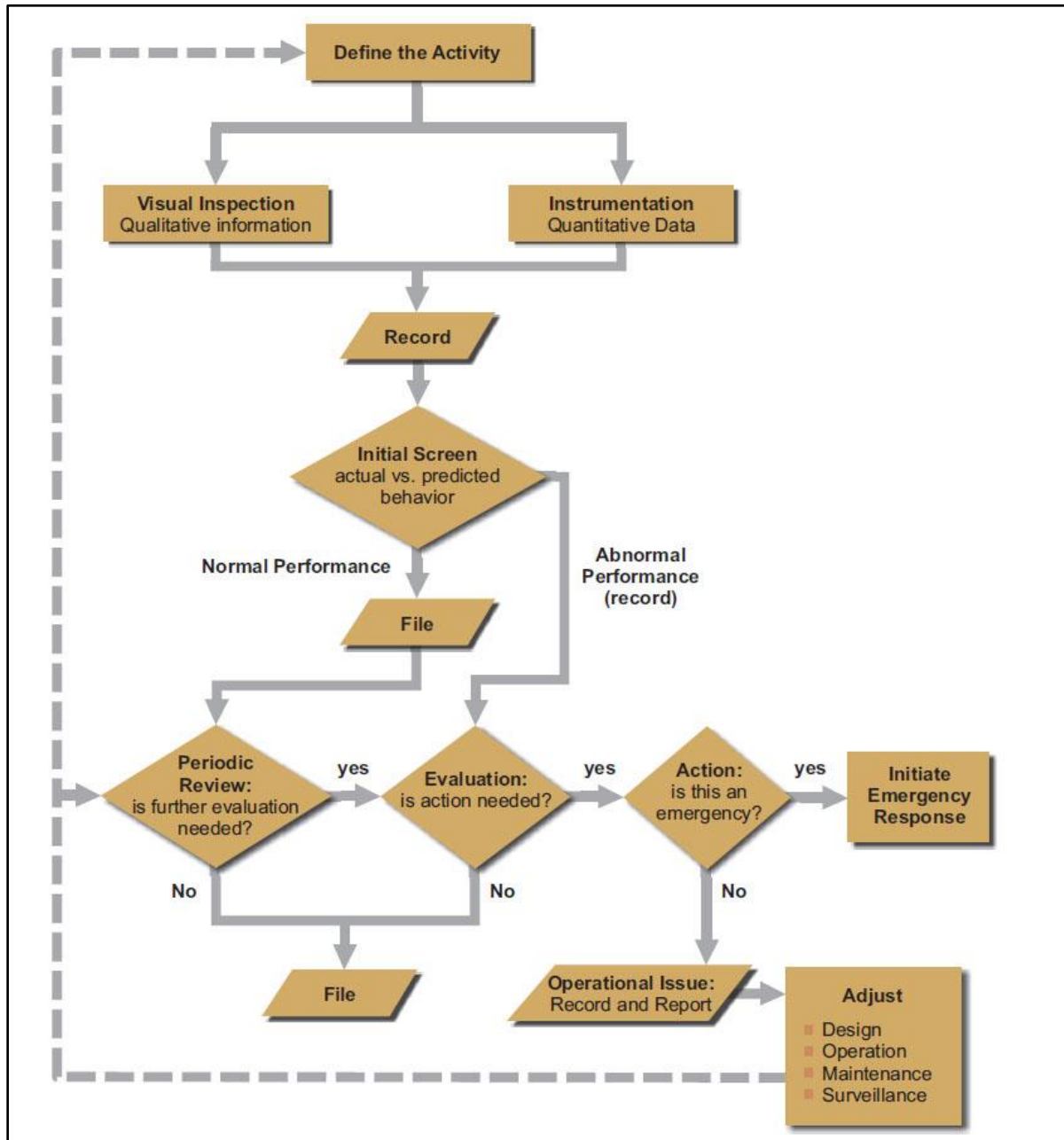
#### **6.0 DAM SAFETY AND SURVEILLANCE**

The RRM tailings and water management surveillance activities involve inspection and monitoring of the operation, structural integrity and safety of a facility. Regular review of surveillance information can provide an early indication of performance trends that, although within specifications, warrant further evaluation or action. The objectives of our surveillance program are as follows:

- Monitoring the operation, safety and environmental performance of tailings and water management facilities;
- Promptly identifying and evaluating deviations from expected behavior that affect operational safety, structural integrity and environmental performance of the facility; and
- Reporting significant observations for response.

The flow chat for surveillance is shown in Figure 7-1. Surveillance is undertaken in two primary methods – visual inspection and reading of instruments. Results of these qualitative and quantitative observations are compared to the expected performance of the TMA and water management facilities. If observations are within the expected range or performance, the results of the surveillance are simply recorded. If observations are outside the expected range, further evaluation is completed to determine if remedial action is necessary. If necessary, this action is taken and may range from a minor adjustment to operational procedures to initiation of emergency response, depending on the severity and nature of the deviation from expected performance.

**Figure 6-1; Surveillance Flow Chart**



**6.1 Surveillance and Inspections by Mine, Mill and Environment Operations Staff**

The purpose of the surveillance program is to identify and classify problems and/or unsafe conditions that are visually evident. Visual inspections are an integral part of proper maintenance and performance of monitoring programs for the TMA and water management facilities. Failure to correct identified maintenance and repair items, or potential adverse behaviour, could result in unsafe conditions or lead to a failure of operating systems or cause an adverse environmental effect.



The surveillance program will consist of making regular observations relating to:

- The conditions and performance of the dams including indications of cracking, bulging, depressions, sinkholes, vegetation, surface erosion and seepage;
- Water levels and pump intake zones;
- Function of ancillary hydraulic structures (diversions, spillways, pipelines etc.);
- Discharge pipeline operations and tailings beach development; and
- Total facility performance.

During inspections, observations will be made at the upstream slope, crest and downstream slope with respect to signs of erosion, scouring, cracking, settlement, deformation, and any instability and abnormality. Seepage rates will be visually estimated and recorded on the inspection forms. Changes in the seepage rate or clarity (i.e., turbidity) require immediate reporting to the Engineer-of-Record.

### **6.1.1 Daily Inspections**

During first filling of all dams except the TMA dams Surveillance records will be maintained in logs at site and submitted to the EOR for review daily and on a monthly basis thereafter, or more frequently as warranted. Any abnormal behaviour including slope slumping, erosion of crest settlement will be reported immediately to the Engineer-of-Record.

Routine daily visual inspections of critical dams (TMA, WMP and MRP), spillways, pipelines, pipeline containment and pumping infrastructure will be carried out on an on-going basis to confirm normal operations and identify unusual or anomalous conditions such as pipeline leaks, pump intake blockages, etc. All active pipelines will be inspected twice per 12 h shift, consistent with EA conditions.

Daily inspection sheets and provided in Appendix F.

### **6.1.2 Weekly Inspections**

Physical inspections of the TMA, process water, water treatment and diversion dams will be conducted on a weekly basis. The weekly inspections will include those discussed in Section 7.1.1 and the following tasks:

- Photographic record of key features;
- Physical inspection of dams, dykes, diversion, ditches and spillways:
  - Indicating and reporting any seepage and erosion.
- Pond levels and freeboard:
  - Additional monitoring maybe required during spring freshet of the dams.

Weekly inspection sheets and SOPs are provided in Appendix F. All weekly inspections will be documented in a report and will be compiled as part of the annual DSI (Section 7.4).

## **6.2 Inspection Required After an Unusual Event**

Several potential failure modes exist for the various tailings and water management and water diversion storage facilities. These potential failure modes, along with likely triggers, observable visual and instrumentation indicators of the failure mode are presented in Table 9-1. Special inspections will be carried out immediately if any of the following events occur:

- Events such as an earthquake, large rainfall (greater than 1:2 year rainfall (51mm)) or large snowfall/snowpack;
- Operating events such as rupture of a pipeline, particularly if on the slope or crest of the dam, sudden loss of pond water, sudden rapid rise of pond water;
- Observations such as cracks, excessive settlements, sinkholes, large slope or foundation deformations, increased seepage, turbidity of seepage water; and
- Instrument readings that deviate from historical trends, or are within “alert” action levels (e.g., trigger levels).

Special inspections after unusual events are necessary as summarized in Tables 7-1 to evaluate whether there has been any damage requiring correction, any safety measures or special operating procedures that need to be implemented, or if there is a need to initiate emergency procedures as described in Section 9.0.

**Table 6-1 Maintenance Requirements following an Unusual Event**

Unusual Event	Post – Event Inspection/Surveillance
Earthquakes	Carry out a detailed walkover of all dam structures, including crests, downstream and upstream (visible) slopes and dam toes, and all spillways, looking for signs of cracks, bulging, settlement and/or other deformations. Look for and note any changes in seepage, particularly with respect to the rate of seepage flows at dam slopes and seepage clarity. Read all piezometers. Inspect downstream toes of dams for sand boils and dam slopes for sinkholes. Inspect ponds upstream of the dams looking for 'whirlpools'. Inspect all pump stations and pipelines. Discuss findings with the Dam Safety Inspector.
Rapid snowmelt and/or heavy rainstorms exceeding a 1:2 year rainfall (51 mm)	Inspect the (visible) slopes and the crests of all the tailings dams looking for areas of concentrated runoff and erosion. Make note of saturated ground/soft ground conditions at dam slopes and toes. Examine dam slopes for indications of localized slumping/instability. Inspect all pump stations and pipelines. Check the water levels in all ponds/reservoirs against the critical levels, and keep checking these levels until the pond/reservoir inflows subside. Discuss findings with the Dam Safety Inspector. Check piezometric levels at dam sites if instructed to do so.
Unusually high winds (exceeding 60 kph i.e., 75 % of maximum likely used in design)	Check the condition of erosion protection on the upstream slopes of the dams.
Extreme snow pack (170cm cumulative snowfall) (i.e., 120% or greater than normal snowfall at Barwick)	Check the water levels in all ponds/reservoirs against the critical levels, and keep checking these levels until the spring freshet is over. Evaluate the situation in terms of possible snowmelt scenarios. Make predictions as to the expected storage capacity available in ponds/reservoirs. If deemed necessary, mobilize pumping and mobile treatment equipment to site.
Significant, relatively rapid erosion (any cause) of dam slope or 'sudden' seepage break at dam slope or downstream of dam in form of continuous seepage or boils	Inspect clarity of seepage, rate of seepage and amount of material sloughed. Notify tailings coordinator – site engineering and EOR.  Consider initiating Emergency Response Plan
Pond level close to, or approaching a critical level	Notify Manager. Consider initiating Emergency Response Plan
Significant change in an instrumentation reading – see table below for definition of significant change	Check the historical readings paying special attention to seasonal changes and check the measurement again.  Carry out visual inspection of all areas in the vicinity of the instrument of interest. Contact the Engineer of Record.

### 6.3 Dam Instrumentation and Monitoring

The instrumentation data is reviewed regularly to identify anomalous readings that could indicate a change in the conditions of the tailings and water management facilities. Dam instrumentation lists are provided in section 4.6. Instrumentation reading and reporting frequencies are outlined in Table 7.2. Responsible parties' record notes and takes pictures of any potential anomalies to provide further information to the EOR. Instrument trigger and alert levels are provided in Table

7.3. Additional details on instrument reading frequencies can be found in the *Geotechnical Monitoring Plan* (Amec Foster Wheeler, 2016b).

**Piezometers:**

- Vibrating Wire Piezometers shall have a reading frequency every hour and recorded by a data logger, with data collected daily during construction. Post-construction after the readings have stabilized, the reading frequency will be reduced to every 12 hours, as defined in the table below;
- Standpipe piezometers shall be measured weekly during construction and monthly following construction;
- The following are considered anomalous:
  - Sudden increases or decreases that do not correlate with seasonal variations (e.g., groundwater recharge during snowmelt affecting foundation piezometers);
  - Trend of piezometric increase that approaches or exceeds the rate of rise of the tailings pond; and
  - Pattern of sudden and large increases followed by rapid declines.

**Inclinometers:**

- Inclinometers shall be monitored semi-weekly during construction and weekly following construction;
- Anomalous data includes:
  - Sudden increases in cumulative displacement/rate of movement of the inclinometers;
  - Zones of concentrated or discrete displacement; and
  - Blockages of the inclinometer casing.

**Settlement Plates and Survey Pins/Monuments:**

- Settlement Plates and Survey Pins/Monuments shall have a reading frequency of semi-weekly during construction and weekly following construction;
- Anomalous data includes:
  - Sudden displacements of the settlement monuments (x, y, z directions); and
  - Accelerating displacement trends (over two or more readings).

If anomalous readings are observed, the following actions should be taken:

- Check data, reductions and calculations for accuracy and correctness;
- If no errors are found in the calculations, notify the EOR, Geotechnical Engineer and Environmental Manager that an anomalous reading has been observed and that further assessment is going to be conducted;
- Check readout equipment to verify that it is functioning correctly; verify calibration;
- Re-read all instrumentation of the type for which the anomalous reading was observed, in order to check the reading and reading in adjacent instruments;

- If it is observed that an instrument or piece of readout equipment has stopped functioning, notify the Mill Manager and/or Superintendent, and the EOR immediately. If considered critical, a replacement instrument should be installed;
- If the anomalous reading is confirmed, notify the Superintendent and EOR immediately; and
- A detailed review of the effects of the reading should be carried out and the monitoring frequency of the instruments in the area of the anomaly increased to assess the progression of the anomaly. Design or remedial actions should be implemented if determined necessary.

All results are downloaded and provided to the EOR. Any anomalies are noted and a request for an additional reading may occur. The EOR will review the data in quarterly monitoring reports, and make any recommendations, such as increased reading frequencies, pertaining to anomalous readings. The EOR, will also assess the trigger and alert levels and update them as necessary, once per year, as part of the DSI.

**Table 6-2; Dam Instrumentation Surveillance Requirements**

Type	Frequency
<i>Routine Inspection:</i>	
Dam	Weekly
Diversions	Weekly
Ditches	Weekly
Seepage collection system	Weekly
Spillways	Weekly
Pipelines	Once per 12 h shift
<i>Tailings Pond Monitoring:</i>	
Pump intake	Weekly
Staff gauges	Weekly (initially every ~12h) in Cell 1 borrow
Inflows, Outflows, Condition	Monthly
<i>Dam Instrumentation:</i>	
<i>TMA, WMP and MRP Comprehensive (and water diversions during initial filling)</i>	<ul style="list-style-type: none"> <li>• Daily during construction and initial filling</li> <li>• Weekly, during initial operations depending on trend</li> <li>• Monthly during routine operation</li> </ul>
<i>Annual Dam Inspection</i>	Annually, with no snow cover
<i>Event Driven Inspection</i>	Following unusual events (defined in table 7.1)
<i>Comprehensive Review (DSR):</i>	
Low and Moderate HPC dams	Every 10 years and prior to decommissioning
Very High HPC dams	Every 5 years and prior to decommissioning

Notes:

1. Dam Hazard Potential Classification (HPC) requires review when changes are made or downstream conditions change.
2. Monthly facility inspections should be carried out by the same staff or small group of staff such that subtle changes in the conditions can be detected.

**Table 6-3; Instrument Trigger and Alert Levels**

Instrument	Parameter	Trigger Level	Alert Level	Remarks
VWP/STP	Pore Pressure Ratio	$r_u = 0.4$	$r_u = 0.5$	Pore pressure data to be evaluated with corresponding fill elevation, and monitored movements at SPs and INs
Survey Pin	Lateral Movement Rate	Uniform (but less than max 75 mm magnitude)	Accelerating	To be evaluated with IN data to define zones of movement
Slope Inclinometer	Lateral Movement Rate	Uniform	Accelerating	Deformation rates will be associated with rate of construction and post construction movements
	Share Strain Magnitude	2%	5%	If specific plane(s) of shearing is observed within the foundation, the construction shall be limited, progressed with caution or ceased depending on the observed phenomena
Notes: 1. $r_u$ of 0.4 corresponds to a piezometric head at 80% of the dam height. $r_u$ 0.5 is at piezometric head at the crest of the dam. 2. $r_u$ of 0.5 is a design criteria to meet dam stability requirements. Source; Geotechnical Monitoring Plan (AMECFW, August 2016)				

## 6.4 Dam Safety Inspections (DSIs) and Dam Safety Reviews (DSRs)

Consistent with MECP ECA approvals, with the regulatory exception of the Clark and West Creek Diversions, engineering inspections will be conducted following best management practices as per the Canadian Dam Association's (CDA) Dam Safety Guidelines (2007, revised 2013, as amended from time to time), and the 2014 CDA Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams (as amended from time to time).

### 6.4.1 Dam Safety Inspections

Annual inspections are intended to be part of a more thorough review of the condition of the facility, and are carried out by the EOR. The inspections will include the following key items:

- Visual inspection of the facility by the engineer, including taking appropriate photographs of the observed conditions;
- Review of routine inspection records prepared by operating personnel in the past year;
- Review whether or not recommendations from previous year's inspection(s) have been addressed, and any incidents or actions arising from those previous recommendations;
- Review of instrumentation and monitoring data;
- Review of tailings deposition and water management operations of the facility including reconciliation of the annual water and mass balance. Review of pond levels (and depth) and freeboard, and reports of any incidents (and remedial measures) that may have occurred;

- An evaluation and interpretation of the structural performance of the dam and related components, and identify any potential safety deficiencies or recommended items that need to be addressed in the coming year;
- Review construction records, QA/QC data and as-built information on dam construction and beaching; and
- Evaluation of the OMS Manual to assess the need for updating.

The results of the inspection and review will be documented in a report.

#### **6.4.2 Dam Safety Review**

The Canadian Dam Association (CDA) Dam Safety Guidelines (CDA, 2007) recommend a comprehensive dam safety review be carried out every 5 years during operations, prior to decommissioning and following closure, by a qualified 3<sup>rd</sup> party consultant.

The comprehensive review provides independent verification of:

- Safety and environmental performance of the facility;
- Adequacy of the surveillance program;
- Adequacy of delivery of OMS Manual requirements;
- Design basis with respect to current standards and possible failure modes; and
- Compliance with new engineering standards (including analysis to confirm if necessary).

#### **6.5 Documentation**

Documentation of surveillance and monitoring activities shall be maintained by the Mill Manger, or as designated, as described in the preceding sections and will include recording of:

- Routine visual observations (departures from normal conditions);
- Photographs;
- Instrumentation monitoring and testing;
- Analyses and evaluations; and
- Reviews.

Documentation will include, as a minimum, the following:

- Weekly routine inspection log;
- Monthly tailings facility and process water pond monitoring report;
- Quarterly instrumentation reports;
- Annual Dam Safety Inspection reports; and
- Comprehensive Dam Safety Review report every 5 years.



Documentation will include a hard copy (paper) and electronic filing system for inspection reports, photographic and video records, incident reports, instrumentation readings, instrumentation plots, annual inspections and third-party reviews, so that they can be quickly retrieved for review and in case of an emergency.

## **6.6 Reporting**

The Mill Manager, or designated responsible party, and Geotechnical Engineer will review collected data records from facility monitoring and assess the need for maintenance activities or response. Corrective actions will be identified and tracked to closure. The Environmental Manager is responsible for overseeing sample and data collection and analysis. Reporting will meet MECP requirements and the annual DSI report will also be submitted to the MRNF. Reporting includes;

- As built reports of the dams, excluding the Clark and West Creek diversions, will be submitted to MECP within 90 days of completion;
- An annual report based on the DSI including ECA approval requirements;
- Monthly water quality monitoring report; and
- Annual report including any operating problems and corrective actions, a summary of calibration and maintenance works, use of contingency plans, surface water and groundwater monitoring reports including water balance, ML/ARD updates, discharge volumes and quality.

Additional reporting requirements may be developed as the RRM progresses.

## **7.0 CLOSURE PLAN**

This section summarizes the objectives of the Closure Plan. The *Rainy River Project – Closure Plan* (Amec Foster Wheeler, 2015c) provides the closure plan and includes temporary closure options for short and medium-term shut-down of site facilities.

### **7.1 Tailings Management Area**

Closure of the TMA will include, but is not limited to, the following:

- Flooding of the TMA with a 2 m or deeper water cover;
- A perimeter zone of tailings beach will be maintained to keep the central pond away from the dams, this zone will be covered with a low permeability cover;
- NPAG rock will be placed at the TMA transition zone with the tailings to prevent erosion and suspension and oxidation of solids; and
- Dam structures containing the TMA have been designed with adequate safety factors to provide overall long term safety and stability.

### **7.2 Monitoring**

Monitoring requirements are described in the *Rainy River Project – Closure Plan* (Amec Foster Wheeler, 2017c).

## **8.0 CONTINGENCIES**

The operations are sensitive to water balance and water quality in discharges. The following are contingencies based on water management and functioning of the diversions.

### **8.1 TMA**

#### **8.1.1 Cell 1 contingency**

- Maintain or add additional pumping capacity to the WMP to drain the cell if required due to the MOWL being exceeded;
- Manage filling of the WMP to consider additional storage capacity of the EDF from cell 1; and
- Accelerate construction of cell 2, where permitted.

#### **8.1.2 Cell 2/3 Contingency**

- The TMA has been designed to operate with a pond volume of 4-6 Mm<sup>3</sup>, with additional capacity for up to 8 Mm<sup>3</sup>. In a wet year pumping to the WMP can be extended longer than planned and discharged from the WMP, pending receptor capacity (Pinewood River flow)
- Any additional precipitation events after the EDF, prior to dewatering, could cause an uncontrolled release of untreated water to the environment, and alternative contingency measures would be required to reduce the water level at a faster rate (i.e. such as pumping excess water to the open pit or transferring TMA Cell 2 water into the WMP with no treatment).
- Pumping will be considered directly from the WMP to TMA Cell 3 to reduce WMP volumes to 1.0 Mm<sup>3</sup> prior to discharge from Cell 2 through the WTP into the WMP.
- Water treatment plant to be completed in September 2018 to allow pumping from cell 2, if required
- TMA raises to be sequenced to avoid a water deficit, however, reduction in discharges to the CW and additional takings from the Pinewood River, West Creek and Clark Diversions will be considered, subject to maintaining minimum flows

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**RAINY RIVER PROJECT**

**PART III - WATER MANAGEMENT POND - OPERATION,  
MAINTENANCE AND SURVEILLANCE MANUAL**

**New Gold Inc.  
Rainy River Project  
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P0W 1E0**

**January 2019**

**Version 2019-1**



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## **1.0 Regulatory Requirements**

This document is consistent with the New Gold Tailings, Heap Leach and Waste Rock Facilities Management Policy and was prepared pursuant to the MAC guidelines for *Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities* (MAC, 2011).

The following is a list of permits that this section of the OMS complies with:

- LRIA-FF-2015-04B: WMP Dams 1,2 and 3
- LRIA-FF-2015-04A: WMP Dams 4 and 5

## **2.0 FACILITY DESCRIPTIONS**

The components of the RRM relative to the scope of the OMS include tailings and process water management, freshwater diversions and water treatment. The site layout is shown on Figure 3-1. While there is interconnectivity between the systems, for the purposes of the OMS they are categorised in these groupings and reference made between them where required e.g., water management pond, water discharge pond and constructed wetland.

Bubblers (10) throughout the WMP provides sufficient aeration to treat for ammonia and will keep the water over the WMP from completely freezing during the winter. Mill make-up water is provided through reclaim from the TMA, WMP and/or the transfer of contact water from the Mine Rock Pond (MRP) as described in Appendix A.1. Treated surplus water is transferred to the WMP before it is discharged to the environment predominately via the constructed wetland. A pipeline to the Pinewood River can also discharge water during a short period in spring. The wetland will treat for nitrate and sulphates and any residual metals and will become the primary treatment plant at closure. Effluents planned for discharge to the environment will meet discharge criteria or be pumped back to the WMP for further treatment.

## **3.0 Tailings Management Area**

Design criteria, including mill throughput, used in the design of the TMA dams is summarised in the follow table. Subsequent sections describe tailings cells 1, 2 and 3 and associated seepage collection systems and supporting infrastructure.

Testing carried out in 2012 for the feasibility study determined that the tailings are non-plastic, predominantly silt sized particles, with 71% of the particles passing the 0.075 mm sieve. The specific gravity is 2.82. Column settling tests (undrained and drained) support a deposited void ratio of 1.0 for deposition planning purposes, inferring a dry density of about 1.4 t/m<sup>3</sup>. This is quite typical for hard rock gold tailings. A much more conservative dry density of 1.1 t/m<sup>3</sup> was adopted for the design of the initial start-up cell due to the small footprint and relatively rapid filling.

**Table 3-1; Mill and Tailings Operating Data used for design**

Revision G		Symbol	Source	Total	Years 1 - 4	Years 4 - 14	Units (metric)
				Total	Total	Total	
<b>Operating data provided (design criteria)</b>							
<b>Ore production</b>							
Resource - Open Pit		A	New Gold	100.1	53.4	46.7	Mt
- underground		B	New Gold	4.2	0.5	3.7	Mt
Design production rate ( <i>while operating</i> )		C	BBA		21,739	21,739	t/day
Mill availability ( <i>% of the time the Mill operates</i> )		D	BBA	92			%
Nominal production rate*		E	C x D		24,000	24,000	t/day
<b>Tailings production</b>							
Tailings / ore ratio		F	BBA	1.0			
Slurry density in the Mill		s <sub>o</sub>	BBA		50.0	50.0	% solids
Discharge slurry percent solids ( <i>mass of solids / total mass</i> )		s <sub>d</sub>	BBA		46.7	46.7	% solids
<b>Tailings properties</b>							
Specific gravity of solid tailings particles		G <sub>s</sub>	AMEC		2.82	2.82	-
Void ratio of deposited tailings ( <i>vol. of voids / vol. of solids</i> )		e	AMEC		1.0	1.0	-
<b>Flows affecting the Mill water balance</b>							
- Moisture content of the ore entering the Mill ( <i>mass of water/mass of solids</i> )		G	New Gold	3.0			%
- Freshwater for glands & reagent mixing ( <i>per ton of ore</i> )		H	AMEC M&M	0.08			m <sup>3</sup> / t
- Evaporation and spillage losses in the Mill ( <i>per ton of ore</i> )		I	assumed	0.02			m <sup>3</sup> /t
<b>Calculated data (design parameters)</b>							
Project design life		J	(A) / (E x 365)	13.5	7.0	6.6	years
<b>Tailings production</b>							
- Nominal tailings production	daily	K	E x F		24,000	24,000	t/d
	monthly		E x F x 30		720,000	720,000	t/mo
	annual		E x 365		8,760,000	8,760,000	t/y
	total		E x 365 x J	103.8	61.4	57.8	Mt
<b>Deposited tailings</b>							
- Dry density		r <sub>d</sub>	G <sub>s</sub> / (1+e)		1.41	1.41	t/m <sup>3</sup>
- Volume	daily	L	K / r <sub>d</sub>		17,021	17,021	m <sup>3</sup> /d
	monthly				510,630	510,630	m <sup>3</sup> /mo
	annual				6,212,665	6,212,665	m <sup>3</sup> /y
	total			A+B/r <sub>d</sub>	73.96	43.5	41.0
- Water content (at 100% saturation) ( <i>mass of water/mass of solids</i> )		w	e / G <sub>s</sub> x 100		35.5	35.5	%

- Water retained in voids	daily	M	K x w	8,520	8,250	m <sup>3</sup> /d
	monthly			255,600	255,600	m <sup>3</sup> /mo
	annual			3,109,800	3,109,800	m <sup>3</sup> /y
<b>Mill water balance</b>						
- Water in ore entering the Mill		N	E x G x 30	21,600	21,600	m <sup>3</sup> /mo
- Freshwater for glands and reagent mixing		O	K x H	57,600	57,600	m <sup>3</sup> /mo
- Water leaving the Mill with the tailings		P	(K / s) - K	821,755	821,755	m <sup>3</sup> /mo
- Losses in the Mill		Q	K x I	14,400	14,400	m <sup>3</sup> /mo
- Make-up water required to balance the Mill		R	P + Q - N - O	756,955	756,955	m <sup>3</sup> /mo

\* assumes maximum capacity of 21 000 + 20%

### 3.1.1.1 WMP

Seepage from the WMP, similar to other dams is designed to be collected in ditches, routed to sumps and pumped back to the WMP. The ditches are designed to convey the 1:25 yr 24h event with flows typically around 5 m<sup>3</sup>/s and up to 8.3 m<sup>3</sup>/s. The ditches have 1 m bottom width, 3:1 slopes and up to 2 m flow depth. The following table provides a summary of the sumps.

**Table 3-2; WMP Seepage Collection Sumps**

Parameter	Sump 1	Sump 2	Sump 3
Location	Dam 2	Dam 3	North of WMP by North starter dam
NWL	359.5	358.0	361.5
MOWL	361.1	360.2	364.0
Storage volume required (m <sup>3</sup> )	18,200	11,800	20,000
Pump capacity (m <sup>3</sup> /day)	4,000	2,500	3,500

Note; Sump 3 to be expanded in 2018 to include seepage from North Dam – Cell 2

### 3.1.2 Supporting Infrastructure

Site infrastructure have been constructed with locally available materials produced through the development of the Open Pit or quarrying sand/gravel deposits and bedrock. Figure 3-1 shows the general arrangement of the RRM, including site and haul roads, laydown areas, and stockpiles.

#### 3.1.2.1 Pipelines

There are five pipeline corridors sed to transfer tailings, fresh water, and reclaim water on site. Drawing 100126-4500-DD10-PIP-0001.001 shows the key plan of the tailings and reclaim pipelines that interact with the plant site. Drawing 100126-6200-DD10-PIP-0001.001 shows the key plan of the Pinewood Pipeline used for effluent discharge (see Appendix B).

- Tailings Pipeline: the tailings pipelines are 4,000 m in length between the Mill and the TMA and are used to transfer tailings to the TMA for discharge. The tailings line is contained within a lined corridor with six emergency dump ponds. The line is with in additional containment over West Creek and its tributaries.
- TMA Reclaim Pipeline: the TMA reclaim pipeline is 4,000 m in length between the TMA and the Mill and is used to transfer mill make-up water. The reclaim line is contained within a lined corridor with six emergency dump ponds. The line is with in additional containment over West Creek and its tributaries.

- MRP Reclaim Pipeline: The MRP reclaim pipeline is 1,750 m in length between the MRP and the Mill and is used to transfer mill make-up water.
- Open Pit Pipeline: The Open Pit pipeline is 1,400 m in length between the Open Pit and the MRP and used to transfer pit dewatering to the MRP.
- TMA Transfer Pipeline: The TMA transfer pipeline is 2,300 m in length between the TMA and the WMP and are used to transfer TMA surplus water to the WMP.
- WMP Freshwater Pipeline: The WMP freshwater pipeline is 4,000 m in length between the WMP and the plant site and used to transfer freshwater to plant site infrastructure and the Mill (if required).
- Pinewood Pipeline: The Pinewood pipeline is 10,300 m in length between the WMP and the Pinewood Pumphouse. It is used to discharge WMP effluent into the Pinewood River.

### 3.1.2.2 Utilities

The following utilities are used on site:

- Power to the plant site is provided by 230 kV transmission lines that are connected to Hydro One northwest of the site at a Switching Station;
- The main 230 kV substation is located near the concentrator building to provide power to the process equipment via underground supply lines. Power to the remainder of the site is provided by a network of overhead power lines fed from the main substation; and
- Site telecommunications and Process Control are distributed via fiber optic lines.

### 3.1.2.3 Mill Make-up Water Supply

Mill make-up water is provided by reclaim from the WMP, TMA cells and MRP. The reclaim water from the TMA is pumped from the central pond using the following three pumps:

**Table 3-3; Make up water supply pump ID and capacity**

Equipment ID	Name	Capacity
4520-PU-0023	Process Plant Pump	1,350 m <sup>3</sup> /hr
4520-PU-0024	Process Plant Pump (Standby)	1,350 m <sup>3</sup> /hr
4520-PU-0035	WMP Pump (Standby)	1,350 m <sup>3</sup> /hr
4520-PU-0036	WMP Pump	1,350 m <sup>3</sup> /hr

Reclaim water from the MRP is pumped using the following two pumps.

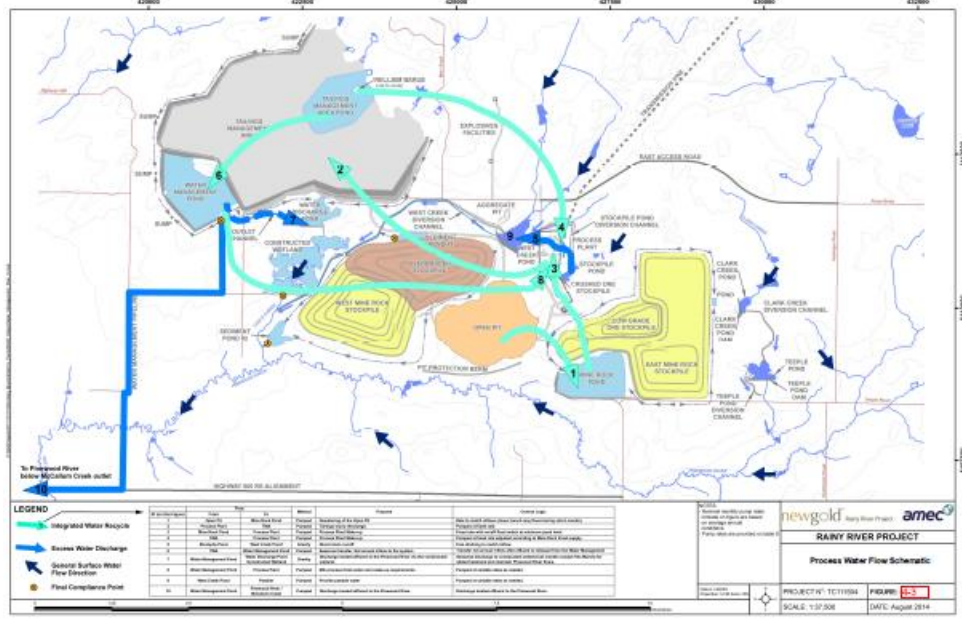
Equipment ID	Name	Capacity
2590-PU-0030	Mine Rock Pond Water Pump	680 m <sup>3</sup> /hr
2590-PU-0031	Mine Rock Pond Water Pump	680 m <sup>3</sup> /hr

## 3.2 Process Water and Water Management

Summary of the process water is shown in Figure 4-1 – process flow diagram water flow sheet. Appendix B includes process flow diagrams. Appendix E includes the process water balance for the TMA and WMP includes TMA cells 1, 2 and 3.



Figure 3-1; Process Water Flow Schematic



### **3.2.1 Water Management Pond**

The WMP collects runoff from direct drainage area, pumping from the Pinewood River and receives transfer from TMA. Initially the WMP will be utilized to build an inventory of 3.8 Mm<sup>3</sup> of water required for mill start-up and process operations. The start-up inventory of water will be provided by pumping from the Pinewood River via the pinewood pipeline.

WMP is made up of 5 dams with a crest of 371.5 m and MOWL of 369.7 m. The dams have a 'very high' hazard potential classification equivalent to extreme hazard classification by the CDA. As-built details will be provided in the WMP as-built report to be issued following construction completion. The IDF is 24h PMF with the emergency spillway invert at 370.5 m in bedrock on the north end of dam 5 into cell 2 / Loslo Creek catchment.

All the WMP dams were completed to their final crest elevation in July 2017 and EOR confirmation of compliance was completed on July 27, 2017. The WMP has been developed in accordance with the design details presented in the following documents and drawings. As-built details will be provided in the *WMP As-built Report*, which will be issued within 90 days of construction completion.

The design basis for the WMP includes, but is not limited to, the following;

- Minimum operating volume of 1.0 Mm<sup>3</sup> (i.e., dead storage below the intake for the pumps to the mill); and
- Maximum operating volume of 5.0 Mm<sup>3</sup>;

The WMP will discharge via pumping to the Water Discharge Pond (except in winter); and pumping surplus effluent, above 10,000m<sup>3</sup>/day, to the Pinewood River (spring and fall). The design criteria for the WMP dams are summarized in section 4.1.

Construction of the WMP began in September 2015 and finished in July 2017. Approval to proceed with the Intermediate Stage of filling to 364.5 m was granted by MNRF in April, 2017. Approval is pending to raise the fill level above 354.5 m to the ultimate elevation, as discussed in section 5.

### **3.3 Instrumentation**

#### **3.3.1 Dam Safety**

Instrumentation has been and will be installed during construction. Instrumentation will include instrumented dam sections that will monitor dam foundation and clay fill pore pressures to infer consolidation characteristics, as well as monitor any movement of dam fill due to deformation. Each dam instrumentation section will include: standpipe(s), a settlement plate, slope inclinometer(s), survey pins/monuments, and a terminal arrangement with data logger and vibrating wire piezometers.

Following construction, the instrumentation will remain for dam monitoring purposes. A detailed report containing the proposed locations, usage, and analysis of all instrumentation is provided in the *Geotechnical Monitoring Plan* (Amec Foster Wheeler, 2016b). The design details for the installed or proposed dam instrumentation is summarized in Table 4-14. The design information provided in Table 4-14 will be confirmed and updated as may be required following development of the As-Built drawings.

**Table 3-4; Dam Instrumentation Summary**

Facility	Section (Sta.)	Dam Instrumentation							Pond Level Gauge (type)
		Slope Stability		Foundation Consolidation		Phreatic Level and Seepage			
		Slope Indinometers (no.)	Survey Pins (no.)	Survey Monuments (no.)	Vibrating Wire Piezometers (no.)	Settlement Plates (no.)	Vibrating Wire Piezometers (no.)	Standpipe Piezometers (no.)	
TMA North	3+300	0		0	2	1	1	2	TBD
	Mass array				142				
TMA South	1+000				2				
	1+380				2	1	1	1	
	1+450	2		2	4	2	1	2	
	1+600	1			4	2	1	1	
	2+200	2		2	4	2	1	2	
	2+350	1			4	2	1	1	
	Mass array				176				
TMA West	0+300			0	1		1		
	0+460	2		0	5		2	1	
	1+450	0	35	0	0	1		0	
	1+500	2		0	4	0	3	0	
	Mass array				82				
TMA Start-up Cell	0+400				2				TBD
	1+000				2				
	Mass array				88				
WMP Dam 1			16						- Staff gauge
WMP Dam 2	0+950	1	34	0	2	0	2	2	- Survey stakes
WMP Dam 3	0+300	0		0	1	0	1	2	
	0+500	1	17	0	2	1	4	1	
Mine Rock Pond	0+220	1		2	2	1	1	4	- Staff gauge
Clark Creek									- Staff gauge
Teeple Road									- Staff gauge
Stockpile Pond	0+125	1	8	0	1	0	1	2	- Staff gauge
West Creek	0+291				2			2	
	0+320	2	2						- Staff gauge
	0+340	2	2		2	1	1		
Water Discharge Pond									TBD
Constructed Wetlands									
- Pond A									TBD
- Pond B									TBD
- Pond C									TBD
- Pond D									TBD
- Pond E									TBD
Sediment Pond #1									TBD
Sediment Pond #2									TBD
Temporary Sediment Pond									TBD

**Notes:**

- 1) Survey pins installed at 100 m centres along 3-5 lengthwise lines (crest, toes, etc.) Quantities are total for each dam
- 2) TMA Dams feature mass array of VWP instruments installed in grids within the dam foundation. Installation of these instruments is currently on-going

In addition to the instrumentation described above, the TMA dams are equipped with an additional suite of vibrating wire piezometers (VWPs) to provide enhanced monitoring resolution during construction. A total of 524 VWPs were installed in the TMA dam foundations, arranged in a grid pattern, and managed with a remote wireless data acquisition and management system.

Instrumentation associated with the management of the dams is being managed through a software system that includes integration with data loggers and data storage and is configured such that alarms for alert levels are defined and available. The software routinely generates reports and if trigger levels are exceeded sends out alarm notifications.

**3.3.2 Other instrumentation**

Additional instrumentation to support the OMS manual and management of water includes;

- Densometer on the tailings pipeline;
- Flow meters on the water management pipelines including from the Pinewood River, tailings reclaim lines, MPR line and freshwater line from the WMP and
- Pressure transducers in the WMP, Clark/Teeple Ponds.

This instrumentation provides continuous recording, which is collected during routine inspections and included.

### **3.4 Regulatory Requirements**

Regulatory requirements, permits and authorizations are summarized in section 1.1. Key approvals include the Federal and Provincial Environmental Assessment conditions and commitments and permits including those issued pursuant to the LRIA and EPA. Additional legislation to be considered in implementing the OMS manual includes the MMER and various Ontario regulations including waste management.

No direct discharges are intended from any of the structures described in this section except the WMP which is described in sections 4 and 5. Seepage will be collected and pumped back from the WMP and TMA cells. Subsequent to this revision and LRIA approvals, additional details for the WDP, CW and sediment ponds discharges will be developed.

## **4.0 OPERATIONS**

The overall operational objectives of the TMA and associated dams and facilities are to dispose and store the tailings and to manage all site water in a safe, economical and environmentally responsible manner. This section defines operating standards in accordance with design criteria and regulatory requirements specified in section 4.

### **4.1 Water Balance**

#### **4.1.1 Dam Raising**

The dams will be raised to maintain discharge availability and sufficient pond storage capacity to contain the Environmental Design Flood (EDF).

### **4.2 Seepage Collection System**

Seepage collection systems, as described in section 4, are in place and required for the WMP and TMA only. The design criteria of 1:25 yr 24h rainfall results in seepage systems (sumps, pumps and ditches) as described in section 4 (including MOWL) and summated here;

- Cell 1 seepage is not expected to exceed 29 m<sup>3</sup>/day. Three sumps will be pumped back to Cell 1. Sumps 1 and 2 pumping will cease once Loslo Creek is impounded by the TMA south dam (June 2018 approx);
- Cell 2 seepage is expected to not exceed 9.2 m<sup>3</sup>/day and a sump of 8,000 m<sup>3</sup> will be pumped back to Cell 2 until Loslo Creek is impounded by the TMA south dam (June 2018 approx);
- Cell 3 seepage is intercepted and routed by ditch into the water discharge pond, and isn't expected to occur until June 2018 (approx.); and
- WMP includes 3 sumps, including a sump shared with the north starter dam and will be pumped back to the TMA, capacity of the sumps is 18,200, 11,800 and 20,000 m<sup>3</sup> for sumps 1, 2 and 3 respectively.

#### **4.2.1 Water Management Pond**

The WMP collects runoff from direct drainage area, pumping from the Pinewood River and receives transfer from TMA. Initially the WMP was utilized to build an inventory of 2.2 Mm<sup>3</sup> of water required for mill start-up and process operations. The start-up inventory of water was provided by pumping from the Pinewood River via the pinewood pipeline. However, additional water sources maybe utilised in filling the WMP including but not limited to:

- Pumping from Open Pit;
- Pumping from South Pond;
- Pumping from Sump #4 (Open Pit); and
- Direct drainage of natural runoff.

During late construction (starting April 27, 2017 from the Pinewood River), the WMP began filling and storing water prior to achieving the final dam crest elevation, as per approval from the MRNF. The start-up inventory of water will be primarily pumped from the Pinewood River, in addition to collecting natural runoff and dewater pumping from the Open Pit. Filling the WMP will occur in two stages:

- Intermediate stage: maximum water level 364.5 m providing 2.0 m of freeboard below the minimum dam crest elevation of 366.5 m

- Final stage: maximum operating water level 369.7 m

During the Intermediate Stage of filling the Interim Fill Plan (rev3 – March 2017) will be followed,

- all WMP dams were constructed to a minimum crest elevation of 366.5 m and width required to satisfy slope stability requirements. The maximum water level in the WMP shall not exceed 2.0 m below the lowest constructed dam crest elevation, i.e. 364.5 m.
- monitoring of water levels and instrumentation will occur daily, and water quality (TSS) will be sampled twice weekly, water quality will be sampled weekly and dam inspections will occur weekly
- Contingency will be maintained with an 8 inch pump ready to discharge to the approved location north of WMP Dam 4, and when water is above 364.0 a 12 inch pump will be mobilised

All the WMP dams were completed to their final crest elevation of 371.5 m in July 2017 and EOR confirmation of compliance was completed in on July 27, 2017. The requirements for the Final Stage of filling have been met and the maximum operating water level may be raised to 369.7 m, pending MNR approval. Final filling of the WMP will be completed based on water takings from the Pinewood River and other approved water takings.

During the use of TMA Cell 1 and Cell 2, WMP filling will consider mill water needs the overall water balance and water quality discharge criteria based on the WMP water balance (Rainy River Project Development TMA Cell 2 and WMP Water Balance RRP-GEO-REP-026 R1).

- Water will be pumped during freshet (April – June 2018) from Cell 2 and the Pinewood River to increase the volume in the WMP
  - Pumping from the Loslo and Marr diversion ditches is proposed if the total water volume in the WMP and TMA Cell 2 is below 4 Mm<sup>3</sup>.
- The mill water use will maintain the WMP below the MOWL till June 2018 (approx.) and target a reduction of water levels to 1.0 Mm<sup>3</sup> stored volume i.e., dead storage
- After June 2018 (approx.) mill reclaim will switch to TMA cell 2 and excess water from Cell 2 will be pumped to Cell 3 (subject to TMA completion and regulatory approval) while the water treatment plant is constructed in the WMP adjacent to Dam 4.

Once the WTP is constructed and operational (prior to September 2018) the WMP will received treated (or blended untreated) supernatant from Cell 2 and subsequently the ultimate TMA. Operations will continue to meet MECP requirements such that:

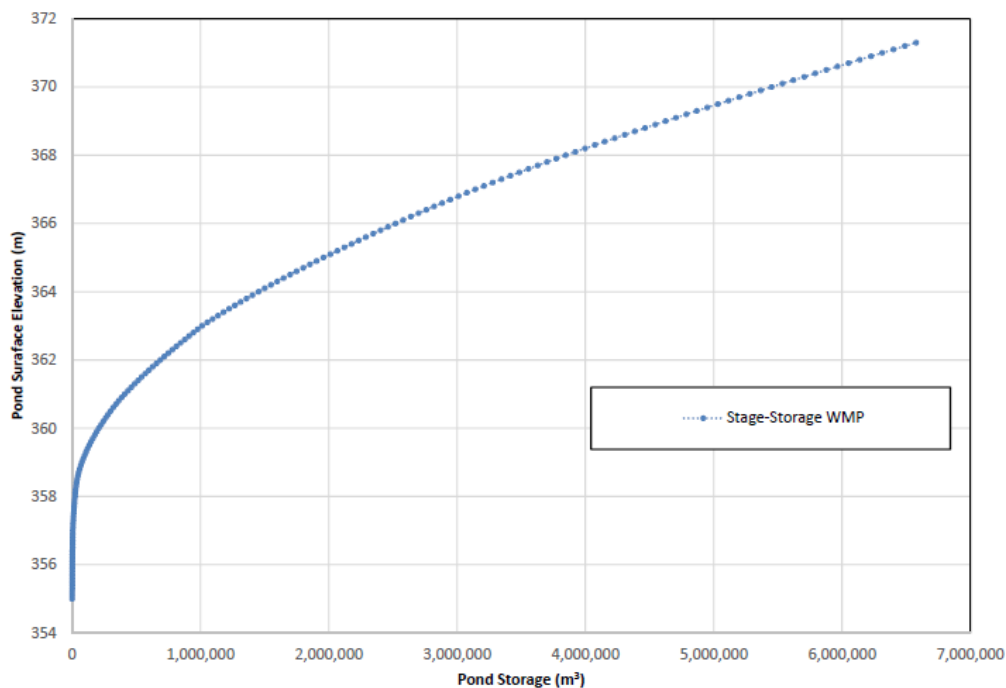
- Supernatant will be transferred from the TMA during June to August (or other times during the year to achieve overall water balance and water treatment objectives);
- Discharges effluent to environment: Preferentially bleed flow through constructed wetland with a 30-day retention time (design volume of 10,000 m<sup>3</sup>/day) – estimated to commence in Spring 2019; and
- Decant to Pinewood River (through discharge pipeline);
- No discharge to occur between December 1 and the following spring melt (defined as a flow rate in the Pinewood River (upstream of Loslo Creek) of 10,000 m<sup>3</sup>/day).

