RAINY RIVER PROJECT

PART IX - EMERGENCY PREPARDNESS PLAN - OPERATION, MAINTENANCE AND SURVEILLANCE MANUAL WATER MANAGEMENT STRUCTURES

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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

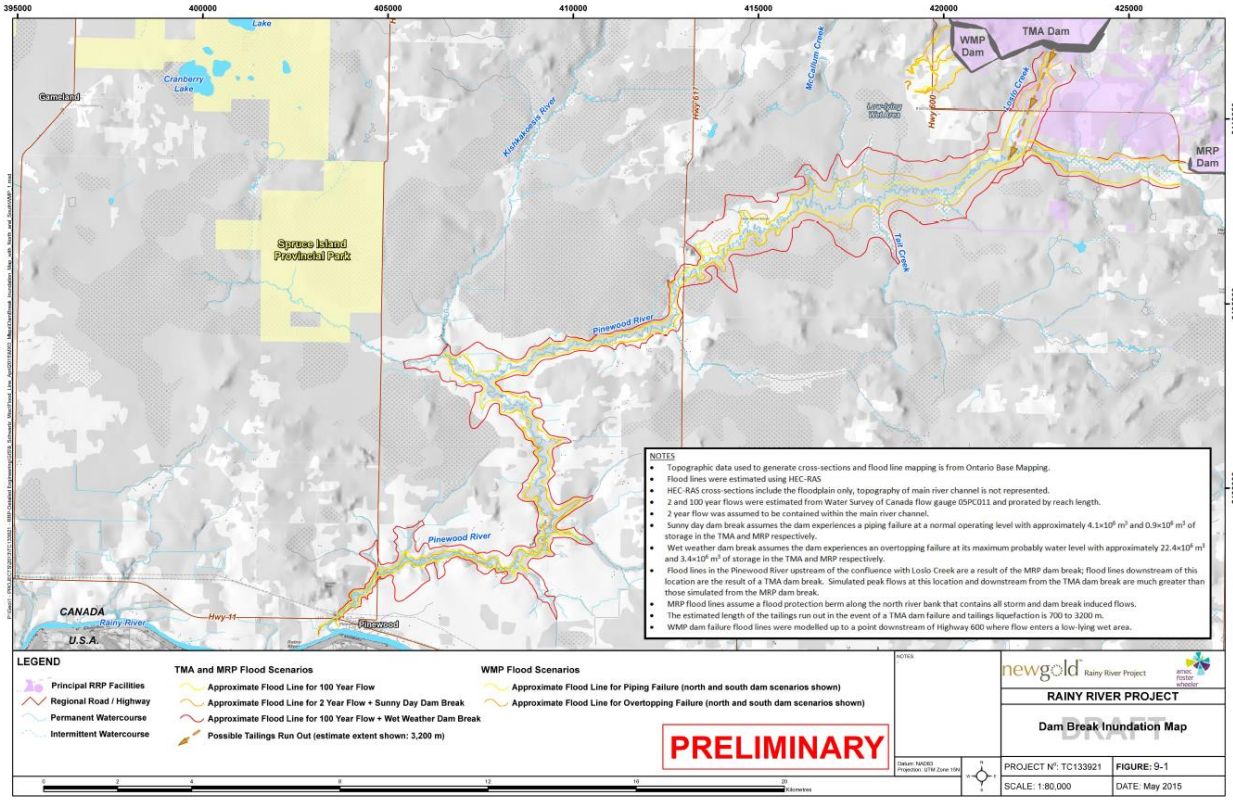
Potential Failure Modes	Possible Causes	Visual Indications	Instrumentation Effects
Break down of pump stations	Blockages, lack of maintenance	No flows	Test on pumps and other related components
Pipeline damage, cracking, blocking, or freezing	Flows blocked by excessively turbid water, debris or ice blockages, 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.	• Check piezometer reading, and check for infilling of piezometer. • If reading confirmed, check all other piezometers, and examine downstream area of dam for changed seepage conditions. • Intensify piezometer readings.
	Decreased seepage discharge accompanied by gradually increasing piezometer levels.	Possible sign of clogging of internal drainage system of dam.	• Check chemistry of seepage discharge for any changes relative to normal. • Request tailings dam engineer to re-evaluate slope stability at this location.
	Increase in size of erosion gullies.	Possible erosion resulting from seepage and/overland runoff. May lead to accelerated erosion and result in dam failure.	• Backfill gullies with filter material and fine rockfill.
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.	• Initiate chain of communication (Figure 9-2) and monitor the situation. • Discontinue tailings discharge in the seepage area. • Intensify monitoring of seepage at this location. • Note if the seepage discharge and/or turbidity continue to increase. • Read piezometers. • Be prepared to place filter material in area of discharge from emergency stockpiles.

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.	• Discontinue tailings discharge in the seepage area. • Place filter material over seepage area using emergency stockpiles. • Continue to monitor area on an intensified basis. • Initiate chain of communications if situation does not improve.
	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.	• Increase frequency of piezometer readings to weekly. • Intensify inspections of downstream dam slope, looking for signs of localized instability/concentrated gully erosion, and for soft ground (saturated slope) conditions.
	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.	• Assess rate of rise and determine if it is steady or accelerating. • If piezometer level increase was sudden, check the reading (repeat it) to eliminate the possibility of a reading error. • Sound bottoms of piezometers to check for infilling. • Send piezometer readings to the tailings dam engineer. • Inspect downstream area for increased seepage and/or turbidity of seepage discharge.
	Long term or sudden increase in rate of inclinometer movements.	Possible sign of impending slope instability.	• Check reading, and contact the Geotechnical Engineer and EOR if confirmed. • Inspect area for any visible signs of instability, bulging on outer slope or at toe, or tension cracks on dam crest. • If tailings discharge is occurring near the inclinometer that indicates unexplained movement, relocate discharge point further away. • Increase frequency of inclinometer readings. • Read nearby piezometers.
	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.	• Check inclinometer readings. • If rate of deformation is accelerating, initiate chain of communication. • Read piezometers. • Check for water inflow into tension cracks. • Regrade to channel runoff away from tension cracks, as water inflow can result in accelerated movement.

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.	• Check decant inlet to see if water turbidity matches that in discharge. • If water at inlet is clear, then close off decant inlet to prevent further discharge. • Notify tailings dam engineer and develop alternate decant arrangements. • Inform Mill.
	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.	• Contact Mill and have discharge of tailings stopped. • Repair the rupture. • Inspect and repair the washed-out portion of the dam slope. • Do not discharge tailings into the area of the washout. • Notify tailings dam engineer to design slope re-construction.
	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.	• Read piezometers. • Assess rate of seepage and whether or not internal erosion is occurring. • If piezometers confirm high phreatic levels, initiate chain of communication. • Carry out weekly monitoring of the seepage discharge area of concern. • Avoid discharge of tailings into the impoundment adjacent to the area.
	Severe flood/intense rainstorm or rapid snowmelt.	Overtopping and washout of dam, and release of pond. Concentrated erosion of tailings slopes, resulting in localized gullying, over-steepening, and potential slope failure. Raising of phreatic surface as a result of infiltration possible.	• Initiate chain of communications (Figure 9-2). • Check the minimum width of tailings beaches. • Inspect spillway for flow and condition. • Stop tailings discharge and slowly lower tailings pond by removing stop logs. • Carry out detailed inspection of dam and pond. • Inspect dam slopes for areas of concentrated erosion, and repair. • Read