Bleed flow and decant to Pinewood River can only occur if there is sufficient flow in the Pinewood River to achieve a minimum mixing ratio of 1:1 with the two discharges combined. A pre-winter inventory of 2.8 Mm<sup>3</sup> will be targeted (to comply with environmental commitments to supply the bleed flow through constructed wetland in all climatic conditions). This is calculated from the sum of the outflows from the WMP between December and the following May;

- -0.04 Mm<sup>3</sup> seepage losses
- -0.10 Mm<sup>3</sup> evaporation losses
- -0.76 Mm<sup>3</sup> bleed to wetland
- -0.90 Mm<sup>3</sup> ice allowance
- 1.0 Mm<sup>3</sup> minimum inventory.

This volume is sufficient to maintain supply to the mill through dry winters and springs, up to the beginning of June, at which time the transfer from the TMA can replenish the WMP inventory. The mill make-up water demand is 22,605 m<sup>3</sup>/day which will be supplied by the MRP and WMP. The make-up water will be preferentially taken from the MRP with the WMP supplying the difference. The Mill requires freshwater for reagent mixing at a rate of 1,729 m<sup>3</sup>/day which will be supplied from the WMP.

**Figure 4-1; Stage - Storage Curve for the WMP**





**Table 4-1; Stage Storage Relationship For the WMP**

Elevation (m)	Available Water Storage Volume (m <sup>3</sup> )
355.00	0
355.50	169
356.00	1,016
356.50	2,384
357.00	4,803
357.50	11,417
358.00	21,533
358.50	38,013
359.00	75,235
359.50	132,541
360.00	207,591
360.50	299,155
361.00	409,425
361.50	541,181
362.00	687,276
362.50	845,119
363.00	1,012,352
363.50	1,223,489
364.00	1,452,674
364.50	1,698,321
365.00	1,958,559
365.50	2,233,087
366.00	2,520,422
366.50	2,821,561
367.00	3,142,089
367.50	3,486,292
368.00	3,846,892
368.50	4,229,229
369.00	4,625,413
369.50	5,033,241
370.00	5,451,690
370.50	5,879,025
371.00	6,314,382
371.30	6,579,245

### 4.3 Progressive Reclamation and Closure

Some progressive reclamation with respect to the TMA is proposed as part of mine operations. By the end of the operations phase a low permeability overburden cover of approximately 150 m in width will be placed on the upstream side of the TMA dam. The overburden cover will cover approximately two thirds of the ultimate perimeter, with the remaining approximately one third of the length to be reclaimed at closure. This cover is intended to prevent the tailings permanent water cover from coming into contact with the TMA dams, and will also serve a secondary function of limiting oxygen diffusion into the uppermost portion of the tailings underneath. The overburden cover will be seeded or hydroseeded with a native seed mix or equivalent, and will be armoured with NPAG rock at the transition zone of the cover with the tailings to prevent suspension and oxidation of solids.

Closure of the RRM in respect to tailings, process water and freshwater management will include but is not limited to the following:

- Flooding of the TMA with a 2 m or deeper water cover;
- A perimeter zone of tailings beach will be maintained to keep the central pond away from the dams, this zone will be covered with a low permeability cover;
- NPAG rock will be placed at the TMA transition zone with the tailings to prevent erosion and suspension and oxidation of solids;

- Dam structures containing the TMA have been designed with adequate safety factors to provide overall long term safety and stability;
- The water management pond dams will be breached to prevent retention of water; upstream dam faces that become exposed will be revegetated;
- The water discharge pond dam will be breached once it no longer has a water management function;
- The constructed wetland will be left in place as this system is designed to operate passively, and will have stabilized as a wetland complex during operations;
- At closure the MRP will collect runoff and seepage from the EMRS which will then be directed to the Open Pit to help flooding;
- Clark Creek Pond, West Creek Pond, Teeple Pond, Stockpile Pond, West Creek Diversion Channel, Clark Creek Diversion Channel, Teeple Pond Diversion Channel and Stockpile Pond Diversion Channel support the creation of fish habitat for compensation purposes as such they will remain in place at closure; and
- Sediment Ponds #1 and #2 will be maintained until such time as the site (or if applicable individual site components) become a recognized closed mine such that monitoring associated with the Metal Mining Effluent Regulation is no longer required, at such a time, pond impoundment structures will be breached and the residual pond sites will be stabilized and restored.

#### **4.4 Safety and Security**

The site safety and security will be following the RRM Health and Safety Management System including but not limited to the following:

- The site will be gated with restricted access to authorized personnel only;
- The TMA will be fenced along portions of the old highway 600 and access will be restricted to authorized personnel only;
- No public access;
- Construction Management provided security measures; and
- Onsite health and safety policies for working around bodies of water, working alone or crossing ice.

#### **4.5 Environmental Protection**

The Environmental Department has oversight over the EMS which contains tailings operations related environmental aspects including:

- Fugitive and point source dust emissions;
- Hydrocarbon Spills and Leaks;
- Pipeline Rupture and Leaks;
- Surface and ground water quantity and quality; and
- Wildlife management (including species at risk).

An environmental aspect register is a comprehensive inventory of tailings operations activities, environment aspects, assessment of risk and identification of controls. Tailings personnel have responsibility to implement and maintain the controls including monitoring and inspection. Refer to the Environment Department for the environmental aspect register (in prep) and environmental related procedures.

As outlined in orientation training, it is every RRM employee’s responsibility to report a suspected spill or uncontrolled release event to their supervisor. This includes suspicious flows of water out of the area, escaping tailings, etc. The sooner appropriate persons can begin to correct a situation, the less likely it is that severe impacts will follow.

Table 5-3 provides a summary of the MECP effluent discharge limits that must be met to discharge from the WMP.

**Table 4-2; MECP Effluent Discharge Limits from the WMP**

<b>Constructed Wetland Final Discharge and Water Management Pond Pipeline Discharge (to the Pinewood River) as stated in MECP ECA 5178-9TUPD9</b>		
<b>Effluent Parameter</b>	<b>Daily Maximum Concentration (mg/l)</b>	<b>Monthly Average (mg/l)</b>
Cadmium	-	0.0010
Cobalt	-	0.0044
CBOD5	-	25.0
E.coli	-	100/100ml geometric mean density
Total Suspended Solids	30	15
Total Phosphorus	-	0.10
Cyanide (total)	0.1	0.05
Cyanide (free)	0.02	0.01
Total Arsenic	0.034	0.017
Total Copper*	0.028	0.014
Total Nickel	0.094	0.047
Total Lead*	0.030	0.015
Total Zinc*	0.348	0.174
Un-ionized Ammonia	0.08	0.04
Acute Toxicity (Rainbow Trout and Daphnia Magna)	Non-acutely lethal (not greater than 50% mortality in undiluted effluent)	
pH of the effluent maintained between 6.0 to 9.5, inclusive, at all times		
<b>Notes:</b>		
<ol style="list-style-type: none"> <li>*Proposed effluent criteria for Total Copper, Total Lead, and Total Zinc are based on a hardness of 200 mg/L CaCO<sub>3</sub>. In the event that water quality sampling indicates that 75<sup>th</sup> percentile hardness concentrations are less than 200 mg/L CaCO<sub>3</sub>, the effluent limits may be changed by the District Manager in writing, consistent with achieving no impairment for receiving waters.</li> <li>Additional effluent limits for sediments 1&amp;2 are stated in MECP ECA 5178-9TUPD9</li> <li>The effluent discharge rate from the Constructed Wetland Final Discharge and the Water Management Pond Pipeline Discharge such that at all times the ratio of the combined flow rate of these effluents to the flow rate of the receiving surface water (Pinewood River) is less than or equal to 1:1 (i.e. the cumulative flow rate of the effluent must be less than or equal to the flow rate of the receiving surface water).</li> <li>Prior to commencing Operations Phase discharges (Constructed Wetland Final Discharge, Water Management Pond Pipeline Discharge, Sediment Pond #1, and Sediment Pond #2), the method for determining daily effluent to receiver flow mixing ratios shall be approved by the District Manager.</li> <li>For sampling frequencies and full parameter list refer to MECP ECA 5178-9TUPD9; sampling frequency varies from thrice weekly to quarterly depending on the parameter</li> </ol>		

#### **4.6 Reporting Requirements**

Reporting is sub-divided as routine, planned reports of defined frequency, and those that are non-routine i.e., event driven.

##### **Routine**

- Submission of asbuilts within 3 months of construction for WMP, TMA, MRP and sediment ponds 1 and 2
- Monthly monitoring report including a summary of all monitoring data collective, all non routine calibration/maintenance procedures, tabulation and description of any bypass/upset conditions
- Annual reporting to MECP on March 31 for the previous year, a works performance report and a surface water monitoring report
- Quarterly electronic effluent monitoring reports to ECCC
- Annual electronic effluent monitoring report and environmental effects monitoring reports to ECCC by March 31

##### **Non-routine**

- Report all spills as defined in the Environmental Protection Act immediately to spills action centre SAC, follow New Gold Incident Reporting Guidelines and follow up in writing to MECP within 10 days describing the cause and discovery of the spill or loss, clean-up and recovery measures taken, preventative measures to be taken and schedule of implementation
- Any observation of sheen/foam/settable solids within the works report immediately to (SAC) immediately and written reporting within 7 days
- Any exceedance of effluent limits report to SAC immediately, written confirmation to MECP within 7 days
- If acute toxicity tests fail, within 15 days report in writing to MECP with the cause and remedial actions proposed/implemented
- Notify ECCC immediate if MMER Sch 4 limits are exceeded, pH is outside 6-9.5 range or if the effluent is acutely lethal with a written report within 30 days

Records are retained consistent with CEAA condition 11 for a minimum of 25 years or until decommissioning ends, whichever is longer and kept locally. This exceeds the ECA permit requirement of 3 years. Records include place/date/time of sampling, dates and analysis performed, analytical techniques used, names of persons collected/analyzing sampling and results of analysis.

An Operations Report will be prepared by the Mill Manager or designate. The report will include metrics and information collected as part of normal operation. Examples of information contained in the Operations report include:

- Total monthly tailings deposition tonnage and slurry water volume;

- Total monthly reclaim volume;
- Pond level and freeboard;
- Updated water balance;
- Water quality results; and
- Intake / Discharge quantities.

Each of the regulatory approval requirements related to the construction, operation and eventual reclamation of the Site have specific compliance reporting requirements with defined deadlines or reporting periodicity. In general, the reporting includes:

- Operation, Maintenance and Surveillance Plan(s) for dams, water management (water quality) and air/noise emissions;
- Emergency Preparedness Plan(s);
- As-Built Drawings and related Construction Reports;
- Dam Safety Inspection and Review Reports
- Environmental Monitoring Plans; and
- Environmental Monitoring and Performance Reports.

The environmental approvals and permits received from the government that are maintained by the New Gold Environmental Department should be referred to for details of monitoring, inspection and reporting requirements.

In addition, the New Gold Environmental Department should be notified of any proposed major modification to RRM facilities, in order that they can liaise with the appropriate government ministries to determine if additional approvals or amendments to existing approvals are required.

## 5.0 MAINTENANCE

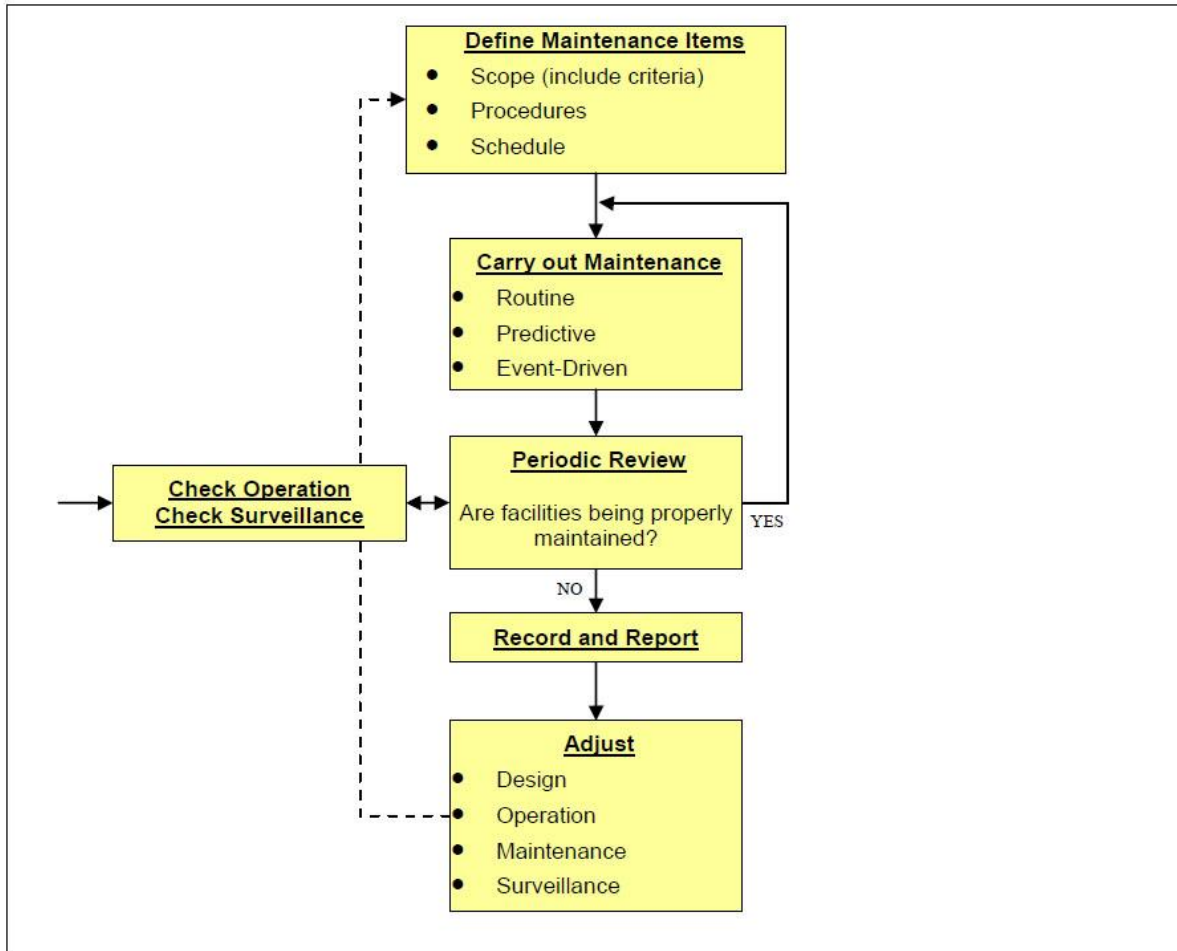
The following periodic maintenance is required:

1. Maintain the tailings and reclaim pumps and associated lines and containment;
2. Clear debris, snow and ice which may block flow through the decant facility or emergency spillways;
3. Maintain water management structures including spillways, ditches and diversions;
4. Maintain equipment, power and water lines, and instrumentation;
5. Repair any deficiencies as noted in the Dam Safety Inspections (DSI); and
6. Reconstruct the support for tailings discharge pipelines wherever washouts occur.

Maintenance records are retained by maintenance personnel performing the work in accordance with the procedures described in this document. Timing of maintenance actions for unusual conditions should be based on specific recommendations from surveillance findings. Scope and time frames for routine maintenance activities are determined and scheduled by the Maintenance Department and based on manufacturer's recommendations and best practices.

The maintenance flowchart is illustrated in Figure 6-1.

**Figure 5-1; Maintenance Flow Chart**



**5.1 Routine and Predictive Maintenance**

Routine and predictive maintenance includes removal of vegetation, beaver dams, ice blockage or sediment accumulation that would otherwise affect the performance of a structure when required.

**5.2 Maintenance and Emergency Preparedness**

A weekly table-top exercise will be conducted with the pump management team to ensure that crews are intimately familiar with the operational strategies for a broad range of operating and emergency scenarios. These table tops will be documented and New Gold management will ensure that any ongoing lessons learned from day-to-day operation are captured including the updating of any corresponding plans, maps, flowsheets or procedures.

The maintenance of pumps is the responsibility of New Gold and maintenance records are required to be maintained. Each installation requires to be equipped with spill pan, spill kits



and the necessary signage. Changes to pumping configurations, ditching, piping or operating parameters need to be approved by the New Gold Mill Manager, the New Gold Maintenance Manager and the New Gold Environmental Manager, during normal working hours. This is particularly the case if splash pads need to be altered in any way. In an emergency call out (after hours), the Managers or their alternate, will provide direction in consultation with the New Gold Environmental Department.

During depositing of tailings the above-mentioned crews are required to complete their inspections daily. Reporting is to be escalated to hourly observations if a rainfall event is escalating and the Cell 2 level is within 200 mm of the intermediate fill elevation of 363.2 masl. The general manager can then decide whether to provide additional surveillance resources in the case where additional duties including maintenance and operation of the Cell 2 dewatering pumps is required to be performed by the allocated crews.

A summary report titled " TMA Cell 2 Water Levels " is circulated each morning at 9 a.m. to summarize the measured water and tailings levels as of 4 p.m. the day prior. This report is prepared and circulated by the mill superintendent or his alternate. The purpose of the report is to highlight trend data for Cell 2.

Fundamental to the successful operation of the ponds and pumping strategy is a timely reaction to rainfall events, and ensuring that pumps come 'on line' or are taken 'off line' as design trigger levels are reached.

### **5.2.1 Dams**

The following are examples of specific maintenance activities:

- Regularly check diversion ditches, spillways and culverts for accumulation of debris or sediment, or any other form of blockage including ice, and remove if required;
- Visually inspect diversions, spillways, seepage collection sumps, dams and all ditches for cracking, bulging, slumping, and any other indications of slope movement (note, any indications of slope movement shall be reported to a qualified geotechnical engineer);
- Re-grade the dam crest, as required, to prevent local ponding and direct surface runoff towards the pond;
- Repair erosion gullies, local slumps or slides in the dam face, diversion ditches or spillway channels; and
- Regularly check diversion ditches for accumulation of debris or sediment, or any other forms of blockage, and remove if required.
- If annual survey determines necessary, correct dam crest, overflow spill way and diversion channel invert irregularities to avoid concentrated runoff.

### **5.2.2 Geotechnical and Water Monitoring Instrumentation**

Instrumentation is calibrated by the manufacturer prior to shipment. Calibration certificates will be maintained by maintenance department. Following instrument installation, initial reading procedures will be followed. Subsequent calibration will follow manufacturer's recommendations.

Malfunctioning or damaged instruments may require repair or replacement per manufacturer guidelines or approved procedure. In the event of replacement of dam instrumentation, several overlapping readings of the old and new instrument are required to ensure continuity of the data records.

### **5.2.3 Pumping Systems and Pipelines**

Maintenance of the tailing delivery, water recirculation systems and seepage pumps will include:

- Perform regular performance tests of the Pinewood Pumphouse pumps and inspections of pump fish screens to remove any debris;
- Perform regular performance tests on seepage pond pumps
- Perform annual calibration and maintenance as required on flow meters;
- Perform regular non-destructive testing appropriate for components of the tailings delivery system, including for example, periodic measurement of pipeline thickness to identify areas of wear and to schedule pipeline replacement if necessary and repair liners as required;
- Replace pipe work, bends and fitting components as required;
- Remove accumulated debris from valves, reducers and off takes;
- Carry out maintenance as recommended by fitting and valve suppliers;
- Regularly inspect major wear components;
- Maintain emergency dump ponds in a dewatered/empty state; and
- Maintain and replace system instrumentation as required.

### **5.2.4 Mobile Equipment**

Mobile equipment is maintained on the basis of a planned reliability program and as otherwise required. Equipment in question includes:

- Dozers;
- Excavators;
- Water truck;
- Pickup trucks;
- Mobile crane;
- Flatbed and picker truck; and
- Replacement of mobile equipment as required.

### **5.3 Event-Driven Maintenance**

In the event of unusual conditions or incidents that require immediate maintenance actions but are not considered an emergency, repairs and replacement of facility components are made as required and activities are documented. RRM staff will provide a means to assess event driven maintenance needs through response action planning. Response planning is based on risk prioritization, maintenance crew mobilization or “call out” procedures, required repairs and replacement material availability. Event driven maintenance actions will follow applicable safety and performance procedures. Normal documentation and maintenance records will be

maintained as a result of any event driven maintenance actions. Unusual conditions that require maintenance are also communicated to maintenance staff as they occur.

### **5.3.1 Pipeline Leaks or Breaks**

In the event of a pipeline leak or break the system in question is de-energized and repaired as follows:

- Inspect entire pipeline;
- Repair or replace affected components;
- Perform opportune and scheduled maintenance;
- Repair any collateral damage caused by a leak or break;
- Collect any released tailings and place in the tailings impoundment;
- Reclaim any disturbed areas; and
- Follow any spill reporting that may be required pending type of spill and following documentation procedures.

### **5.3.2 Earthquake Occurrence**

Following an earthquake, the following are undertaken:

- Inspect dam and beach areas for sign of distress due to deformation;
- Inspect dam for signs of liquefaction (e.g., local sand boils, etc.);
- Measure freeboard for compliance with design requirements;
- Inspect toe area of dam for signs of deformation or piping of fines;
- Inspect diversions, ditches and spillways for sign of slumping or changes in geometry;
- Inspect seepage collection areas; and
- Collect instrumentation data and submit to EOR for analysis.

### **5.3.3 Flood Event**

Following extreme storms (as defined in section 7) the following are undertaken:

- Measure freeboard for compliance with design requirements;
- Inspect dam, diversions, ditches, spillways and diversions for signs of excessive erosion and repair if required;
- Inspect seepage return system for adequacy; and
- Implement appropriate response based on observations/measurements as defined in this manual.

## **5.4 Reporting Requirements**

Maintenance information will be communicated internally through formal and informal meetings, interaction between various levels of the organization (department and/or crew meetings), through information posted at the site and through this OMS Manual.

Communications with applicable contractors involved in tailings management will be conducted daily and weekly during tailings activity meetings, as appropriate. All employees and contractors are encouraged to communicate openly with site management about operational conditions requiring maintenance and reporting any significant observations such as event-driven maintenance or any maintenance requirements that exceed expected norms.

Equipment logs and manuals will be maintained for reference and use by responsible staff.

Maintenance diaries and logs shall be maintained and accessible for review by other parties.

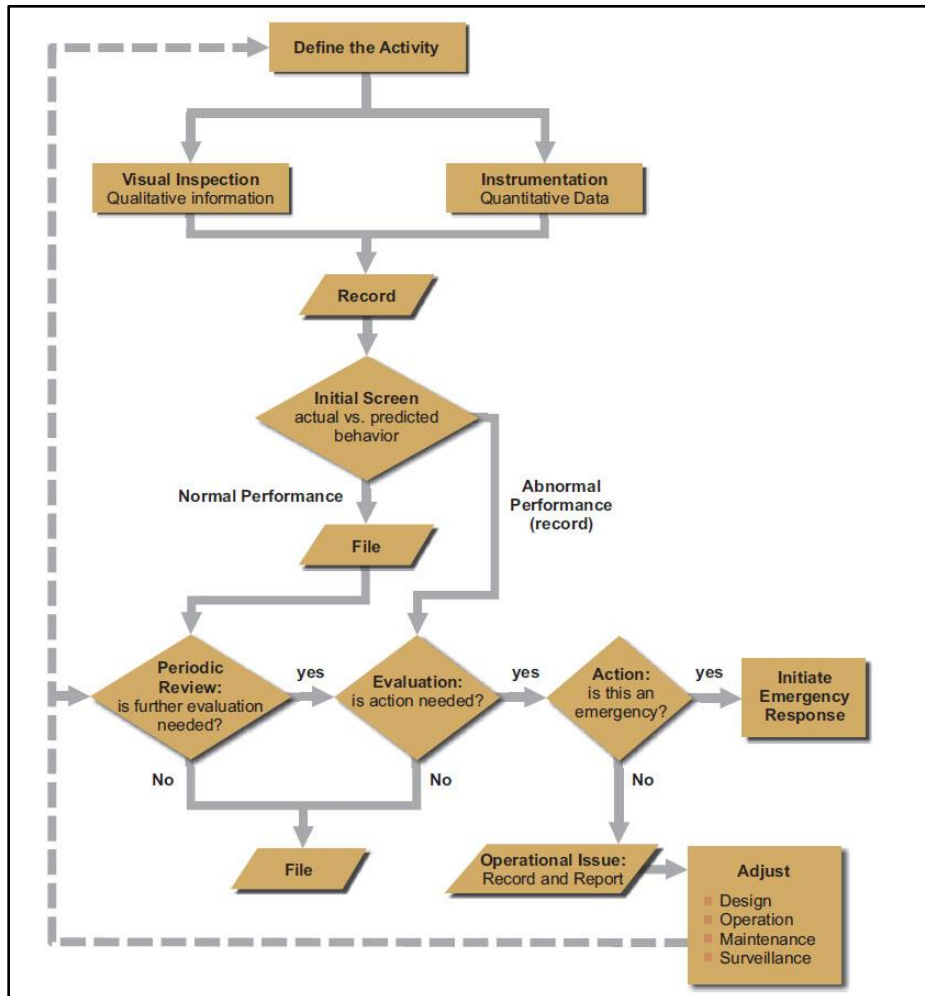
## **6.0 DAM SAFETY AND SURVEILLANCE**

The RRM tailings and water management surveillance activities involve inspection and monitoring of the operation, structural integrity and safety of a facility. Regular review of surveillance information can provide an early indication of performance trends that, although within specifications, warrant further evaluation or action. The objectives of our surveillance program are as follows:

- Monitoring the operation, safety and environmental performance of tailings and water management facilities;
- Promptly identifying and evaluating deviations from expected behavior that affect operational safety, structural integrity and environmental performance of the facility; and
- Reporting significant observations for response.

The flow chart for surveillance is shown in Figure 7-1. Surveillance is undertaken in two primary methods – visual inspection and reading of instruments. Results of these qualitative and quantitative observations are compared to the expected performance of the TMA and water management facilities. If observations are within the expected range or performance, the results of the surveillance are simply recorded. If observations are outside the expected range, further evaluation is completed to determine if remedial action is necessary. If necessary, this action is taken and may range from a minor adjustment to operational procedures to initiation of emergency response, depending on the severity and nature of the deviation from expected performance.

**Figure 6-1; Surveillance Flow Chart**



### 6.1 Surveillance and Inspections by Mine, Mill and Environment Operations Staff

The purpose of the surveillance program is to identify and classify problems and/or unsafe conditions that are visually evident. Visual inspections are an integral part of proper maintenance and performance of monitoring programs for the TMA and water management facilities. Failure to correct identified maintenance and repair items, or potential adverse behaviour, could result in unsafe conditions or lead to a failure of operating systems or cause an adverse environmental effect.

The surveillance program will consist of making regular observations relating to:

- The conditions and performance of the dams including indications of cracking, bulging, depressions, sinkholes, vegetation, surface erosion and seepage;
- Water levels and pump intake zones;
- Function of ancillary hydraulic structures (diversions, spillways, pipelines etc.);
- Discharge pipeline operations and tailings beach development; and

- Total facility performance.

During inspections, observations will be made at the upstream slope, crest and downstream slope with respect to signs of erosion, scouring, cracking, settlement, deformation, and any instability and abnormality. Seepage rates will be visually estimated and recorded on the inspection forms. Changes in the seepage rate or clarity (i.e., turbidity) require immediate reporting to the Engineer-of-Record.

### **6.1.1 Daily Inspections**

During first filling of all dams except the TMA dams Surveillance records will be maintained in logs at site and submitted to the EOR for review daily and on a monthly basis thereafter, or more frequently as warranted. Any abnormal behaviour including slope slumping, erosion of crest settlement will be reported immediately to the Engineer-of-Record.

Routine daily visual inspections of critical dams (TMA, WMP and MRP), spillways, pipelines, pipeline containment and pumping infrastructure will be carried out on an on-going basis to confirm normal operations and identify unusual or anomalous conditions such as pipeline leaks, pump intake blockages, etc. All active pipelines will be inspected twice per 12 h shift, consistent with EA conditions.

Daily inspection sheets and provided in Appendix F.

### **6.1.2 Weekly Inspections**

Physical inspections of the TMA, process water, water treatment and diversion dams will be conducted on a weekly basis. The weekly inspections will include those discussed in Section 7.1.1 and the following tasks:

- Photographic record of key features;
- Physical inspection of dams, dykes, diversion, ditches and spillways:
  - Indicating and reporting any seepage and erosion.
- Pond levels and freeboard:
  - Additional monitoring maybe required during spring freshet of the dams.

Weekly inspection sheets and SOPs are provided in Appendix F. All weekly inspections will be documented in a report and will be compiled as part of the annual DSI (Section 7.4).

### **6.1.3 Other Inspections**

#### **6.1.3.1 Diversions**

The Clark and West Creek diversions, while designed to operate passively, have specific surveillance requirements as part of the approved Fisheries Act authorizations. Further, impediments to water flow in diversions have the potential to alter water levels in the ponds. For the diversions, in addition to requirements specified above, and following the as built report for the Clark Creek Diversion these surveillance requirements will be conducted;

- Inspection of fish habitat features, as per Fisheries Act Authorization 15-HCAA-00039;
- Complete a survey of the Clark and Teeple dam crests and diversion channel inverts annually, observations of crest irregularity will require correction to avoid concentrated runoff in the overflow spillway;



- Monitoring pond levels include Teeple and Stockpile ponds (by staff gauge, transducer or other suitable means) daily. The frequency will be re-evaluated after one year of operation (May 2018).

## 6.2 Inspection Required After an Unusual Event

Several potential failure modes exist for the various tailings and water management and water diversion storage facilities. These potential failure modes, along with likely triggers, observable visual and instrumentation indicators of the failure mode are presented in Table 9-1. Special inspections will be carried out immediately if any of the following events occur:

- Events such as an earthquake, large rainfall (greater than 1:2 year rainfall (51mm)) or large snowfall/snowpack;
- Operating events such as rupture of a pipeline, particularly if on the slope or crest of the dam, sudden loss of pond water, sudden rapid rise of pond water;
- Observations such as cracks, excessive settlements, sinkholes, large slope or foundation deformations, increased seepage, turbidity of seepage water; and
- Instrument readings that deviate from historical trends, or are within “alert” action levels (e.g., trigger levels).

Special inspections after unusual events are necessary as summarized in Tables 7-1 to evaluate whether there has been any damage requiring correction, any safety measures or special operating procedures that need to be implemented, or if there is a need to initiate emergency procedures as described in Section 9.0.

**Table 6-1; Maintenance Requirements following an Unusual Event**

Unusual Event	Post – Event Inspection/Surveillance
Earthquakes	Carry out a detailed walkover of all dam structures, including crests, downstream and upstream (visible) slopes and dam toes, and all spillways, looking for signs of cracks, bulging, settlement and/or other deformations. Look for and note any changes in seepage, particularly with respect to the rate of seepage flows at dam slopes and seepage clarity. Read all piezometers. Inspect downstream toes of dams for sand boils and dam slopes for sinkholes. Inspect ponds upstream of the dams looking for ‘whirlpools’. Inspect all pump stations and pipelines. Discuss findings with the Dam Safety Inspector.
Rapid snowmelt and/or heavy rainstorms exceeding a 1:2 year rainfall (51 mm)	Inspect the (visible) slopes and the crests of all the tailings dams looking for areas of concentrated runoff and erosion. Make note of saturated ground/soft ground conditions at dam slopes and toes. Examine dam slopes for indications of localized slumping/instability. Inspect all pump stations and pipelines. Check the water levels

Unusual Event	Post – Event Inspection/Surveillance
	in all ponds/reservoirs against the critical levels, and keep checking these levels until the pond/reservoir inflows subside. Discuss findings with the Dam Safety Inspector. Check piezometric levels at dam sites if instructed to do so.
Unusually high winds (exceeding 60 kph i.e., 75 % of maximum likely used in design)	Check the condition of erosion protection on the upstream slopes of the dams.
Extreme snow pack (170cm cumulative snowfall) (i.e., 120% or greater than normal snowfall at Barwick)	Check the water levels in all ponds/reservoirs against the critical levels, and keep checking these levels until the spring freshet is over. Evaluate the situation in terms of possible snowmelt scenarios. Make predictions as to the expected storage capacity available in ponds/reservoirs. If deemed necessary, mobilize pumping and mobile treatment equipment to site.
Significant, relatively rapid erosion (any cause) of dam slope or 'sudden' seepage break at dam slope or downstream of dam in form of continuous seepage or boils	Inspect clarity of seepage, rate of seepage and amount of material sloughed. Notify tailings coordinator – site engineering and EOR.  Consider initiating Emergency Response Plan
Pond level close to, or approaching a critical level	Notify Manager. Consider initiating Emergency Response Plan
Significant change in an instrumentation reading – see table below for definition of significant change	Check the historical readings paying special attention to seasonal changes and check the measurement again.  Carry out visual inspection of all areas in the vicinity of the instrument of interest. Contact the Engineer of Record.

### 6.3 Dam Instrumentation and Monitoring

The instrumentation data is reviewed regularly to identify anomalous readings that could indicate a change in the conditions of the tailings and water management facilities. Dam instrumentation lists are provided in section 4.6. Instrumentation reading and reporting frequencies are outlined in Table 7.2. Responsible parties' record notes and takes pictures of any potential anomalies to provide further information to the EOR. Instrument trigger and alert levels are provided in Table 7.3. Additional details on instrument reading frequencies can be found in the *Geotechnical Monitoring Plan* (Amec Foster Wheeler, 2016b).

#### Piezometers:

- Vibrating Wire Piezometers shall have a reading frequency every hour and recorded by a data logger, with data collected daily during construction. Post-construction after the readings have stabilized, the reading frequency will be reduced to every 12 hours, as defined in the table below;
- Standpipe piezometers shall be measured weekly during construction and monthly following construction;
- The following are considered anomalous:

- Sudden increases or decreases that do not correlate with seasonal variations (e.g., groundwater recharge during snowmelt affecting foundation piezometers);
- Trend of piezometric increase that approaches or exceeds the rate of rise of the tailings pond; and
- Pattern of sudden and large increases followed by rapid declines.

**Inclinometers:**

- Inclinometers shall be monitored semi-weekly during construction and weekly following construction;
- Anomalous data includes:
  - Sudden increases in cumulative displacement/rate of movement of the inclinometers;
  - Zones of concentrated or discrete displacement; and
  - Blockages of the inclinometer casing.

**Settlement Plates and Survey Pins/Monuments:**

- Settlement Plates and Survey Pins/Monuments shall have a reading frequency of semi-weekly during construction and weekly following construction;
- Anomalous data includes:
  - Sudden displacements of the settlement monuments (x, y, z directions); and
  - Accelerating displacement trends (over two or more readings).

If anomalous readings are observed, the following actions should be taken:

- Check data, reductions and calculations for accuracy and correctness;
- If no errors are found in the calculations, notify the EOR, Geotechnical Engineer and Environmental Manager that an anomalous reading has been observed and that further assessment is going to be conducted;
- Check readout equipment to verify that it is functioning correctly; verify calibration;
- Re-read all instrumentation of the type for which the anomalous reading was observed, in order to check the reading and reading in adjacent instruments;
- If it is observed that an instrument or piece of readout equipment has stopped functioning, notify the Mill Manager and/or Superintendent, and the EOR immediately. If considered critical, a replacement instrument should be installed;
- If the anomalous reading is confirmed, notify the Superintendent and EOR immediately; and
- A detailed review of the effects of the reading should be carried out and the monitoring frequency of the instruments in the area of the anomaly increased to assess the progression of the anomaly. Design or remedial actions should be implemented if determined necessary.

All results are downloaded and provided to the EOR. Any anomalies are noted and a request for an additional reading may occur. The EOR will review the data in quarterly monitoring reports,

and make any recommendations, such as increased reading frequencies, pertaining to anomalous readings. The EOR, will also assess the trigger and alert levels and update them as necessary, once per year, as part of the DSI.

**Table 6-2; Dam Instrumentation Surveillance Requirements**

Type	Frequency
<i>Routine Inspection:</i>	
Dam	Weekly
Diversions	Weekly
Ditches	Weekly
Seepage collection system	Weekly
Spillways	Weekly
Pipelines	Once per 12 h shift
<i>Tailings Pond Monitoring:</i>	
Pump intake	Weekly
Staff gauges	Weekly (initially every ~12h) in Cell 1 borrow
Inflows, Outflows, Condition	Monthly
<i>Dam Instrumentation:</i>	
<i>TMA, WMP and MRP Comprehensive (and water diversions during initial filling)</i>	<ul style="list-style-type: none"> <li>• Daily during construction and initial filling</li> <li>• Weekly, during initial operations depending on trend</li> <li>• Monthly during routine operation</li> </ul>
<i>Annual Dam Inspection</i>	Annually, with no snow cover
<i>Event Driven Inspection</i>	Following unusual events (defined in table 7.1)
<i>Comprehensive Review (DSR):</i>	
Low and Moderate HPC dams	Every 10 years and prior to decommissioning
Very High HPC dams	Every 5 years and prior to decommissioning

Notes:

1. Dam Hazard Potential Classification (HPC) requires review when changes are made or downstream conditions change.
2. Monthly facility inspections should be carried out by the same staff or small group of staff such that subtle changes in the conditions can be detected.

**Table 6-3; Instrument Trigger and Alert Levels**

Instrument	Parameter	Trigger Level	Alert Level	Remarks
VWP/STP	Pore Pressure Ratio	$r_u = 0.4$	$r_u = 0.5$	Pore pressure data to be evaluated with corresponding fill elevation, and monitored movements at SPs and INs
Survey Pin	Lateral Movement Rate	Uniform (but less than max 75 mm magnitude)	Accelerating	To be evaluated with IN data to define zones of movement
	Lateral Movement Rate	Uniform	Accelerating	Deformation rates will be associated with rate of construction and post construction movements

Slope Inclinometer	Share Strain Magnitude	2%	5%	If specific plane(s) of shearing is observed within the foundation, the construction shall be limited, progressed with caution or ceased depending on the observed phenomena
Notes: 1. $r_u$ of 0.4 corresponds to a piezometric head at 80% of the dam height. $r_u$ 0.5 is at piezometric head at the crest of the dam. 2. $r_u$ of 0.5 is a design criteria to meet dam stability requirements. Source; Geotechnical Monitoring Plan (AMECFW, August 2016)				

## 6.4 Dam Safety Inspections (DSIs) and Dam Safety Reviews (DSRs)

Consistent with MECP ECA approvals, with the regulatory exception of the Clark and West Creek Diversions, engineering inspections will be conducted following best management practices as per the Canadian Dam Association's (CDA) Dam Safety Guidelines (2007, revised 2013, as amended from time to time), and the 2014 CDA Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams (as amended from time to time).

### 6.4.1 Dam Safety Inspections

Annual inspections are intended to be part of a more thorough review of the condition of the facility, and are carried out by the EOR. The inspections will include the following key items:

- Visual inspection of the facility by the engineer, including taking appropriate photographs of the observed conditions;
- Review of routine inspection records prepared by operating personnel in the past year;
- Review whether or not recommendations from previous year's inspection(s) have been addressed, and any incidents or actions arising from those previous recommendations;
- Review of instrumentation and monitoring data;
- Review of tailings deposition and water management operations of the facility including reconciliation of the annual water and mass balance. Review of pond levels (and depth) and freeboard, and reports of any incidents (and remedial measures) that may have occurred;
- An evaluation and interpretation of the structural performance of the dam and related components, and identify any potential safety deficiencies or recommended items that need to be addressed in the coming year;
- Review construction records, QA/QC data and as-built information on dam construction and beaching; and
- Evaluation of the OMS Manual to assess the need for updating.

The results of the inspection and review will be documented in a report.

### 6.4.2 Dam Safety Review

The Canadian Dam Association (CDA) Dam Safety Guidelines (CDA, 2007) recommend a comprehensive dam safety review be carried out every 5 years during operations, prior to decommissioning and following closure, by a qualified 3<sup>rd</sup> party consultant.

The comprehensive review provides independent verification of:

- Safety and environmental performance of the facility;
- Adequacy of the surveillance program;
- Adequacy of delivery of OMS Manual requirements;
- Design basis with respect to current standards and possible failure modes; and
- Compliance with new engineering standards (including analysis to confirm if necessary).

## **6.5 Documentation**

Documentation of surveillance and monitoring activities shall be maintained by the Mill Manger, or as designated, as described in the preceding sections and will include recording of:

- Routine visual observations (departures from normal conditions);
- Photographs;
- Instrumentation monitoring and testing;
- Analyses and evaluations; and
- Reviews.

Documentation will include, as a minimum, the following:

- Weekly routine inspection log;
- Monthly tailings facility and process water pond monitoring report;
- Quarterly instrumentation reports;
- Annual Dam Safety Inspection reports; and
- Comprehensive Dam Safety Review report every 5 years.

Documentation will include a hard copy (paper) and electronic filing system for inspection reports, photographic and video records, incident reports, instrumentation readings, instrumentation plots, annual inspections and third-party reviews, so that they can be quickly retrieved for review and in case of an emergency.

## **6.6 Reporting**

The Mill Manager, or designated responsible party, and Geotechnical Engineer will review collected data records from facility monitoring and assess the need for maintenance activities or response. Corrective actions will be identified and tracked to closure. The Environmental Manager is responsible for overseeing sample and data collection and analysis. Reporting will meet MECP requirements and the annual DSI report will also be submitted to the MRNF. Reporting includes;

- As built reports of the dams, excluding the Clark and West Creek diversions, will be submitted to MECP within 90 days of completion;
- An annual report based on the DSI including ECA approval requirements;
- Monthly water quality monitoring report; and
- Annual report including any operating problems and corrective actions, a summary of calibration and maintenance works, use of contingency plans, surface water and groundwater monitoring reports including water balance, ML/ARD updates, discharge volumes and quality.

Additional reporting requirements may be developed as the RRM progresses.

## **7.0 CLOSURE PLAN**

This section summarizes the objectives of the Closure Plan. The *Rainy River Project – Closure Plan* (Amec Foster Wheeler, 2015c) provides the closure plan and includes temporary closure options for short and medium-term shut-down of site facilities.

### **7.1 Monitoring**

Monitoring requirements are described in the *Rainy River Project – Closure Plan* (Amec Foster Wheeler, 2017c).

## **8.0 CONTINGENCIES**

The operations are sensitive to water balance and water quality in discharges. The following are contingencies based on water management and functioning of the diversions.

### **8.1 Water Management Pond**

- Accelerate, where permitted, completion of TMA to enable draining of WMP;
- Additional pumping capacity to cell 2/3; and
- Implement contingencies for Water Quality as outlined below (Water Treatment).

## **9.0 REFERENCES**

AMEC, 2013. Rainy River Project – Final Environmental Assessment Report. Report TC111504 prepared by AMEC Environment & Infrastructure, submitted to New Gold Inc., October 2013.

AMEC, 2014a. Rainy River Project – Tailings Deposition Plan. Technical memorandum TC133921.40 prepared by AMEC Environment & Infrastructure, in progress, October 2015 [RRP Doc. No. 3098004-004000-A1-ETR-0005-AB].



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- Amec Foster Wheeler, 2016d. Rainy River Project – LRIA Work Permit Application Support Document – WMP Dams 4 and 5 prepared by AMEC Environment & Infrastructure, submitted to Ministry of Natural Resources and Forestry, July 28, 2016 [RRP-GEO-LRIA-004A-R4].
- Amec Foster Wheeler, 2016e. Rainy River Project – Design Brief – TMA Start-Up Cell prepared by AMEC Environment & Infrastructure, submitted to New Gold Inc., August 25, 2016 [RRP-GEO-REP-008-R1].
- Amec Foster Wheeler, 2016f. Rainy River Project – Geotechnical Investigations Report – TMA – Volume 1 – Dam Design Implications – Version 3.1 prepared by AMEC Environment & Infrastructure, submitted to New Gold Inc., August 11, 2016 [RRP-GEO-REP-001A-R3].
- Amec Foster Wheeler, 2016g. Rainy River Project – Geotechnical Investigations Report – TMA – Volume 2 – Investigations and Interpretations prepared by AMEC Environment & Infrastructure, submitted to New Gold Inc., August 12, 2016 [RRP-GEO-REP-001B-R3].
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**RAINY RIVER PROJECT**

**PART V- SEDIMENT POND OPERATION, MAINTENANCE  
AND SURVEILLANCE MANUAL WATER MANAGEMENT  
STRUCTURES**

**New Gold Inc.  
Rainy River Project  
5967 Highway 11/71, P.O. Box 5  
Emo, Ontario  
P0W 1E0**

**November 2018**

**Version 2018-11**

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- Appendix B Water Pumping Data (simple list of pumps, capacity, PFDs, other)
- Appendix C New Gold Tailings, Heap Leach and Waste Rock Facilities Management Policy
- Appendix D Tailings Deposition Plan (Schematic)
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- Appendix G MNRF Comments on the Pre-Production OMS Manual and New Gold Responses on revision AG (October 2016) & ITRB Review Comments on Pre-Production Version (July 2017)

## **1.0 Regulatory Requirement**

This document is consistent with the New Gold Tailings, Heap Leach and Waste Rock Facilities Management Policy and was prepared pursuant to the MAC guidelines for *Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities* (MAC, 2011).

The following is a list of permits that this section of the OMS complies with:

- LRIA-FF-2017-02: Sediment Ponds 1 and 2

## **2.0 FACILITY DESCRIPTIONS**

Water treatment is provided by the following;

- Water Treatment Plant, Water Discharge Pond (WDP) and the Constructed wetland – (CW); and
- Sediment ponds 1 and 2.

Sedimentation ponds have been designed to allow for the settlement of total suspended solids present in the non-contact runoff or effluent prior to discharge to the environment. Sediment Ponds #1 and #2 receive runoff and seepage from the West Mine Rock Stockpile (WMRS). The Water Discharge Pond (WDP) and Constructed Wetland receive discharge water from the WMP. The constructed wetland is the primary and priority discharge location from the WMP (to mitigate flow reductions in the Pinewood River) ahead of discharging to the Pinewood River downstream of McCallum Creek.

### **2.1.1 Sediment Ponds 1 & 2**

Sediment Ponds #1 and #2 collect seepage and runoff from the West Mine Rock Stockpile (WMRS) to allow for settlement of Total Suspended Solids (TSS). The sediment ponds have been designed to provide a 12-day hydraulic retention time. Sediment Pond #1 will also receive

overflow water from the West Creek Overflow Weir during large storm events. Critical to the function of the sediment ponds is progressive reclamation. The ponds have been designed to meet the retention time objectives for Year 3 of mine operations. Further details on design are provided in the following documents:

**Table 2-1; Sediment Ponds 1 and 2 Design Detail Documents**

<b>Document Title</b>	<b>Reference</b>
LAKES AND RIVERS IMPROVEMENT ACT WORK PERMIT APPLICATION SUPPORT DOCUMENT SEDIMENT PONDS	RRP-GEO-LRIA-012 R1
As-built Report	TBD
<b>Drawing Title</b>	<b>New Gold Document Number</b>
Temporary Sedimentation Pond Plan and Details	3098004-004430-A1-D70-0002
Sediment Pond #2 – Plan, Cross Sections, and Details	3098004-004440-A1-D70-0002

After 2018, progressive rehabilitation would be required to reduce the sediment load on the ponds, or the ponds could be increased in size. After 3 years of mine operations, a better estimate of sediment loading from the stockpile area should be available to adequately design for additional area as required.

Seepage collection ditches will be constructed around the Overburden and NPAG stockpiles to convey runoff to the sediment ponds. The ditches will be constructed to minimize erosion protection requirements where practically possible. Flows may also be directed to the ponds using road side ditches.

Good engineering practices for placement, sediment and erosion control will be adopted for the management of the overburden pile to help reduce the sediment load and increase the chance that settling alone (as opposed to the addition of coagulants and flocculants) can be used for settling out the TSS. These practices include pre-settling ponds that are regularly cleaned out, construction of ditches with appropriate slopes, maintenance of the ditches, and progressive re-vegetation of the overburden stockpile.

## **2.2 Instrumentation**

### **2.2.1 Dam Safety**

Instrumentation has been and will be installed during construction. Instrumentation will include instrumented dam sections that will monitor dam foundation and clay fill pore pressures to infer consolidation characteristics, as well as monitor any movement of dam fill due to deformation. Each dam instrumentation section will include: standpipe(s), a settlement plate, slope inclinometer(s), survey pins/monuments, and a terminal arrangement with data logger and vibrating wire piezometers.

Following construction, the instrumentation will remain for dam monitoring purposes. A detailed report containing the proposed locations, usage, and analysis of all instrumentation is provided in the *Geotechnical Monitoring Plan* (Amec Foster Wheeler, 2016b). The design details for the installed or proposed dam instrumentation is summarized in Table 4-14. The design information provided in Table 4-14 will be confirmed and updated as may be required following development of the As-Built drawings.

Table 2-2; Dam Instrumentation Summary

Facility	Section (Sta.)	Dam Instrumentation							Pond Level Gauge (type)
		Slope Stability			Foundation Consolidation		Phreatic Level and Seepage		
		Slope Inclinometers (no.)	Survey Pins (no.)	Survey Monuments (no.)	Vibrating Wire Piezometers (no.)	Settlement Plates (no.)	Vibrating Wire Piezometers (no.)	Standpipe Piezometers (no.)	
TMA North	3+300	0		0	2	1	1	2	TBD
	Mass array				142				
TMA South	1+000				2				
	1+380				2	1	1	1	
	1+450	2		2	4	2	1	2	
	1+600	1			4	2	1	1	
	2+200	2		2	4	2	1	2	
	2+350	1			4	2	1	1	
	Mass array				176				
TMA West	0+300			0	1		1		
	0+460	2		0	5		2	1	
	1+450	0	35	0	0	1		0	
	1+500	2		0	4	0	3	0	
	Mass array				82				
TMA Start-up Cell	0+400				2				
	1+000				2				
	Mass array				88				
WMP Dam 1			16					- Staff gauge	
WMP Dam 2	0+950	1	34	0	2	0	2	2	- Survey stakes
WMP Dam 3	0+300	0		0	1	0	1	2	
	0+500	1	17	0	2	1	4	1	
Mine Rock Pond	0+220	1		2	2	1	1	4	- Staff gauge
Clark Creek									- Staff gauge
Teeple Road									- Staff gauge
Stockpile Pond	0+125	1	8	0	1	0	1	2	- Staff gauge
West Creek	0+291				2			2	
	0+320	2	2						- Staff gauge
	0+340	2	2		2	1	1		
Water Discharge Pond									TBD
Constructed Wetlands									
- Pond A									TBD
- Pond B									TBD
- Pond C									TBD
- Pond D									TBD
- Pond E									TBD
Sediment Pond #1									TBD
Sediment Pond #2									TBD
Temporary Sediment Pond									TBD

Notes:

- 1) Survey pins installed at 100 m centres along 3-5 lengthwise lines (crest, toes, etc.) Quantities are total for each dam
- 2) TMA Dams feature mass array of VWP instruments installed in grids within the dam foundation. Installation of these instruments is currently on-going

In addition to the instrumentation described above, the TMA dams are equipped with an additional suite of vibrating wire piezometers (VWPs) to provide enhanced monitoring resolution during construction. A total of 524 VWPs were installed in the TMA dam foundations, arranged in a grid pattern, and managed with a remote wireless data acquisition and management system.

Instrumentation associated with the management of the dams is being managed through a software system that includes integration with data loggers and data storage and is configured such that alarms for alert levels are defined and available. The software routinely generates reports and if trigger levels are exceeded sends out alarm notifications.

### **2.2.2 Other instrumentation**

Additional instrumentation to support the OMS manual and management of water includes;

- Densometer on the tailings pipeline;
- Flow meters on the water management pipelines including from the Pinewood River, tailings reclaim lines, MPR line and freshwater line from the WMP and
- Pressure transducers in the WMP, Clark/Teeple Ponds.

This instrumentation provides continuous recording, which is collected during routine inspections and included.

### **2.3 Regulatory Requirements**

Regulatory requirements, permits and authorizations are summarized in section 1.1. Key approvals include the Federal and Provincial Environmental Assessment conditions and commitments and permits including those issued pursuant to the LRIA and EPA. Additional legislation to be considered in implementing the OMS manual includes the MMER and various Ontario regulations including waste management.

No direct discharges are intended from any of the structures described in this section except the WMP which is described in sections 4 and 5. Seepage will be collected and pumped back from the WMP and TMA cells. Subsequent to this revision and LRIA approvals, additional details for the WDP, CW and sediment ponds discharges will be developed.





### **3.0 OPERATIONS**

The overall operational objectives of the TMA and associated dams and facilities are to dispose and store the tailings and to manage all site water in a safe, economical and environmentally responsible manner. This section defines operating standards in accordance with design criteria and regulatory requirements specified in section 4.

#### **3.1.1 Sediment Ponds 1 and 2**

Sediment ponds are designed to provide a 12-day hydraulic retention time for all events up to and including the 25-year return period, 24-hour storm.

##### **Sediment Pond #1** (Drawing 3098004-004430-A1-D70-0002)

- Collects runoff from the overburden stockpile;
- Will also receive additional inflow from overflow from West Creek Diversion during storm events large than the 25 year 24-hour storm event;
- The low flow outlet is designed to achieve the required retention time for the 25-year 24-hour storm event; and
- To prevent dam overtopping emergency spillway is designed for the 100-year storm event discharging to the West Creek Diversion Channel.

##### **Sediment Pond #2** (Drawing 3098004-004440-A1-D70-0002)

- Collects runoff from the west mine rock pile (Non-Potentially Acid Generating [NPAG]) and is closer to the Pinewood River;
- The low flow outlet is designed to achieve the required retention time for the 25-year 24-hour storm event; and
- To prevent dam overtopping the high flow spillway is designed for the Regional Storm Event (Timmins storm event), discharging directly to the Pinewood River.

### 3.2 Environmental Protection

The Environmental Department has oversight over the EMS which contains tailings operations related environmental aspects including:

- Fugitive and point source dust emissions;
- Hydrocarbon Spills and Leaks;
- Pipeline Rupture and Leaks;
- Surface and ground water quantity and quality; and
- Wildlife management (including species at risk).

An environmental aspect register is a comprehensive inventory of tailings operations activities, environment aspects, assessment of risk and identification of controls. Tailings personnel have responsibility to implement and maintain the controls including monitoring and inspection. Refer to the Environment Department for the environmental aspect register (in prep) and environmental related procedures.

As outlined in orientation training, it is every RRM employee’s responsibility to report a suspected spill or uncontrolled release event to their supervisor. This includes suspicious flows of water out of the area, escaping tailings, etc. The sooner appropriate persons can begin to correct a situation, the less likely it is that severe impacts will follow.

Table 5-3 provides a summary of the MECP effluent discharge limits that must be met to discharge from the WMP.

**Table 3-1; MECP Effluent Discharge Limits from the WMP**

<b>Constructed Wetland Final Discharge and Water Management Pond Pipeline Discharge (to the Pinewood River) as stated in MECP ECA 5178-9TUPD9</b>		
<b>Effluent Parameter</b>	<b>Daily Maximum Concentration (mg/l)</b>	<b>Monthly Average (mg/l)</b>
Cadmium	-	0.0010

Cobalt	-	0.0044
CBOD5	-	25.0
E.coli	-	100/100ml geometric mean density
Total Suspended Solids	30	15
Total Phosphorus	-	0.10
Cyanide (total)	0.1	0.05
Cyanide (free)	0.02	0.01
Total Arsenic	0.034	0.017
Total Copper*	0.028	0.014
Total Nickel	0.094	0.047
Total Lead*	0.030	0.015
Total Zinc*	0.348	0.174
Un-ionized Ammonia	0.08	0.04
Acute Toxicity (Rainbow Trout and Daphnia Magna)	Non-acutely lethal (not greater than 50% mortality in undiluted effluent)	
pH of the effluent maintained between 6.0 to 9.5, inclusive, at all times		
<b>Notes:</b>		
<ol style="list-style-type: none"> <li>*Proposed effluent criteria for Total Copper, Total Lead, and Total Zinc are based on a hardness of 200 mg/L CaCO<sub>3</sub>. In the event that water quality sampling indicates that 75<sup>th</sup> percentile hardness concentrations are less than 200 mg/L CaCO<sub>3</sub>, the effluent limits may be changed by the District Manager in writing, consistent with achieving no impairment for receiving waters.</li> <li>Additional effluent limits for sediments 1&amp;2 are stated in MECP ECA 5178-9TUPD9</li> <li>The effluent discharge rate from the Constructed Wetland Final Discharge and the Water Management Pond Pipeline Discharge such that at all times the ratio of the combined flow rate of these effluents to the flow rate of the receiving surface water (Pinewood River) is less than or equal to 1:1 (i.e. the cumulative flow rate of the effluent must be less than or equal to the flow rate of the receiving surface water).</li> <li>Prior to commencing Operations Phase discharges (Constructed Wetland Final Discharge, Water Management Pond Pipeline Discharge, Sediment Pond #1, and Sediment Pond #2), the method for determining daily effluent to receiver flow mixing ratios shall be approved by the District Manager.</li> <li>For sampling frequencies and full parameter list refer to MECP ECA 5178-9TUPD9; sampling frequency varies from thrice weekly to quarterly depending on the parameter</li> </ol>		

### **3.3 Reporting Requirements**

Reporting is sub-divided as routine, planned reports of defined frequency, and those that are non-routine i.e., event driven.

#### **Routine**

- Submission of asbuilts within 3 months of construction for WMP, TMA, MRP and sediment ponds 1 and 2
- Monthly monitoring report including a summary of all monitoring data collective, all non routine calibration/maintenance procedures, tabulation and description of any bypass/upset conditions
- Annual reporting to MECP on March 31 for the previous year, a works performance report and a surface water monitoring report
- Quarterly electronic effluent monitoring reports to ECCC
- Annual electronic effluent monitoring report and environmental effects monitoring reports to ECCC by March 31

#### **Non-routine**

- Report all spills as defined in the Environmental Protection Act immediately to spills action centre SAC, follow New Gold Incident Reporting Guidelines and follow up in writing to MECP within 10 days describing the cause and discovery of the spill or loss, clean-up and recovery measures taken, preventative measures to be taken and schedule of implementation
- Any observation of sheen/foam/settable solids within the works report immediately to (SAC) immediately and written reporting within 7 days
- Any exceedance of effluent limits report to SAC immediately, written confirmation to MECP within 7 days
- If acute toxicity tests fail, within 15 days report in writing to MECP with the cause and remedial actions proposed/implemented

- Notify ECCC immediate if MMER Sch 4 limits are exceeded, pH is outside 6-9.5 range or if the effluent is acutely lethal with a written report within 30 days

Records are retained consistent with CEAA condition 11 for a minimum of 25 years or until decommissioning ends, whichever is longer and kept locally. This exceeds the ECA permit requirement of 3 years. Records include place/date/time of sampling, dates and analysis performed, analytical techniques used, names of persons collected/analyzing sampling and results of analysis.

An Operations Report will be prepared by the Mill Manager or designate. The report will include metrics and information collected as part of normal operation. Examples of information contained in the Operations report include:

- Total monthly tailings deposition tonnage and slurry water volume;
- Total monthly reclaim volume;
- Pond level and freeboard;
- Updated water balance;
- Water quality results; and
- Intake / Discharge quantities.

Each of the regulatory approval requirements related to the construction, operation and eventual reclamation of the Site have specific compliance reporting requirements with defined deadlines or reporting periodicity. In general, the reporting includes:

- Operation, Maintenance and Surveillance Plan(s) for dams, water management (water quality) and air/noise emissions;
- Emergency Preparedness Plan(s);
- As-Built Drawings and related Construction Reports;
- Dam Safety Inspection and Review Reports
- Environmental Monitoring Plans; and
- Environmental Monitoring and Performance Reports.

The environmental approvals and permits received from the government that are maintained by the New Gold Environmental Department should be referred to for details of monitoring, inspection and reporting requirements.

In addition, the New Gold Environmental Department should be notified of any proposed major modification to RRM facilities, in order that they can liaise with the appropriate government ministries to determine if additional approvals or amendments to existing approvals are required.

#### **4.0 MAINTENANCE**

The following periodic maintenance is required:

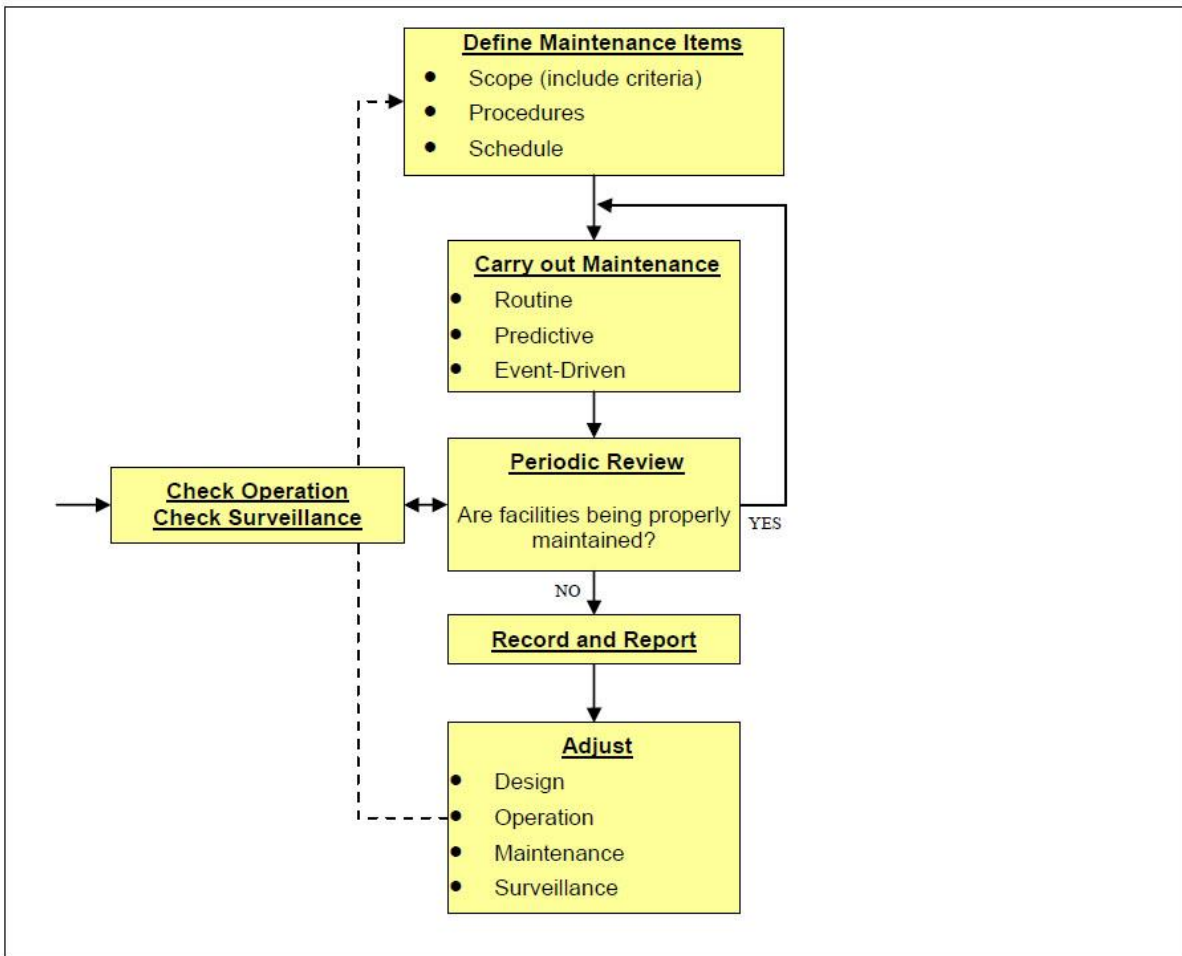
1. Maintain the tailings and reclaim pumps and associated lines and containment;
2. Clear debris, snow and ice which may block flow through the decant facility or emergency spillways;
3. Maintain water management structures including spillways, ditches and diversions;
4. Maintain equipment, power and water lines, and instrumentation;
5. Repair any deficiencies as noted in the Dam Safety Inspections (DSI); and
6. Reconstruct the support for tailings discharge pipelines wherever washouts occur.

Maintenance records are retained by maintenance personnel performing the work in accordance with the procedures described in this document. Timing of maintenance actions for unusual conditions should be based on specific recommendations from surveillance findings. Scope and time frames for routine maintenance activities are determined and scheduled by the Maintenance Department and based on manufacturer's recommendations and best practices.

The maintenance flowchart is illustrated in Figure 6-1.

**Figure 4-1; Maintenance Flow Chart**





**4.1 Routine and Predictive Maintenance**

Routine and predictive maintenance includes removal of vegetation, beaver dams, ice blockage or sediment accumulation that would otherwise affect the performance of a structure when required.

#### **4.2 Maintenance and Emergency Preparedness**

A weekly table-top exercise will be conducted with the pump management team to ensure that crews are intimately familiar with the operational strategies for a broad range of operating and emergency scenarios. These table tops will be documented and New Gold management will ensure that any ongoing lessons learned from day-to-day operation are captured including the updating of any corresponding plans, maps, flowsheets or procedures.

The maintenance of pumps is the responsibility of New Gold and maintenance records are required to be maintained. Each installation requires to be equipped with spill pan, spill kits and the necessary signage. Changes to pumping configurations, ditching, piping or operating parameters need to be approved by the New Gold Mill Manager, the New Gold Maintenance Manager and the New Gold Environmental Manager, during normal working hours. This is particularly the case if splash pads need to be altered in any way. In an emergency call out (after hours), the Managers or their alternate, will provide direction in consultation with the New Gold Environmental Department.

During depositing of tailings the above-mentioned crews are required to complete their inspections daily. Reporting is to be escalated to hourly observations if a rainfall event is escalating and the Cell 2 level is within 200 mm of the intermediate fill elevation of 363.2 masl. The general manager can then decide whether to provide additional surveillance resources in the case where additional duties including maintenance and operation of the Cell 2 dewatering pumps is required to be performed by the allocated crews.

A summary report titled " TMA Cell 2 Water Levels " is circulated each morning at 9 a.m. to summarize the measured water and tailings levels as of 4 p.m. the day prior. This

report is prepared and circulated by the mill superintendent or his alternate. The purpose of the report is to highlight trend data for Cell 2.

Fundamental to the successful operation of the ponds and pumping strategy is a timely reaction to rainfall events, and ensuring that pumps come 'on line' or are taken 'off line' as design trigger levels are reached.

#### **4.2.1 Dams**

The following are examples of specific maintenance activities:

- Regularly check diversion ditches, spillways and culverts for accumulation of debris or sediment, or any other form of blockage including ice, and remove if required;
- Visually inspect diversions, spillways, seepage collection sumps, dams and all ditches for cracking, bulging, slumping, and any other indications of slope movement (note, any indications of slope movement shall be reported to a qualified geotechnical engineer);
- Re-grade the dam crest, as required, to prevent local ponding and direct surface runoff towards the pond;
- Repair erosion gullies, local slumps or slides in the dam face, diversion ditches or spillway channels; and
- Regularly check diversion ditches for accumulation of debris or sediment, or any other forms of blockage, and remove if required.
- If annual survey determines necessary, correct dam crest, overflow spill way and diversion channel invert irregularities to avoid concentrated runoff.

#### **4.2.2 Ditches and spillways**

Ditch maintenance includes replacement or enhancement of erosion protection to prevent sediment generation or sloughing of slopes, as required.

#### **4.2.3 Geotechnical and Water Monitoring Instrumentation**

Instrumentation is calibrated by the manufacturer prior to shipment. Calibration certificates will be maintained by maintenance department. Following instrument installation, initial reading procedures will be followed. Subsequent calibration will follow manufacturer's recommendations.

Malfunctioning or damaged instruments may require repair or replacement per manufacturer guidelines or approved procedure. In the event of replacement of dam instrumentation, several overlapping readings of the old and new instrument are required to ensure continuity of the data records.

#### **4.2.4 Pumping Systems and Pipelines**

Maintenance of the tailing delivery, water recirculation systems and seepage pumps will include:

- Perform regular performance tests of the Pinewood Pumphouse pumps and inspections of pump fish screens to remove any debris;
- Perform regular performance tests on seepage pond pumps
- Perform annual calibration and maintenance as required on flow meters;
- Perform regular non-destructive testing appropriate for components of the tailings delivery system, including for example, periodic measurement of pipeline thickness to identify areas of wear and to schedule pipeline replacement if necessary and repair liners as required;
- Replace pipe work, bends and fitting components as required;
- Remove accumulated debris from valves, reducers and off takes;
- Carry out maintenance as recommended by fitting and valve suppliers;
- Regularly inspect major wear components;
- Maintain emergency dump ponds in a dewatered/empty state; and
- Maintain and replace system instrumentation as required.

#### **4.2.5 Mobile Equipment**

Mobile equipment is maintained on the basis of a planned reliability program and as otherwise required. Equipment in question includes:

- Dozers;
- Excavators;
- Water truck;
- Pickup trucks;
- Mobile crane;
- Flatbed and picker truck; and
- Replacement of mobile equipment as required.

#### **4.3 Event-Driven Maintenance**

In the event of unusual conditions or incidents that require immediate maintenance actions but are not considered an emergency, repairs and replacement of facility components are made as required and activities are documented. RRM staff will provide a means to assess event driven maintenance needs through response action planning. Response planning is based on risk prioritization, maintenance crew mobilization or “call out” procedures, required repairs and replacement material availability. Event driven maintenance actions will follow applicable safety and performance procedures. Normal documentation and maintenance records will be maintained as a result of any event driven maintenance actions. Unusual conditions that require maintenance are also communicated to maintenance staff as they occur.

##### **4.3.1 Pipeline Leaks or Breaks**

In the event of a pipeline leak or break the system in question is de-energized and repaired as follows:

- Inspect entire pipeline;

- Repair or replace affected components;
- Perform opportune and scheduled maintenance;
- Repair any collateral damage caused by a leak or break;
- Collect any released tailings and place in the tailings impoundment;
- Reclaim any disturbed areas; and
- Follow any spill reporting that may be required pending type of spill and following documentation procedures.

#### **4.3.2 Earthquake Occurrence**

Following an earthquake, the following are undertaken:

- Inspect dam and beach areas for sign of distress due to deformation;
- Inspect dam for signs of liquefaction (e.g., local sand boils, etc.);
- Measure freeboard for compliance with design requirements;
- Inspect toe area of dam for signs of deformation or piping of fines;
- Inspect diversions, ditches and spillways for sign of slumping or changes in geometry;
- Inspect seepage collection areas; and
- Collect instrumentation data and submit to EOR for analysis.

#### **4.3.3 Flood Event**

Following extreme storms (as defined in section 7) the following are undertaken:

- Measure freeboard for compliance with design requirements;
- Inspect dam, diversions, ditches, spillways and diversions for signs of excessive erosion and repair if required;

- Inspect seepage return system for adequacy; and
- Implement appropriate response based on observations/measurements as defined in this manual.

#### **4.4 Reporting Requirements**

Maintenance information will be communicated internally through formal and informal meetings, interaction between various levels of the organization (department and/or crew meetings), through information posted at the site and through this OMS Manual.

Communications with applicable contractors involved in tailings management will be conducted daily and weekly during tailings activity meetings, as appropriate. All employees and contractors are encouraged to communicate openly with site management about operational conditions requiring maintenance and reporting any significant observations such as event-driven maintenance or any maintenance requirements that exceed expected norms.

Equipment logs and manuals will be maintained for reference and use by responsible staff.

Maintenance diaries and logs shall be maintained and accessible for review by other parties.

## **5.0 DAM SAFETY AND SURVEILLANCE**

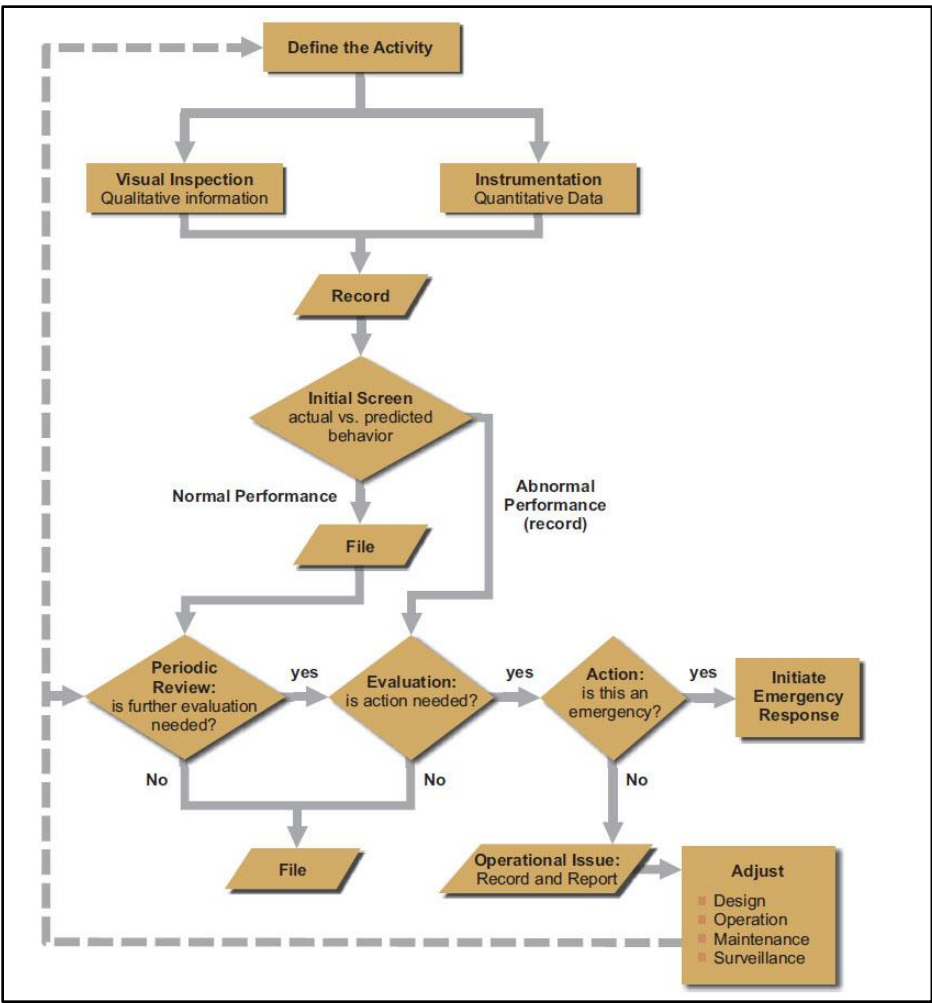
The RRM tailings and water management surveillance activities involve inspection and monitoring of the operation, structural integrity and safety of a facility. Regular review of surveillance information can provide an early indication of performance trends that, although within specifications, warrant further evaluation or action. The objectives of our surveillance program are as follows:

- Monitoring the operation, safety and environmental performance of tailings and water management facilities;
- Promptly identifying and evaluating deviations from expected behavior that affect operational safety, structural integrity and environmental performance of the facility; and
- Reporting significant observations for response.

The flow chart for surveillance is shown in Figure 7-1. Surveillance is undertaken in two primary methods – visual inspection and reading of instruments. Results of these qualitative and quantitative observations are compared to the expected performance of the TMA and water management facilities. If observations are within the expected range or performance, the results of the surveillance are simply recorded. If observations are outside the expected range, further evaluation is completed to determine if remedial action is necessary. If necessary, this action is taken and may range from a minor adjustment to operational procedures to initiation of emergency response, depending on the severity and nature of the deviation from expected performance.



**Figure 5-1; Surveillance Flow Chart**



## **5.1 Surveillance and Inspections by Mine, Mill and Environment Operations Staff**

The purpose of the surveillance program is to identify and classify problems and/or unsafe conditions that are visually evident. Visual inspections are an integral part of proper maintenance and performance of monitoring programs for the TMA and water management facilities. Failure to correct identified maintenance and repair items, or potential adverse behaviour, could result in unsafe conditions or lead to a failure of operating systems or cause an adverse environmental effect.

The surveillance program will consist of making regular observations relating to:

- The conditions and performance of the dams including indications of cracking, bulging, depressions, sinkholes, vegetation, surface erosion and seepage;
- Water levels and pump intake zones;
- Function of ancillary hydraulic structures (diversions, spillways, pipelines etc.);
- Discharge pipeline operations and tailings beach development; and
- Total facility performance.

During inspections, observations will be made at the upstream slope, crest and downstream slope with respect to signs of erosion, scouring, cracking, settlement, deformation, and any instability and abnormality. Seepage rates will be visually estimated and recorded on the inspection forms. Changes in the seepage rate or clarity (i.e., turbidity) require immediate reporting to the Engineer-of-Record.

### **5.1.1 Daily Inspections**

During first filling of all dams except the TMA dams Surveillance records will be maintained in logs at site and submitted to the EOR for review daily and on a monthly basis thereafter, or more frequently as warranted. Any abnormal behaviour including slope slumping, erosion of crest settlement will be reported immediately to the Engineer-of-Record.

Routine daily visual inspections of critical dams (TMA, WMP and MRP), spillways, pipelines, pipeline containment and pumping infrastructure will be carried out on an on-going basis to confirm normal operations and identify unusual or anomalous conditions such as pipeline leaks, pump intake blockages, etc. All active pipelines will be inspected twice per 12 h shift, consistent with EA conditions.

Daily inspection sheets and provided in Appendix F.

### **5.1.2 Weekly Inspections**

Physical inspections of the TMA, process water, water treatment and diversion dams will be conducted on a weekly basis. The weekly inspections will include those discussed in Section 7.1.1 and the following tasks:

- Photographic record of key features;
- Physical inspection of dams, dykes, diversion, ditches and spillways:
  - Indicating and reporting any seepage and erosion.
- Pond levels and freeboard:
  - Additional monitoring maybe required during spring freshet of the dams.

Weekly inspection sheets and SOPs are provided in Appendix F. All weekly inspections will be documented in a report and will be compiled as part of the annual DSI (Section 7.4).

### **5.1.3 Other Inspections**

## **5.2 Inspection Required After an Unusual Event**

Several potential failure modes exist for the various tailings and water management and water diversion storage facilities. These potential failure modes, along with likely triggers, observable visual and instrumentation indicators of the failure mode are presented in Table 9-1. Special inspections will be carried out immediately if any of the following events occur:

- Events such as an earthquake, large rainfall (greater than 1:2 year rainfall (51mm)) or large snowfall/snowpack;
- Operating events such as rupture of a pipeline, particularly if on the slope or crest of the dam, sudden loss of pond water, sudden rapid rise of pond water;
- Observations such as cracks, excessive settlements, sinkholes, large slope or foundation deformations, increased seepage, turbidity of seepage water; and
- Instrument readings that deviate from historical trends, or are within “alert” action levels (e.g., trigger levels).

Special inspections after unusual events are necessary as summarized in Tables 7-1 to evaluate whether there has been any damage requiring correction, any safety measures or special operating procedures that need to be implemented, or if there is a need to initiate emergency procedures as described in Section 9.0.

**Table 5-1; Maintenance Requirements following an Unusual Event**

Unusual Event	Post – Event Inspection/Surveillance
Earthquakes	Carry out a detailed walkover of all dam structures, including crests, downstream and upstream (visible) slopes and dam toes, and all spillways, looking for signs of

Unusual Event	Post – Event Inspection/Surveillance
	cracks, bulging, settlement and/or other deformations. Look for and note any changes in seepage, particularly with respect to the rate of seepage flows at dam slopes and seepage clarity. Read all piezometers. Inspect downstream toes of dams for sand boils and dam slopes for sinkholes. Inspect ponds upstream of the dams looking for 'whirlpools'. Inspect all pump stations and pipelines. Discuss findings with the Dam Safety Inspector.
Rapid snowmelt and/or heavy rainstorms exceeding a 1:2 year rainfall (51 mm)	Inspect the (visible) slopes and the crests of all the tailings dams looking for areas of concentrated runoff and erosion. Make note of saturated ground/soft ground conditions at dam slopes and toes. Examine dam slopes for indications of localized slumping/instability. Inspect all pump stations and pipelines. Check the water levels in all ponds/reservoirs against the critical levels, and keep checking these levels until the pond/reservoir inflows subside. Discuss findings with the Dam Safety Inspector. Check piezometric levels at dam sites if instructed to do so.
Unusually high winds (exceeding 60 kph i.e., 75 % of maximum likely used in design)	Check the condition of erosion protection on the upstream slopes of the dams.
Extreme snow pack (170cm cumulative snowfall) (i.e., 120% or greater than normal snowfall at Barwick)	Check the water levels in all ponds/reservoirs against the critical levels, and keep checking these levels until the spring freshet is over. Evaluate the situation in terms of possible snowmelt scenarios. Make predictions as to the expected storage capacity available in ponds/reservoirs. If deemed necessary, mobilize pumping and mobile treatment equipment to site.
Significant, relatively rapid erosion (any cause) of dam slope or 'sudden' seepage break at dam slope or downstream of dam in form of continuous seepage or boils	Inspect clarity of seepage, rate of seepage and amount of material sloughed. Notify tailings coordinator – site engineering and EOR.  Consider initiating Emergency Response Plan
Pond level close to, or approaching a critical level	Notify Manager. Consider initiating Emergency Response Plan

Unusual Event	Post – Event Inspection/Surveillance
Significant change in an instrumentation reading – see table below for definition of significant change	<p>Check the historical readings paying special attention to seasonal changes and check the measurement again.</p> <p>Carry out visual inspection of all areas in the vicinity of the instrument of interest. Contact the Engineer of Record.</p>

### 5.3 Dam Instrumentation and Monitoring

The instrumentation data is reviewed regularly to identify anomalous readings that could indicate a change in the conditions of the tailings and water management facilities. Dam instrumentation lists are provided in section 4.6. Instrumentation reading and reporting frequencies are outlined in Table 7.2. Responsible parties’ record notes and takes pictures of any potential anomalies to provide further information to the EOR. Instrument trigger and alert levels are provided in Table 7.3. Additional details on instrument reading frequencies can be found in the *Geotechnical Monitoring Plan* (Amec Foster Wheeler, 2016b).

#### Piezometers:

- Vibrating Wire Piezometers shall have a reading frequency every hour and recorded by a data logger, with data collected daily during construction. Post-construction after the readings have stabilized, the reading frequency will be reduced to every 12 hours, as defined in the table below;
- Standpipe piezometers shall be measured weekly during construction and monthly following construction;
- The following are considered anomalous:
  - Sudden increases or decreases that do not correlate with seasonal variations (e.g., groundwater recharge during snowmelt affecting foundation piezometers);

- Trend of piezometric increase that approaches or exceeds the rate of rise of the tailings pond; and
- Pattern of sudden and large increases followed by rapid declines.

**Inclinometers:**

- Inclinometers shall be monitored semi-weekly during construction and weekly following construction;
- Anomalous data includes:
  - Sudden increases in cumulative displacement/rate of movement of the inclinometers;
  - Zones of concentrated or discrete displacement; and
  - Blockages of the inclinometer casing.

**Settlement Plates and Survey Pins/Monuments:**

- Settlement Plates and Survey Pins/Monuments shall have a reading frequency of semi-weekly during construction and weekly following construction;
- Anomalous data includes:
  - Sudden displacements of the settlement monuments (x, y, z directions); and
  - Accelerating displacement trends (over two or more readings).

If anomalous readings are observed, the following actions should be taken:

- Check data, reductions and calculations for accuracy and correctness;
- If no errors are found in the calculations, notify the EOR, Geotechnical Engineer and Environmental Manager that an anomalous reading has been observed and that further assessment is going to be conducted;
- Check readout equipment to verify that it is functioning correctly; verify calibration;



- Re-read all instrumentation of the type for which the anomalous reading was observed, in order to check the reading and reading in adjacent instruments;
- If it is observed that an instrument or piece of readout equipment has stopped functioning, notify the Mill Manager and/or Superintendent, and the EOR immediately. If considered critical, a replacement instrument should be installed;
- If the anomalous reading is confirmed, notify the Superintendent and EOR immediately; and
- A detailed review of the effects of the reading should be carried out and the monitoring frequency of the instruments in the area of the anomaly increased to assess the progression of the anomaly. Design or remedial actions should be implemented if determined necessary.

All results are downloaded and provided to the EOR. Any anomalies are noted and a request for an additional reading may occur. The EOR will review the data in quarterly monitoring reports, and make any recommendations, such as increased reading frequencies, pertaining to anomalous readings. The EOR, will also assess the trigger and alert levels and update them as necessary, once per year, as part of the DSI.

**Table 5-2; Dam Instrumentation Surveillance Requirements**

<b>Type</b>	<b>Frequency</b>
<i>Routine Inspection:</i>	
Dam	Weekly
Diversions	Weekly
Ditches	Weekly
Seepage collection system	Weekly
Spillways	Weekly
Pipelines	Once per 12 h shift
<i>Tailings Pond Monitoring:</i>	
	Weekly

Type	Frequency
Pump intake	Weekly
Staff gauges	Weekly (initially every ~12h) in Cell 1 borrow
Inflows, Outflows, Condition	Monthly
<i>Dam Instrumentation:</i>	Weekly
<i>TMA, WMP and MRP Comprehensive (and water diversions during initial filling)</i>	<ul style="list-style-type: none"> <li>• Daily during construction and initial filling</li> <li>• Weekly, during initial operations depending on trend</li> <li>• Monthly during routine operation</li> </ul>
<i>Annual Dam Inspection</i>	Annually, with no snow cover
<i>Event Driven Inspection</i>	Following unusual events (defined in table 7.1)
<i>Comprehensive Review (DSR):</i>	
Low and Moderate HPC dams	Every 10 years and prior to decommissioning
Very High HPC dams	Every 5 years and prior to decommissioning

Notes:

1. Dam Hazard Potential Classification (HPC) requires review when changes are made or downstream conditions change.
2. Monthly facility inspections should be carried out by the same staff or small group of staff such that subtle changes in the conditions can be detected.

**Table 5-3; Instrument Trigger and Alert Levels**

Instrument	Parameter	Trigger Level	Alert Level	Remarks
VWP/STP	Pore Pressure Ratio	$r_u = 0.4$	$r_u = 0.5$	Pore pressure data to be evaluated with corresponding fill elevation, and monitored movements at SPs and INs
Survey Pin	Lateral Movement Rate	Uniform (but less than max 75 mm magnitude)	Accelerating	To be evaluated with IN data to define zones of movement

Slope Inclinometer	Lateral Movement Rate	Uniform	Accelerating	Deformation rates will be associated with rate of construction and post construction movements
	Share Strain Magnitude	2%	5%	If specific plane(s) of shearing is observed within the foundation, the construction shall be limited, progressed with caution or ceased depending on the observed phenomena
Notes: 1. $r_u$ of 0.4 corresponds to a piezometric head at 80% of the dam height. $r_u$ 0.5 is at piezometric head at the crest of the dam. 2. $r_u$ of 0.5 is a design criteria to meet dam stability requirements. Source; Geotechnical Monitoring Plan (AMECFW, August 2016)				

## 5.4 Dam Safety Inspections (DSIs) and Dam Safety Reviews (DSRs)

Consistent with MECP ECA approvals, with the regulatory exception of the Clark and West Creek Diversions, engineering inspections will be conducted following best management practices as per the Canadian Dam Association's (CDA) Dam Safety Guidelines (2007, revised 2013, as amended from time to time), and the 2014 CDA Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams (as amended from time to time).

### 5.4.1 Dam Safety Inspections

Annual inspections are intended to be part of a more thorough review of the condition of the facility, and are carried out by the EOR. The inspections will include the following key items:

- Visual inspection of the facility by the engineer, including taking appropriate photographs of the observed conditions;
- Review of routine inspection records prepared by operating personnel in the past year;
- Review whether or not recommendations from previous year's inspection(s) have been addressed, and any incidents or actions arising from those previous recommendations;

- Review of instrumentation and monitoring data;
- Review of tailings deposition and water management operations of the facility including reconciliation of the annual water and mass balance. Review of pond levels (and depth) and freeboard, and reports of any incidents (and remedial measures) that may have occurred;
- An evaluation and interpretation of the structural performance of the dam and related components, and identify any potential safety deficiencies or recommended items that need to be addressed in the coming year;
- Review construction records, QA/QC data and as-built information on dam construction and beaching; and
- Evaluation of the OMS Manual to assess the need for updating.

The results of the inspection and review will be documented in a report.

#### **5.4.2 Dam Safety Review**

The Canadian Dam Association (CDA) Dam Safety Guidelines (CDA, 2007) recommend a comprehensive dam safety review be carried out every 5 years during operations, prior to decommissioning and following closure, by a qualified 3<sup>rd</sup> party consultant.

The comprehensive review provides independent verification of:

- Safety and environmental performance of the facility;
- Adequacy of the surveillance program;
- Adequacy of delivery of OMS Manual requirements;
- Design basis with respect to current standards and possible failure modes; and
- Compliance with new engineering standards (including analysis to confirm if necessary).

## **5.5 Documentation**

Documentation of surveillance and monitoring activities shall be maintained by the Mill Manger, or as designated, as described in the preceding sections and will include recording of:

- Routine visual observations (departures from normal conditions);
- Photographs;
- Instrumentation monitoring and testing;
- Analyses and evaluations; and
- Reviews.

Documentation will include, as a minimum, the following:

- Weekly routine inspection log;
- Monthly tailings facility and process water pond monitoring report;
- Quarterly instrumentation reports;
- Annual Dam Safety Inspection reports; and
- Comprehensive Dam Safety Review report every 5 years.

Documentation will include a hard copy (paper) and electronic filing system for inspection reports, photographic and video records, incident reports, instrumentation readings, instrumentation plots, annual inspections and third-party reviews, so that they can be quickly retrieved for review and in case of an emergency.

## **5.6 Reporting**

The Mill Manager, or designated responsible party, and Geotechnical Engineer will review collected data records from facility monitoring and assess the need for maintenance activities or response. Corrective actions will be identified and tracked to closure. The Environmental Manager is responsible for overseeing sample and data collection and analysis. Reporting will meet MECP requirements and the annual DSI report will also be submitted to the MRNF. Reporting includes;

- As built reports of the dams, excluding the Clark and West Creek diversions, will be submitted to MECP within 90 days of completion;
- An annual report based on the DSI including ECA approval requirements;
- Monthly water quality monitoring report; and
- Annual report including any operating problems and corrective actions, a summary of calibration and maintenance works, use of contingency plans, surface water and groundwater monitoring reports including water balance, ML/ARD updates, discharge volumes and quality.

Additional reporting requirements may be developed as the RRM progresses.

## **6.0 CLOSURE PLAN**

This section summarizes the objectives of the Closure Plan. The *Rainy River Project – Closure Plan* (Amec Foster Wheeler, 2015c) provides the closure plan and includes temporary closure options for short and medium-term shut-down of site facilities.

### **6.1 Tailings Management Area**

Closure of the TMA will include, but is not limited to, the following:

- Flooding of the TMA with a 2 m or deeper water cover;

- A perimeter zone of tailings beach will be maintained to keep the central pond away from the dams, this zone will be covered with a low permeability cover;
- NPAG rock will be placed at the TMA transition zone with the tailings to prevent erosion and suspension and oxidation of solids; and
- Dam structures containing the TMA have been designed with adequate safety factors to provide overall long term safety and stability.

## **6.2 Embankments**

Closure of the embankments will typically involve, but is not limited to reaching of embankments to prevent ponding of water and revegetating slopes to reclaim the area. Some embankment structures will still have a role during the closure phase and these will not be breached. The following structures will continue to be operated during the closure phase:

- MRP will collect runoff and seepage from EMRS, which will be directed to the Open Pit to help flooding;
- Sediment Ponds #1 and #2 will be maintained until site is recognized as a closed mine and monitoring associated with the Metal Mining Effluent Regulation is no longer required

Freshwater diversion and constructed wetland structures are designed to operate passively and will remain in place at closure.

## **6.3 Monitoring**

Monitoring requirements are described in the *Rainy River Project – Closure Plan* (Amec Foster Wheeler, 2017c).

## **7.0 EMERGENCY PREPAREDNESS**

The objectives of this section is to describe procedures to prevent the occurrence of emergencies and reduce the impact, should they arise. This manual covers only those emergency situations that could potentially pose a threat to the structural integrity of the dams or result in the release

of tailings and/or supernatant pond water into the surrounding environment. This document was developed to work in conjunction with the Emergency Preparedness and Response Plan (EPRP) (as reviewed annually and maintained by New Gold H&S team – latest revision February 2017).

The ultimate goal is to protect human life and health, the social well-being of the local community and employees, public infrastructure and company facilities; and environmental conditions and habitats.

## **7.1 Definition and Classification of Emergencies**

An emergency is defined as:

*“A situation or a set of circumstances which, if not promptly eliminated, controlled or contained, results or could result in a significant injury to people (including the community) and/or damage to the tailings facility, property and/or the environment.”*

## **7.2 Potential Dam Failure Modes**

The containment dams at the RRM are predominately zoned embankments with clay cores and rock fill shells. The primary method of dam construction uses the centreline method which is considered to be a stable form of construction. Adherence to design drawings and specifications is critical to minimize the risk of failure.

Several potential failure modes exist for the various tailings storage and water management facilities. These potential failure modes, along with likely triggers, observable visual and instrumentation indicators of the failure mode are presented in Table 9-1. A preliminary dam break inundation map is provided in Figure 9-1.

External hazards originate outside the boundary of the dam and reservoir system and are beyond the control of the dam owner. External hazards include the following:

- Meteorological events, such as floods, intense rainstorms (causing local erosion or landslides), temperature extremes, ice, lightning strikes, and windstorms;
- Seismic events, either natural, cause by economic activity such as mining, or even reservoir induced;



- The reservoir environment, including rim features, such as upstream dams and slopes around the reservoir that pose a threat; and
- Vandalism and security threats.

Internal hazards may arise from the ageing process or from errors and omissions in the design, construction, operation, and maintenance of the dam and water conveyance structures. Internal hazards can be subdivided by source:

- Components that retain or interfere with the body of water;
- Water conveyance structures required to direct water around or through the dam in a controlled way;
- Mechanical, electrical, and control subsystems;
- Infrastructure and plans, including instruments, operating orders, maintenance strategies and procedures, surveillance procedures, and emergency plans, as well as inflow forecasts.

A failure mode describes how a component failure occurs to cause loss of the system function. Failure modes may be interdependent and change in nature and significance at different stages of a dam's life. In any analysis, the failure characteristics, including extent and rate of development, should be determined to an appropriate level of detail. At a general level, there are three dam failure modes:

- Overtopping – water flows over the crest of the dam, contrary to design intent;
- Collapse – internal resistance to the applied forces is inadequate; and
- Contaminated seepage – contaminated fluid escapes to the natural environment.

Dam safety risk management is directed to (1) prevention of the initiation of a failure sequence; (2) control of a deteriorating situation, and (3) mitigation of situations where the failure sequence cannot be stopped.

**Table 7-1; Potential Failure Modes, Triggers and Observable Effects**

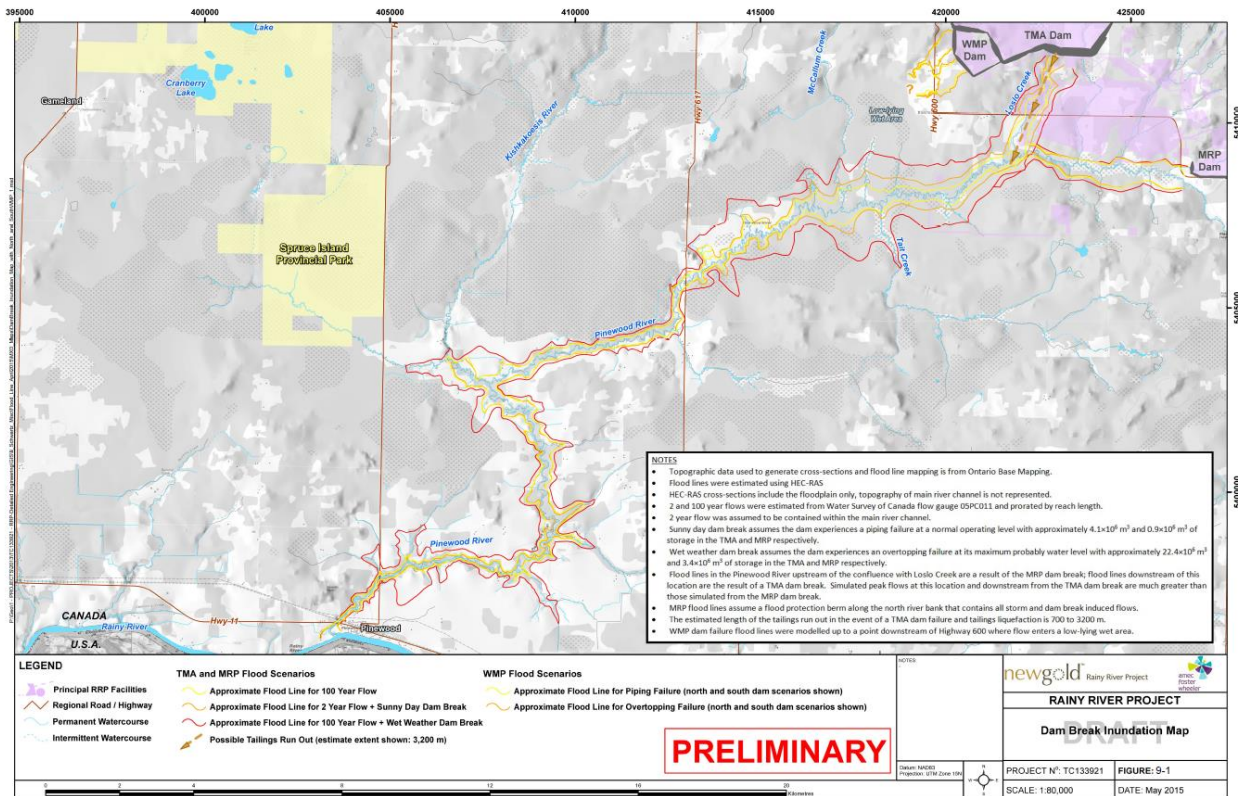
<b>Potential Failure Modes</b>	<b>Possible Causes</b>	<b>Visual Indications</b>	<b>Instrumentation Effects</b>
Break down of pump stations	Blockages, lack of maintenance	No flows	Test on pumps and other related components
Pipeline damage, cracking, blocking, or freezing	Flows blocked by excessively turbid water, debris or ice blockages, extreme weather	No or partial flows; pipeline leaking, cracking or bulging	Pipeline thickness; line pressures; pipeline flow rates
Overtopping	Excessive foundation movements, high wind and wave erosion of beach landslide generated wave, erosion of freeboard, settlement of crest, gully growth towards upstream crest due to seepage, surface runoff or pipe ruptures	Instability in reservoir slopes – slumping, sliding, etc. Damage to upstream face of dam, breach of crest	None
Slope Failure	Changes to porewater pressure within the dam (filters becoming non-functional, earthquake included)	Bulging, slumping, sliding or cracking of dam, increase in volume of seepage	Increase in porewater pressures measured within dam
Foundation Failure	Changes to pore water pressure in the foundation or increases to load applied to foundation (Increase in dam height or pond elevation)	Bulging, slumping, sliding or cracking of dam, or natural ground surrounding the dam	Increase in porewater pressures measured within dam and/or foundation, increase in rate of movement observed in inclinometers and/or survey prisms

Potential Failure Modes	Possible Causes	Visual Indications	Instrumentation Effects
Surface Erosion	Waves, wind or precipitation	Slumping or raveling of upstream or downstream faces of dam	None
Internal Erosion	Erosion of core, creating a pipe/conduit for water flow through dam, growth of a gully behind the crest of dam, turbid seepage water	Rapid increase or unexplained cloudy appearance of seepage through the tailings dams and/or their foundations; appearance of seepage in new locations; formation of sinkholes in dam or on tailings beach	Rapid change if the in porewater pressures measured within dam and/or foundation
Cracking	Differential settlement of dam, earthquake induced	Cracks on dam crest or faces; bulging or slumping of dam	Increase to rate of movement observed in inclinometers or survey monuments or prisms

Other failure modes might also include the following:

- Slumping, sliding, cracking or bulging of the tailings dam
- Rapid increase or unexplained cloudy appearance of seepage through the tailings dam and/or its foundation
- Formation of sinkholes on the tailings beach or dam
- Breakage of tailings pipelines, which may result in dam erosion and/or release of tailings slurry
- Earthquakes
- Major storm events or flood
- Sabotage and other criminal activities

Figure 7-1; Preliminary Draft Inundation Map



### 7.3 Warning Signs and Threshold Criteria

The warning signs for an emergency are defined below:

- Level I: Conditions that do not yet represent a potential emergency but that do require investigation and resolution on a prompt basis, along with intensified surveillance.
- Level II: Conditions that represent a potential emergency if allowed to continue to progress, but no such emergency is imminent.
- Level III: An obvious emergency has occurred or is imminent.

Table 9-2 discusses potential warning signs, consequences and actions to be taken.

**Table 7-2; Warning Signs, Level of Emergency and Responses**

Level	Warning Sign/Situation	Actual or Potential Consequences	Action(s) to be Taken
1	Unusually high, one-time reading from a single piezometer.	Possible early warning sign of worsening piezometric/seepage conditions.	<ul style="list-style-type: none"> <li>• Check piezometer reading, and check for infilling of piezometer.</li> <li>• If reading confirmed, check all other piezometers, and examine downstream area of dam for changed seepage conditions.</li> <li>• Intensify piezometer readings.</li> </ul>
	Decreased seepage discharge accompanied by gradually increasing piezometer levels.	Possible sign of clogging of internal drainage system of dam.	<ul style="list-style-type: none"> <li>• Check chemistry of seepage discharge for any changes relative to normal.</li> <li>• Request tailings dam engineer to re-evaluate slope stability at this location.</li> </ul>

Level	Warning Sign/Situation	Actual or Potential Consequences	Action(s) to be Taken
	Increase in size of erosion gullies.	Possible erosion resulting from seepage and/overland runoff. May lead to accelerated erosion and result in dam failure.	<ul style="list-style-type: none"> <li>• Backfill gullies with filter material and fine rockfill.</li> </ul>
2	Increase in seepage discharge, accompanied by discharge of tailings within seepage (dirty water).	Possible indication of a developing internal erosion (piping), that could eventually lead to dam breach/pond release, or excessively high levels of saturation that could result in slope instability.	<ul style="list-style-type: none"> <li>• Initiate chain of communication (Figure 9-2) and monitor the situation.</li> <li>• Discontinue tailings discharge in the seepage area.</li> <li>• Intensify monitoring of seepage at this location.</li> <li>• Note if the seepage discharge and/or turbidity continue to increase.</li> <li>• Read piezometers.</li> <li>• Be prepared to place filter material in area of discharge from emergency stockpiles.</li> </ul>
	Seepage on dam abutments, causing localized erosion and slumping of dam slope.	Could lead to progressive slope failure on abutment, resulting in dam failure and breach of pond.	<ul style="list-style-type: none"> <li>• Discontinue tailings discharge in the seepage area.</li> <li>• Place filter material over seepage area using emergency stockpiles.</li> <li>• Continue to monitor area on an intensified basis.</li> <li>• Initiate chain of communications if situation does not improve.</li> </ul>

Level	Warning Sign/Situation	Actual or Potential Consequences	Action(s) to be Taken
	Extended period of unusually heavy rainfall, or unusually large snowmelt.	Could lead to raised levels of saturation within the dam slope, which could in turn lead to slope instability.	<ul style="list-style-type: none"> <li>• Increase frequency of piezometer readings to weekly.</li> <li>• Intensify inspections of downstream dam slope, looking for signs of localized instability/concentrated gully erosion, and for soft ground (saturated slope) conditions.</li> </ul>
	Relatively high, unexplained, and ongoing increase in piezometer levels within the dam and/or foundation – threshold limits being approached.	Probable sign of progressive deterioration of toe drainage provided by starter dams. Could, if left unattended eventually lead to failure of the dam.	<ul style="list-style-type: none"> <li>• Assess rate of rise and determine if it is steady or accelerating.</li> <li>• If piezometer level increase was sudden, check the reading (repeat it) to eliminate the possibility of a reading error.</li> <li>• Sound bottoms of piezometers to check for infilling.</li> <li>• Send piezometer readings to the tailings dam engineer.</li> <li>• Inspect downstream area for increased seepage and/or turbidity of seepage discharge.</li> </ul>
	Long term or sudden increase in rate of inclinometer movements.	Possible sign of impending slope instability.	<ul style="list-style-type: none"> <li>• Check reading, and contact the Geotechnical Engineer and EOR if confirmed.</li> <li>• Inspect area for any visible signs of instability, bulging on outer slope or at toe, or tension cracks on dam crest.</li> <li>• If tailings discharge is occurring near the inclinometer that indicates unexplained movement, relocate discharge point further away.</li> <li>• Increase frequency of inclinometer readings.</li> <li>• Read nearby piezometers.</li> </ul>

Level	Warning Sign/Situation	Actual or Potential Consequences	Action(s) to be Taken
	Ongoing cracking and evidence of dam and/or foundation movement.	Possible sign of impending failure of dam, especially if the rate of movement/cracking is accelerating.	<ul style="list-style-type: none"> <li>• Check inclinometer readings.</li> <li>• If rate of deformation is accelerating, initiate chain of communication.</li> <li>• Read piezometers.</li> <li>• Check for water inflow into tension cracks.</li> <li>• Regrade to channel runoff away from tension cracks, as water inflow can result in accelerated movement.</li> </ul>
	Highly turbidity discharge from decant outlet.	Possible sign of collapse of a portion of the decant, allowing tailings into outlet. Can, if left unattended, lead to internal erosion failure and eventual dam breach.	<ul style="list-style-type: none"> <li>• Check decant inlet to see if water turbidity matches that in discharge.</li> <li>• If water at inlet is clear, then close off decant inlet to prevent further discharge.</li> <li>• Notify tailings dam engineer and develop alternate decant arrangements.</li> <li>• Inform Mill.</li> </ul>
	Rupture of tailings and/or water pipelines on crest of dam, resulting in erosion of downstream dam slope	Could lead to erosive failure of dam, and pond breach, if allowed to continue.	<ul style="list-style-type: none"> <li>• Contact Mill and have discharge of tailings stopped.</li> <li>• Repair the rupture.</li> <li>• Inspect and repair the washed-out portion of the dam slope.</li> <li>• Do not discharge tailings into the area of the washout.</li> <li>• Notify tailings dam engineer to design slope re-construction.</li> </ul>



Level	Warning Sign/Situation	Actual or Potential Consequences	Action(s) to be Taken
	Seepage daylighting from tailings slope at a significantly higher elevation than had previously been observed at that particular location.	Could lead to erosion, and progressive slope failure, resulting in dam failure and breach of pond.	<ul style="list-style-type: none"> <li>• Read piezometers.</li> <li>• Assess rate of seepage and whether or not internal erosion is occurring.</li> <li>• If piezometers confirm high phreatic levels, initiate chain of communication.</li> <li>• Carry out weekly monitoring of the seepage discharge area of concern.</li> <li>• Avoid discharge of tailings into the impoundment adjacent to the area.</li> </ul>
	Severe flood/intense rainstorm or rapid snowmelt.	Overtopping and washout of dam, and release of pond. Concentrated erosion of tailings slopes, resulting in localized gulying, over-steepening, and potential slope failure. Raising of phreatic surface as a result of infiltration possible.	<ul style="list-style-type: none"> <li>• Initiate chain of communications (Figure 9-2).</li> <li>• Check the minimum width of tailings beaches.</li> <li>• Inspect spillway for flow and condition.</li> <li>• Stop tailings discharge and <u>slowly</u> lower tailings pond by removing stop logs.</li> <li>• Carry out detailed inspection of dam and pond.</li> <li>• Inspect dam slopes for areas of concentrated erosion, and repair.</li> <li>• Read all piezometers.</li> <li>• Mobilize emergency pumps if needed.</li> </ul>
3	Failure or suspected imminent failure of a dam.	Catastrophic breach and release of pond.	<ul style="list-style-type: none"> <li>• Initiate chain of communications (Figure 9-3).</li> <li>• Stop tailings discharge and lower tailings pond by removing stop logs.</li> </ul>

Level	Warning Sign/Situation	Actual or Potential Consequences	Action(s) to be Taken
	Slumping, sliding, or bulging of a dam slope or adjacent ground.	Catastrophic breach and release of pond.	<ul style="list-style-type: none"> <li>• Initiate chain of communications (Figure 9-3).</li> <li>• Lower pond by removing stop logs.</li> <li>• Do not attempt construction (e.g., construction of a stabilizing berm) until the EOR is on the site (earthmoving equipment should be mobilized).</li> </ul>
	Water vortex (whirlpool) within the tailings pond.	Indicates an internal erosion failure in progress, with potential breach of the tailings dam.	<ul style="list-style-type: none"> <li>• Initiate chain of communications (Figure 9-3).</li> <li>• Stop tailings discharge and lower tailings pond by removing stop logs.</li> <li>• Check downstream area of dam for areas of increased and/or turbid seepage discharge.</li> <li>• Place granular filter buttress against any such areas, using emergency stockpiles.</li> <li>• Go directly to decant outlets if vortex is on a decant line; plug decant outlet with granular material if tailings are discharging through decant.</li> </ul>
	Sinkhole observed on tailings beach or on a downstream dam slope.	Indicative of internal erosion, which could progress to the point where dam breach results.	<ul style="list-style-type: none"> <li>• Initiate chain of communications (Figure 9-3).</li> <li>• Stop tailings discharge and lower tailings pond by removing stop logs.</li> <li>• Immediately check dam toe areas/decant outlets for heavy seepage that is transporting tailings solids.</li> <li>• Place granular filter buttress against any such areas, using emergency stockpiles.</li> </ul>

Level	Warning Sign/Situation	Actual or Potential Consequences	Action(s) to be Taken
	Large earthquake.	Dam failure, breach and release of pond.	<ul style="list-style-type: none"> <li>• Initiate chain of communications (Figure 9-3).</li> <li>• Carry out detailed post-earthquake inspection of the dam.</li> <li>• Read all instrumentation (piezometers and inclinometers).</li> </ul>
	Rapid, unexplained, orders of magnitude increase in seepage rate and turbidity (dirty water indicating transport of tailings) at a dam slope seepage location and/or foundation.	Internal erosion (piping) failure leading to dam breach and release of pond. Elevation of pore pressure conditions that could initiate a slope failure.	<ul style="list-style-type: none"> <li>• Initiate chain of communications (Figure 9-2).</li> <li>• Place stockpiled filter materials over seepage discharge area to prevent further erosion of material.</li> <li>• Read piezometers in area of seepage discharge.</li> </ul>

#### 7.4 Incident Notifications Procedures

Roles and responsibilities:

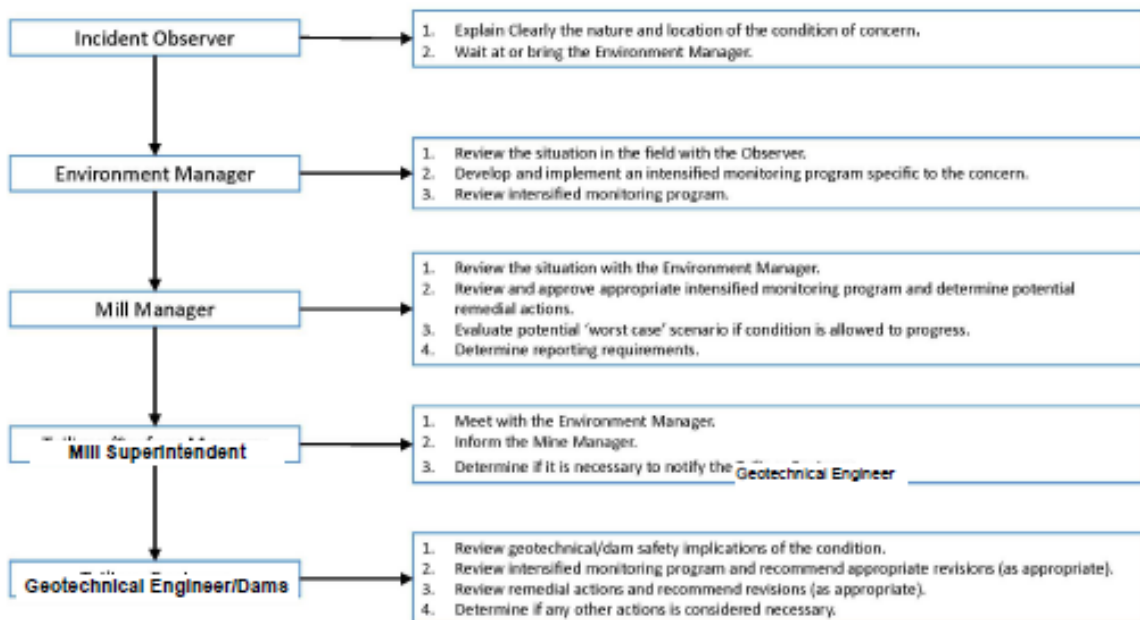
- Any individual who observes an incident shall initiate the appropriate notification procedure.
- All members listed on the notification procedures shall be familiar with established protocol and familiar with the OMS Manual (as per training Section 2.5).

- If a member of the team on the notification procedures is not contactable then the Incident Commander shall be notified and proceed with the notification procedure.

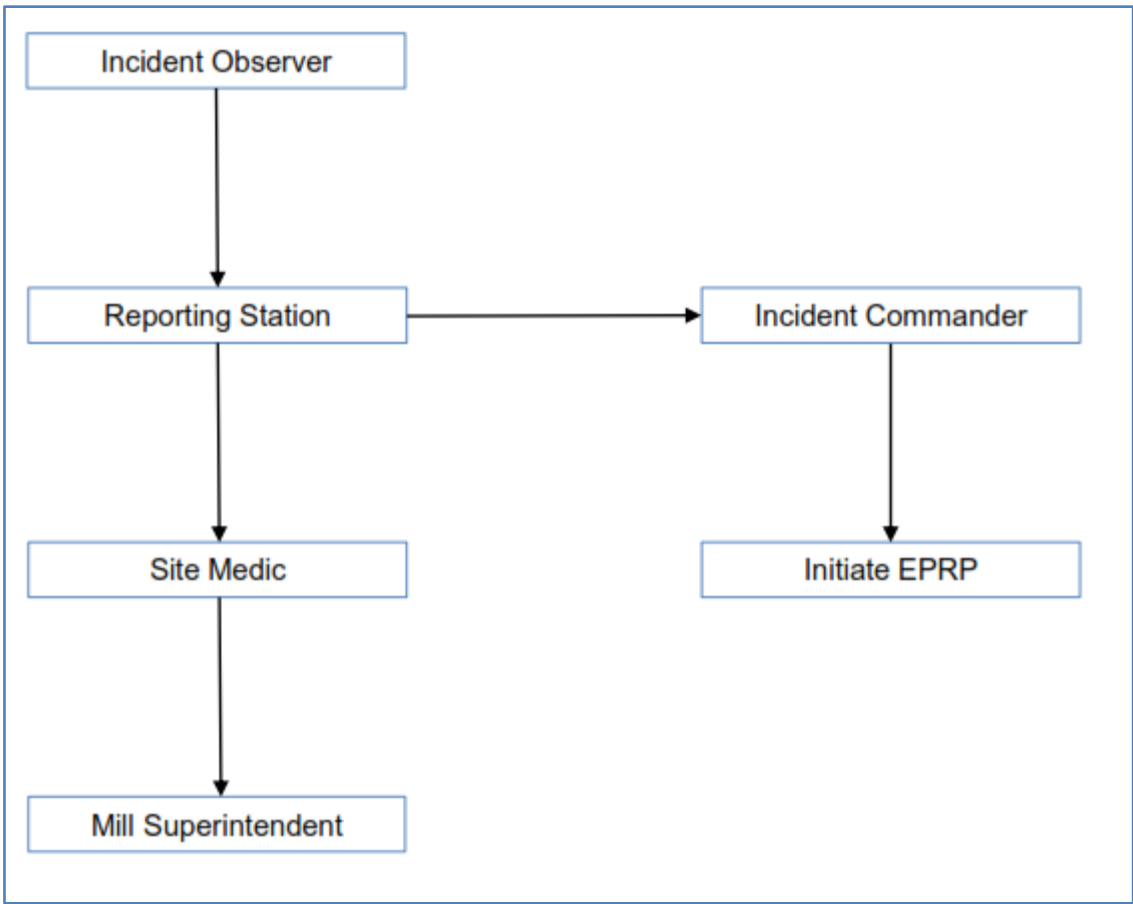
Notification procedures have been developed for Level I, II and III emergencies provided below to ensure quick onsite responses in the event of an identified emergency. The Mill Manager will be in charge of initiating the site wide EPRP (NG, 2017) in the event of a Level III emergency.

The notification procedures for a Level I and Level II emergency are illustrated on Figure 9-2. The notification procedure and initiation of the EPRP in the event of a Level III emergency is shown on Figure 9-3. Rapid response to Level III emergencies is critical to ensuring that staff, contractors and site visitors safely reach a muster station and that timely notification is made to appropriate local and provincial authorities as well as external stakeholders.

**Figure 7-2; Levels I and II Emergency Notification Procedure Flowchart**



**Figure 7-3; Level III Emergency Notification Procedure Flowchart**



## **7.5 Emergency Contacts**

Internal emergency contact information is provided RRM EPRP. An emergency response can be initiated through;

- RRM radio channel 4 – state ‘Emergency, Emergency, Emergency’ and describe the type and location of the emergency
- RRM internal phone system – dial 8888
- RRM security direct line – 1-807-708-0646
- 

## **7.6 Emergency Preparedness Procedures**

All employees, including contractors working at the RRM must be familiar with the procedures outlined in the EPRP for the site and TMA to the extent required to perform their functional role. All supervisors and contact persons for contractors must ensure their employees understand those procedures relevant to their work area and ensure that their employees are familiar with, and recognize the proper course of action in the event of an emergency. The supervisor must also ensure that all employees are made aware of any revisions to the EPRP for the site and TMA.

The EPRP is the site and TMA’s guidance document relating to emergency responses and protocols to be followed during upset conditions, unusual events or incidents. A preliminary dam break inundation map is provided in figure 9-3.

Emergency preparedness measures with regard to dam safety include: maintenance of access to dam locations; availability of fill materials and equipment required in the event that remedial works are required; and the ability to access and traffic control measures to ensure safety of workers and public.

## **8.0 CONTINGENCIES**



The operations are sensitive to water balance and water quality in discharges. The following are contingencies based on water management and functioning of the diversions.

## **8.1 Sediment Ponds**

### **8.1.1 Sediment Pond #1**

Water from Sediment Pond #1 can't be discharged to the environment. Sediment Pond #1 will be continuously pumped to the TMA and water level will be kept at 1.5 m from the bottom. The following contingency plan of Sediment Pond #1 will be required if one of the following criteria are met:

1. Sediment Pond #1 water level has exceeded the MOWL of 353.7 masl.
2. Dam performance conditions deemed unsafe by the Engineer of Record
3. In the event the water quality nears discharge exceedance values, water will be pumped at greater volume to prevent unauthorized discharge.

Should criteria 1 or 2 be triggered:

- Notify the authorities
- If insufficient, pump water to the TMA
- If insufficient, pump water to the MRP
- If insufficient, pump to the Pit

Should criteria 3 be triggered:

- Notify the authorities
- Add pumping capacity to the TMA
- If insufficient, pump water to the MRP
- If insufficient, pump to the Pit

If the dewatering is required, the MOECC and MNRF will be informed immediately of the planned emergency procedures. Dam safety is of primary importance and the EOR should be contacted immediately.

### **8.1.2 Sediment Pond #2**

Water from Sediment Pond #2 can't be discharged to the environment. Sediment Pond #2 will be continuously pumped to the TMA and water level will be kept at 1.5 m from the bottom. The following contingency plan of Sediment Pond #1 will be required if one of the following criteria are met:

1. Sediment Pond #2 water level has exceeded the MOWL of 348.2 masl.
2. Dam performance conditions deemed unsafe by the Engineer of Record
3. In the event the water quality nears discharge exceedance values, water will be pumped at greater volume to prevent unauthorized discharge.

Should criteria 1 or 2 be triggered:

- Notify the authorities
- Add pumping capacity to the TMA
- If insufficient, pump water to the MRP
- If insufficient, pump to the Pit

Should criteria 3 be triggered:

- Notify the authorities
- Add pumping capacity to the TMA
- If insufficient, pump water to the MRP
- If insufficient, pump to the Pit

If the dewatering is required, the MECP and MNRF will be informed immediately of the planned emergency procedures. Dam safety is of primary importance and the EOR should be contacted immediately.

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**RAINY RIVER PROJECT**

**PART VI - DIVERSIONS - OPERATION, MAINTENANCE  
AND SURVEILLANCE MANUAL WATER MANAGEMENT  
STRUCTURES**

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**January 2019**

**Version 2019-1**



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## 1.0 Regulatory Requirements

This document is consistent with the New Gold Tailings, Heap Leach and Waste Rock Facilities Management Policy and was prepared pursuant to the MAC guidelines for *Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities* (MAC, 2011).

The following is a list of permits that this section of the OMS complies with:

- LRIA-FF-2015-03B/A: Clark Creek Dam, Clark Creek Pond, Clark Creek Diversion Channel, Teeple Dam, Teeple Pond, and Teeple Pond Diversion Channel.
- LRIA-FF-2015-02B/A: Stockpile Pond Dam, Stockpile Diversion Channel, West Creek Pond Dam, and West Creel Diversion Channel
- LRIA-FF-2017-01:

## 2.0 FACILITY DESCRIPTIONS

Freshwater diversion is provided by the following;

- Clark Creek diversion including the Clark Creek and Teeple dam and diversions; and
- West Creek diversion including the Stockpile and West Creek dam and diversions.

The freshwater diversions function to reduce inflows to the RRM and provide offsetting habitat for the loss of portions of Loslo, Marr, Clark and West creeks. Diversion of the non-contact runoff from these catchments reduces the effluent management requirements. All structures support fish habitat.

### 2.1 Freshwater Diversion Dams and Channels

The freshwater ponds are designed to minimize the net freshwater inflows into the project by diverting non-contact runoff around the site via dams, ponds and diversion channels. The West Creek Pond, Clark Creek, Stockpile Pond and Teeple Road dams were developed in a single dam raise during the construction phase to support the requirements of the *Water Management Plan for Operations* (Amec Foster Wheeler, 2015a). Additional details regarding these dams, ponds, and diversion channels are provided in section 4.1.

The freshwater diversion structures have been developed in accordance with the following design briefs. As-built reports have been issued. A detailed list of Drawings is provided in Appendix A.

**Table 2-1; Supporting Documents for the West Creek and Clark Creek Diversions**

Document Title	Reference
Design Brief – Water Management Dams	(Amec Foster Wheeler, 2015b)

Design Update – Clark Creek Pond Dam	(Amec Foster Wheeler, 2016i)
Stockpile Pond Dam – Design Revision and Operating Guidelines	(Amec Foster Wheeler, 2016j)
West Creek Dam – Design Revision and Operating Guidelines	(Amec Foster Wheeler, 2016k)
Clark Creek Diversion – As-built Report	(Amec Foster Wheeler, 2017a)
West Creek Diversion – As-built Report in preparation	(Amec Foster Wheeler, 2017b)
<b>Drawing Title</b>	<b>New Gold Document Number</b>
West Creek Pond Dam – Layout and Foundation – Preparation Plan & Details	3098004-002510-A1-D50-0001
West Creek Diversion Channel – Plan and Profile	3098004-002510-A1-D70-0003
Stockpile Pond Dam – Plan, Typical Section and Profile	3098004-002580-A1-D70-0002
Stockpile Pond Diversion Channel – Plan and Profile	3098004-002580-A1-D70-0004
Clark Creek Pond Dam – Plan, Typical Section and Profile	3098004-004400-A1-D70-0001
Clark Creek Pond Diversion Channel – Plan and Profile	3098004-004400-A1-D70-0002
Teeple Road Dam – Plan, Typical Section and Profile	3098004-004400-A1-D70-0003
Teeple Road Pond Diversion Channel – Plan and Profile	3098004-004400-A1-D70-0004

**Table 2-2; Summary of the Diversion Characteristics**

Dam and Pond				Channel										Additional features		
Name	Crest Elev. (m)	Area (ha.)	Vol. (Mm <sup>3</sup> )	Diversion Channel Inlet/Outlet	Design Peak Flow Event (-)	Segment (Sta.)	Function	Channel Design Criteria							Side Slopes (H : V)	
								Design Flow (m <sup>3</sup> /s)	Freeboard (m)	Flow Depth (m)	Base Width (m)	Length (m)	Gradient (%)			
<b>Clark Creek Diversion</b>																
Clark Creek	380.0	9.2		Clark Creek Pond to Teeple Road Pond	100-yr 24-hr	0+000 - 1+229	Channel				6	1229	0.10	4 : 1		
Teeple Road	379.0	2.9		Teeple Road Pond to Pinewood River	100-yr 24-hr	0+020 - 0+580	Channel				6	560	1.25	4 : 1		
<b>West Creek Diversion</b>																
Stockpile Pond	375.5	4.6		Stockpile Pond to West Creek Pond	PMF	0+150 - 0+200 0+200 - 0+250 0+250 - 1+346	Spillway Channel				33 33 to 6 6	50 50 1096	0.96	4 : 1	- Tributary 2 confluence (Sta. 0+775)	
West Creek	364.9	13.2		West Creek Pond to Loslo Creek	100-yr 24-hr	PMF	0+000 - 0+584.5	Spillway				8	584.5	0.00 to 1.00	4 : 1	- High level side weir at flow control structure - Culverts?
							0+584.5 - 0+647	Flow control structure				8 to 3	62.5	1.00		
							0+647 - 2+150 2+150 - 2+750					3	1503	1.00 to 0.10		
							2+750 - 4+576	Channel				5	600	0.10		
											3	1826	0.10 to 0.57			

Notes  
 1) Low flow and fish habitat features are included in all diversion channels below the hydraulic flow section

### 2.1.1 West Creek Diversion

The West Creek Diversion system diverts flows from the West Creek and its tributaries around the Open Pit and discharges into the Pinewood River at Loslo Creek. It includes the Stockpile

Pond Dam and Diversion Channel, which divert flows around the Plant Site, and the West Creek Pond and Diversion Channel, which divert flows around the Open Pit. The dams have a 'very high' hazard potential classification equivalent to extreme hazard classification by the CDA. The following sections describe the components of this diversion.

#### **2.1.1.1 Stockpile Pond and Diversion Channel**

The objective of the Stockpile Pond is to divert freshwater from natural ground into the West Creek Watershed. The Stockpile Pond Diversion Channel was designed to convey the Probable Maximum Flood (PMF) from the plant site area to the West Creek Pond. The Stockpile Pond Diversion will also provide fish habitat compensation. The Stockpile Pond Diversion Channel base width varies from 6 to 33 m with 4H:1V side slopes. The total length of the diversion channel is about 1,200 m.

The dam height is 7.5 m with 4:1 slopes with a crest width of 6 m and length of 175 m. The dam crest elevation is 375.5 m and the diversion channel invert is 372.2 m. NOWL provides capacity for 93,700 m<sup>3</sup> of storage with greater volumes discharges through the 33 m spillway into the diversion channel. The diversion channel is a low (<1%) gradient channel reporting to the West Creek Pond with a typical bottom width of 6 m.

The design brief for the dam is RRP-GEO-REP-003. Construction was completed on the diversion in November 2016 and confirmed by the EOR (RRP-GEO-MEM-080-R1). Construction of the dam was completed in May 2017 and confirmed by the EOR (RRP-GEO-MEM-119-R1). The dam was constructed with a central clay core and random fill and or NPAG rock shells.

#### **2.1.1.2 West Creek Pond and Diversion Channel**

The West Creek Pond is located upstream of the Open Pit and west of the Process Plant at a point that allows for the raising of the pond water level sufficiently to divert flows westerly through a diversion channel and around the Open Pit. The West Creek Dam intercepts all West Creek flows from the north, as well as drainage from two tributaries to the east, diverted through the Stockpile Diversion Channel.

The West Creek Dam is a central clay core with random fill upstream shell and NPAG mine rock downstream shell. It has a crest elevation of 364.9 m (~156,000 m<sup>3</sup>), maximum height of 7.4 m, and overall side slopes of 7.9H:1V including rock toe berms. The West Creek Pond has been designed to contain the PMF while discharging to the West Creek Diversion Channel.

The first 615 m of the West Creek Diversion Channel acts as the Emergency Spillway of the West Creek Dam and has been designed to convey a PMF event. The spillway invert elevation is 361.0 m and is 8 m wide. This provides a freeboard of 4.0 m at normal water level in the pond. During a PMF event the peak water level would rise to 364.5 m, leaving 0.4 m of freeboard.

#### **2.1.1.3 West Creek Diversion Overflow Structure**

The Overflow Structure (or weir) is located at Sta. 0+615 within the Diversion Channel. A box culvert (62.5 m long by 2.4 m wide/tall) constricts the channel flow such that a side overflow weir may be activated (invert elevation 360 m, width 50 m). The purpose of the overflow structure is to restrict the flow rate discharging from the culvert under high flow conditions. The remaining ~4,000 m of diversion channel is over flat ground with minimal elevation change. The reduced flows through this section of diversion channel allow a much smaller channel excavation.

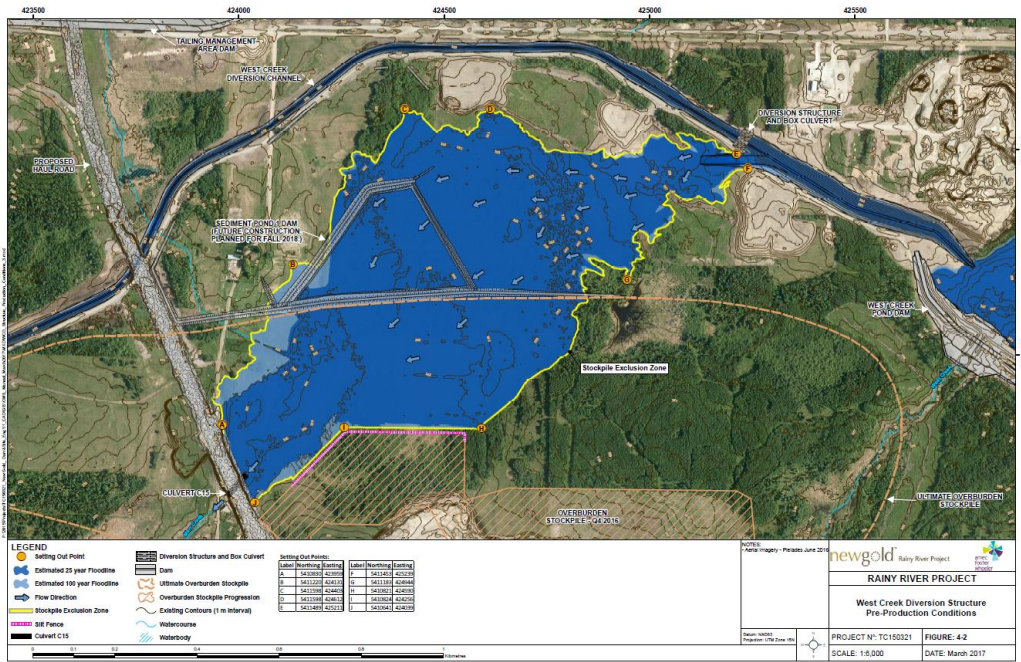
The overflow structure has been designed such that during a PMF event, the flow rate downstream of the culvert, i.e., in the channel, does not exceed the 100-year flood outflow from

the West Creek Pond ( $26.9 \text{ m}^3/\text{s}$ ). The diversion channel upstream of the diversion structure will back up, with excess flows diverted through the side overflow channel. Containment is provided above the culvert by a berm across the diversion channel with a crest elevation of 363 m. The peak water level in the diversion channel during a PMF event will be 362.5 m, providing 0.5 m of freeboard to the crest of the berm.

The overflow structure will be activated for events greater than the 10-year storm. The peak overflow channel discharge during a PMF event will be  $163.8 \text{ m}^3/\text{s}$ . The overflow channel discharges onto a flat, grassy plain south of the West Creek Diversion Channel and north of the ultimate WMRS. This area, termed the exclusion zone, is shown on Figure 4-2 and is required to remain undeveloped to prevent the loss of natural vegetation until Sediment Pond 1 berm is constructed, north of the WMRS. In the field, this area is demarcated by bright coloured stakes and ribbons. The ground topography will naturally drain any overland flow through Culvert C15 into Marr Creek.



**Figure 2-1; West Creek Diversion Overflow Exclusion Zone**





## 2.1.2 Clark Creek Diversion

The purpose of the Clark Creek diversion is to divert natural drainage and runoff around the East Mine Rock Stockpile and provide fish habitat offsetting. The Clark Creek Diversion Channel diverts runoff from the Clark Creek upstream of the Clark Creek Dam and the EMRS, through the Clark Creek diversion channel into Teeple Pond and subsequently into Teeple Diversion and to the Pinewood River via a culvert under Teeple Road.

Construction of the Clark Creek Diversion occurred between August 29, 2015 and December 4, 2016 and authorised by LRIA FF-2015-03A and the Fisheries Act approval. There are applicable federal and provincial EA commitments, however as a freshwater diversion there a limited MECP requirements beyond sediment control.

Clark Creek and Teeple Road Dams were constructed as homogenous clay fill embankments utilizing native clay overburden. The clay fill is protected by gravel and cobble sized materials, with a layer of geotextile separation, to prevent erosion. Overflow sections for Teeple Dam are included on the dams to carry storm flows (i.e., activated by 2-year event) and have been designed to handle events in excess of the 100-year return design flow. Overflow sections are provided to permit the safe passage of water in the event the pond level exceeds the maximum operating water level. There are no active controls on the water flows. Clark Creek Dam features a 20 m wide overflow section and Teeple Road Dam features a 150 m wide overflow section designed to allow water and fish to flow over the structure.

The diversions are designed to convey the 1:100 year flow and are typically 6 m wide (base width) with 4:1 slopes. The Clark Creek diversion is 1,200 m and the Teeple Diversion is 580 m long.

**Table 2-3; Design Parameters for the Clark Creek Diversion**

Design Parameter	Unit	Clark Creek	Teeple
Embankment dam crest elevation	m	380.0	379.0
Dam overflow section invert elevation	m	379.9	378.7
Normal Water Level (NWL) elevation	m	378.75	378.5
Diversion channel inlet invert elv.	m	378.75	378.5
Diversion channel outlet elv.	m	377.6	371.5
Diversion channel gradient (average)	%	0.1	1.2
Diversion channel side slopes		4:1	4:1

Deviations from design occurred for both diversions, however not anticipated to have a negative effect of stability. Examples of deviation include absence of low flow channel, oversized boulders, variances on habitat feature frequency and riffles either not meeting design elevation or being too steep

## 2.2 Instrumentation

### 2.2.1 Dam Safety

Instrumentation has been and will be installed during construction. Instrumentation will include instrumented dam sections that will monitor dam foundation and clay fill pore pressures to infer consolidation characteristics, as well as monitor any movement of dam fill due to deformation.

Each dam instrumentation section will include: standpipe(s), a settlement plate, slope inclinometer(s), survey pins/monuments, and a terminal arrangement with data logger and vibrating wire piezometers.

Following construction, the instrumentation will remain for dam monitoring purposes. A detailed report containing the proposed locations, usage, and analysis of all instrumentation is provided in the *Geotechnical Monitoring Plan* (Amec Foster Wheeler, 2016b). The design details for the installed or proposed dam instrumentation is summarized in Table 4-14. The design information provided in Table 4-14 will be confirmed and updated as may be required following development of the As-Built drawings.

**Table 2-4; Dam Instrumentation Summary**

Facility	Section	Dam Instrumentation							Pond Level Gauge
		Slope Stability			Foundation Consolidation		Phreatic Level and Seepage		
		Slope Inclinometers	Survey Pins	Survey Monuments	Vibrating Wire Piezometers	Settlement Plates	Vibrating Wire Piezometers	Standpipe Piezometers	
(Sta.)	(no.)	(no.)	(no.)	(no.)	(no.)	(no.)	(no.)	(type)	
TMA North	3+300	0		0	2	1	1	2	TBD
	Mass array				142				
TMA South	1+000				2				
	1+380				2	1	1	1	
	1+450	2		2	4	2	1	2	
	1+600	1			4	2	1	1	
	2+200	2		2	4	2	1	2	
	2+350	1			4	2	1	1	
	Mass array				176				
TMA West	0+300		35	0	1		1		
	0+460	2		0	5		2	1	
	1+450	0		0	0	1		0	
	1+500	2		0	4	0	3	0	
	Mass array					82			
TMA Start-up Cell	0+400				2				
	1+000				2				
	Mass array				88				
WMP Dam 1			16					- Staff gauge	
WMP Dam 2	0+950	1	34	0	2	0	2	2	- Survey stakes
WMP Dam 3	0+300	0	17	0	1	0	1	2	
	0+500	1		0	2	1	4	1	
Mine Rock Pond	0+220	1		2	2	1	1	4	- Staff gauge
Clark Creek									- Staff gauge
Teeple Road									- Staff gauge
Stockpile Pond	0+125	1	8	0	1	0	1	2	- Staff gauge
	0+291				2			2	
West Creek	0+320	2	2						- Staff gauge
	0+340	2	2		2	1	1		
Water Discharge Pond									TBD
Constructed Wetlands									
- Pond A									TBD
- Pond B									TBD
- Pond C									TBD
- Pond D									TBD
- Pond E									TBD
Sediment Pond #1									TBD
Sediment Pond #2									TBD
Temporary Sediment Pond									TBD

Notes:

- 1) Survey pins installed at 100 m centres along 3-5 lengthwise lines (crest, toes, etc.) Quantities are total for each dam
- 2) TMA Dams feature mass array of VWP instruments installed in grids within the dam foundation. Installation of these instruments is currently on-going

In addition to the instrumentation described above, the TMA dams are equipped with an additional suite of vibrating wire piezometers (VWPs) to provide enhanced monitoring resolution during construction. A total of 524 VWPs were installed in the TMA dam foundations, arranged in a grid pattern, and managed with a remote wireless data acquisition and management system.

Instrumentation associated with the management of the dams is being managed through a software system that includes integration with data loggers and data storage and is configured

such that alarms for alert levels are defined and available. The software routinely generates reports and if trigger levels are exceeded sends out alarm notifications.

### **2.2.2 Other instrumentation**

Additional instrumentation to support the OMS manual and management of water includes;

- Densometer on the tailings pipeline;
- Flow meters on the water management pipelines including from the Pinewood River, tailings reclaim lines, MPR line and freshwater line from the WMP and
- Pressure transducers in the WMP, Clark/Teeple Ponds.

This instrumentation provides continuous recording, which is collected during routine inspections and included.

### **2.3 Regulatory Requirements**

Regulatory requirements, permits and authorizations are summarized in section 1.1. Key approvals include the Federal and Provincial Environmental Assessment conditions and commitments and permits including those issued pursuant to the LRIA and EPA. Additional legislation to be considered in implementing the OMS manual includes the MMER and various Ontario regulations including waste management.

No direct discharges are intended from any of the structures described in this section except the WMP which is described in sections 4 and 5. Seepage will be collected and pumped back from the WMP and TMA cells. Subsequent to this revision and LRIA approvals, additional details for the WDP, CW and sediment ponds discharges will be developed.

### **3.0 OPERATIONS**

The overall operational objectives of the TMA and associated dams and facilities are to dispose and store the tailings and to manage all site water in a safe, economical and environmentally responsible manner. This section defines operating standards in accordance with design criteria and regulatory requirements specified in section 4.

#### **3.1 Freshwater Diversions**

The freshwater diversion structures (dams and diversion channels) are designed to be operated passively. Clark and Teeple Ponds are full and the diversions are flowing naturally. Stockpile pond is currently filling and will flow through the stockpile diversion once the water level is above the invert to the diversion. West Creek is being allowed to slowly fill, however a terminal plug remains in place and pumps are being used to dewater the diversion.

In summer/fall 2017, the plug will be removed and the plug area will stabilise prior to water flowing through location of the former plug.

Culverts at Georgeson Lane and Marr Creek are below the design specification of the West Creek Diversion below the hydraulic control. Pending Schedule 2 approval (anticipated January 2018) these two culverts will be removed prior to freshet 2018 and the channel stabilised consistent with the design outlined in section 4.

#### **3.2 Progressive Reclamation and Closure**

Some progressive reclamation with respect to the TMA is proposed as part of mine operations. By the end of the operations phase a low permeability overburden cover of approximately 150 m in width will be placed on the upstream side of the TMA dam. The overburden cover will cover approximately two thirds of the ultimate perimeter, with the remaining approximately one third of the length to be reclaimed at closure. This cover is intended to prevent the tailings permanent water cover from coming into contact with the TMA dams, and will also serve a secondary function of limiting oxygen diffusion into the uppermost portion of the tailings underneath. The overburden cover will be seeded or hydroseeded with a native seed mix or equivalent, and will be armoured with NPAG rock at the transition zone of the cover with the tailings to prevent suspension and oxidation of solids.

Closure of the RRM in respect to tailings, process water and freshwater management will include but is not limited to the following:

- Clark Creek Pond, West Creek Pond, Teeple Pond, Stockpile Pond, West Creek Diversion Channel, Clark Creek Diversion Channel, Teeple Pond Diversion Channel and Stockpile Pond Diversion Channel support the creation of fish habitat for compensation purposes as such they will remain in place at closure; and

#### **3.3 Safety and Security**

The site safety and security will be following the RRM Health and Safety Management System including but not limited to the following:

- The site will be gated with restricted access to authorized personnel only;
- The TMA will be fenced along portions of the old highway 600 and access will be restricted to authorized personnel only;
- No public access;

- Construction Management provided security measures; and
- Onsite health and safety policies for working around bodies of water, working alone or crossing ice.

### 3.4 Environmental Protection

The Environmental Department has oversight over the EMS which contains tailings operations related environmental aspects including:

- Fugitive and point source dust emissions;
- Hydrocarbon Spills and Leaks;
- Pipeline Rupture and Leaks;
- Surface and ground water quantity and quality; and
- Wildlife management (including species at risk).

An environmental aspect register is a comprehensive inventory of tailings operations activities, environment aspects, assessment of risk and identification of controls. Tailings personnel have responsibility to implement and maintain the controls including monitoring and inspection. Refer to the Environment Department for the environmental aspect register (in prep) and environmental related procedures.

As outlined in orientation training, it is every RRM employee’s responsibility to report a suspected spill or uncontrolled release event to their supervisor. This includes suspicious flows of water out of the area, escaping tailings, etc. The sooner appropriate persons can begin to correct a situation, the less likely it is that severe impacts will follow.

Table 5-3 provides a summary of the MECP effluent discharge limits that must be met to discharge from the WMP.

**Table 3-1; MECP Effluent Discharge Limits from the WMP**

Constructed Wetland Final Discharge and Water Management Pond Pipeline Discharge (to the Pinewood River) as stated in MECP ECA 5178-9TUPD9		
Effluent Parameter	Daily Maximum Concentration (mg/l)	Monthly Average (mg/l)
Cadmium	-	0.0010
Cobalt	-	0.0044
CBOD5	-	25.0
E.coli	-	100/100ml geometric mean density
Total Suspended Solids	30	15
Total Phosphorus	-	0.10
Cyanide (total)	0.1	0.05
Cyanide (free)	0.02	0.01
Total Arsenic	0.034	0.017
Total Copper*	0.028	0.014
Total Nickel	0.094	0.047
Total Lead*	0.030	0.015
Total Zinc*	0.348	0.174
Un-ionized Ammonia	0.08	0.04
Acute Toxicity (Rainbow Trout and Daphnia Magna)	Non-acutely lethal (not greater than 50% mortality in undiluted effluent)	

pH of the effluent maintained between 6.0 to 9.5, inclusive, at all times

**Notes:**

1. \*Proposed effluent criteria for Total Copper, Total Lead, and Total Zinc are based on a hardness of 200 mg/L CaCO<sub>3</sub>. In the event that water quality sampling indicates that 75<sup>th</sup> percentile hardness concentrations are less than 200 mg/L CaCO<sub>3</sub>, the effluent limits may be changed by the District Manager in writing, consistent with achieving no impairment for receiving waters.
2. Additional effluent limits for sediments 1&2 are stated in MECP ECA 5178-9TUPD9
3. The effluent discharge rate from the Constructed Wetland Final Discharge and the Water Management Pond Pipeline Discharge such that at all times the ratio of the combined flow rate of these effluents to the flow rate of the receiving surface water (Pinewood River) is less than or equal to 1:1 (i.e. the cumulative flow rate of the effluent must be less than or equal to the flow rate of the receiving surface water).
4. Prior to commencing Operations Phase discharges (Constructed Wetland Final Discharge, Water Management Pond Pipeline Discharge, Sediment Pond #1, and Sediment Pond #2), the method for determining daily effluent to receiver flow mixing ratios shall be approved by the District Manager.
5. For sampling frequencies and full parameter list refer to MECP ECA 5178-9TUPD9; sampling frequency varies from thrice weekly to quarterly depending on the parameter

### 3.5 Reporting Requirements

Reporting is sub-divided as routine, planned reports of defined frequency, and those that are non-routine i.e., event driven.

#### Routine

- Submission of asbuilts within 3 months of construction for WMP, TMA, MRP and sediment ponds 1 and 2
- Monthly monitoring report including a summary of all monitoring data collective, all non routine calibration/maintenance procedures, tabulation and description of any bypass/upset conditions
- Annual reporting to MECP on March 31 for the previous year, a works performance report and a surface water monitoring report
- Quarterly electronic effluent monitoring reports to ECCC
- Annual electronic effluent monitoring report and environmental effects monitoring reports to ECCC by March 31

#### Non-routine

- Report all spills as defined in the Environmental Protection Act immediately to spills action centre SAC, follow New Gold Incident Reporting Guidelines and follow up in writing to MECP within 10 days describing the cause and discovery of the spill or loss, clean-up and recovery measures taken, preventative measures to be taken and schedule of implementation
- Any observation of sheen/foam/settable solids within the works report immediately to (SAC) immediately and written reporting within 7 days
- Any exceedance of effluent limits report to SAC immediately, written confirmation to MECP within 7 days
- If acute toxicity tests fail, within 15 days report in writing to MECP with the cause and remedial actions proposed/implemented
- Notify ECCC immediate if MMR Sch 4 limits are exceeded, pH is outside 6-9.5 range or if the effluent is acutely lethal with a written report within 30 days

Records are retained consistent with CEAA condition 11 for a minimum of 25 years or until decommissioning ends, whichever is longer and kept locally. This exceeds the ECA permit requirement of 3 years. Records include place/date/time of sampling, dates and analysis performed, analytical techniques used, names of persons collected/analyzing sampling and results of analysis.

An Operations Report will be prepared by the Mill Manager or designate. The report will include metrics and information collected as part of normal operation. Examples of information contained in the Operations report include:

- Total monthly tailings deposition tonnage and slurry water volume;
- Total monthly reclaim volume;
- Pond level and freeboard;
- Updated water balance;
- Water quality results; and
- Intake / Discharge quantities.

Each of the regulatory approval requirements related to the construction, operation and eventual reclamation of the Site have specific compliance reporting requirements with defined deadlines or reporting periodicity. In general, the reporting includes:

- Operation, Maintenance and Surveillance Plan(s) for dams, water management (water quality) and air/noise emissions;
- Emergency Preparedness Plan(s);
- As-Built Drawings and related Construction Reports;
- Dam Safety Inspection and Review Reports
- Environmental Monitoring Plans; and
- Environmental Monitoring and Performance Reports.

The environmental approvals and permits received from the government that are maintained by the New Gold Environmental Department should be referred to for details of monitoring, inspection and reporting requirements.

In addition, the New Gold Environmental Department should be notified of any proposed major modification to RRM facilities, in order that they can liaise with the appropriate government ministries to determine if additional approvals or amendments to existing approvals are required.



#### **4.0 MAINTENANCE**

The following periodic maintenance is required:

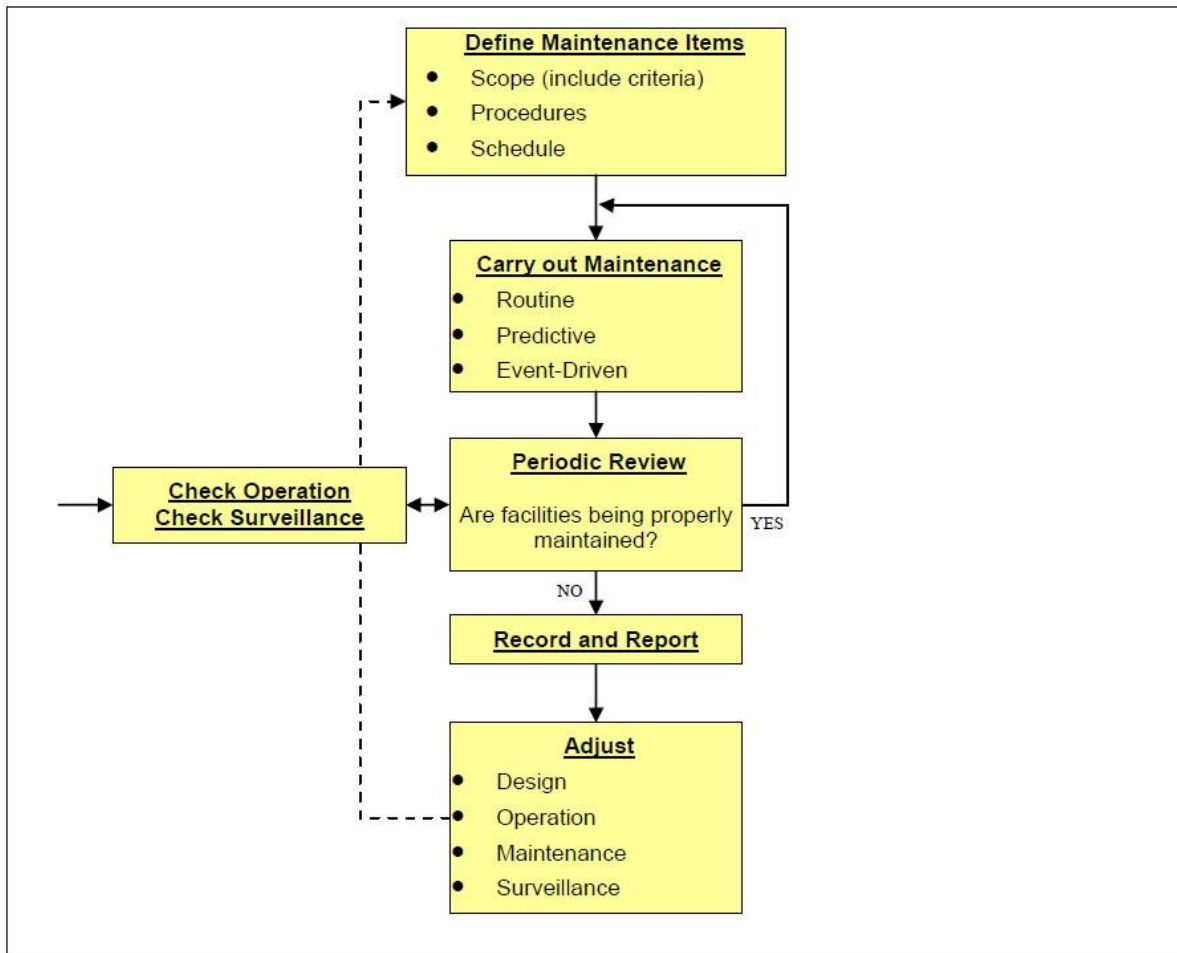
1. Maintain the tailings and reclaim pumps and associated lines and containment;
2. Clear debris, snow and ice which may block flow through the decant facility or emergency spillways;
3. Maintain water management structures including spillways, ditches and diversions;
4. Maintain equipment, power and water lines, and instrumentation;
5. Repair any deficiencies as noted in the Dam Safety Inspections (DSI); and
6. Reconstruct the support for tailings discharge pipelines wherever washouts occur.

Maintenance records are retained by maintenance personnel performing the work in accordance with the procedures described in this document. Timing of maintenance actions for unusual conditions should be based on specific recommendations from surveillance findings. Scope and time frames for routine maintenance activities are determined and scheduled by the Maintenance Department and based on manufacturer's recommendations and best practices.

The maintenance flowchart is illustrated in Figure 6-1.



**Figure 4-1; Maintenance Flow Chart**



**4.1 Routine and Predictive Maintenance**

Routine and predictive maintenance includes removal of vegetation, beaver dams, ice blockage or sediment accumulation that would otherwise affect the performance of a structure when required.

**4.2 Maintenance and Emergency Preparedness**

A weekly table-top exercise will be conducted with the pump management team to ensure that crews are intimately familiar with the operational strategies for a broad range of operating and emergency scenarios. These table tops will be documented and New Gold management will ensure that any ongoing lessons learned from day-to-day operation are captured including the updating of any corresponding plans, maps, flowsheets or procedures.

The maintenance of pumps is the responsibility of New Gold and maintenance records are required to be maintained. Each installation requires to be equipped with spill pan, spill kits

and the necessary signage. Changes to pumping configurations, ditching, piping or operating parameters need to be approved by the New Gold Mill Manager, the New Gold Maintenance Manager and the New Gold Environmental Manager, during normal working hours. This is particularly the case if splash pads need to be altered in any way. In an emergency call out (after hours), the Managers or their alternate, will provide direction in consultation with the New Gold Environmental Department.

During depositing of tailings the above-mentioned crews are required to complete their inspections daily. Reporting is to be escalated to hourly observations if a rainfall event is escalating and the Cell 2 level is within 200 mm of the intermediate fill elevation of 363.2 masl. The general manager can then decide whether to provide additional surveillance resources in the case where additional duties including maintenance and operation of the Cell 2 dewatering pumps is required to be performed by the allocated crews.

A summary report titled " TMA Cell 2 Water Levels " is circulated each morning at 9 a.m. to summarize the measured water and tailings levels as of 4 p.m. the day prior. This report is prepared and circulated by the mill superintendent or his alternate. The purpose of the report is to highlight trend data for Cell 2.

Fundamental to the successful operation of the ponds and pumping strategy is a timely reaction to rainfall events, and ensuring that pumps come 'on line' or are taken 'off line' as design trigger levels are reached.

#### **4.2.1 Dams**

The following are examples of specific maintenance activities:

- Regularly check diversion ditches, spillways and culverts for accumulation of debris or sediment, or any other form of blockage including ice, and remove if required;
- Visually inspect diversions, spillways, seepage collection sumps, dams and all ditches for cracking, bulging, slumping, and any other indications of slope movement (note, any indications of slope movement shall be reported to a qualified geotechnical engineer);
- Re-grade the dam crest, as required, to prevent local ponding and direct surface runoff towards the pond;
- Repair erosion gullies, local slumps or slides in the dam face, diversion ditches or spillway channels; and
- Regularly check diversion ditches for accumulation of debris or sediment, or any other forms of blockage, and remove if required.
- If annual survey determines necessary, correct dam crest, overflow spill way and diversion channel invert irregularities to avoid concentrated runoff.

#### **4.2.2 Ditches and spillways**

Ditch maintenance includes replacement or enhancement of erosion protection to prevent sediment generation or sloughing of slopes, as required.

#### **4.2.3 Diversions**

There are approximately 10 km of diversions associated with the Clark and West Creek diversion. Maintenance activities required include;

- Repair erosion and bank stability particularly in areas of concentrated flow e.g., culverts;
- Remove debris, and where required and approved beaver dams, that aren't part of natural progression of channel development
- Repair/modify fish habitat features if monitoring determines they are not meeting the success criteria per Fisheries Act Authorization 15-HCAA-00039, including dam crest/slope

Specifically, for the Clark Creek diversion, as per the as built report, the following maintenance will be conducted;

- Repair riffles in the Teeple Road Diversion, directly downstream of the inlet in fall 2017.

#### **4.2.4 Geotechnical and Water Monitoring Instrumentation**

Instrumentation is calibrated by the manufacturer prior to shipment. Calibration certificates will be maintained by maintenance department. Following instrument installation, initial reading procedures will be followed. Subsequent calibration will follow manufacturer's recommendations.

Malfunctioning or damaged instruments may require repair or replacement per manufacturer guidelines or approved procedure. In the event of replacement of dam instrumentation, several overlapping readings of the old and new instrument are required to ensure continuity of the data records.

#### **4.2.5 Pumping Systems and Pipelines**

Maintenance of the tailing delivery, water recirculation systems and seepage pumps will include:

- Perform regular performance tests of the Pinewood Pumphouse pumps and inspections of pump fish screens to remove any debris;
- Perform regular performance tests on seepage pond pumps
- Perform annual calibration and maintenance as required on flow meters;
- Perform regular non-destructive testing appropriate for components of the tailings delivery system, including for example, periodic measurement of pipeline thickness to identify areas of wear and to schedule pipeline replacement if necessary and repair liners as required;
- Replace pipe work, bends and fitting components as required;
- Remove accumulated debris from valves, reducers and off takes;
- Carry out maintenance as recommended by fitting and valve suppliers;
- Regularly inspect major wear components;
- Maintain emergency dump ponds in a dewatered/empty state; and
- Maintain and replace system instrumentation as required.

#### **4.2.6 Mobile Equipment**

Mobile equipment is maintained on the basis of a planned reliability program and as otherwise required. Equipment in question includes:

- Dozers;
- Excavators;
- Water truck;
- Pickup trucks;
- Mobile crane;
- Flatbed and picker truck; and
- Replacement of mobile equipment as required.

#### **4.3 Event-Driven Maintenance**

In the event of unusual conditions or incidents that require immediate maintenance actions but are not considered an emergency, repairs and replacement of facility components are made as required and activities are documented. RRM staff will provide a means to assess event driven maintenance needs through response action planning. Response planning is based on risk prioritization, maintenance crew mobilization or “call out” procedures, required repairs and replacement material availability. Event driven maintenance actions will follow applicable safety and performance procedures. Normal documentation and maintenance records will be maintained as a result of any event driven maintenance actions. Unusual conditions that require maintenance are also communicated to maintenance staff as they occur.

##### **4.3.1 Pipeline Leaks or Breaks**

In the event of a pipeline leak or break the system in question is de-energized and repaired as follows:

- Inspect entire pipeline;
- Repair or replace affected components;
- Perform opportune and scheduled maintenance;
- Repair any collateral damage caused by a leak or break;
- Collect any released tailings and place in the tailings impoundment;
- Reclaim any disturbed areas; and
- Follow any spill reporting that may be required pending type of spill and following documentation procedures.

##### **4.3.2 Earthquake Occurrence**

Following an earthquake, the following are undertaken:

- Inspect dam and beach areas for sign of distress due to deformation;
- Inspect dam for signs of liquefaction (e.g., local sand boils, etc.);
- Measure freeboard for compliance with design requirements;

- Inspect toe area of dam for signs of deformation or piping of fines;
- Inspect diversions, ditches and spillways for sign of slumping or changes in geometry;
- Inspect seepage collection areas; and
- Collect instrumentation data and submit to EOR for analysis.

#### **4.3.3 Flood Event**

Following extreme storms (as defined in section 7) the following are undertaken:

- Measure freeboard for compliance with design requirements;
- Inspect dam, diversions, ditches, spillways and diversions for signs of excessive erosion and repair if required;
- Inspect seepage return system for adequacy; and
- Implement appropriate response based on observations/measurements as defined in this manual.

#### **4.4 Reporting Requirements**

Maintenance information will be communicated internally through formal and informal meetings, interaction between various levels of the organization (department and/or crew meetings), through information posted at the site and through this OMS Manual.

Communications with applicable contractors involved in tailings management will be conducted daily and weekly during tailings activity meetings, as appropriate. All employees and contractors are encouraged to communicate openly with site management about operational conditions requiring maintenance and reporting any significant observations such as event-driven maintenance or any maintenance requirements that exceed expected norms.

Equipment logs and manuals will be maintained for reference and use by responsible staff.

Maintenance diaries and logs shall be maintained and accessible for review by other parties.

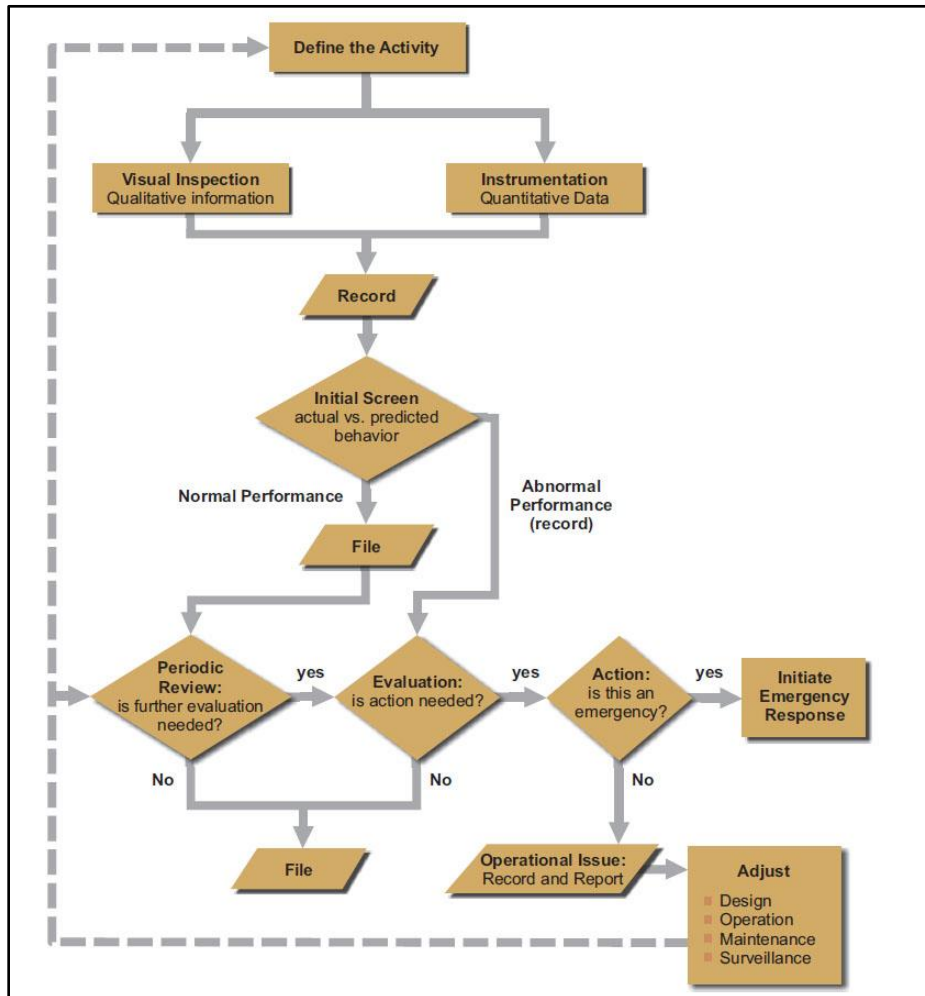
## **5.0 DAM SAFETY AND SURVEILLANCE**

The RRM tailings and water management surveillance activities involve inspection and monitoring of the operation, structural integrity and safety of a facility. Regular review of surveillance information can provide an early indication of performance trends that, although within specifications, warrant further evaluation or action. The objectives of our surveillance program are as follows:

- Monitoring the operation, safety and environmental performance of tailings and water management facilities;
- Promptly identifying and evaluating deviations from expected behavior that affect operational safety, structural integrity and environmental performance of the facility; and
- Reporting significant observations for response.

The flow chart for surveillance is shown in Figure 7-1. Surveillance is undertaken in two primary methods – visual inspection and reading of instruments. Results of these qualitative and quantitative observations are compared to the expected performance of the TMA and water management facilities. If observations are within the expected range or performance, the results of the surveillance are simply recorded. If observations are outside the expected range, further evaluation is completed to determine if remedial action is necessary. If necessary, this action is taken and may range from a minor adjustment to operational procedures to initiation of emergency response, depending on the severity and nature of the deviation from expected performance.

**Figure 5-1; Surveillance Flow Chart**



### 5.1 Surveillance and Inspections by Mine, Mill and Environment Operations Staff

The purpose of the surveillance program is to identify and classify problems and/or unsafe conditions that are visually evident. Visual inspections are an integral part of proper maintenance and performance of monitoring programs for the TMA and water management facilities. Failure to correct identified maintenance and repair items, or potential adverse behaviour, could result in unsafe conditions or lead to a failure of operating systems or cause an adverse environmental effect.

The surveillance program will consist of making regular observations relating to:

- The conditions and performance of the dams including indications of cracking, bulging, depressions, sinkholes, vegetation, surface erosion and seepage;
- Water levels and pump intake zones;
- Function of ancillary hydraulic structures (diversions, spillways, pipelines etc.);
- Discharge pipeline operations and tailings beach development; and



- Total facility performance.

During inspections, observations will be made at the upstream slope, crest and downstream slope with respect to signs of erosion, scouring, cracking, settlement, deformation, and any instability and abnormality. Seepage rates will be visually estimated and recorded on the inspection forms. Changes in the seepage rate or clarity (i.e., turbidity) require immediate reporting to the Engineer-of-Record.

### **5.1.1 Daily Inspections**

During first filling of all dams except the TMA dams Surveillance records will be maintained in logs at site and submitted to the EOR for review daily and on a monthly basis thereafter, or more frequently as warranted. Any abnormal behaviour including slope slumping, erosion of crest settlement will be reported immediately to the Engineer-of-Record.

Routine daily visual inspections of critical dams (TMA, WMP and MRP), spillways, pipelines, pipeline containment and pumping infrastructure will be carried out on an on-going basis to confirm normal operations and identify unusual or anomalous conditions such as pipeline leaks, pump intake blockages, etc. All active pipelines will be inspected twice per 12 h shift, consistent with EA conditions.

Daily inspection sheets and provided in Appendix F.

### **5.1.2 Weekly Inspections**

Physical inspections of the TMA, process water, water treatment and diversion dams will be conducted on a weekly basis. The weekly inspections will include those discussed in Section 7.1.1 and the following tasks:

- Photographic record of key features;
- Physical inspection of dams, dykes, diversion, ditches and spillways:
  - Indicating and reporting any seepage and erosion.
- Pond levels and freeboard:
  - Additional monitoring maybe required during spring freshet of the dams.

Weekly inspection sheets and SOPs are provided in Appendix F. All weekly inspections will be documented in a report and will be compiled as part of the annual DSI (Section 7.4).

### **5.1.3 Other Inspections**

#### **5.1.3.1 Diversions**

The Clark and West Creek diversions, while designed to operate passively, have specific surveillance requirements as part of the approved Fisheries Act authorizations. Further, impediments to water flow in diversions have the potential to alter water levels in the ponds. For the diversions, in addition to requirements specified above, and following the as built report for the Clark Creek Diversion these surveillance requirements will be conducted;

- Inspection of fish habitat features, as per Fisheries Act Authorization 15-HCAA-00039;
- Complete a survey of the Clark and Teeple dam crests and diversion channel inverts annually, observations of crest irregularity will require correction to avoid concentrated runoff in the overflow spillway;



- Monitoring pond levels include Teeple and Stockpile ponds (by staff gauge, transducer or other suitable means) daily. The frequency will be re-evaluated after one year of operation (May 2018).

## 5.2 Inspection Required After an Unusual Event

Several potential failure modes exist for the various tailings and water management and water diversion storage facilities. These potential failure modes, along with likely triggers, observable visual and instrumentation indicators of the failure mode are presented in Table 9-1. Special inspections will be carried out immediately if any of the following events occur:

- Events such as an earthquake, large rainfall (greater than 1:2 year rainfall (51mm)) or large snowfall/snowpack;
- Operating events such as rupture of a pipeline, particularly if on the slope or crest of the dam, sudden loss of pond water, sudden rapid rise of pond water;
- Observations such as cracks, excessive settlements, sinkholes, large slope or foundation deformations, increased seepage, turbidity of seepage water; and
- Instrument readings that deviate from historical trends, or are within “alert” action levels (e.g., trigger levels).

Special inspections after unusual events are necessary as summarized in Tables 7-1 to evaluate whether there has been any damage requiring correction, any safety measures or special operating procedures that need to be implemented, or if there is a need to initiate emergency procedures as described in Section 9.0.

**Table 5-1; Maintenance Requirements following an Unusual Event**

Unusual Event	Post – Event Inspection/Surveillance
Earthquakes	Carry out a detailed walkover of all dam structures, including crests, downstream and upstream (visible) slopes and dam toes, and all spillways, looking for signs of cracks, bulging, settlement and/or other deformations. Look for and note any changes in seepage, particularly with respect to the rate of seepage flows at dam slopes and seepage clarity. Read all piezometers. Inspect downstream toes of dams for sand boils and dam slopes for sinkholes. Inspect ponds upstream of the dams looking for ‘whirlpools’. Inspect all pump stations and pipelines. Discuss findings with the Dam Safety Inspector.
Rapid snowmelt and/or heavy rainstorms exceeding a 1:2 year rainfall (51 mm)	Inspect the (visible) slopes and the crests of all the tailings dams looking for areas of concentrated runoff and erosion. Make note of saturated ground/soft ground conditions at dam slopes and toes. Examine dam slopes for indications of localized slumping/instability. Inspect all pump stations and pipelines. Check the water levels

Unusual Event	Post – Event Inspection/Surveillance
	in all ponds/reservoirs against the critical levels, and keep checking these levels until the pond/reservoir inflows subside. Discuss findings with the Dam Safety Inspector. Check piezometric levels at dam sites if instructed to do so.
Unusually high winds (exceeding 60 kph i.e., 75 % of maximum likely used in design)	Check the condition of erosion protection on the upstream slopes of the dams.
Extreme snow pack (170cm cumulative snowfall) (i.e., 120% or greater than normal snowfall at Barwick)	Check the water levels in all ponds/reservoirs against the critical levels, and keep checking these levels until the spring freshet is over. Evaluate the situation in terms of possible snowmelt scenarios. Make predictions as to the expected storage capacity available in ponds/reservoirs. If deemed necessary, mobilize pumping and mobile treatment equipment to site.
Significant, relatively rapid erosion (any cause) of dam slope or 'sudden' seepage break at dam slope or downstream of dam in form of continuous seepage or boils	Inspect clarity of seepage, rate of seepage and amount of material sloughed. Notify tailings coordinator – site engineering and EOR.  Consider initiating Emergency Response Plan
Pond level close to, or approaching a critical level	Notify Manager. Consider initiating Emergency Response Plan
Significant change in an instrumentation reading – see table below for definition of significant change	Check the historical readings paying special attention to seasonal changes and check the measurement again.  Carry out visual inspection of all areas in the vicinity of the instrument of interest. Contact the Engineer of Record.

### 5.3 Dam Instrumentation and Monitoring

The instrumentation data is reviewed regularly to identify anomalous readings that could indicate a change in the conditions of the tailings and water management facilities. Dam instrumentation lists are provided in section 4.6. Instrumentation reading and reporting frequencies are outlined in Table 7.2. Responsible parties' record notes and takes pictures of any potential anomalies to provide further information to the EOR. Instrument trigger and alert levels are provided in Table 7.3. Additional details on instrument reading frequencies can be found in the *Geotechnical Monitoring Plan* (Amec Foster Wheeler, 2016b).

#### Piezometers:

- Vibrating Wire Piezometers shall have a reading frequency every hour and recorded by a data logger, with data collected daily during construction. Post-construction after the readings have stabilized, the reading frequency will be reduced to every 12 hours, as defined in the table below;
- Standpipe piezometers shall be measured weekly during construction and monthly following construction;
- The following are considered anomalous:

- Sudden increases or decreases that do not correlate with seasonal variations (e.g., groundwater recharge during snowmelt affecting foundation piezometers);
- Trend of piezometric increase that approaches or exceeds the rate of rise of the tailings pond; and
- Pattern of sudden and large increases followed by rapid declines.

**Inclinometers:**

- Inclinometers shall be monitored semi-weekly during construction and weekly following construction;
- Anomalous data includes:
  - Sudden increases in cumulative displacement/rate of movement of the inclinometers;
  - Zones of concentrated or discrete displacement; and
  - Blockages of the inclinometer casing.

**Settlement Plates and Survey Pins/Monuments:**

- Settlement Plates and Survey Pins/Monuments shall have a reading frequency of semi-weekly during construction and weekly following construction;
- Anomalous data includes:
  - Sudden displacements of the settlement monuments (x, y, z directions); and
  - Accelerating displacement trends (over two or more readings).

If anomalous readings are observed, the following actions should be taken:

- Check data, reductions and calculations for accuracy and correctness;
- If no errors are found in the calculations, notify the EOR, Geotechnical Engineer and Environmental Manager that an anomalous reading has been observed and that further assessment is going to be conducted;
- Check readout equipment to verify that it is functioning correctly; verify calibration;
- Re-read all instrumentation of the type for which the anomalous reading was observed, in order to check the reading and reading in adjacent instruments;
- If it is observed that an instrument or piece of readout equipment has stopped functioning, notify the Mill Manager and/or Superintendent, and the EOR immediately. If considered critical, a replacement instrument should be installed;
- If the anomalous reading is confirmed, notify the Superintendent and EOR immediately; and
- A detailed review of the effects of the reading should be carried out and the monitoring frequency of the instruments in the area of the anomaly increased to assess the progression of the anomaly. Design or remedial actions should be implemented if determined necessary.

All results are downloaded and provided to the EOR. Any anomalies are noted and a request for an additional reading may occur. The EOR will review the data in quarterly monitoring reports,

and make any recommendations, such as increased reading frequencies, pertaining to anomalous readings. The EOR, will also assess the trigger and alert levels and update them as necessary, once per year, as part of the DSI.

**Table 5-2; Dam Instrumentation Surveillance Requirements**

Type	Frequency
<i>Routine Inspection:</i>	
Dam	Weekly
Diversions	Weekly
Ditches	Weekly
Seepage collection system	Weekly
Spillways	Weekly
Pipelines	Once per 12 h shift
<i>Tailings Pond Monitoring:</i>	
Pump intake	Weekly
Staff gauges	Weekly (initially every ~12h) in Cell 1 borrow
Inflows, Outflows, Condition	Monthly
<i>Dam Instrumentation:</i>	
<i>TMA, WMP and MRP Comprehensive (and water diversions during initial filling)</i>	<ul style="list-style-type: none"> <li>• Daily during construction and initial filling</li> <li>• Weekly, during initial operations depending on trend</li> <li>• Monthly during routine operation</li> </ul>
<i>Annual Dam Inspection</i>	Annually, with no snow cover
<i>Event Driven Inspection</i>	Following unusual events (defined in table 7.1)
<i>Comprehensive Review (DSR):</i>	
Low and Moderate HPC dams	Every 10 years and prior to decommissioning
Very High HPC dams	Every 5 years and prior to decommissioning

Notes:

1. Dam Hazard Potential Classification (HPC) requires review when changes are made or downstream conditions change.
2. Monthly facility inspections should be carried out by the same staff or small group of staff such that subtle changes in the conditions can be detected.

**Table 5-3; Instrument Trigger and Alert Levels**

Instrument	Parameter	Trigger Level	Alert Level	Remarks
VWP/STP	Pore Pressure Ratio	$r_u = 0.4$	$r_u = 0.5$	Pore pressure data to be evaluated with corresponding fill elevation, and monitored movements at SPs and INs
Survey Pin	Lateral Movement Rate	Uniform (but less than max 75 mm magnitude)	Accelerating	To be evaluated with IN data to define zones of movement
	Lateral Movement Rate	Uniform	Accelerating	Deformation rates will be associated with rate of construction and post construction movements

Slope Inclinometer	Share Strain Magnitude	2%	5%	If specific plane(s) of shearing is observed within the foundation, the construction shall be limited, progressed with caution or ceased depending on the observed phenomena
Notes: 1. $r_u$ of 0.4 corresponds to a piezometric head at 80% of the dam height. $r_u$ 0.5 is at piezometric head at the crest of the dam. 2. $r_u$ of 0.5 is a design criteria to meet dam stability requirements. Source; Geotechnical Monitoring Plan (AMECFW, August 2016)				

## 5.4 Dam Safety Inspections (DSIs) and Dam Safety Reviews (DSRs)

Consistent with MECP ECA approvals, with the regulatory exception of the Clark and West Creek Diversions, engineering inspections will be conducted following best management practices as per the Canadian Dam Association's (CDA) Dam Safety Guidelines (2007, revised 2013, as amended from time to time), and the 2014 CDA Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams (as amended from time to time).

### 5.4.1 Dam Safety Inspections

Annual inspections are intended to be part of a more thorough review of the condition of the facility, and are carried out by the EOR. The inspections will include the following key items:

- Visual inspection of the facility by the engineer, including taking appropriate photographs of the observed conditions;
- Review of routine inspection records prepared by operating personnel in the past year;
- Review whether or not recommendations from previous year's inspection(s) have been addressed, and any incidents or actions arising from those previous recommendations;
- Review of instrumentation and monitoring data;
- Review of tailings deposition and water management operations of the facility including reconciliation of the annual water and mass balance. Review of pond levels (and depth) and freeboard, and reports of any incidents (and remedial measures) that may have occurred;
- An evaluation and interpretation of the structural performance of the dam and related components, and identify any potential safety deficiencies or recommended items that need to be addressed in the coming year;
- Review construction records, QA/QC data and as-built information on dam construction and beaching; and
- Evaluation of the OMS Manual to assess the need for updating.

The results of the inspection and review will be documented in a report.

### 5.4.2 Dam Safety Review

The Canadian Dam Association (CDA) Dam Safety Guidelines (CDA, 2007) recommend a comprehensive dam safety review be carried out every 5 years during operations, prior to decommissioning and following closure, by a qualified 3<sup>rd</sup> party consultant.

The comprehensive review provides independent verification of:

- Safety and environmental performance of the facility;
- Adequacy of the surveillance program;
- Adequacy of delivery of OMS Manual requirements;
- Design basis with respect to current standards and possible failure modes; and
- Compliance with new engineering standards (including analysis to confirm if necessary).

## **5.5 Documentation**

Documentation of surveillance and monitoring activities shall be maintained by the Mill Manger, or as designated, as described in the preceding sections and will include recording of:

- Routine visual observations (departures from normal conditions);
- Photographs;
- Instrumentation monitoring and testing;
- Analyses and evaluations; and
- Reviews.

Documentation will include, as a minimum, the following:

- Weekly routine inspection log;
- Monthly tailings facility and process water pond monitoring report;
- Quarterly instrumentation reports;
- Annual Dam Safety Inspection reports; and
- Comprehensive Dam Safety Review report every 5 years.

Documentation will include a hard copy (paper) and electronic filing system for inspection reports, photographic and video records, incident reports, instrumentation readings, instrumentation plots, annual inspections and third-party reviews, so that they can be quickly retrieved for review and in case of an emergency.

## **5.6 Reporting**

The Mill Manager, or designated responsible party, and Geotechnical Engineer will review collected data records from facility monitoring and assess the need for maintenance activities or response. Corrective actions will be identified and tracked to closure. The Environmental Manager is responsible for overseeing sample and data collection and analysis. Reporting will meet MECP requirements and the annual DSI report will also be submitted to the MRNF. Reporting includes;

- As built reports of the dams, excluding the Clark and West Creek diversions, will be submitted to MECP within 90 days of completion;
- An annual report based on the DSI including ECA approval requirements;
- Monthly water quality monitoring report; and
- Annual report including any operating problems and corrective actions, a summary of calibration and maintenance works, use of contingency plans, surface water and groundwater monitoring reports including water balance, ML/ARD updates, discharge volumes and quality.

Additional reporting requirements may be developed as the RRM progresses.

## 6.0 CLOSURE PLAN

This section summarizes the objectives of the Closure Plan. The *Rainy River Project – Closure Plan* (Amec Foster Wheeler, 2015c) provides the closure plan and includes temporary closure options for short and medium-term shut-down of site facilities.

### 6.1 Embankments

Closure of the embankments will typically involve, but is not limited to reaching of embankments to prevent ponding of water and revegetating slopes to reclaim the area. Some embankment structures will still have a role during the closure phase and these will not be breached. The following structures will continue to be operated during the closure phase:

- MRP will collect runoff and seepage from EMRS, which will be directed to the Open Pit to help flooding;
- Sediment Ponds #1 and #2 will be maintained until site is recognized as a closed mine and monitoring associated with the Metal Mining Effluent Regulation is no longer required

Freshwater diversion and constructed wetland structures are designed to operate passively and will remain in place at closure.

### 6.2 Monitoring

Monitoring requirements are described in the *Rainy River Project – Closure Plan* (Amec Foster Wheeler, 2017c).

## 7.0 CONTINGENCIES

The operations are sensitive to water balance and water quality in discharges. The following are contingencies based on water management and functioning of the diversions.

### 7.1 Freshwater Diversions

There are specific contingencies required, based on the Fisheries Act authorization (application Table 6) for the freshwater diversion that relate to the OMS i.e., not biological. These are provided in the following table.

**Table 7-1; Contingencies for Freshwater Diversions**

Attribute	Mode of Failure	Contingency
Physical construction of offset measures	<ul style="list-style-type: none"> <li>• Dam not constructed as per plans</li> <li>• Channel not constructed as per plan.</li> </ul>	<ul style="list-style-type: none"> <li>• Engineer to assess failure and recommend corrective actions.</li> </ul>



	<ul style="list-style-type: none"> <li>Water area, depths and or habitat structures not in place or present as per the plans.</li> </ul>	<ul style="list-style-type: none"> <li>Proponent to take required corrective action.</li> </ul>
Physical function of offset measures	<ul style="list-style-type: none"> <li>Conditions do not provide for fish passage</li> </ul>	<ul style="list-style-type: none"> <li>Engineer / biologist to assess cause of failure and recommend corrective actions.</li> <li>Take required corrective action</li> </ul>
	<ul style="list-style-type: none"> <li>Water level not consistent with those specified in plans.</li> </ul>	<ul style="list-style-type: none"> <li>Adjust grades of structures to alter water levels</li> <li>Excavate pools to specified depths.</li> </ul>
Stability of structures	<ul style="list-style-type: none"> <li>Constructed habitat features (log and boulder structures) missing or not functional</li> </ul>	<ul style="list-style-type: none"> <li>Repair or replace structures</li> </ul>
	<ul style="list-style-type: none"> <li>Shorelines and graded offset features not stable (less than 80% of features are considered stable)</li> </ul>	<ul style="list-style-type: none"> <li>Assess cause and areas of instability</li> <li>Add permanent erosion control (rock, vegetation) in areas of erosion</li> <li>Grade channel or shore to decrease velocity</li> </ul>
	<ul style="list-style-type: none"> <li>Riparian vegetation cover and plantings are less than 80% coverage of area, and or survival of planted stock</li> </ul>	<ul style="list-style-type: none"> <li>Apply seed and replacement plantings where required</li> <li>Substitute species, and/or use soil amendments if conditions require.</li> </ul>

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**RAINY RIVER PROJECT**

**PART VII - WATER TREATMENT - OPERATION,  
MAINTENANCE AND SURVEILLANCE MANUAL WATER  
MANAGEMENT STRUCTURES**

**New Gold Inc.  
Rainy River Project  
5967 Highway 11/71, P.O. Box 5  
Emo, Ontario  
P0W 1E0**

**January 2019**

**Version 2019-1**

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## **1.0 Regulatory Requirements**

This document is consistent with the New Gold Tailings, Heap Leach and Waste Rock Facilities Management Policy and was prepared pursuant to the MAC guidelines for *Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities* (MAC, 2011).

The following is a list of permits that this section of the OMS complies with:

## **2.0 FACILITY DESCRIPTIONS**

Water treatment is provided by the following;

- Water Treatment Plant, Water Discharge Pond (WDP) and the Constructed wetland – (CW); and
- Sediment ponds 1 and 2.

Sedimentation ponds have been designed to allow for the settlement of total suspended solids present in the non-contact runoff or effluent prior to discharge to the environment. Sediment Ponds #1 and #2 receive runoff and seepage from the West Mine Rock Stockpile (WMRS). The Water Discharge Pond (WDP) and Constructed Wetland receive discharge water from the WMP. The constructed wetland is the primary and priority discharge location from the WMP (to mitigate flow reductions in the Pinewood River) ahead of discharging to the Pinewood River downstream of McCallum Creek.

### **2.1 Water Treatment**

At the time of preparation for this revision the constructed wetland and sediment ponds 1 and 2 have not been constructed or received all regulatory approvals. Based on the anticipated MMER schedule 2 approval timing, construction of these facilities is planned for 2018. The following section provides a summary of their design and intended operation, which is intended to be updated on receipt of all regulatory approvals.

#### **2.1.1 Water Discharge Pond and Constructed Wetland**

The Water Discharge Pond (WDP) has been designed to collect runoff from natural ground catchment south of the TMA, seepage from the seepage collection ditch, and bleed flow from the WMP (design rate of 10,000 m<sup>3</sup>/day) for discharge to the constructed wetland. The WDP will also provide sediment control south of the TMA.

The constructed wetlands collect the water discharged from the WDP. They have been designed to provide a target 30-day retention time following discharge from the WDP. The wetlands are comprised of five ponds (Pond A, B, C, D, E), and the downstream pond (Pond A) will feature a control structure to stop discharge if the water quality does not meet discharge criteria. If required, water in Pond A would be pumped back to the TMA or WMP.

The design criteria for the Water Discharge and constructed wetland dams and ponds are provided in Tables 4-3 and 4-5, respectively. Further design details and typical cross-sections of the effluent dams are provided in the following documents:



**Table 2-1; Water Discharge Pond and Constructed Wetland Documents**

<b>Document Title</b>	<b>Reference</b>
LAKES AND RIVERS IMPROVEMENT ACT WORK PERMIT APPLICATION SUPPORT DOCUMENT WATER DISCHARGE POND AND CONSTRUCTED WETLAND	RRP-GEO-LRIA-004D R2
As-built Report(s)	TBD
<b>Drawing Title</b>	<b>New Gold Document Number</b>
Water Discharge Pond Dam – Plan and Typical Cross Sections	3098004-004410-A1-D70-0002
Constructed Wetland – Plan, Profiles & Section	3098004-004420-A1-D70-0002

## 2.2 Instrumentation

### 2.2.1 Dam Safety

Instrumentation has been and will be installed during construction. Instrumentation will include instrumented dam sections that will monitor dam foundation and clay fill pore pressures to infer consolidation characteristics, as well as monitor any movement of dam fill due to deformation. Each dam instrumentation section will include: standpipe(s), a settlement plate, slope inclinometer(s), survey pins/monuments, and a terminal arrangement with data logger and vibrating wire piezometers.

Following construction, the instrumentation will remain for dam monitoring purposes. A detailed report containing the proposed locations, usage, and analysis of all instrumentation is provided in the *Geotechnical Monitoring Plan* (Amec Foster Wheeler, 2016b). The design details for the installed or proposed dam instrumentation is summarized in Table 4-14. The design information provided in Table 4-14 will be confirmed and updated as may be required following development of the As-Built drawings.

**Table 2-2; Dam Instrumentation Summary**

Facility	Section (Sta.)	Dam Instrumentation							Pond Level Gauge (type)
		Slope Stability		Foundation Consolidation		Phreatic Level and Seepage			
		Slope Indinometers (no.)	Survey Pins (no.)	Survey Monuments (no.)	Vibrating Wire Piezometers (no.)	Settlement Plates (no.)	Vibrating Wire Piezometers (no.)	Standpipe Piezometers (no.)	
TMA North	3+300	0		0	2	1	1	2	TBD
	Mass array				142				
TMA South	1+000				2				
	1+380				2	1	1	1	
	1+450	2		2	4	2	1	2	
	1+600	1			4	2	1	1	
	2+200	2		2	4	2	1	2	
	2+350	1			4	2	1	1	
	Mass array				176				
TMA West	0+300			0	1		1		
	0+460	2		0	5		2	1	
	1+450	0	35	0	0	1		0	
	1+500	2		0	4	0	3	0	
	Mass array				82				
TMA Start-up Cell	0+400				2				TBD
	1+000				2				
	Mass array				88				
WMP Dam 1			16						- Staff gauge
WMP Dam 2	0+950	1	34	0	2	0	2	2	- Survey stakes
WMP Dam 3	0+300	0		0	1	0	1	2	
	0+500	1	17	0	2	1	4	1	
Mine Rock Pond	0+220	1		2	2	1	1	4	- Staff gauge
Clark Creek									- Staff gauge
Teeple Road									- Staff gauge
Stockpile Pond	0+125	1	8	0	1	0	1	2	- Staff gauge
West Creek	0+291				2			2	
	0+320	2	2						- Staff gauge
	0+340	2	2		2	1	1		
Water Discharge Pond									TBD
Constructed Wetlands									
- Pond A									TBD
- Pond B									TBD
- Pond C									TBD
- Pond D									TBD
- Pond E									TBD
Sediment Pond #1									TBD
Sediment Pond #2									TBD
Temporary Sediment Pond									TBD

**Notes:**

- 1) Survey pins installed at 100 m centres along 3-5 lengthwise lines (crest, toes, etc.) Quantities are total for each dam
- 2) TMA Dams feature mass array of VWP instruments installed in grids within the dam foundation. Installation of these instruments is currently on-going

In addition to the instrumentation described above, the TMA dams are equipped with an additional suite of vibrating wire piezometers (VWPs) to provide enhanced monitoring resolution during construction. A total of 524 VWPs were installed in the TMA dam foundations, arranged in a grid pattern, and managed with a remote wireless data acquisition and management system.

Instrumentation associated with the management of the dams is being managed through a software system that includes integration with data loggers and data storage and is configured such that alarms for alert levels are defined and available. The software routinely generates reports and if trigger levels are exceeded sends out alarm notifications.

**2.2.2 Other instrumentation**

Additional instrumentation to support the OMS manual and management of water includes;

- Densometer on the tailings pipeline;
- Flow meters on the water management pipelines including from the Pinewood River, tailings reclaim lines, MPR line and freshwater line from the WMP and
- Pressure transducers in the WMP, Clark/Teeple Ponds.

This instrumentation provides continuous recording, which is collected during routine inspections and included.

### **2.3 Regulatory Requirements**

Regulatory requirements, permits and authorizations are summarized in section 1.1. Key approvals include the Federal and Provincial Environmental Assessment conditions and commitments and permits including those issued pursuant to the LRIA and EPA. Additional legislation to be considered in implementing the OMS manual includes the MMER and various Ontario regulations including waste management.

No direct discharges are intended from any of the structures described in this section except the WMP which is described in sections 4 and 5. Seepage will be collected and pumped back from the WMP and TMA cells. Subsequent to this revision and LRIA approvals, additional details for the WDP, CW and sediment ponds discharges will be developed.

### **3.0 OPERATIONS**

The overall operational objectives of the TMA and associated dams and facilities are to dispose and store the tailings and to manage all site water in a safe, economical and environmentally responsible manner. This section defines operating standards in accordance with design criteria and regulatory requirements specified in section 4.

#### **3.1 Water Treatment**

For this revision of the OMS the WDP and CW have yet to be constructed or approved for construction (LRIA and MMER Schedule 2), however information is included in this revision for completeness and will be updated prior to operation of the WMP/CW, or as specified in regulatory approvals. Ahead of any discharges this section will be updated and a contaminant release plan, consistent with MECP requirements will be developed.

The TMA has been designed to optimize natural degradation processes to provide further water treatment, by ensuring there is sufficient retention time to allow these reactions to occur. The natural degradation processes are most effective during warm weather conditions when biophysical activity is optimal, and are also augmented by exposure to sunlight. Effluents that are planned for discharge to the environment will be held for a sufficient period of time under warm weather conditions, to maximize the effects of natural degradation. Such effluent aging will take place mainly in the summer months (June through mid-September) in both the TMA and WMP.

To optimize both water quality and river flow effects, final effluent is released to the Pinewood River at two separate locations:

- Through the constructed wetland to the Pinewood River at the Loslo Creek outflow (via lower Loslo Creek); and
- Directly to the Pinewood River just downstream of the McCallum Creek outflow, by pipeline.

The rationale for using two separate discharge locations derives from the need to achieve effective water quality treatment while minimizing adverse flow effects on the Pinewood River, under varying hydrologic operating conditions. The constructed wetland is located further upstream on the Pinewood River pumphouse, and will help to maintain flow in the Pinewood River, however has a lower assimilative capacity. All effluent from the water management pond which is not discharged through the constructed wetland will be discharged by pipeline to the Pinewood River downstream of McCallum to take advantage of increased river assimilative capacity at this point, since wetland polishing would not be available for this portion of the discharged effluent.

The transfer of water from the TMA to the WMP (for discharge to the environment) will normally occur during the months of June through August. To facilitate this process, the water in the WMP would be drawn down by the end of May in each year. The release of WMP effluent to Pinewood River downstream of McCallum Creek outflow would occur during the spring and fall, to take advantage of extended aging in the TMA and WMP, and higher receiver assimilative capacity. Water which is not discharged from the WMP in the fall would be held over, without any further inputs from the TMA pond, until the following spring for release.

Effluent from the WMP will be discharged to the constructed wetland (as bleed flow) during all months of the year, except February and March, with more limited discharge in December and January. The bleed flow through the wetland represents the larger quantity of water that is

discharged throughout the year (except in a very wet year). In low runoff years, virtually all final effluent discharge would be through the constructed wetland.

In conjunction with effluent aging and wetland treatment, final effluent quality is expected to be consistent with water quality discharge limits. Each discharge has specific discharge criteria as specified in MECP ECA #5178-9TUPD9 which must be met prior to discharge.

### **3.1.1 Water Discharge Pond and Constructed Wetlands**

The WDP collects runoff from natural ground catchment south of the TMA dam, seepage from the seepage collection ditch and the bleed flow from the WMP (maximum rate of 10,000 m<sup>3</sup>/day) for discharge to the constructed wetland. The Water Discharge Pond (Drawing 3098004-004410-A1-D70-0002) will also provide erosion and sediment control south of the TMA dam.

The Constructed Wetlands are designed to provide a target of 30 days of retention time of 10,000 m<sup>3</sup>/day following discharge from the WMP into the WDP. The Constructed Wetlands are comprised of five ponds (Pond A, B, C, D, E). The downstream pond (Pond A), will contain a control structure to stop discharge to the environment in the event that water quality does not meet discharge criteria (in this case water from Pond A could be pumped back to the TMA or WMP).

### **3.2 Progressive Reclamation and Closure**

Some progressive reclamation with respect to the TMA is proposed as part of mine operations. By the end of the operations phase a low permeability overburden cover of approximately 150 m in width will be placed on the upstream side of the TMA dam. The overburden cover will cover approximately two thirds of the ultimate perimeter, with the remaining approximately one third of the length to be reclaimed at closure. This cover is intended to prevent the tailings permanent water cover from coming into contact with the TMA dams, and will also serve a secondary function of limiting oxygen diffusion into the uppermost portion of the tailings underneath. The overburden cover will be seeded or hydroseeded with a native seed mix or equivalent, and will be armoured with NPAG rock at the transition zone of the cover with the tailings to prevent suspension and oxidation of solids.

Closure of the RRM in respect to tailings, process water and freshwater management will include but is not limited to the following:

- The water discharge pond dam will be breached once it no longer has a water management function;
- The constructed wetland will be left in place as this system is designed to operate passively, and will have stabilized as a wetland complex during operations;

### **3.3 Safety and Security**

The site safety and security will be following the RRM Health and Safety Management System including but not limited to the following:

- The site will be gated with restricted access to authorized personnel only;
- The TMA will be fenced along portions of the old highway 600 and access will be restricted to authorized personnel only;
- No public access;
- Construction Management provided security measures; and

- Onsite health and safety policies for working around bodies of water, working alone or crossing ice.

### 3.4 Environmental Protection

The Environmental Department has oversight over the EMS which contains tailings operations related environmental aspects including:

- Fugitive and point source dust emissions;
- Hydrocarbon Spills and Leaks;
- Pipeline Rupture and Leaks;
- Surface and ground water quantity and quality; and
- Wildlife management (including species at risk).

An environmental aspect register is a comprehensive inventory of tailings operations activities, environment aspects, assessment of risk and identification of controls. Tailings personnel have responsibility to implement and maintain the controls including monitoring and inspection. Refer to the Environment Department for the environmental aspect register (in prep) and environmental related procedures.

As outlined in orientation training, it is every RRM employee’s responsibility to report a suspected spill or uncontrolled release event to their supervisor. This includes suspicious flows of water out of the area, escaping tailings, etc. The sooner appropriate persons can begin to correct a situation, the less likely it is that severe impacts will follow.

Table 5-3 provides a summary of the MECP effluent discharge limits that must be met to discharge from the WMP.

**Table 3-1; MECP Effluent Discharge Limits from the WMP**

<b>Constructed Wetland Final Discharge and Water Management Pond Pipeline Discharge (to the Pinewood River) as stated in MECP ECA 5178-9TUPD9</b>		
<b>Effluent Parameter</b>	<b>Daily Maximum Concentration (mg/l)</b>	<b>Monthly Average (mg/l)</b>
Cadmium	-	0.0010
Cobalt	-	0.0044
CBOD5	-	25.0
E.coli	-	100/100ml geometric mean density
Total Suspended Solids	30	15
Total Phosphorus	-	0.10
Cyanide (total)	0.1	0.05
Cyanide (free)	0.02	0.01
Total Arsenic	0.034	0.017
Total Copper*	0.028	0.014
Total Nickel	0.094	0.047
Total Lead*	0.030	0.015
Total Zinc*	0.348	0.174
Un-ionized Ammonia	0.08	0.04
Acute Toxicity (Rainbow Trout and Daphnia Magna)	Non-acutely lethal (not greater than 50% mortality in undiluted effluent)	
pH of the effluent maintained between 6.0 to 9.5, inclusive, at all times		

**Notes:**

1. \*Proposed effluent criteria for Total Copper, Total Lead, and Total Zinc are based on a hardness of 200 mg/L CaCO<sub>3</sub>. In the event that water quality sampling indicates that 75<sup>th</sup> percentile hardness concentrations are less than 200 mg/L CaCO<sub>3</sub>, the effluent limits may be changed by the District Manager in writing, consistent with achieving no impairment for receiving waters.
2. Additional effluent limits for sediments 1&2 are stated in MECP ECA 5178-9TUPD9
3. The effluent discharge rate from the Constructed Wetland Final Discharge and the Water Management Pond Pipeline Discharge such that at all times the ratio of the combined flow rate of these effluents to the flow rate of the receiving surface water (Pinewood River) is less than or equal to 1:1 (i.e. the cumulative flow rate of the effluent must be less than or equal to the flow rate of the receiving surface water).
4. Prior to commencing Operations Phase discharges (Constructed Wetland Final Discharge, Water Management Pond Pipeline Discharge, Sediment Pond #1, and Sediment Pond #2), the method for determining daily effluent to receiver flow mixing ratios shall be approved by the District Manager.
5. For sampling frequencies and full parameter list refer to MECP ECA 5178-9TUPD9; sampling frequency varies from thrice weekly to quarterly depending on the parameter

### 3.5 Reporting Requirements

Reporting is sub-divided as routine, planned reports of defined frequency, and those that are non-routine i.e., event driven.

#### Routine

- Submission of asbuilts within 3 months of construction for WMP, TMA, MRP and sediment ponds 1 and 2
- Monthly monitoring report including a summary of all monitoring data collective, all non routine calibration/maintenance procedures, tabulation and description of any bypass/upset conditions
- Annual reporting to MECP on March 31 for the previous year, a works performance report and a surface water monitoring report
- Quarterly electronic effluent monitoring reports to ECCC
- Annual electronic effluent monitoring report and environmental effects monitoring reports to ECCC by March 31

#### Non-routine

- Report all spills as defined in the Environmental Protection Act immediately to spills action centre SAC, follow New Gold Incident Reporting Guidelines and follow up in writing to MECP within 10 days describing the cause and discovery of the spill or loss, clean-up and recovery measures taken, preventative measures to be taken and schedule of implementation
- Any observation of sheen/foam/settable solids within the works report immediately to (SAC) immediately and written reporting within 7 days
- Any exceedance of effluent limits report to SAC immediately, written confirmation to MECP within 7 days
- If acute toxicity tests fail, within 15 days report in writing to MECP with the cause and remedial actions proposed/implemented
- Notify ECCC immediate if MMR Sch 4 limits are exceeded, pH is outside 6-9.5 range or if the effluent is acutely lethal with a written report within 30 days



Records are retained consistent with CEAA condition 11 for a minimum of 25 years or until decommissioning ends, whichever is longer and kept locally. This exceeds the ECA permit requirement of 3 years. Records include place/date/time of sampling, dates and analysis performed, analytical techniques used, names of persons collected/analyzing sampling and results of analysis.

An Operations Report will be prepared by the Mill Manager or designate. The report will include metrics and information collected as part of normal operation. Examples of information contained in the Operations report include:

- Total monthly tailings deposition tonnage and slurry water volume;
- Total monthly reclaim volume;
- Pond level and freeboard;
- Updated water balance;
- Water quality results; and
- Intake / Discharge quantities.

Each of the regulatory approval requirements related to the construction, operation and eventual reclamation of the Site have specific compliance reporting requirements with defined deadlines or reporting periodicity. In general, the reporting includes:

- Operation, Maintenance and Surveillance Plan(s) for dams, water management (water quality) and air/noise emissions;
- Emergency Preparedness Plan(s);
- As-Built Drawings and related Construction Reports;
- Dam Safety Inspection and Review Reports
- Environmental Monitoring Plans; and
- Environmental Monitoring and Performance Reports.

The environmental approvals and permits received from the government that are maintained by the New Gold Environmental Department should be referred to for details of monitoring, inspection and reporting requirements.

In addition, the New Gold Environmental Department should be notified of any proposed major modification to RRM facilities, in order that they can liaise with the appropriate government ministries to determine if additional approvals or amendments to existing approvals are required.



#### **4.0 MAINTENANCE**

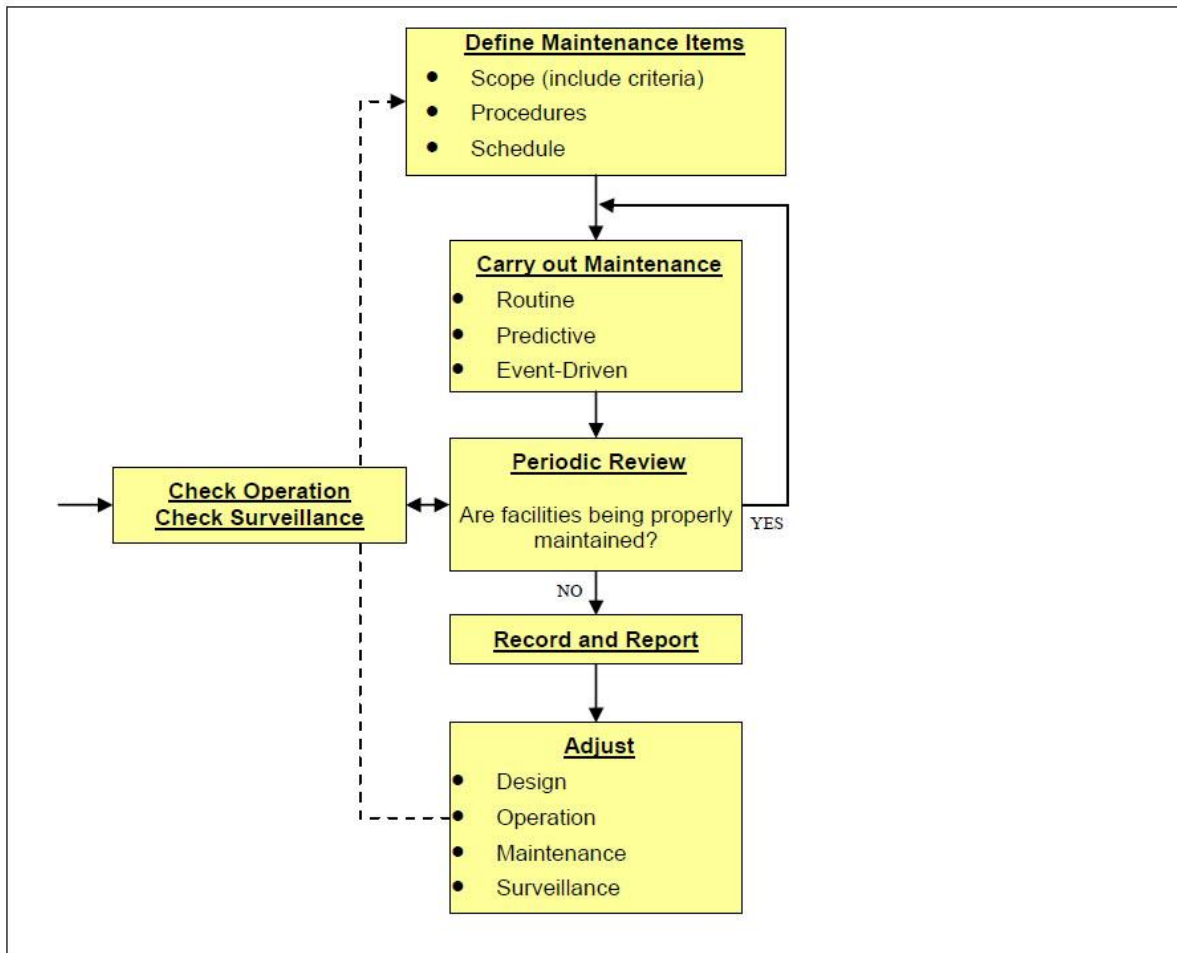
The following periodic maintenance is required:

1. Maintain the tailings and reclaim pumps and associated lines and containment;
2. Clear debris, snow and ice which may block flow through the decant facility or emergency spillways;
3. Maintain water management structures including spillways, ditches and diversions;
4. Maintain equipment, power and water lines, and instrumentation;
5. Repair any deficiencies as noted in the Dam Safety Inspections (DSI); and
6. Reconstruct the support for tailings discharge pipelines wherever washouts occur.

Maintenance records are retained by maintenance personnel performing the work in accordance with the procedures described in this document. Timing of maintenance actions for unusual conditions should be based on specific recommendations from surveillance findings. Scope and time frames for routine maintenance activities are determined and scheduled by the Maintenance Department and based on manufacturer's recommendations and best practices.

The maintenance flowchart is illustrated in Figure 6-1.

**Figure 4-1; Maintenance Flow Chart**



**4.1 Routine and Predictive Maintenance**

Routine and predictive maintenance includes removal of vegetation, beaver dams, ice blockage or sediment accumulation that would otherwise affect the performance of a structure when required.

**4.2 Maintenance and Emergency Preparedness**

A weekly table-top exercise will be conducted with the pump management team to ensure that crews are intimately familiar with the operational strategies for a broad range of operating and emergency scenarios. These table tops will be documented and New Gold management will ensure that any ongoing lessons learned from day-to-day operation are captured including the updating of any corresponding plans, maps, flowsheets or procedures.

The maintenance of pumps is the responsibility of New Gold and maintenance records are required to be maintained. Each installation requires to be equipped with spill pan, spill kits

and the necessary signage. Changes to pumping configurations, ditching, piping or operating parameters need to be approved by the New Gold Mill Manager, the New Gold Maintenance Manager and the New Gold Environmental Manager, during normal working hours. This is particularly the case if splash pads need to be altered in any way. In an emergency call out (after hours), the Managers or their alternate, will provide direction in consultation with the New Gold Environmental Department.

During depositing of tailings the above-mentioned crews are required to complete their inspections daily. Reporting is to be escalated to hourly observations if a rainfall event is escalating and the Cell 2 level is within 200 mm of the intermediate fill elevation of 363.2 masl. The general manager can then decide whether to provide additional surveillance resources in the case where additional duties including maintenance and operation of the Cell 2 dewatering pumps is required to be performed by the allocated crews.

A summary report titled " TMA Cell 2 Water Levels " is circulated each morning at 9 a.m. to summarize the measured water and tailings levels as of 4 p.m. the day prior. This report is prepared and circulated by the mill superintendent or his alternate. The purpose of the report is to highlight trend data for Cell 2.

Fundamental to the successful operation of the ponds and pumping strategy is a timely reaction to rainfall events, and ensuring that pumps come 'on line' or are taken 'off line' as design trigger levels are reached.

#### **4.2.1 Dams**

The following are examples of specific maintenance activities:

- Regularly check diversion ditches, spillways and culverts for accumulation of debris or sediment, or any other form of blockage including ice, and remove if required;
- Visually inspect diversions, spillways, seepage collection sumps, dams and all ditches for cracking, bulging, slumping, and any other indications of slope movement (note, any indications of slope movement shall be reported to a qualified geotechnical engineer);
- Re-grade the dam crest, as required, to prevent local ponding and direct surface runoff towards the pond;
- Repair erosion gullies, local slumps or slides in the dam face, diversion ditches or spillway channels; and
- Regularly check diversion ditches for accumulation of debris or sediment, or any other forms of blockage, and remove if required.
- If annual survey determines necessary, correct dam crest, overflow spill way and diversion channel invert irregularities to avoid concentrated runoff.

#### **4.2.2 Ditches and spillways**

Ditch maintenance includes replacement or enhancement of erosion protection to prevent sediment generation or sloughing of slopes, as required.

#### **4.2.3 Geotechnical and Water Monitoring Instrumentation**

Instrumentation is calibrated by the manufacturer prior to shipment. Calibration certificates will be maintained by maintenance department. Following instrument installation, initial reading procedures will be followed. Subsequent calibration will follow manufacturer's recommendations.

Malfunctioning or damaged instruments may require repair or replacement per manufacturer guidelines or approved procedure. In the event of replacement of dam instrumentation, several overlapping readings of the old and new instrument are required to ensure continuity of the data records.

#### **4.2.4 Pumping Systems and Pipelines**

Maintenance of the tailing delivery, water recirculation systems and seepage pumps will include:

- Perform regular performance tests of the Pinewood Pumphouse pumps and inspections of pump fish screens to remove any debris;
- Perform regular performance tests on seepage pond pumps
- Perform annual calibration and maintenance as required on flow meters;
- Perform regular non-destructive testing appropriate for components of the tailings delivery system, including for example, periodic measurement of pipeline thickness to identify areas of wear and to schedule pipeline replacement if necessary and repair liners as required;
- Replace pipe work, bends and fitting components as required;
- Remove accumulated debris from valves, reducers and off takes;
- Carry out maintenance as recommended by fitting and valve suppliers;
- Regularly inspect major wear components;
- Maintain emergency dump ponds in a dewatered/empty state; and
- Maintain and replace system instrumentation as required.

#### **4.2.5 Mobile Equipment**

Mobile equipment is maintained on the basis of a planned reliability program and as otherwise required. Equipment in question includes:

- Dozers;
- Excavators;
- Water truck;
- Pickup trucks;
- Mobile crane;
- Flatbed and picker truck; and
- Replacement of mobile equipment as required.

#### **4.3 Event-Driven Maintenance**

In the event of unusual conditions or incidents that require immediate maintenance actions but are not considered an emergency, repairs and replacement of facility components are made as

required and activities are documented. RRM staff will provide a means to assess event driven maintenance needs through response action planning. Response planning is based on risk prioritization, maintenance crew mobilization or “call out” procedures, required repairs and replacement material availability. Event driven maintenance actions will follow applicable safety and performance procedures. Normal documentation and maintenance records will be maintained as a result of any event driven maintenance actions. Unusual conditions that require maintenance are also communicated to maintenance staff as they occur.

#### **4.3.1 Pipeline Leaks or Breaks**

In the event of a pipeline leak or break the system in question is de-energized and repaired as follows:

- Inspect entire pipeline;
- Repair or replace affected components;
- Perform opportune and scheduled maintenance;
- Repair any collateral damage caused by a leak or break;
- Collect any released tailings and place in the tailings impoundment;
- Reclaim any disturbed areas; and
- Follow any spill reporting that may be required pending type of spill and following documentation procedures.

#### **4.3.2 Earthquake Occurrence**

Following an earthquake, the following are undertaken:

- Inspect dam and beach areas for sign of distress due to deformation;
- Inspect dam for signs of liquefaction (e.g., local sand boils, etc.);
- Measure freeboard for compliance with design requirements;
- Inspect toe area of dam for signs of deformation or piping of fines;
- Inspect diversions, ditches and spillways for sign of slumping or changes in geometry;
- Inspect seepage collection areas; and
- Collect instrumentation data and submit to EOR for analysis.

#### **4.3.3 Flood Event**

Following extreme storms (as defined in section 7) the following are undertaken:

- Measure freeboard for compliance with design requirements;
- Inspect dam, diversions, ditches, spillways and diversions for signs of excessive erosion and repair if required;
- Inspect seepage return system for adequacy; and
- Implement appropriate response based on observations/measurements as defined in this manual.

#### **4.4 Reporting Requirements**

Maintenance information will be communicated internally through formal and informal meetings, interaction between various levels of the organization (department and/or crew meetings), through information posted at the site and through this OMS Manual.

Communications with applicable contractors involved in tailings management will be conducted daily and weekly during tailings activity meetings, as appropriate. All employees and contractors are encouraged to communicate openly with site management about operational conditions requiring maintenance and reporting any significant observations such as event-driven maintenance or any maintenance requirements that exceed expected norms.

Equipment logs and manuals will be maintained for reference and use by responsible staff.

Maintenance diaries and logs shall be maintained and accessible for review by other parties.

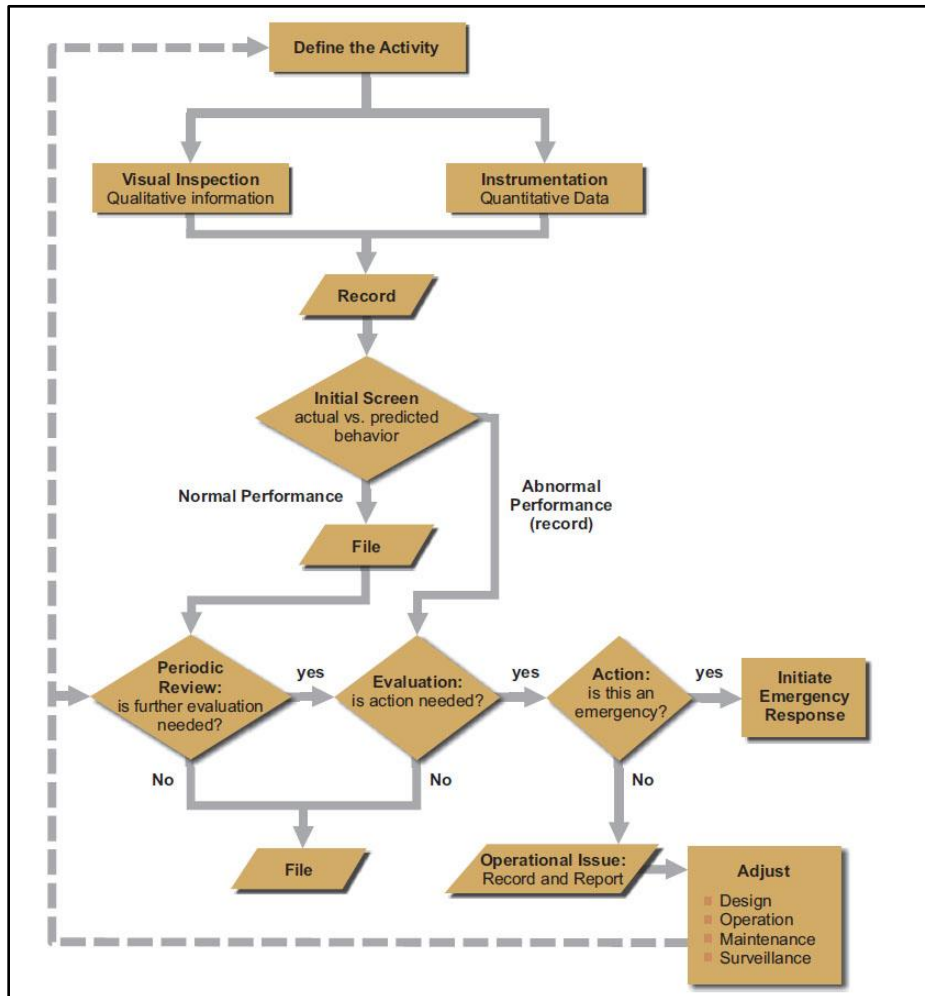
## **5.0 DAM SAFETY AND SURVEILLANCE**

The RRM tailings and water management surveillance activities involve inspection and monitoring of the operation, structural integrity and safety of a facility. Regular review of surveillance information can provide an early indication of performance trends that, although within specifications, warrant further evaluation or action. The objectives of our surveillance program are as follows:

- Monitoring the operation, safety and environmental performance of tailings and water management facilities;
- Promptly identifying and evaluating deviations from expected behavior that affect operational safety, structural integrity and environmental performance of the facility; and
- Reporting significant observations for response.

The flow chart for surveillance is shown in Figure 7-1. Surveillance is undertaken in two primary methods – visual inspection and reading of instruments. Results of these qualitative and quantitative observations are compared to the expected performance of the TMA and water management facilities. If observations are within the expected range or performance, the results of the surveillance are simply recorded. If observations are outside the expected range, further evaluation is completed to determine if remedial action is necessary. If necessary, this action is taken and may range from a minor adjustment to operational procedures to initiation of emergency response, depending on the severity and nature of the deviation from expected performance.

**Figure 5-1; Surveillance Flow Chart**



### 5.1 Surveillance and Inspections by Mine, Mill and Environment Operations Staff

The purpose of the surveillance program is to identify and classify problems and/or unsafe conditions that are visually evident. Visual inspections are an integral part of proper maintenance and performance of monitoring programs for the TMA and water management facilities. Failure to correct identified maintenance and repair items, or potential adverse behaviour, could result in unsafe conditions or lead to a failure of operating systems or cause an adverse environmental effect.

The surveillance program will consist of making regular observations relating to:

- The conditions and performance of the dams including indications of cracking, bulging, depressions, sinkholes, vegetation, surface erosion and seepage;
- Water levels and pump intake zones;
- Function of ancillary hydraulic structures (diversions, spillways, pipelines etc.);
- Discharge pipeline operations and tailings beach development; and



- Total facility performance.

During inspections, observations will be made at the upstream slope, crest and downstream slope with respect to signs of erosion, scouring, cracking, settlement, deformation, and any instability and abnormality. Seepage rates will be visually estimated and recorded on the inspection forms. Changes in the seepage rate or clarity (i.e., turbidity) require immediate reporting to the Engineer-of-Record.

### **5.1.1 Daily Inspections**

During first filling of all dams except the TMA dams Surveillance records will be maintained in logs at site and submitted to the EOR for review daily and on a monthly basis thereafter, or more frequently as warranted. Any abnormal behaviour including slope slumping, erosion of crest settlement will be reported immediately to the Engineer-of-Record.

Routine daily visual inspections of critical dams (TMA, WMP and MRP), spillways, pipelines, pipeline containment and pumping infrastructure will be carried out on an on-going basis to confirm normal operations and identify unusual or anomalous conditions such as pipeline leaks, pump intake blockages, etc. All active pipelines will be inspected twice per 12 h shift, consistent with EA conditions.

Daily inspection sheets and provided in Appendix F.

### **5.1.2 Weekly Inspections**

Physical inspections of the TMA, process water, water treatment and diversion dams will be conducted on a weekly basis. The weekly inspections will include those discussed in Section 7.1.1 and the following tasks:

- Photographic record of key features;
- Physical inspection of dams, dykes, diversion, ditches and spillways:
  - Indicating and reporting any seepage and erosion.
- Pond levels and freeboard:
  - Additional monitoring maybe required during spring freshet of the dams.

Weekly inspection sheets and SOPs are provided in Appendix F. All weekly inspections will be documented in a report and will be compiled as part of the annual DSI (Section 7.4).

### **5.1.3 Other Inspections**

#### **5.1.3.1 Water Treatment**

The water treatment facilities, WDP, CW and sediment ponds 1 and 2 will be inspected consistent with LRIA approvals (pending) and the MECP ECA approval. This section will be updated in future revisions, to describe surveillance requirements in addition to those outlined above which may include;

- Discharge pipeline and mixing structure;
- Up to thrice weekly water quality sampling from discharge points; and
- Inspections to confirm the absence of oil/sheen.

## 5.2 Inspection Required After an Unusual Event

Several potential failure modes exist for the various tailings and water management and water diversion storage facilities. These potential failure modes, along with likely triggers, observable visual and instrumentation indicators of the failure mode are presented in Table 9-1. Special inspections will be carried out immediately if any of the following events occur:

- Events such as an earthquake, large rainfall (greater than 1:2 year rainfall (51mm)) or large snowfall/snowpack;
- Operating events such as rupture of a pipeline, particularly if on the slope or crest of the dam, sudden loss of pond water, sudden rapid rise of pond water;
- Observations such as cracks, excessive settlements, sinkholes, large slope or foundation deformations, increased seepage, turbidity of seepage water; and
- Instrument readings that deviate from historical trends, or are within “alert” action levels (e.g., trigger levels).

Special inspections after unusual events are necessary as summarized in Tables 7-1 to evaluate whether there has been any damage requiring correction, any safety measures or special operating procedures that need to be implemented, or if there is a need to initiate emergency procedures as described in Section 9.0.

**Table 5-1; Maintenance Requirements following an Unusual Event**

Unusual Event	Post – Event Inspection/Surveillance
Earthquakes	Carry out a detailed walkover of all dam structures, including crests, downstream and upstream (visible) slopes and dam toes, and all spillways, looking for signs of cracks, bulging, settlement and/or other deformations. Look for and note any changes in seepage, particularly with respect to the rate of seepage flows at dam slopes and seepage clarity. Read all piezometers. Inspect downstream toes of dams for sand boils and dam slopes for sinkholes. Inspect ponds upstream of the dams looking for ‘whirlpools’. Inspect all pump stations and pipelines. Discuss findings with the Dam Safety Inspector.
Rapid snowmelt and/or heavy rainstorms exceeding a 1:2 year rainfall (51 mm)	Inspect the (visible) slopes and the crests of all the tailings dams looking for areas of concentrated runoff and erosion. Make note of saturated ground/soft ground conditions at dam slopes and toes. Examine dam slopes for indications of localized slumping/instability. Inspect all pump stations and pipelines. Check the water levels in all ponds/reservoirs against the critical levels, and keep checking these levels until the pond/reservoir inflows subside. Discuss findings with the Dam Safety Inspector. Check piezometric levels at dam sites if instructed to do so.

Unusual Event	Post – Event Inspection/Surveillance
Unusually high winds (exceeding 60 kph i.e., 75 % of maximum likely used in design)	Check the condition of erosion protection on the upstream slopes of the dams.
Extreme snow pack (170cm cumulative snowfall) (i.e., 120% or greater than normal snowfall at Barwick)	Check the water levels in all ponds/reservoirs against the critical levels, and keep checking these levels until the spring freshet is over. Evaluate the situation in terms of possible snowmelt scenarios. Make predictions as to the expected storage capacity available in ponds/reservoirs. If deemed necessary, mobilize pumping and mobile treatment equipment to site.
Significant, relatively rapid erosion (any cause) of dam slope of 'sudden' seepage break at dam slope or downstream of dam in form of continuous seepage or boils	Inspect clarity of seepage, rate of seepage and amount of material sloughed. Notify tailings coordinator – site engineering and EOR. Consider initiating Emergency Response Plan
Pond level close to, or approaching a critical level	Notify Manager. Consider initiating Emergency Response Plan
Significant change in an instrumentation reading – see table below for definition of significant change	Check the historical readings paying special attention to seasonal changes and check the measurement again. Carry out visual inspection of all areas in the vicinity of the instrument of interest. Contact the Engineer of Record.

### 5.3 Dam Instrumentation and Monitoring

The instrumentation data is reviewed regularly to identify anomalous readings that could indicate a change in the conditions of the tailings and water management facilities. Dam instrumentation lists are provided in section 4.6. Instrumentation reading and reporting frequencies are outlined in Table 7.2. Responsible parties' record notes and takes pictures of any potential anomalies to provide further information to the EOR. Instrument trigger and alert levels are provided in Table 7.3. Additional details on instrument reading frequencies can be found in the *Geotechnical Monitoring Plan* (Amec Foster Wheeler, 2016b).

#### Piezometers:

- Vibrating Wire Piezometers shall have a reading frequency every hour and recorded by a data logger, with data collected daily during construction. Post-construction after the readings have stabilized, the reading frequency will be reduced to every 12 hours, as defined in the table below;
- Standpipe piezometers shall be measured weekly during construction and monthly following construction;
- The following are considered anomalous:
  - Sudden increases or decreases that do not correlate with seasonal variations (e.g., groundwater recharge during snowmelt affecting foundation piezometers);

- Trend of piezometric increase that approaches or exceeds the rate of rise of the tailings pond; and
- Pattern of sudden and large increases followed by rapid declines.

**Inclinometers:**

- Inclinometers shall be monitored semi-weekly during construction and weekly following construction;
- Anomalous data includes:
  - Sudden increases in cumulative displacement/rate of movement of the inclinometers;
  - Zones of concentrated or discrete displacement; and
  - Blockages of the inclinometer casing.

**Settlement Plates and Survey Pins/Monuments:**

- Settlement Plates and Survey Pins/Monuments shall have a reading frequency of semi-weekly during construction and weekly following construction;
- Anomalous data includes:
  - Sudden displacements of the settlement monuments (x, y, z directions); and
  - Accelerating displacement trends (over two or more readings).

If anomalous readings are observed, the following actions should be taken:

- Check data, reductions and calculations for accuracy and correctness;
- If no errors are found in the calculations, notify the EOR, Geotechnical Engineer and Environmental Manager that an anomalous reading has been observed and that further assessment is going to be conducted;
- Check readout equipment to verify that it is functioning correctly; verify calibration;
- Re-read all instrumentation of the type for which the anomalous reading was observed, in order to check the reading and reading in adjacent instruments;
- If it is observed that an instrument or piece of readout equipment has stopped functioning, notify the Mill Manager and/or Superintendent, and the EOR immediately. If considered critical, a replacement instrument should be installed;
- If the anomalous reading is confirmed, notify the Superintendent and EOR immediately; and
- A detailed review of the effects of the reading should be carried out and the monitoring frequency of the instruments in the area of the anomaly increased to assess the progression of the anomaly. Design or remedial actions should be implemented if determined necessary.

All results are downloaded and provided to the EOR. Any anomalies are noted and a request for an additional reading may occur. The EOR will review the data in quarterly monitoring reports, and make any recommendations, such as increased reading frequencies, pertaining to

anomalous readings. The EOR, will also assess the trigger and alert levels and update them as necessary, once per year, as part of the DSI.

**Table 5-2; Dam Instrumentation Surveillance Requirements**

Type	Frequency
<i>Routine Inspection:</i>	
Dam	Weekly
Diversions	Weekly
Ditches	Weekly
Seepage collection system	Weekly
Spillways	Weekly
Pipelines	Once per 12 h shift
<i>Tailings Pond Monitoring:</i>	
Pump intake	Weekly
Staff gauges	Weekly (initially every ~12h) in Cell 1 borrow
Inflows, Outflows, Condition	Monthly
<i>Dam Instrumentation:</i>	
<i>TMA, WMP and MRP Comprehensive (and water diversions during initial filling)</i>	<ul style="list-style-type: none"> <li>Daily during construction and initial filling</li> <li>Weekly, during initial operations depending on trend</li> <li>Monthly during routine operation</li> </ul>
<i>Annual Dam Inspection</i>	Annually, with no snow cover
<i>Event Driven Inspection</i>	Following unusual events (defined in table 7.1)
<i>Comprehensive Review (DSR):</i>	
Low and Moderate HPC dams	Every 10 years and prior to decommissioning
Very High HPC dams	Every 5 years and prior to decommissioning

Notes:

1. Dam Hazard Potential Classification (HPC) requires review when changes are made or downstream conditions change.
2. Monthly facility inspections should be carried out by the same staff or small group of staff such that subtle changes in the conditions can be detected.

**Table 5-3; Instrument Trigger and Alert Levels**

Instrument	Parameter	Trigger Level	Alert Level	Remarks
VWP/STP	Pore Pressure Ratio	$r_u = 0.4$	$r_u = 0.5$	Pore pressure data to be evaluated with corresponding fill elevation, and monitored movements at SPs and INs
Survey Pin	Lateral Movement Rate	Uniform (but less than max 75 mm magnitude)	Accelerating	To be evaluated with IN data to define zones of movement
	Lateral Movement Rate	Uniform	Accelerating	Deformation rates will be associated with rate of construction and post construction movements

Slope Inclinometer	Share Strain Magnitude	2%	5%	If specific plane(s) of shearing is observed within the foundation, the construction shall be limited, progressed with caution or ceased depending on the observed phenomena
Notes: 1. $r_u$ of 0.4 corresponds to a piezometric head at 80% of the dam height. $r_u$ 0.5 is at piezometric head at the crest of the dam. 2. $r_u$ of 0.5 is a design criteria to meet dam stability requirements. Source; Geotechnical Monitoring Plan (AMECFW, August 2016)				

## 5.4 Dam Safety Inspections (DSIs) and Dam Safety Reviews (DSRs)

Consistent with MECP ECA approvals, with the regulatory exception of the Clark and West Creek Diversions, engineering inspections will be conducted following best management practices as per the Canadian Dam Association's (CDA) Dam Safety Guidelines (2007, revised 2013, as amended from time to time), and the 2014 CDA Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams (as amended from time to time).

### 5.4.1 Dam Safety Inspections

Annual inspections are intended to be part of a more thorough review of the condition of the facility, and are carried out by the EOR. The inspections will include the following key items:

- Visual inspection of the facility by the engineer, including taking appropriate photographs of the observed conditions;
- Review of routine inspection records prepared by operating personnel in the past year;
- Review whether or not recommendations from previous year's inspection(s) have been addressed, and any incidents or actions arising from those previous recommendations;
- Review of instrumentation and monitoring data;
- Review of tailings deposition and water management operations of the facility including reconciliation of the annual water and mass balance. Review of pond levels (and depth) and freeboard, and reports of any incidents (and remedial measures) that may have occurred;
- An evaluation and interpretation of the structural performance of the dam and related components, and identify any potential safety deficiencies or recommended items that need to be addressed in the coming year;
- Review construction records, QA/QC data and as-built information on dam construction and beaching; and
- Evaluation of the OMS Manual to assess the need for updating.

The results of the inspection and review will be documented in a report.

### 5.4.2 Dam Safety Review

The Canadian Dam Association (CDA) Dam Safety Guidelines (CDA, 2007) recommend a comprehensive dam safety review be carried out every 5 years during operations, prior to decommissioning and following closure, by a qualified 3<sup>rd</sup> party consultant.

The comprehensive review provides independent verification of:

- Safety and environmental performance of the facility;
- Adequacy of the surveillance program;
- Adequacy of delivery of OMS Manual requirements;
- Design basis with respect to current standards and possible failure modes; and
- Compliance with new engineering standards (including analysis to confirm if necessary).

## **5.5 Documentation**

Documentation of surveillance and monitoring activities shall be maintained by the Mill Manger, or as designated, as described in the preceding sections and will include recording of:

- Routine visual observations (departures from normal conditions);
- Photographs;
- Instrumentation monitoring and testing;
- Analyses and evaluations; and
- Reviews.

Documentation will include, as a minimum, the following:

- Weekly routine inspection log;
- Monthly tailings facility and process water pond monitoring report;
- Quarterly instrumentation reports;
- Annual Dam Safety Inspection reports; and
- Comprehensive Dam Safety Review report every 5 years.

Documentation will include a hard copy (paper) and electronic filing system for inspection reports, photographic and video records, incident reports, instrumentation readings, instrumentation plots, annual inspections and third-party reviews, so that they can be quickly retrieved for review and in case of an emergency.

## **5.6 Reporting**

The Mill Manager, or designated responsible party, and Geotechnical Engineer will review collected data records from facility monitoring and assess the need for maintenance activities or response. Corrective actions will be identified and tracked to closure. The Environmental Manager is responsible for overseeing sample and data collection and analysis. Reporting will meet MECP requirements and the annual DSI report will also be submitted to the MRNF. Reporting includes;



- As built reports of the dams, excluding the Clark and West Creek diversions, will be submitted to MECP within 90 days of completion;
- An annual report based on the DSI including ECA approval requirements;
- Monthly water quality monitoring report; and
- Annual report including any operating problems and corrective actions, a summary of calibration and maintenance works, use of contingency plans, surface water and groundwater monitoring reports including water balance, ML/ARD updates, discharge volumes and quality.

Additional reporting requirements may be developed as the RRM progresses.

## **6.0 CLOSURE PLAN**

This section summarizes the objectives of the Closure Plan. The *Rainy River Project – Closure Plan* (Amec Foster Wheeler, 2015c) provides the closure plan and includes temporary closure options for short and medium-term shut-down of site facilities.

### **6.1 Embankments**

Closure of the embankments will typically involve, but is not limited to reaching of embankments to prevent ponding of water and revegetating slopes to reclaim the area. Some embankment structures will still have a role during the closure phase and these will not be breached. The following structures will continue to be operated during the closure phase:

- MRP will collect runoff and seepage from EMRS, which will be directed to the Open Pit to help flooding;
- Sediment Ponds #1 and #2 will be maintained until site is recognized as a closed mine and monitoring associated with the Metal Mining Effluent Regulation is no longer required

Freshwater diversion and constructed wetland structures are designed to operate passively and will remain in place at closure.

### **6.2 Monitoring**

Monitoring requirements are described in the *Rainy River Project – Closure Plan* (Amec Foster Wheeler, 2017c).

## **7.0 CONTINGENCIES**

The operations are sensitive to water balance and water quality in discharges. The following are contingencies based on water management and functioning of the diversions.

### **7.1 Water Treatment**

Two contingency plans have been developed as part of MECP approvals for water treatment;

- Pinewood River Quality Contingency Plan, Version 1 August 2016; and
- Groundwater and Surface Water Contingency Plan, Version 2 October 2015.

Contingency options are to limit discharges, acceleration of TMA dam raises, add water quality treatment, additional monitoring, provision of water to affect areas and increased mixing ratios/improved mixing. The trigger for implementation of contingency in surface water is if



protection of aquatic life criteria are not achieved 90 % of the time. The trigger for contingencies in groundwater is if water quality parameters exceed background metals concentrations in groundwater at the mining lease boundary or groundwater wells outside of the zone of influence are affected.

## **8.0 REFERENCES**

AMEC, 2013. Rainy River Project – Final Environmental Assessment Report. Report TC111504 prepared by AMEC Environment & Infrastructure, submitted to New Gold Inc., October 2013.

AMEC, 2014a. Rainy River Project – Tailings Deposition Plan. Technical memorandum TC133921.40 prepared by AMEC Environment & Infrastructure, in progress, October 2015 [RRP Doc. No. 3098004-004000-A1-ETR-0005-AB].

AMEC, 2014b. Rainy River Project – Fish Habitat Offset Strategy. Report TC111504 prepared by AMEC Environment & Infrastructure, submitted to New Gold Inc., July 2014.

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**RAINY RIVER PROJECT**

**PART VIII - PINWOOD AND CULVERTS - OPERATION,  
MAINTENANCE AND SURVEILLANCE MANUAL WATER  
MANAGEMENT STRUCTURES**

**New Gold Inc.  
Rainy River Project  
5967 Highway 11/71, P.O. Box 5  
Emo, Ontario  
P0W 1E0**

**January 2019**

**Version 2019-1**

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## 1.0 Regulatory Requirements

This document is consistent with the New Gold Tailings, Heap Leach and Waste Rock Facilities Management Policy and was prepared pursuant to the MAC guidelines for *Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities* (MAC, 2011).

The following is a list of permits that this section of the OMS complies with:

- LRIA-FF-2015-08: Culvert Crossing C-15
- LRIA-FF-2016-02A: Culvert Crossing CPL5
- LRIA-FF-2015-01: Culvert C2, C6, C8
- LRIA-FF-2015-07: Pinewood River Intake/Discharge Structure

## 2.0 FACILITY DESCRIPTIONS

The components of the RRM relative to the scope of the OMS include tailings and process water management, freshwater diversions and water treatment. The site layout is shown on Figure 3-1. While there is interconnectivity between the systems, for the purposes of the OMS they are categorised in these groupings and reference made between them where required e.g., water management pond, water discharge pond and constructed wetland.

### 2.1.1.1 Freshwater Taking from the Pinewood

The Pinewood Water Intake/Discharge Structure is located along the Pinewood River on the outside of a meander bend. The pumphouse is used for the initial filling of the WMP, after which it becomes a discharge structure used to discharge effluent from the WMP.

The Pinewood Water Intake/Discharge has been constructed to support the requirements of the *Water Management Plan for Operations* (Amec Foster Wheeler, 2015a). These features are illustrated in the following drawings:

Drawing Title	New Gold Drawing Number
Pinewood Water Intake - Structural - General Arrangement	3098004-006200-A1-D20-0003
Pinewood Water Intake/Discharge - Mechanical - General Arrangement	3098004-006200-A1-D20-0004

The Pinewood Pump House structural and mechanical details are illustrated in the following General Arrangement Drawings:

Drawing Title	New Gold Drawing Number
Pinewood Water Intake/Discharge - Mechanical - Details	3098004-006200-A1-D30-0001

Pinewood Water Intake - Mechanical - Specifications	3098004-006200-A1-D30-0002
Pinewood Water Intake - Structural - Details	3098004-006200-A1-D70-0004

## **2.2 Instrumentation**

### **2.2.1 Dam Safety**

Instrumentation has been and will be installed during construction. Instrumentation will include instrumented dam sections that will monitor dam foundation and clay fill pore pressures to infer consolidation characteristics, as well as monitor any movement of dam fill due to deformation. Each dam instrumentation section will include: standpipe(s), a settlement plate, slope inclinometer(s), survey pins/monuments, and a terminal arrangement with data logger and vibrating wire piezometers.

Following construction, the instrumentation will remain for dam monitoring purposes. A detailed report containing the proposed locations, usage, and analysis of all instrumentation is provided in the *Geotechnical Monitoring Plan* (Amec Foster Wheeler, 2016b). The design details for the installed or proposed dam instrumentation is summarized in Table 4-14. The design information provided in Table 4-14 will be confirmed and updated as may be required following development of the As-Built drawings.

**Table 2-1; Dam Instrumentation Summary**

Facility	Section (Sta.)	Dam Instrumentation							Pond Level Gauge (type)
		Slope Stability		Foundation Consolidation		Phreatic Level and Seepage			
		Slope Indinometers (no.)	Survey Pins (no.)	Survey Monuments (no.)	Vibrating Wire Piezometers (no.)	Settlement Plates (no.)	Vibrating Wire Piezometers (no.)	Standpipe Piezometers (no.)	
TMA North	3+300	0		0	2	1	1	2	TBD
	Mass array				142				
TMA South	1+000				2				
	1+380				2	1	1	1	
	1+450	2		2	4	2	1	2	
	1+600	1			4	2	1	1	
	2+200	2		2	4	2	1	2	
	2+350	1			4	2	1	1	
	Mass array				176				
TMA West	0+300			0	1		1		
	0+460	2		0	5		2	1	
	1+450	0	35	0	0	1		0	
	1+500	2		0	4	0	3	0	
	Mass array				82				
TMA Start-up Cell	0+400				2				
	1+000				2				
	Mass array				88				
WMP Dam 1			16					- Staff gauge	
WMP Dam 2	0+950	1	34	0	2	0	2	2	- Survey stakes
WMP Dam 3	0+300	0		0	1	0	1	2	
	0+500	1	17	0	2	1	4	1	
Mine Rock Pond	0+220	1		2	2	1	1	4	- Staff gauge
Clark Creek									- Staff gauge
Teeple Road									- Staff gauge
Stockpile Pond	0+125	1	8	0	1	0	1	2	- Staff gauge
West Creek	0+291				2			2	
	0+320	2	2						- Staff gauge
	0+340	2	2		2	1	1		
Water Discharge Pond									TBD
Constructed Wetlands									
- Pond A									TBD
- Pond B									TBD
- Pond C									TBD
- Pond D									TBD
- Pond E									TBD
Sediment Pond #1									TBD
Sediment Pond #2									TBD
Temporary Sediment Pond									TBD

**Notes:**

- 1) Survey pins installed at 100 m centres along 3-5 lengthwise lines (crest, toes, etc.) Quantities are total for each dam
- 2) TMA Dams feature mass array of VWP instruments installed in grids within the dam foundation. Installation of these instruments is currently on-going

In addition to the instrumentation described above, the TMA dams are equipped with an additional suite of vibrating wire piezometers (VWPs) to provide enhanced monitoring resolution during construction. A total of 524 VWPs were installed in the TMA dam foundations, arranged in a grid pattern, and managed with a remote wireless data acquisition and management system.

Instrumentation associated with the management of the dams is being managed through a software system that includes integration with data loggers and data storage and is configured such that alarms for alert levels are defined and available. The software routinely generates reports and if trigger levels are exceeded sends out alarm notifications.

**2.2.2 Other instrumentation**

Additional instrumentation to support the OMS manual and management of water includes;

- Densometer on the tailings pipeline;
- Flow meters on the water management pipelines including from the Pinewood River, tailings reclaim lines, MPR line and freshwater line from the WMP and
- Pressure transducers in the WMP, Clark/Teeple Ponds.

This instrumentation provides continuous recording, which is collected during routine inspections and included.

### **2.3 Regulatory Requirements**

Regulatory requirements, permits and authorizations are summarized in section 1.1. Key approvals include the Federal and Provincial Environmental Assessment conditions and commitments and permits including those issued pursuant to the LRIA and EPA. Additional legislation to be considered in implementing the OMS manual includes the MMER and various Ontario regulations including waste management.

No direct discharges are intended from any of the structures described in this section except the WMP which is described in sections 4 and 5. Seepage will be collected and pumped back from the WMP and TMA cells. Subsequent to this revision and LRIA approvals, additional details for the WDP, CW and sediment ponds discharges will be developed.

### **3.0 OPERATIONS**

The overall operational objectives of the TMA and associated dams and facilities are to dispose and store the tailings and to manage all site water in a safe, economical and environmentally responsible manner. This section defines operating standards in accordance with design criteria and regulatory requirements specified in section 4.

#### **3.1.1.1 Pinewood River Pump House**

The Pinewood River pump house shall not exceed the maximum water intake of 20,000 litres/minute as per Permit to Take Water (PTTW) number 8776-9W2QN3 which expires November 30, 2018. Additional seasonal restrictions to the water taking as stipulated in PTTW number 8776-9W2QN3 include:

- March 1 through July 31: the water taking to an amount not more than 20% of the daily flow rate (as measured at the water intake location, and including allowance for site watershed capture) and that the calculated flow rate after pumping in the Pinewood River remains above 10,000 m<sup>3</sup>/day;
- August 1 through November 30: the water taking is restricted to an amount not more than 15% of the daily flow rate (as measured at the water intake location, and including allowance for site watershed capture) and that the calculated flow rate after pumping in the Pinewood River remains above 5,000 m<sup>3</sup>/day; and
- December 1 through February 28: no water taking in the Pinewood River shall occur.

This approval was amended till August 31, 2017 to allow for additional water takings;

- The total combined water taking (including all PTTW sources) from the Pinewood River can increase to not more than 30 % of the daily flow where 43,200 m<sup>3</sup>/day is the minimum flow threshold for this level of water taking
- The total combined water taking (including all PTTW sources) from the Pinewood River can increase to not more than 20 % of the daily flow where 10,000 m<sup>3</sup>/day is the minimum flow threshold for this level of water taking

The water taking for the day (24h period) is calculated based on a 24h period of flow in the previous 72h as measured consistent with the Pinewood hydrometric monitoring plan. This uses either the New Gold hydrometric station or the WSC hydrometric station at Hwy 617, consistent with MECP approved plans. Monthly and annual reporting of takings is provided to MECP.

### **3.2 Progressive Reclamation and Closure**

Some progressive reclamation with respect to the TMA is proposed as part of mine operations. By the end of the operations phase a low permeability overburden cover of approximately 150 m in width will be placed on the upstream side of the TMA dam. The overburden cover will cover approximately two thirds of the ultimate perimeter, with the remaining approximately one third of the length to be reclaimed at closure. This cover is intended to prevent the tailings permanent water cover from coming into contact with the TMA dams, and will also serve a secondary function of limiting oxygen diffusion into the uppermost portion of the tailings underneath. The overburden cover will be seeded or hydroseeded with a native seed mix or equivalent, and will be armoured

with NPAG rock at the transition zone of the cover with the tailings to prevent suspension and oxidation of solids.

Closure of the RRM in respect to tailings, process water and freshwater management will include but is not limited to the following:

- Flooding of the TMA with a 2 m or deeper water cover;
- A perimeter zone of tailings beach will be maintained to keep the central pond away from the dams, this zone will be covered with a low permeability cover;
- NPAG rock will be placed at the TMA transition zone with the tailings to prevent erosion and suspension and oxidation of solids;
- Dam structures containing the TMA have been designed with adequate safety factors to provide overall long term safety and stability;
- The constructed wetland will be left in place as this system is designed to operate passively, and will have stabilized as a wetland complex during operations;
- At closure the MRP will collect runoff and seepage from the EMRS which will then be directed to the Open Pit to help flooding;

### **3.3 Safety and Security**

The site safety and security will be following the RRM Health and Safety Management System including but not limited to the following:

- The site will be gated with restricted access to authorized personnel only;
- The TMA will be fenced along portions of the old highway 600 and access will be restricted to authorized personnel only;
- No public access;
- Construction Management provided security measures; and
- Onsite health and safety policies for working around bodies of water, working alone or crossing ice.

### **3.4 Environmental Protection**

The Environmental Department has oversight over the EMS which contains tailings operations related environmental aspects including:

- Fugitive and point source dust emissions;
- Hydrocarbon Spills and Leaks;
- Pipeline Rupture and Leaks;
- Surface and ground water quantity and quality; and
- Wildlife management (including species at risk).

An environmental aspect register is a comprehensive inventory of tailings operations activities, environment aspects, assessment of risk and identification of controls. Tailings personnel have responsibility to implement and maintain the controls including monitoring and inspection. Refer



to the Environment Department for the environmental aspect register (in prep) and environmental related procedures.

As outlined in orientation training, it is every RRM employee's responsibility to report a suspected spill or uncontrolled release event to their supervisor. This includes suspicious flows of water out of the area, escaping tailings, etc. The sooner appropriate persons can begin to correct a situation, the less likely it is that severe impacts will follow.

Table 5-3 provides a summary of the MECP effluent discharge limits that must be met to discharge from the WMP.

**Table 3-1; MECP Effluent Discharge Limits from the WMP**

<b>Constructed Wetland Final Discharge and Water Management Pond Pipeline Discharge (to the Pinewood River) as stated in MECP ECA 5178-9TUPD9</b>		
<b>Effluent Parameter</b>	<b>Daily Maximum Concentration (mg/l)</b>	<b>Monthly Average (mg/l)</b>
Cadmium	-	0.0010
Cobalt	-	0.0044
CBOD5	-	25.0
E.coli	-	100/100ml geometric mean density
Total Suspended Solids	30	15
Total Phosphorus	-	0.10
Cyanide (total)	0.1	0.05
Cyanide (free)	0.02	0.01
Total Arsenic	0.034	0.017
Total Copper*	0.028	0.014
Total Nickel	0.094	0.047
Total Lead*	0.030	0.015
Total Zinc*	0.348	0.174
Un-ionized Ammonia	0.08	0.04
Acute Toxicity (Rainbow Trout and Daphnia Magna)	Non-acutely lethal (not greater than 50% mortality in undiluted effluent)	
pH of the effluent maintained between 6.0 to 9.5, inclusive, at all times		
<b>Notes:</b>		
<ol style="list-style-type: none"> <li>*Proposed effluent criteria for Total Copper, Total Lead, and Total Zinc are based on a hardness of 200 mg/L CaCO<sub>3</sub>. In the event that water quality sampling indicates that 75<sup>th</sup> percentile hardness concentrations are less than 200 mg/L CaCO<sub>3</sub>, the effluent limits may be changed by the District Manager in writing, consistent with achieving no impairment for receiving waters.</li> <li>Additional effluent limits for sediments 1&amp;2 are stated in MECP ECA 5178-9TUPD9</li> <li>The effluent discharge rate from the Constructed Wetland Final Discharge and the Water Management Pond Pipeline Discharge such that at all times the ratio of the combined flow rate of these effluents to the flow rate of the receiving surface water (Pinewood River) is less than or equal to 1:1 (i.e. the cumulative flow rate of the effluent must be less than or equal to the flow rate of the receiving surface water).</li> <li>Prior to commencing Operations Phase discharges (Constructed Wetland Final Discharge, Water Management Pond Pipeline Discharge, Sediment Pond #1, and Sediment Pond #2), the method for determining daily effluent to receiver flow mixing ratios shall be approved by the District Manager.</li> <li>For sampling frequencies and full parameter list refer to MECP ECA 5178-9TUPD9; sampling frequency varies from thrice weekly to quarterly depending on the parameter</li> </ol>		

### 3.5 Reporting Requirements

Reporting is sub-divided as routine, planned reports of defined frequency, and those that are non-routine i.e., event driven.

## **Routine**

- Submission of asbuilts within 3 months of construction for WMP, TMA, MRP and sediment ponds 1 and 2
- Monthly monitoring report including a summary of all monitoring data collective, all non routine calibration/maintenance procedures, tabulation and description of any bypass/upset conditions
- Annual reporting to MECP on March 31 for the previous year, a works performance report and a surface water monitoring report
- Quarterly electronic effluent monitoring reports to ECCC
- Annual electronic effluent monitoring report and environmental effects monitoring reports to ECCC by March 31

## **Non-routine**

- Report all spills as defined in the Environmental Protection Act immediately to spills action centre SAC, follow New Gold Incident Reporting Guidelines and follow up in writing to MECP within 10 days describing the cause and discovery of the spill or loss, clean-up and recovery measures taken, preventative measures to be taken and schedule of implementation
- Any observation of sheen/foam/settable solids within the works report immediately to (SAC) immediately and written reporting within 7 days
- Any exceedance of effluent limits report to SAC immediately, written confirmation to MECP within 7 days
- If acute toxicity tests fail, within 15 days report in writing to MECP with the cause and remedial actions proposed/implemented
- Notify ECCC immediate if MMER Sch 4 limits are exceeded, pH is outside 6-9.5 range or if the effluent is acutely lethal with a written report within 30 days

Records are retained consistent with CEAA condition 11 for a minimum of 25 years or until decommissioning ends, whichever is longer and kept locally. This exceeds the ECA permit requirement of 3 years. Records include place/date/time of sampling, dates and analysis performed, analytical techniques used, names of persons collected/analyzing sampling and results of analysis.

An Operations Report will be prepared by the Mill Manager or designate. The report will include metrics and information collected as part of normal operation. Examples of information contained in the Operations report include:

- Total monthly tailings deposition tonnage and slurry water volume;
- Total monthly reclaim volume;
- Pond level and freeboard;
- Updated water balance;

- Water quality results; and
- Intake / Discharge quantities.

Each of the regulatory approval requirements related to the construction, operation and eventual reclamation of the Site have specific compliance reporting requirements with defined deadlines or reporting periodicity. In general, the reporting includes:

- Operation, Maintenance and Surveillance Plan(s) for dams, water management (water quality) and air/noise emissions;
- Emergency Preparedness Plan(s);
- As-Built Drawings and related Construction Reports;
- Dam Safety Inspection and Review Reports
- Environmental Monitoring Plans; and
- Environmental Monitoring and Performance Reports.

The environmental approvals and permits received from the government that are maintained by the New Gold Environmental Department should be referred to for details of monitoring, inspection and reporting requirements.

In addition, the New Gold Environmental Department should be notified of any proposed major modification to RRM facilities, in order that they can liaise with the appropriate government ministries to determine if additional approvals or amendments to existing approvals are required.

#### **4.0 MAINTENANCE**

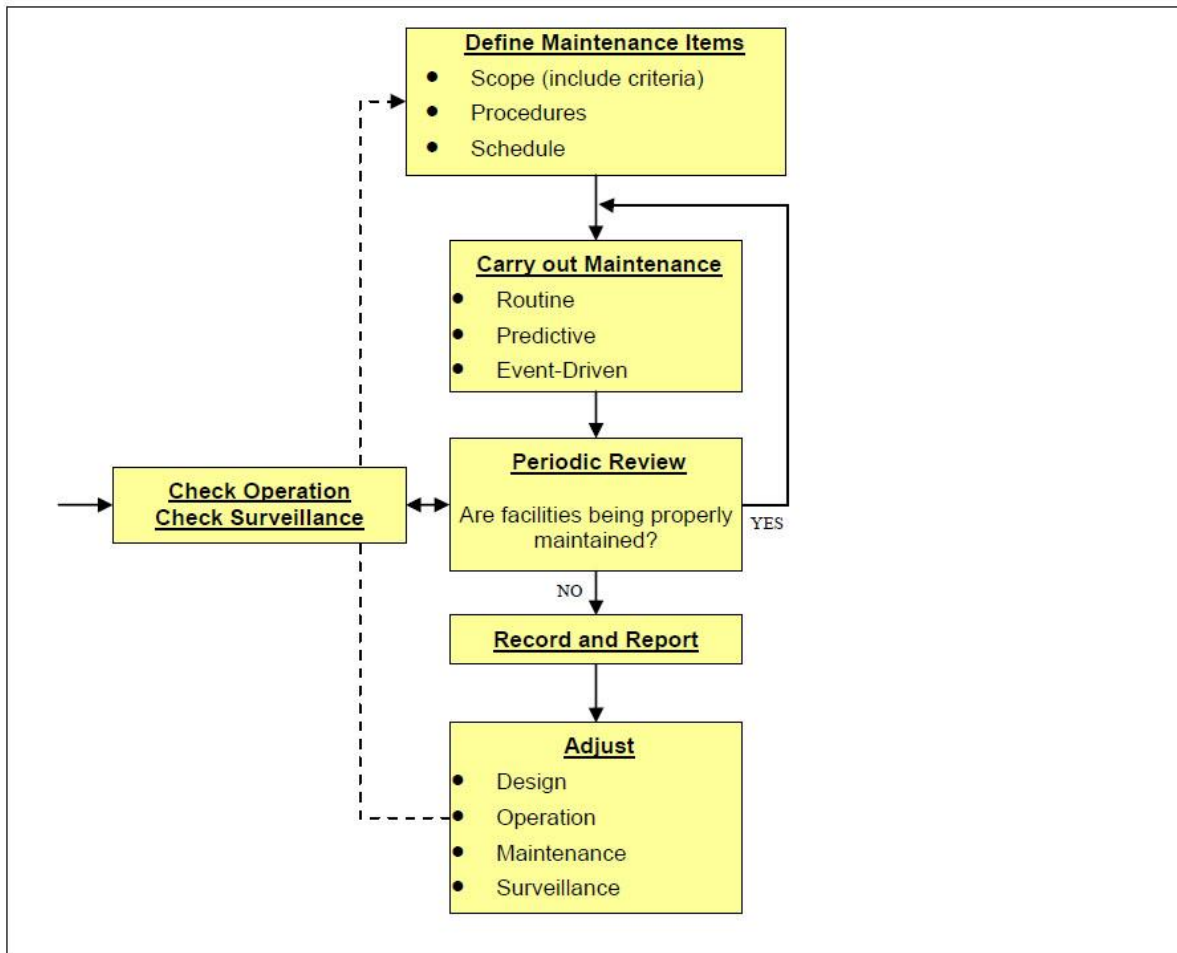
The following periodic maintenance is required:

1. Maintain the tailings and reclaim pumps and associated lines and containment;
2. Clear debris, snow and ice which may block flow through the decant facility or emergency spillways;
3. Maintain water management structures including spillways, ditches and diversions;
4. Maintain equipment, power and water lines, and instrumentation;
5. Repair any deficiencies as noted in the Dam Safety Inspections (DSI); and
6. Reconstruct the support for tailings discharge pipelines wherever washouts occur.

Maintenance records are retained by maintenance personnel performing the work in accordance with the procedures described in this document. Timing of maintenance actions for unusual conditions should be based on specific recommendations from surveillance findings. Scope and time frames for routine maintenance activities are determined and scheduled by the Maintenance Department and based on manufacturer's recommendations and best practices.

The maintenance flowchart is illustrated in Figure 6-1.

**Figure 4-1; Maintenance Flow Chart**



**4.1 Routine and Predictive Maintenance**

Routine and predictive maintenance includes removal of vegetation, beaver dams, ice blockage or sediment accumulation that would otherwise affect the performance of a structure when required.

**4.2 Maintenance and Emergency Preparedness**

A weekly table-top exercise will be conducted with the pump management team to ensure that crews are intimately familiar with the operational strategies for a broad range of operating and emergency scenarios. These table tops will be documented and New Gold management will ensure that any ongoing lessons learned from day-to-day operation are captured including the updating of any corresponding plans, maps, flowsheets or procedures.

The maintenance of pumps is the responsibility of New Gold and maintenance records are required to be maintained. Each installation requires to be equipped with spill pan, spill kits

and the necessary signage. Changes to pumping configurations, ditching, piping or operating parameters need to be approved by the New Gold Mill Manager, the New Gold Maintenance Manager and the New Gold Environmental Manager, during normal working hours. This is particularly the case if splash pads need to be altered in any way. In an emergency call out (after hours), the Managers or their alternate, will provide direction in consultation with the New Gold Environmental Department.

During depositing of tailings the above-mentioned crews are required to complete their inspections daily. Reporting is to be escalated to hourly observations if a rainfall event is escalating and the Cell 2 level is within 200 mm of the intermediate fill elevation of 363.2 masl. The general manager can then decide whether to provide additional surveillance resources in the case where additional duties including maintenance and operation of the Cell 2 dewatering pumps is required to be performed by the allocated crews.

A summary report titled " TMA Cell 2 Water Levels " is circulated each morning at 9 a.m. to summarize the measured water and tailings levels as of 4 p.m. the day prior. This report is prepared and circulated by the mill superintendent or his alternate. The purpose of the report is to highlight trend data for Cell 2.

Fundamental to the successful operation of the ponds and pumping strategy is a timely reaction to rainfall events, and ensuring that pumps come 'on line' or are taken 'off line' as design trigger levels are reached.

#### **4.2.1 Dams**

The following are examples of specific maintenance activities:

- Regularly check diversion ditches, spillways and culverts for accumulation of debris or sediment, or any other form of blockage including ice, and remove if required;
- Visually inspect diversions, spillways, seepage collection sumps, dams and all ditches for cracking, bulging, slumping, and any other indications of slope movement (note, any indications of slope movement shall be reported to a qualified geotechnical engineer);
- Re-grade the dam crest, as required, to prevent local ponding and direct surface runoff towards the pond;
- Repair erosion gullies, local slumps or slides in the dam face, diversion ditches or spillway channels; and
- Regularly check diversion ditches for accumulation of debris or sediment, or any other forms of blockage, and remove if required.
- If annual survey determines necessary, correct dam crest, overflow spill way and diversion channel invert irregularities to avoid concentrated runoff.

#### **4.2.2 Ditches and spillways**

Ditch maintenance includes replacement or enhancement of erosion protection to prevent sediment generation or sloughing of slopes, as required.

#### **4.2.3 Diversions**

There are approximately 10 km of diversions associated with the Clark and West Creek diversion. Maintenance activities required include;

- Repair erosion and bank stability particularly in areas of concentrated flow e.g., culverts;
- Remove debris, and where required and approved beaver dams, that aren't part of natural progression of channel development
- Repair/modify fish habitat features if monitoring determines they are not meeting the success criteria per Fisheries Act Authorization 15-HCAA-00039, including dam crest/slope

Specifically, for the Clark Creek diversion, as per the as built report, the following maintenance will be conducted;

- Repair riffles in the Teeple Road Diversion, directly downstream of the inlet in fall 2017.

#### **4.2.4 Geotechnical and Water Monitoring Instrumentation**

Instrumentation is calibrated by the manufacturer prior to shipment. Calibration certificates will be maintained by maintenance department. Following instrument installation, initial reading procedures will be followed. Subsequent calibration will follow manufacturer's recommendations.

Malfunctioning or damaged instruments may require repair or replacement per manufacturer guidelines or approved procedure. In the event of replacement of dam instrumentation, several overlapping readings of the old and new instrument are required to ensure continuity of the data records.

#### **4.2.5 Pumping Systems and Pipelines**

Maintenance of the tailing delivery, water recirculation systems and seepage pumps will include:

- Perform regular performance tests of the Pinewood Pumphouse pumps and inspections of pump fish screens to remove any debris;
- Perform regular performance tests on seepage pond pumps
- Perform annual calibration and maintenance as required on flow meters;
- Perform regular non-destructive testing appropriate for components of the tailings delivery system, including for example, periodic measurement of pipeline thickness to identify areas of wear and to schedule pipeline replacement if necessary and repair liners as required;
- Replace pipe work, bends and fitting components as required;
- Remove accumulated debris from valves, reducers and off takes;
- Carry out maintenance as recommended by fitting and valve suppliers;
- Regularly inspect major wear components;
- Maintain emergency dump ponds in a dewatered/empty state; and
- Maintain and replace system instrumentation as required.

#### **4.2.6 Mobile Equipment**

Mobile equipment is maintained on the basis of a planned reliability program and as otherwise required. Equipment in question includes:

- Dozers;
- Excavators;
- Water truck;
- Pickup trucks;
- Mobile crane;
- Flatbed and picker truck; and
- Replacement of mobile equipment as required.

#### **4.3 Event-Driven Maintenance**

In the event of unusual conditions or incidents that require immediate maintenance actions but are not considered an emergency, repairs and replacement of facility components are made as required and activities are documented. RRM staff will provide a means to assess event driven maintenance needs through response action planning. Response planning is based on risk prioritization, maintenance crew mobilization or “call out” procedures, required repairs and replacement material availability. Event driven maintenance actions will follow applicable safety and performance procedures. Normal documentation and maintenance records will be maintained as a result of any event driven maintenance actions. Unusual conditions that require maintenance are also communicated to maintenance staff as they occur.

##### **4.3.1 Pipeline Leaks or Breaks**

In the event of a pipeline leak or break the system in question is de-energized and repaired as follows:

- Inspect entire pipeline;
- Repair or replace affected components;
- Perform opportune and scheduled maintenance;
- Repair any collateral damage caused by a leak or break;
- Collect any released tailings and place in the tailings impoundment;
- Reclaim any disturbed areas; and
- Follow any spill reporting that may be required pending type of spill and following documentation procedures.

##### **4.3.2 Earthquake Occurrence**

Following an earthquake, the following are undertaken:

- Inspect dam and beach areas for sign of distress due to deformation;
- Inspect dam for signs of liquefaction (e.g., local sand boils, etc.);
- Measure freeboard for compliance with design requirements;



- Inspect toe area of dam for signs of deformation or piping of fines;
- Inspect diversions, ditches and spillways for sign of slumping or changes in geometry;
- Inspect seepage collection areas; and
- Collect instrumentation data and submit to EOR for analysis.

#### **4.3.3 Flood Event**

Following extreme storms (as defined in section 7) the following are undertaken:

- Measure freeboard for compliance with design requirements;
- Inspect dam, diversions, ditches, spillways and diversions for signs of excessive erosion and repair if required;
- Inspect seepage return system for adequacy; and
- Implement appropriate response based on observations/measurements as defined in this manual.

#### **4.4 Reporting Requirements**

Maintenance information will be communicated internally through formal and informal meetings, interaction between various levels of the organization (department and/or crew meetings), through information posted at the site and through this OMS Manual.

Communications with applicable contractors involved in tailings management will be conducted daily and weekly during tailings activity meetings, as appropriate. All employees and contractors are encouraged to communicate openly with site management about operational conditions requiring maintenance and reporting any significant observations such as event-driven maintenance or any maintenance requirements that exceed expected norms.

Equipment logs and manuals will be maintained for reference and use by responsible staff.

Maintenance diaries and logs shall be maintained and accessible for review by other parties.

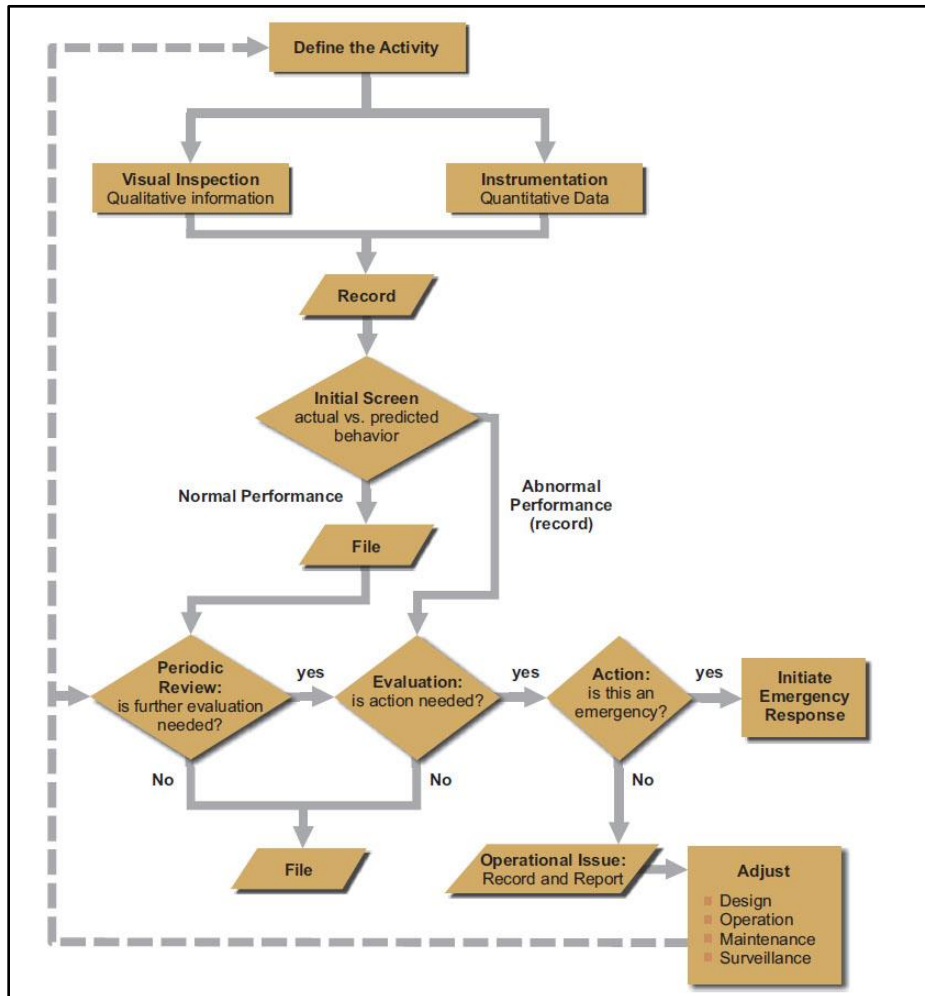
## **5.0 DAM SAFETY AND SURVEILLANCE**

The RRM tailings and water management surveillance activities involve inspection and monitoring of the operation, structural integrity and safety of a facility. Regular review of surveillance information can provide an early indication of performance trends that, although within specifications, warrant further evaluation or action. The objectives of our surveillance program are as follows:

- Monitoring the operation, safety and environmental performance of tailings and water management facilities;
- Promptly identifying and evaluating deviations from expected behavior that affect operational safety, structural integrity and environmental performance of the facility; and
- Reporting significant observations for response.

The flow chart for surveillance is shown in Figure 7-1. Surveillance is undertaken in two primary methods – visual inspection and reading of instruments. Results of these qualitative and quantitative observations are compared to the expected performance of the TMA and water management facilities. If observations are within the expected range or performance, the results of the surveillance are simply recorded. If observations are outside the expected range, further evaluation is completed to determine if remedial action is necessary. If necessary, this action is taken and may range from a minor adjustment to operational procedures to initiation of emergency response, depending on the severity and nature of the deviation from expected performance.

**Figure 5-1; Surveillance Flow Chart**



### 5.1 Surveillance and Inspections by Mine, Mill and Environment Operations Staff

The purpose of the surveillance program is to identify and classify problems and/or unsafe conditions that are visually evident. Visual inspections are an integral part of proper maintenance and performance of monitoring programs for the TMA and water management facilities. Failure to correct identified maintenance and repair items, or potential adverse behaviour, could result in unsafe conditions or lead to a failure of operating systems or cause an adverse environmental effect.

The surveillance program will consist of making regular observations relating to:

- The conditions and performance of the dams including indications of cracking, bulging, depressions, sinkholes, vegetation, surface erosion and seepage;
- Water levels and pump intake zones;
- Function of ancillary hydraulic structures (diversions, spillways, pipelines etc.);
- Discharge pipeline operations and tailings beach development; and

- Total facility performance.

During inspections, observations will be made at the upstream slope, crest and downstream slope with respect to signs of erosion, scouring, cracking, settlement, deformation, and any instability and abnormality. Seepage rates will be visually estimated and recorded on the inspection forms. Changes in the seepage rate or clarity (i.e., turbidity) require immediate reporting to the Engineer-of-Record.

### **5.1.1 Daily Inspections**

During first filling of all dams except the TMA dams Surveillance records will be maintained in logs at site and submitted to the EOR for review daily and on a monthly basis thereafter, or more frequently as warranted. Any abnormal behaviour including slope slumping, erosion of crest settlement will be reported immediately to the Engineer-of-Record.

Routine daily visual inspections of critical dams (TMA, WMP and MRP), spillways, pipelines, pipeline containment and pumping infrastructure will be carried out on an on-going basis to confirm normal operations and identify unusual or anomalous conditions such as pipeline leaks, pump intake blockages, etc. All active pipelines will be inspected twice per 12 h shift, consistent with EA conditions.

Daily inspection sheets and provided in Appendix F.

### **5.1.2 Weekly Inspections**

Physical inspections of the TMA, process water, water treatment and diversion dams will be conducted on a weekly basis. The weekly inspections will include those discussed in Section 7.1.1 and the following tasks:

- Photographic record of key features;
- Physical inspection of dams, dykes, diversion, ditches and spillways:
  - Indicating and reporting any seepage and erosion.
- Pond levels and freeboard:
  - Additional monitoring maybe required during spring freshet of the dams.

Weekly inspection sheets and SOPs are provided in Appendix F. All weekly inspections will be documented in a report and will be compiled as part of the annual DSI (Section 7.4).

### **5.1.3 Other Inspections**

## **5.2 Inspection Required After an Unusual Event**

Several potential failure modes exist for the various tailings and water management and water diversion storage facilities. These potential failure modes, along with likely triggers, observable visual and instrumentation indicators of the failure mode are presented in Table 9-1. Special inspections will be carried out immediately if any of the following events occur:

- Events such as an earthquake, large rainfall (greater than 1:2 year rainfall (51mm)) or large snowfall/snowpack;
- Operating events such as rupture of a pipeline, particularly if on the slope or crest of the dam, sudden loss of pond water, sudden rapid rise of pond water;

- Observations such as cracks, excessive settlements, sinkholes, large slope or foundation deformations, increased seepage, turbidity of seepage water; and
- Instrument readings that deviate from historical trends, or are within “alert” action levels (e.g., trigger levels).

Special inspections after unusual events are necessary as summarized in Tables 7-1 to evaluate whether there has been any damage requiring correction, any safety measures or special operating procedures that need to be implemented, or if there is a need to initiate emergency procedures as described in Section 9.0.

**Table 5-1; Maintenance Requirements following an Unusual Event**

Unusual Event	Post – Event Inspection/Surveillance
Earthquakes	Carry out a detailed walkover of all dam structures, including crests, downstream and upstream (visible) slopes and dam toes, and all spillways, looking for signs of cracks, bulging, settlement and/or other deformations. Look for and note any changes in seepage, particularly with respect to the rate of seepage flows at dam slopes and seepage clarity. Read all piezometers. Inspect downstream toes of dams for sand boils and dam slopes for sinkholes. Inspect ponds upstream of the dams looking for ‘whirlpools’. Inspect all pump stations and pipelines. Discuss findings with the Dam Safety Inspector.
Rapid snowmelt and/or heavy rainstorms exceeding a 1:2 year rainfall (51 mm)	Inspect the (visible) slopes and the crests of all the tailings dams looking for areas of concentrated runoff and erosion. Make note of saturated ground/soft ground conditions at dam slopes and toes. Examine dam slopes for indications of localized slumping/instability. Inspect all pump stations and pipelines. Check the water levels in all ponds/reservoirs against the critical levels, and keep checking these levels until the pond/reservoir inflows subside. Discuss findings with the Dam Safety Inspector. Check piezometric levels at dam sites if instructed to do so.
Unusually high winds (exceeding 60 kph i.e., 75 % of maximum likely used in design)	Check the condition of erosion protection on the upstream slopes of the dams.
Extreme snow pack (170cm cumulative snowfall) (i.e., 120% or greater than normal snowfall at Barwick)	Check the water levels in all ponds/reservoirs against the critical levels, and keep checking these levels until the spring freshet is over. Evaluate the situation in terms of possible snowmelt scenarios. Make predictions as to the expected storage capacity available in ponds/reservoirs. If deemed necessary, mobilize pumping and mobile treatment equipment to site.
Significant, relatively rapid erosion (any cause) of dam slope or ‘sudden’ seepage break at dam	Inspect clarity of seepage, rate of seepage and amount of material sloughed. Notify tailings coordinator – site engineering and EOR.

Unusual Event	Post – Event Inspection/Surveillance
slope or downstream of dam in form of continuous seepage or boils	Consider initiating Emergency Response Plan
Pond level close to, or approaching a critical level	Notify Manager. Consider initiating Emergency Response Plan
Significant change in an instrumentation reading – see table below for definition of significant change	<p>Check the historical readings paying special attention to seasonal changes and check the measurement again.</p> <p>Carry out visual inspection of all areas in the vicinity of the instrument of interest. Contact the Engineer of Record.</p>

### 5.3 Dam Instrumentation and Monitoring

The instrumentation data is reviewed regularly to identify anomalous readings that could indicate a change in the conditions of the tailings and water management facilities. Dam instrumentation lists are provided in section 4.6. Instrumentation reading and reporting frequencies are outlined in Table 7.2. Responsible parties’ record notes and takes pictures of any potential anomalies to provide further information to the EOR. Instrument trigger and alert levels are provided in Table 7.3. Additional details on instrument reading frequencies can be found in the *Geotechnical Monitoring Plan* (Amec Foster Wheeler, 2016b).

#### Piezometers:

- Vibrating Wire Piezometers shall have a reading frequency every hour and recorded by a data logger, with data collected daily during construction. Post-construction after the readings have stabilized, the reading frequency will be reduced to every 12 hours, as defined in the table below;
- Standpipe piezometers shall be measured weekly during construction and monthly following construction;
- The following are considered anomalous:
  - Sudden increases or decreases that do not correlate with seasonal variations (e.g., groundwater recharge during snowmelt affecting foundation piezometers);
  - Trend of piezometric increase that approaches or exceeds the rate of rise of the tailings pond; and
  - Pattern of sudden and large increases followed by rapid declines.

#### Inclinometers:

- Inclinometers shall be monitored semi-weekly during construction and weekly following construction;
- Anomalous data includes:
  - Sudden increases in cumulative displacement/rate of movement of the inclinometers;
  - Zones of concentrated or discrete displacement; and

- Blockages of the inclinometer casing.

**Settlement Plates and Survey Pins/Monuments:**

- Settlement Plates and Survey Pins/Monuments shall have a reading frequency of semi-weekly during construction and weekly following construction;
- Anomalous data includes:
  - Sudden displacements of the settlement monuments (x, y, z directions); and
  - Accelerating displacement trends (over two or more readings).

If anomalous readings are observed, the following actions should be taken:

- Check data, reductions and calculations for accuracy and correctness;
- If no errors are found in the calculations, notify the EOR, Geotechnical Engineer and Environmental Manager that an anomalous reading has been observed and that further assessment is going to be conducted;
- Check readout equipment to verify that it is functioning correctly; verify calibration;
- Re-read all instrumentation of the type for which the anomalous reading was observed, in order to check the reading and reading in adjacent instruments;
- If it is observed that an instrument or piece of readout equipment has stopped functioning, notify the Mill Manager and/or Superintendent, and the EOR immediately. If considered critical, a replacement instrument should be installed;
- If the anomalous reading is confirmed, notify the Superintendent and EOR immediately; and
- A detailed review of the effects of the reading should be carried out and the monitoring frequency of the instruments in the area of the anomaly increased to assess the progression of the anomaly. Design or remedial actions should be implemented if determined necessary.

All results are downloaded and provided to the EOR. Any anomalies are noted and a request for an additional reading may occur. The EOR will review the data in quarterly monitoring reports, and make any recommendations, such as increased reading frequencies, pertaining to anomalous readings. The EOR, will also assess the trigger and alert levels and update them as necessary, once per year, as part of the DSI.

**Table 5-2; Dam Instrumentation Surveillance Requirements**

Type	Frequency
<i>Routine Inspection:</i>	
Dam	Weekly
Diversions	Weekly
Ditches	Weekly
Seepage collection system	Weekly
Spillways	Weekly
Pipelines	Once per 12 h shift
<i>Tailings Pond Monitoring:</i>	
	Weekly



Type	Frequency
Pump intake	Weekly
Staff gauges	Weekly (initially every ~12h) in Cell 1 borrow
Inflows, Outflows, Condition	Monthly
<i>Dam Instrumentation:</i>	Weekly
<i>TMA, WMP and MRP Comprehensive (and water diversions during initial filling)</i>	<ul style="list-style-type: none"> <li>• Daily during construction and initial filling</li> <li>• Weekly, during initial operations depending on trend</li> <li>• Monthly during routine operation</li> </ul>
<i>Annual Dam Inspection</i>	Annually, with no snow cover
<i>Event Driven Inspection</i>	Following unusual events (defined in table 7.1)
<i>Comprehensive Review (DSR):</i>	
Low and Moderate HPC dams	Every 10 years and prior to decommissioning
Very High HPC dams	Every 5 years and prior to decommissioning

Notes:

1. Dam Hazard Potential Classification (HPC) requires review when changes are made or downstream conditions change.
2. Monthly facility inspections should be carried out by the same staff or small group of staff such that subtle changes in the conditions can be detected.

**Table 5-3; Instrument Trigger and Alert Levels**

Instrument	Parameter	Trigger Level	Alert Level	Remarks
VWP/STP	Pore Pressure Ratio	$r_u = 0.4$	$r_u = 0.5$	Pore pressure data to be evaluated with corresponding fill elevation, and monitored movements at SPs and INs
Survey Pin	Lateral Movement Rate	Uniform (but less than max 75 mm magnitude)	Accelerating	To be evaluated with IN data to define zones of movement
Slope Inclinator	Lateral Movement Rate	Uniform	Accelerating	Deformation rates will be associated with rate of construction and post construction movements
	Share Strain Magnitude	2%	5%	If specific plane(s) of shearing is observed within the foundation, the construction shall be limited, progressed with caution or ceased depending on the observed phenomena

Notes:

1.  $r_u$  of 0.4 corresponds to a piezometric head at 80% of the dam height.  $r_u$  0.5 is at piezometric head at the crest of the dam.
2.  $r_u$  of 0.5 is a design criteria to meet dam stability requirements.

Source; Geotechnical Monitoring Plan (AMECFW, August 2016)

#### 5.4 Dam Safety Inspections (DSIs) and Dam Safety Reviews (DSRs)

Consistent with MECP ECA approvals, with the regulatory exception of the Clark and West Creek Diversions, engineering inspections will be conducted following best management practices as per the Canadian Dam Association's (CDA) Dam Safety Guidelines (2007, revised 2013, as amended



from time to time), and the 2014 CDA Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams (as amended from time to time).

#### **5.4.1 Dam Safety Inspections**

Annual inspections are intended to be part of a more thorough review of the condition of the facility, and are carried out by the EOR. The inspections will include the following key items:

- Visual inspection of the facility by the engineer, including taking appropriate photographs of the observed conditions;
- Review of routine inspection records prepared by operating personnel in the past year;
- Review whether or not recommendations from previous year's inspection(s) have been addressed, and any incidents or actions arising from those previous recommendations;
- Review of instrumentation and monitoring data;
- Review of tailings deposition and water management operations of the facility including reconciliation of the annual water and mass balance. Review of pond levels (and depth) and freeboard, and reports of any incidents (and remedial measures) that may have occurred;
- An evaluation and interpretation of the structural performance of the dam and related components, and identify any potential safety deficiencies or recommended items that need to be addressed in the coming year;
- Review construction records, QA/QC data and as-built information on dam construction and beaching; and
- Evaluation of the OMS Manual to assess the need for updating.

The results of the inspection and review will be documented in a report.

#### **5.4.2 Dam Safety Review**

The Canadian Dam Association (CDA) Dam Safety Guidelines (CDA, 2007) recommend a comprehensive dam safety review be carried out every 5 years during operations, prior to decommissioning and following closure, by a qualified 3<sup>rd</sup> party consultant.

The comprehensive review provides independent verification of:

- Safety and environmental performance of the facility;
- Adequacy of the surveillance program;
- Adequacy of delivery of OMS Manual requirements;
- Design basis with respect to current standards and possible failure modes; and
- Compliance with new engineering standards (including analysis to confirm if necessary).

### **5.5 Documentation**

Documentation of surveillance and monitoring activities shall be maintained by the Mill Manger, or as designated, as described in the preceding sections and will include recording of:

- Routine visual observations (departures from normal conditions);

- Photographs;
- Instrumentation monitoring and testing;
- Analyses and evaluations; and
- Reviews.

Documentation will include, as a minimum, the following:

- Weekly routine inspection log;
- Monthly tailings facility and process water pond monitoring report;
- Quarterly instrumentation reports;
- Annual Dam Safety Inspection reports; and
- Comprehensive Dam Safety Review report every 5 years.

Documentation will include a hard copy (paper) and electronic filing system for inspection reports, photographic and video records, incident reports, instrumentation readings, instrumentation plots, annual inspections and third-party reviews, so that they can be quickly retrieved for review and in case of an emergency.

## **5.6 Reporting**

The Mill Manager, or designated responsible party, and Geotechnical Engineer will review collected data records from facility monitoring and assess the need for maintenance activities or response. Corrective actions will be identified and tracked to closure. The Environmental Manager is responsible for overseeing sample and data collection and analysis. Reporting will meet MECP requirements and the annual DSI report will also be submitted to the MRNF. Reporting includes;

- As built reports of the dams, excluding the Clark and West Creek diversions, will be submitted to MECP within 90 days of completion;
- An annual report based on the DSI including ECA approval requirements;
- Monthly water quality monitoring report; and
- Annual report including any operating problems and corrective actions, a summary of calibration and maintenance works, use of contingency plans, surface water and groundwater monitoring reports including water balance, ML/ARD updates, discharge volumes and quality.

Additional reporting requirements may be developed as the RRM progresses.

## **6.0 CLOSURE PLAN**

This section summarizes the objectives of the Closure Plan. The *Rainy River Project – Closure Plan* (Amec Foster Wheeler, 2015c) provides the closure plan and includes temporary closure options for short and medium-term shut-down of site facilities.

## 6.1 Tailings Management Area

Closure of the TMA will include, but is not limited to, the following:

- Flooding of the TMA with a 2 m or deeper water cover;
- A perimeter zone of tailings beach will be maintained to keep the central pond away from the dams, this zone will be covered with a low permeability cover;
- NPAG rock will be placed at the TMA transition zone with the tailings to prevent erosion and suspension and oxidation of solids; and
- Dam structures containing the TMA have been designed with adequate safety factors to provide overall long term safety and stability.

## 6.2 Embankments

Closure of the embankments will typically involve, but is not limited to reaching of embankments to prevent ponding of water and revegetating slopes to reclaim the area. Some embankment structures will still have a role during the closure phase and these will not be breached. The following structures will continue to be operated during the closure phase:

- MRP will collect runoff and seepage from EMRS, which will be directed to the Open Pit to help flooding;
- Sediment Ponds #1 and #2 will be maintained until site is recognized as a closed mine and monitoring associated with the Metal Mining Effluent Regulation is no longer required

Freshwater diversion and constructed wetland structures are designed to operate passively and will remain in place at closure.

## 6.3 Monitoring

Monitoring requirements are described in the *Rainy River Project – Closure Plan* (Amec Foster Wheeler, 2017c).

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**RAINY RIVER PROJECT**

**PART IX - EMERGENCY PREPARDNESS PLAN -  
OPERATION, MAINTENANCE AND SURVEILLANCE  
MANUAL WATER MANAGEMENT STRUCTURES**

**New Gold Inc.  
Rainy River Project  
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**January 2019**

**Version 2019-1**



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## **1.0 EMERGENCY PREPAREDNESS**

The objectives of this section is to describe procedures to prevent the occurrence of emergencies and reduce the impact, should they arise. This manual covers only those emergency situations that could potentially pose a threat to the structural integrity of the dams or result in the release of tailings and/or supernatant pond water into the surrounding environment. This document was developed to work in conjunction with the Emergency Preparedness and Response Plan (EPRP) (as reviewed annually and maintained by New Gold H&S team – latest revision February 2017).

The ultimate goal is to protect human life and health, the social well-being of the local community and employees, public infrastructure and company facilities; and environmental conditions and habitats.

### **1.1 Definition and Classification of Emergencies**

An emergency is defined as:

*“A situation or a set of circumstances which, if not promptly eliminated, controlled or contained, results or could result in a significant injury to people (including the community) and/or damage to the tailings facility, property and/or the environment.”*

### **1.2 Potential Dam Failure Modes**

The containment dams at the RRM are predominately zoned embankments with clay cores and rock fill shells. The primary method of dam construction uses the centreline method which is considered to be a stable form of construction. Adherence to design drawings and specifications is critical to minimize the risk of failure.

Several potential failure modes exist for the various tailings storage and water management facilities. These potential failure modes, along with likely triggers, observable visual and instrumentation indicators of the failure mode are presented in Table 9-1. A preliminary dam break inundation map is provided in Figure 9-1.

External hazards originate outside the boundary of the dam and reservoir system and are beyond the control of the dam owner. External hazards include the following:

- Meteorological events, such as floods, intense rainstorms (causing local erosion or landslides), temperature extremes, ice, lightning strikes, and windstorms;
- Seismic events, either natural, cause by economic activity such as mining, or even reservoir induced;
- The reservoir environment, including rim features, such as upstream dams and slopes around the reservoir that pose a threat; and
- Vandalism and security threats.

Internal hazards may arise from the ageing process or from errors and omissions in the design, construction, operation, and maintenance of the dam and water conveyance structures. Internal hazards can be subdivided by source:

- Components that retain or interfere with the body of water;
- Water conveyance structures required to direct water around or through the dam in a controlled way;

- Mechanical, electrical, and control subsystems;
- Infrastructure and plans, including instruments, operating orders, maintenance strategies and procedures, surveillance procedures, and emergency plans, as well as inflow forecasts.

A failure mode describes how a component failure occurs to cause loss of the system function. Failure modes may be interdependent and change in nature and significance at different stages of a dam's life. In any analysis, the failure characteristics, including extent and rate of development, should be determined to an appropriate level of detail. At a general level, there are three dam failure modes:

- Overtopping – water flows over the crest of the dam, contrary to design intent;
- Collapse – internal resistance to the applied forces is inadequate; and
- Contaminated seepage – contaminated fluid escapes to the natural environment.

Dam safety risk management is directed to (1) prevention of the initiation of a failure sequence; (2) control of a deteriorating situation, and (3) mitigation of situations where the failure sequence cannot be stopped.

**Table 1-1; Potential Failure Modes, Triggers and Observable Effects**

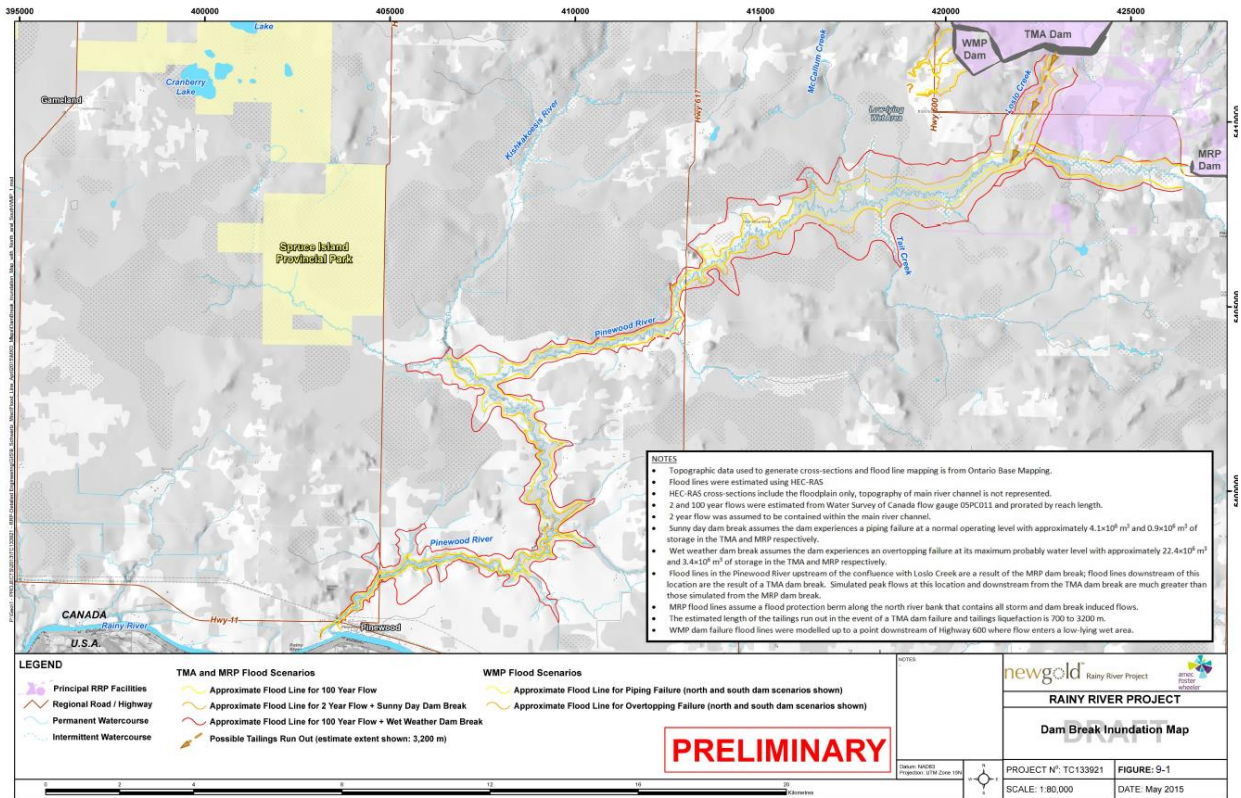
Potential Failure Modes	Possible Causes	Visual Indications	Instrumentation Effects
Break down of pump stations	Blockages, lack of maintenance	No flows	Test on pumps and other related components
Pipeline damage, cracking, blocking, or freezing	Flows blocked by excessively turbid water, debris or ice blockages, extreme weather	No or partial flows; pipeline leaking, cracking or bulging	Pipeline thickness; line pressures; pipeline flow rates
Overtopping	Excessive foundation movements, high wind and wave erosion of beach landslide generated wave, erosion of freeboard, settlement of crest, gully growth towards upstream crest due to seepage, surface runoff or pipe ruptures	Instability in reservoir slopes – slumping, sliding, etc. Damage to upstream face of dam, breach of crest	None
Slope Failure	Changes to porewater pressure within the dam (filters becoming non-functional, earthquake included)	Bulging, slumping, sliding or cracking of dam, increase in volume of seepage	Increase in porewater pressures measured within dam
Foundation Failure	Changes to pore water pressure in the foundation or increases to load applied to foundation (Increase in dam height or pond elevation)	Bulging, slumping, sliding or cracking of dam, or natural ground surrounding the dam	Increase in porewater pressures measured within dam and/or foundation, increase in rate of movement observed in inclinometers and/or survey prisms

Potential Failure Modes	Possible Causes	Visual Indications	Instrumentation Effects
Surface Erosion	Waves, wind or precipitation	Slumping or raveling of upstream or downstream faces of dam	None
Internal Erosion	Erosion of core, creating a pipe/conduit for water flow through dam, growth of a gully behind the crest of dam, turbid seepage water	Rapid increase or unexplained cloudy appearance of seepage through the tailings dams and/or their foundations; appearance of seepage in new locations; formation of sinkholes in dam or on tailings beach	Rapid change if the in porewater pressures measured within dam and/or foundation
Cracking	Differential settlement of dam, earthquake induced	Cracks on dam crest or faces; bulging or slumping of dam	Increase to rate of movement observed in inclinometers or survey monuments or prisms

Other failure modes might also include the following:

- Slumping, sliding, cracking or bulging of the tailings dam
- Rapid increase or unexplained cloudy appearance of seepage through the tailings dam and/or its foundation
- Formation of sinkholes on the tailings beach or dam
- Breakage of tailings pipelines, which may result in dam erosion and/or release of tailings slurry
- Earthquakes
- Major storm events or flood
- Sabotage and other criminal activities

**Figure 1-1; Preliminary Draft Inundation Map**



### 1.3 Warning Signs and Threshold Criteria

The warning signs for an emergency are defined below:

- Level I: Conditions that do not yet represent a potential emergency but that do require investigation and resolution on a prompt basis, along with intensified surveillance.
- Level II: Conditions that represent a potential emergency if allowed to continue to progress, but no such emergency is imminent.
- Level III: An obvious emergency has occurred or is imminent.

Table 9-2 discusses potential warning signs, consequences and actions to be taken.

**Table 1-2; Warning Signs, Level of Emergency and Responses**

Level	Warning Sign/Situation	Actual or Potential Consequences	Action(s) to be Taken
1	Unusually high, one-time reading from a single piezometer.	Possible early warning sign of worsening piezometric/seepage conditions.	<ul style="list-style-type: none"> <li>• Check piezometer reading, and check for infilling of piezometer.</li> <li>• If reading confirmed, check all other piezometers, and examine downstream area of dam for changed seepage conditions.</li> <li>• Intensify piezometer readings.</li> </ul>
	Decreased seepage discharge accompanied by gradually increasing piezometer levels.	Possible sign of clogging of internal drainage system of dam.	<ul style="list-style-type: none"> <li>• Check chemistry of seepage discharge for any changes relative to normal.</li> <li>• Request tailings dam engineer to re-evaluate slope stability at this location.</li> </ul>
	Increase in size of erosion gullies.	Possible erosion resulting from seepage and/overland runoff. May lead to accelerated erosion and result in dam failure.	<ul style="list-style-type: none"> <li>• Backfill gullies with filter material and fine rockfill.</li> </ul>
2	Increase in seepage discharge, accompanied by discharge of tailings within seepage (dirty water).	Possible indication of a developing internal erosion (piping), that could eventually lead to dam breach/pond release, or excessively high levels of saturation that could result in slope instability.	<ul style="list-style-type: none"> <li>• Initiate chain of communication (Figure 9-2) and monitor the situation.</li> <li>• Discontinue tailings discharge in the seepage area.</li> <li>• Intensify monitoring of seepage at this location.</li> <li>• Note if the seepage discharge and/or turbidity continue to increase.</li> <li>• Read piezometers.</li> <li>• Be prepared to place filter material in area of discharge from emergency stockpiles.</li> </ul>



Level	Warning Sign/Situation	Actual or Potential Consequences	Action(s) to be Taken
	Seepage on dam abutments, causing localized erosion and slumping of dam slope.	Could lead to progressive slope failure on abutment, resulting in dam failure and breach of pond.	<ul style="list-style-type: none"> <li>• Discontinue tailings discharge in the seepage area.</li> <li>• Place filter material over seepage area using emergency stockpiles.</li> <li>• Continue to monitor area on an intensified basis.</li> <li>• Initiate chain of communications if situation does not improve.</li> </ul>
	Extended period of unusually heavy rainfall, or unusually large snowmelt.	Could lead to raised levels of saturation within the dam slope, which could in turn lead to slope instability.	<ul style="list-style-type: none"> <li>• Increase frequency of piezometer readings to weekly.</li> <li>• Intensify inspections of downstream dam slope, looking for signs of localized instability/concentrated gully erosion, and for soft ground (saturated slope) conditions.</li> </ul>
	Relatively high, unexplained, and ongoing increase in piezometer levels within the dam and/or foundation – threshold limits being approached.	Probable sign of progressive deterioration of toe drainage provided by starter dams. Could, if left unattended eventually lead to failure of the dam.	<ul style="list-style-type: none"> <li>• Assess rate of rise and determine if it is steady or accelerating.</li> <li>• If piezometer level increase was sudden, check the reading (repeat it) to eliminate the possibility of a reading error.</li> <li>• Sound bottoms of piezometers to check for infilling.</li> <li>• Send piezometer readings to the tailings dam engineer.</li> <li>• Inspect downstream area for increased seepage and/or turbidity of seepage discharge.</li> </ul>
	Long term or sudden increase in rate of inclinometer movements.	Possible sign of impending slope instability.	<ul style="list-style-type: none"> <li>• Check reading, and contact the Geotechnical Engineer and EOR if confirmed.</li> <li>• Inspect area for any visible signs of instability, bulging on outer slope or at toe, or tension cracks on dam crest.</li> <li>• If tailings discharge is occurring near the inclinometer that indicates unexplained movement, relocate discharge point further away.</li> <li>• Increase frequency of inclinometer readings.</li> <li>• Read nearby piezometers.</li> </ul>
	Ongoing cracking and evidence of dam and/or foundation movement.	Possible sign of impending failure of dam, especially if the rate of movement/cracking is accelerating.	<ul style="list-style-type: none"> <li>• Check inclinometer readings.</li> <li>• If rate of deformation is accelerating, initiate chain of communication.</li> <li>• Read piezometers.</li> <li>• Check for water inflow into tension cracks.</li> <li>• Regrade to channel runoff away from tension cracks, as water inflow can result in accelerated movement.</li> </ul>



Level	Warning Sign/Situation	Actual or Potential Consequences	Action(s) to be Taken
	Highly turbidity discharge from decant outlet.	Possible sign of collapse of a portion of the decant, allowing tailings into outlet. Can, if left unattended, lead to internal erosion failure and eventual dam breach.	<ul style="list-style-type: none"> <li>• Check decant inlet to see if water turbidity matches that in discharge.</li> <li>• If water at inlet is clear, then close off decant inlet to prevent further discharge.</li> <li>• Notify tailings dam engineer and develop alternate decant arrangements.</li> <li>• Inform Mill.</li> </ul>
	Rupture of tailings and/or water pipelines on crest of dam, resulting in erosion of downstream dam slope	Could lead to erosive failure of dam, and pond breach, if allowed to continue.	<ul style="list-style-type: none"> <li>• Contact Mill and have discharge of tailings stopped.</li> <li>• Repair the rupture.</li> <li>• Inspect and repair the washed-out portion of the dam slope.</li> <li>• Do not discharge tailings into the area of the washout.</li> <li>• Notify tailings dam engineer to design slope re-construction.</li> </ul>
	Seepage daylighting from tailings slope at a significantly higher elevation than had previously been observed at that particular location.	Could lead to erosion, and progressive slope failure, resulting in dam failure and breach of pond.	<ul style="list-style-type: none"> <li>• Read piezometers.</li> <li>• Assess rate of seepage and whether or not internal erosion is occurring.</li> <li>• If piezometers confirm high phreatic levels, initiate chain of communication.</li> <li>• Carry out weekly monitoring of the seepage discharge area of concern.</li> <li>• Avoid discharge of tailings into the impoundment adjacent to the area.</li> </ul>
	Severe flood/intense rainstorm or rapid snowmelt.	Overtopping and washout of dam, and release of pond. Concentrated erosion of tailings slopes, resulting in localized gulying, over-steepening, and potential slope failure. Raising of phreatic surface as a result of infiltration possible.	<ul style="list-style-type: none"> <li>• Initiate chain of communications (Figure 9-2).</li> <li>• Check the minimum width of tailings beaches.</li> <li>• Inspect spillway for flow and condition.</li> <li>• Stop tailings discharge and <u>slowly</u> lower tailings pond by removing stop logs.</li> <li>• Carry out detailed inspection of dam and pond.</li> <li>• Inspect dam slopes for areas of concentrated erosion, and repair.</li> <li>• Read all piezometers.</li> <li>• Mobilize emergency pumps if needed.</li> </ul>
3	Failure or suspected imminent failure of a dam.	Catastrophic breach and release of pond.	<ul style="list-style-type: none"> <li>• Initiate chain of communications (Figure 9-3).</li> <li>• Stop tailings discharge and lower tailings pond by removing stop logs.</li> </ul>

Level	Warning Sign/Situation	Actual or Potential Consequences	Action(s) to be Taken
	Slumping, sliding, or bulging of a dam slope or adjacent ground.	Catastrophic breach and release of pond.	<ul style="list-style-type: none"> <li>Initiate chain of communications (Figure 9-3).</li> <li>Lower pond by removing stop logs.</li> <li>Do not attempt construction (e.g., construction of a stabilizing berm) until the EOR is on the site (earthmoving equipment should be mobilized).</li> </ul>
	Water vortex (whirlpool) within the tailings pond.	Indicates an internal erosion failure in progress, with potential breach of the tailings dam.	<ul style="list-style-type: none"> <li>Initiate chain of communications (Figure 9-3).</li> <li>Stop tailings discharge and lower tailings pond by removing stop logs.</li> <li>Check downstream area of dam for areas of increased and/or turbid seepage discharge.</li> <li>Place granular filter buttress against any such areas, using emergency stockpiles.</li> <li>Go directly to decant outlets if vortex is on a decant line; plug decant outlet with granular material if tailings are discharging through decant.</li> </ul>
	Sinkhole observed on tailings beach or on a downstream dam slope.	Indicative of internal erosion, which could progress to the point where dam breach results.	<ul style="list-style-type: none"> <li>Initiate chain of communications (Figure 9-3).</li> <li>Stop tailings discharge and lower tailings pond by removing stop logs.</li> <li>Immediately check dam toe areas/decant outlets for heavy seepage that is transporting tailings solids.</li> <li>Place granular filter buttress against any such areas, using emergency stockpiles.</li> </ul>
	Large earthquake.	Dam failure, breach and release of pond.	<ul style="list-style-type: none"> <li>Initiate chain of communications (Figure 9-3).</li> <li>Carry out detailed post-earthquake inspection of the dam.</li> <li>Read all instrumentation (piezometers and inclinometers).</li> </ul>
	Rapid, unexplained, orders of magnitude increase in seepage rate and turbidity (dirty water indicating transport of tailings) at a dam slope seepage location and/or foundation.	Internal erosion (piping) failure leading to dam breach and release of pond. Elevation of pore pressure conditions that could initiate a slope failure.	<ul style="list-style-type: none"> <li>Initiate chain of communications (Figure 9-2).</li> <li>Place stockpiled filter materials over seepage discharge area to prevent further erosion of material.</li> <li>Read piezometers in area of seepage discharge.</li> </ul>

## 1.4 Incident Notifications Procedures

Roles and responsibilities:

- Any individual who observes an incident shall initiate the appropriate notification procedure.
- All members listed on the notification procedures shall be familiar with established protocol and familiar with the OMS Manual (as per training Section 2.5).
- If a member of the team on the notification procedures is not contactable then the Incident Commander shall be notified and proceed with the notification procedure.

Notification procedures have been developed for Level I, II and III emergencies provided below to ensure quick onsite responses in the event of an identified emergency. The Mill Manager will be in charge of initiating the site wide EPRP (NG, 2017) in the event of a Level III emergency.

The notification procedures for a Level I and Level II emergency are illustrated on Figure 9-2. The notification procedure and initiation of the EPRP in the event of a Level III emergency is shown on Figure 9-3. Rapid response to Level III emergencies is critical to ensuring that staff, contractors and site visitors safely reach a muster station and that timely notification is made to appropriate local and provincial authorities as well as external stakeholders.

**Figure 1-2; Levels I and II Emergency Notification Procedure Flowchart**

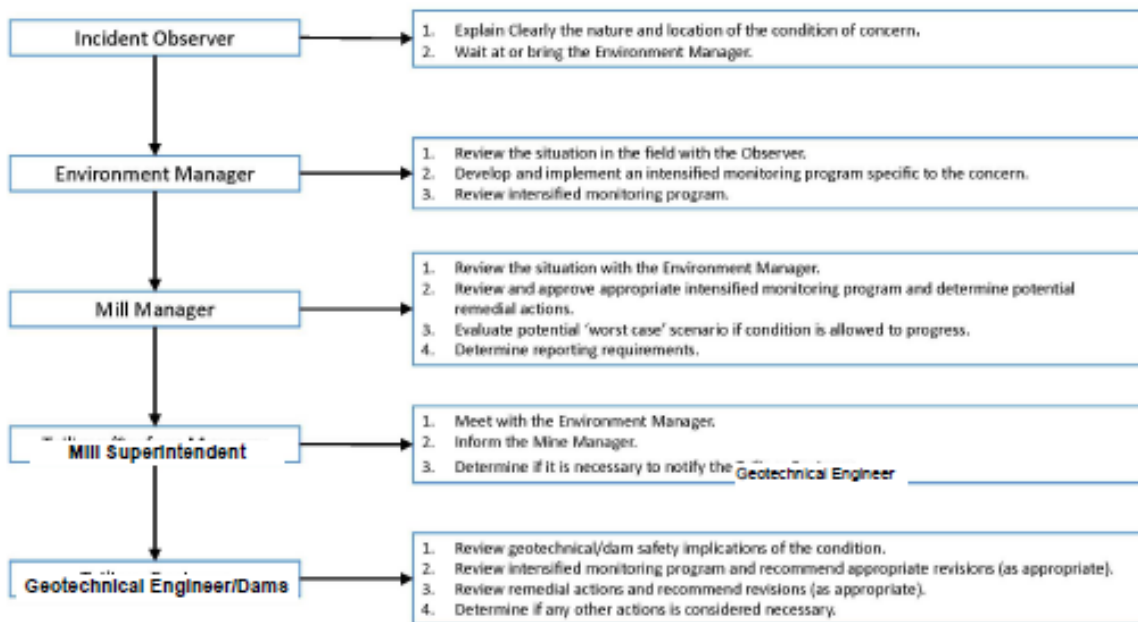
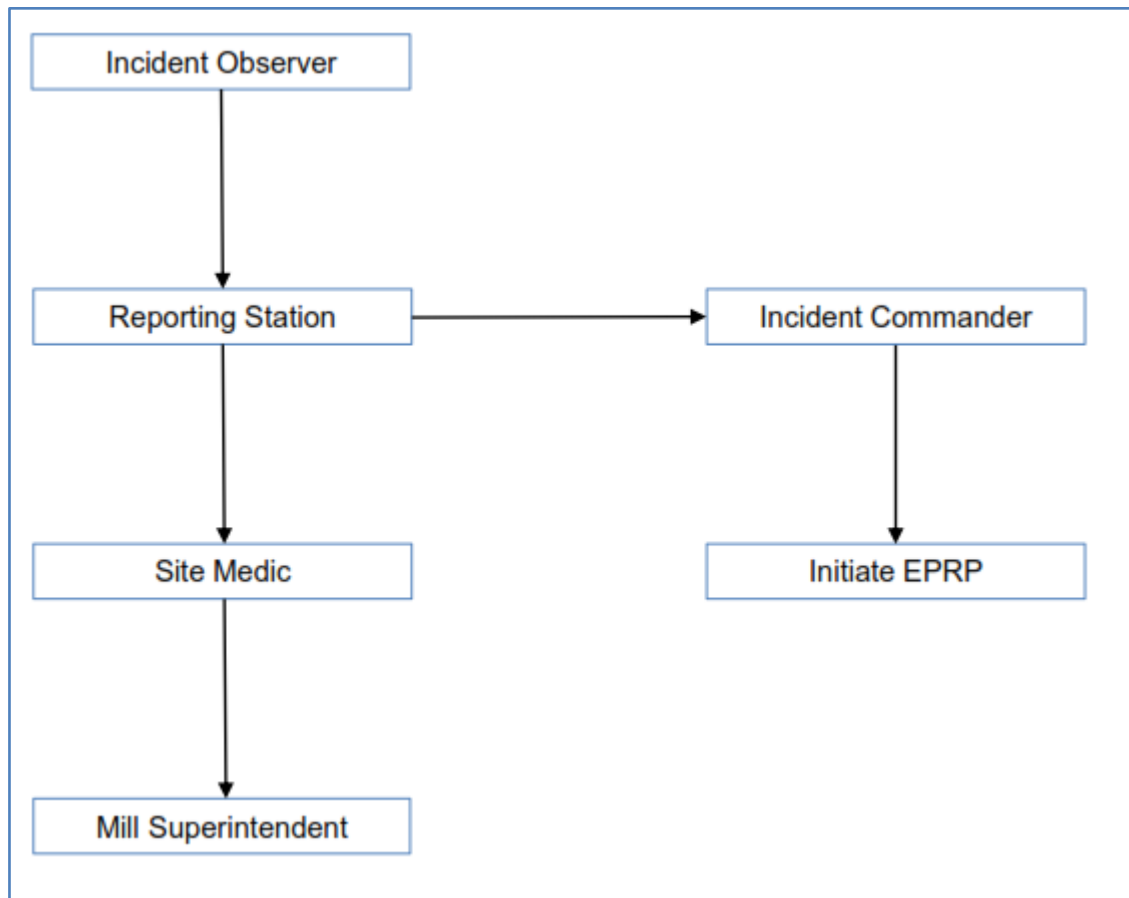


Figure 1-3; Level III Emergency Notification Procedure Flowchart



### 1.5 Emergency Contacts

Internal emergency contact information is provided RRM EPRP. An emergency response can be initiated through;

- RRM radio channel 4 – state ‘Emergency, Emergency, Emergency’ and describe the type and location of the emergency
- RRM internal phone system – dial 8888
- RRM security direct line – 1-807-708-0646
- 

## **1.6 Emergency Preparedness Procedures**

All employees, including contractors working at the RRM must be familiar with the procedures outlined in the EPRP for the site and TMA to the extent required to perform their functional role. All supervisors and contact persons for contractors must ensure their employees understand those procedures relevant to their work area and ensure that their employees are familiar with, and recognize the proper course of action in the event of an emergency. The supervisor must also ensure that all employees are made aware of any revisions to the EPRP for the site and TMA.

The EPRP is the site and TMA’s guidance document relating to emergency responses and protocols to be followed during upset conditions, unusual events or incidents. A preliminary dam break inundation map is provided in figure 9-3.

Emergency preparedness measures with regard to dam safety include: maintenance of access to dam locations; availability of fill materials and equipment required in the event that remedial works are required; and the ability to access and traffic control measures to ensure safety of workers and public.

## **2.0 REFERENCES**

AMEC, 2013. Rainy River Project – Final Environmental Assessment Report. Report TC111504 prepared by AMEC Environment & Infrastructure, submitted to New Gold Inc., October 2013.

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**Project Title:** TMA Tailings Discharge & Pipe Relocation

**Roles and Responsibilities**

Responsible, Accountable, Supportive, Consulted, Informed

RASCI Matrix		Roles	Capital Projects Manager	Tailings Dam Engineer	Project Coordinator	Superintendent	Mill Manager	Superintendent	Metalurgy Superintendent	Maintenance Superintendent	Environmental Manager	Water Resources Engineer	Mine Manager	Chief Engineer	Superintendent	BGC	O'Kane	Maintenance Manager	Superintendent	Supply Chain
		Deliverable or Task	Status	Project Team			Mill			Environment		Mine Operations			Consultants		Site Services		Others	
<b>Phase 1 - Deposition Schedule</b>																				
1.1	Develop Deposition Plan		A	R	I	I	C	I			C	S	I	I		R	I	I	I	
1.2	Develop Schedule		I	R	S	I	A	S	S		I	I	I	I						
1.3	Survey Pond Elevations			I			I	I			A	R	I	I		I	I			
1.4	Survey Pond Bottoms			I			I				A	R	I	I		I	I			
1.5	Monitor Pond - Design Thresholds		I	S			I				A	R	I	I		I				
1.6	Develop Water Balance Model		I	I			C				A	R	C	C		I	S			
1.7	Beach Survey		I	S	I		I	I			A	R					I			
1.8	Monthly Presentation Feedback		A	R	I	I	C	I		I	I	C								
1.9	Tailings Sampling			R		S	A	S	I										S	
<b>Phase 2 - Operating Tailings Line</b>																				
2.1	Commission Tailings Line		A	I	R	S	C	S		I	I	I						I	S	S
2.2	Maintain Infrastructure - HDPE						A	C		I	I	I						I	R	S
2.3	Maintain Infrastructure - Pumping						A	R		I	I	I						I	S	S
2.2	Maintain Infrastructure - Instruments						A	S		R	I	I								S
2.4	Switch Spigot Discharge Locations			I	I		A	R		I	I	I							S	
2.5	Inspect Tailings Lines			I			A	R		I	I	I						I		
2.6	Monitor and Record Flow Rates		I	I	I		A	R			I	I	I	I						
2.7	Install New Tailings Lines		A	C	R	S	C	S		I	C	I							S	S
2.8	Install Booster Pumps		A	C	R	S	C	S		S	C	I						I		S
2.9	Water Quality Sampling			I							A	R					I			
2.10	Dust Management			I	I	R		R			A				R					
<b>Phase 3 - Tailings Line Modifications</b>																				
3.1	Detailed Work Plan		C	C	C	S	A	R		I	I	I	I	I		I		I	S	
3.2	Deactivating Tailings Line		I	I	C	S	A	R		I	I	I				I				
3.3	Moving Tailings Line		I	I	C	S	A	S		I	I	I				I		I	R	
3.4	Reconnecting Tailings Line		I	I	C	S	A	S		I	I	I				I		I	R	
3.5	Geotechnical Instrumentation		A	R	I	S										I			S	
3.6	Cutting Back Spigots			I	I		A	S		I								I	R	

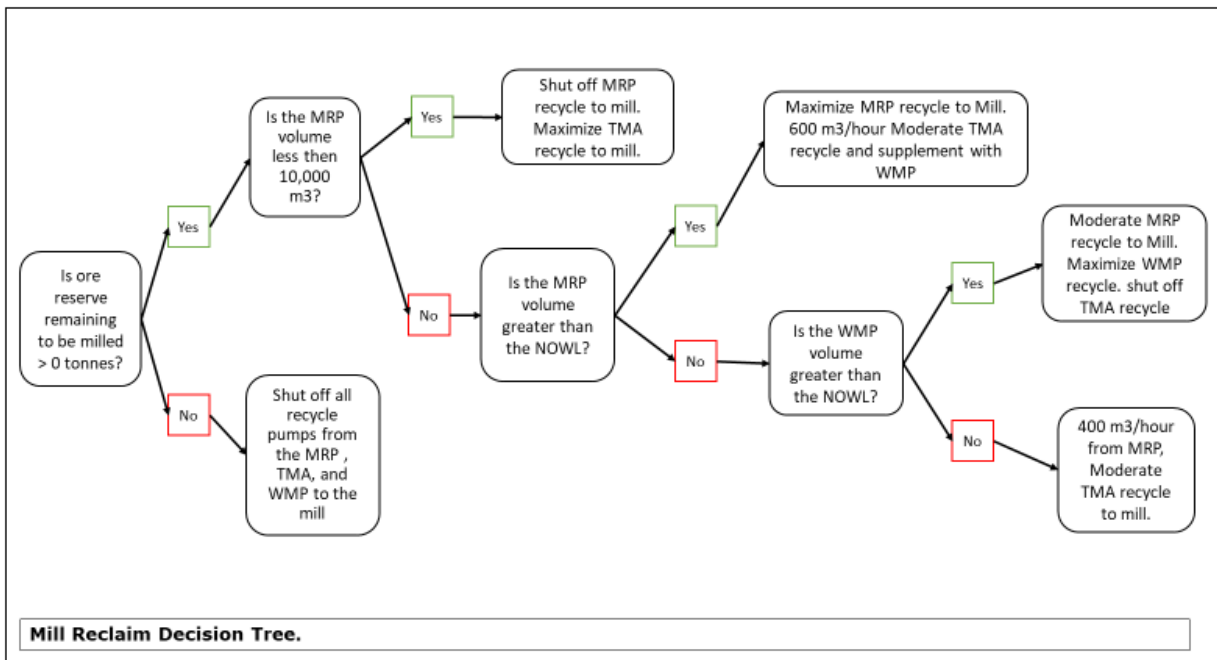
- R** Responsible
- A** Accountable
- S** Support
- C** Consulted
- I** Informed

Assigned to complete the task or deliverable  
 Has final decision-making authority and accountability for complete. Only 1 per task.  
 Provides support and assistance to the responsible role  
 An adviser, stakeholder, or subject matter expert who is consulted before a decision or action  
 Must be informed after a decision or action

## Water Balance and Reclaim Operations

The Rainy River Mine (RRM) developed a water balance to be update periodically during the mine life using the goldsim program. There are 3 major ponds used for reclaiming water the Mine Rock Pond (MRP), the Water Management Pond (WMP), and the Tailings Management Area (TMA). This model defines the logic for reclaim operations shown in Figure X. Below are a few scenarios which describe a certain set of conditions and the appropriate response to these using the reclaim logic.

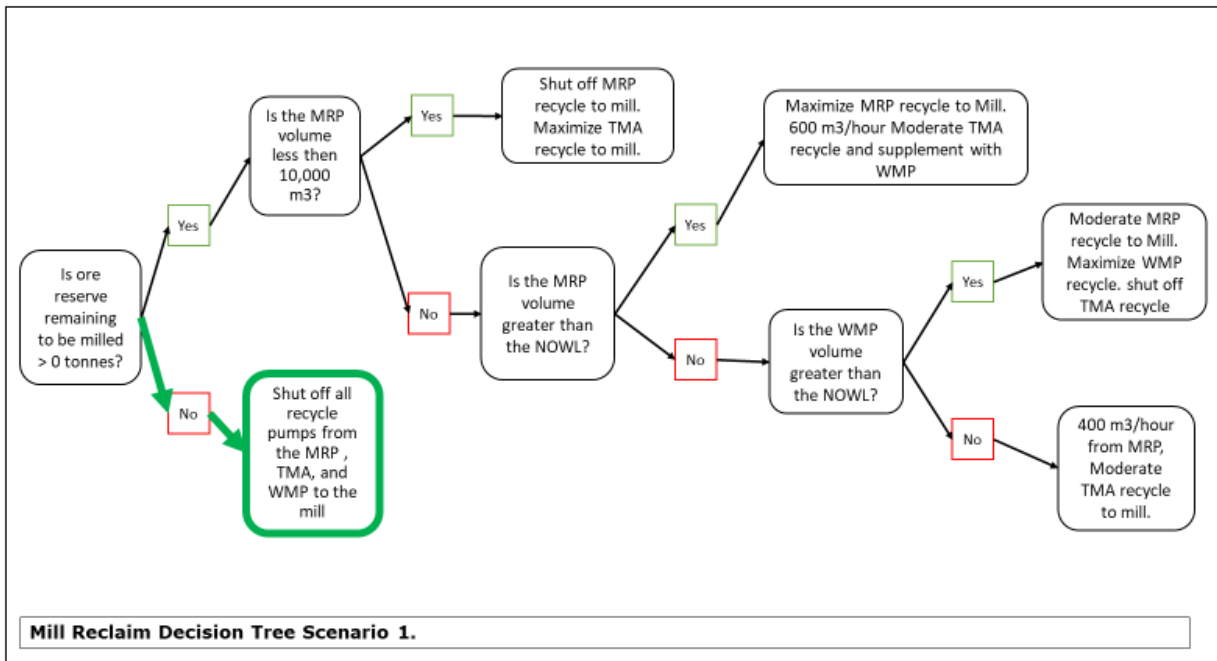
Figure X: Mill Reclaim Decision Tree



**Scenario 1:** No ore tonnage remained to be mill.

Response: Shut off all reclaim pumps. See in Figure X below.

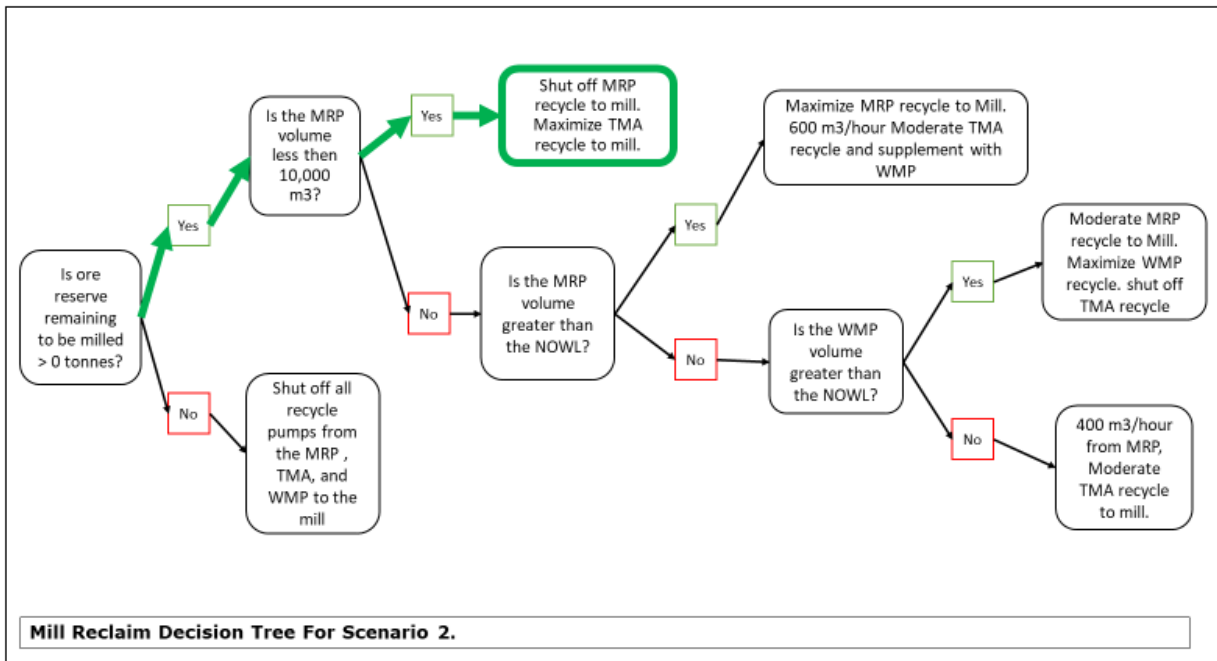
Figure X: Mill Reclaim Decision Tree Scenario 1



**Scenario 2:** MRP volume is 5000 m3, WMP and TMA are at normal elevations

Response: Shut off MRP reclaim and maximize the TMA reclaim. See in Figure X below.

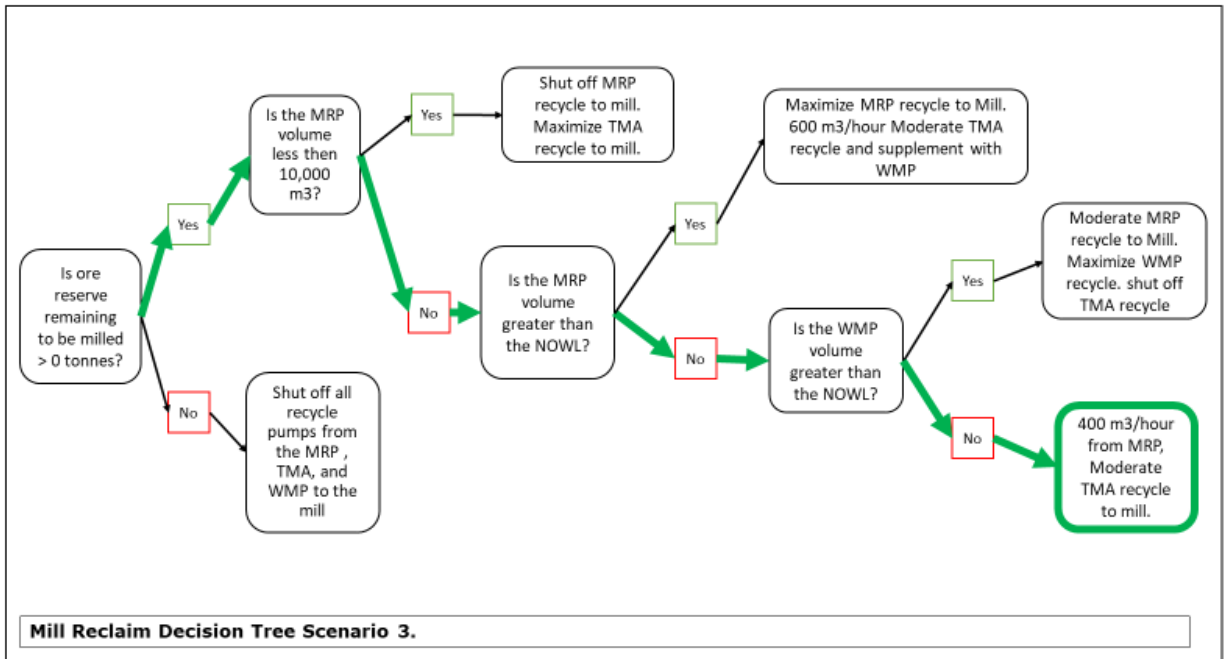
**Figure X: Mill Reclaim Decision Tree Scenario 2**



**Scenario 3:** All ponds elevations are below Normal operation water levels.

Response: Set MRP reclaim at 400 m3/hr, reclaim the rest from the TMA. See in Figure X below.

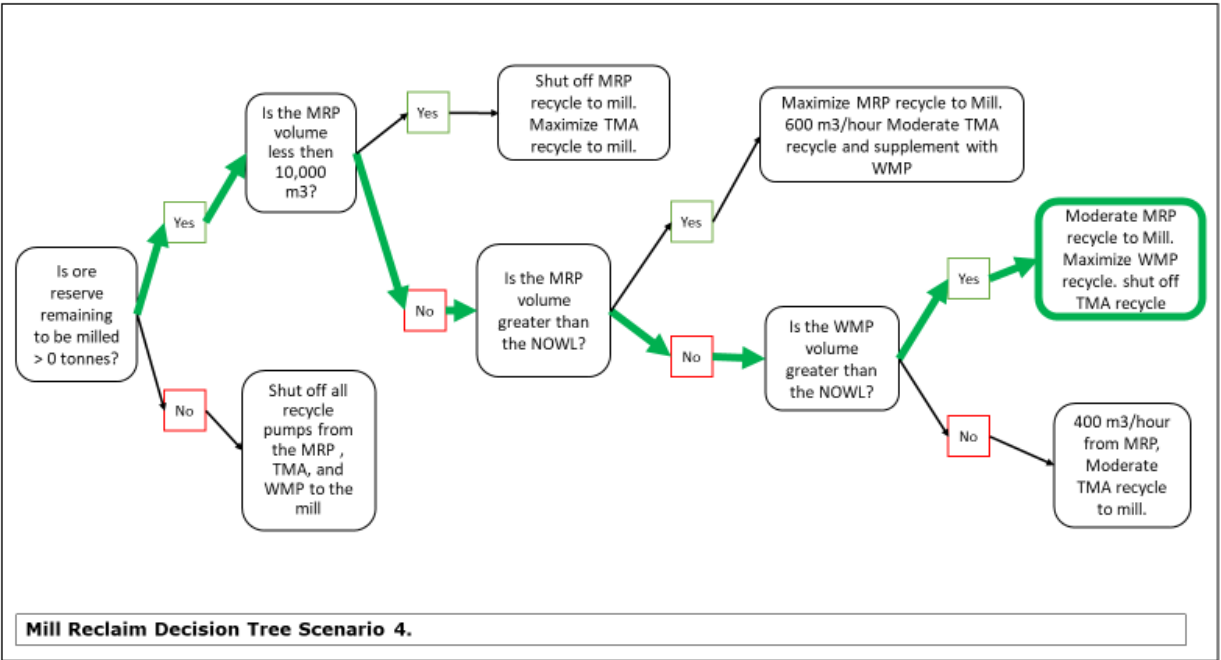
**Figure X: Mill Reclaim Decision Tree Scenario 3**



**Scenario 4:** WWP water elevation is above the normal operating water level, all other ponds are below the normal operating water level.

Response: Maximize WWP reclaim and moderate with MRP reclaim. Shut off TMA reclaim.

**Figure X: Mill Reclaim Decision Tree Scenario 4**



**Mill Reclaim Decision Tree Scenario 4.**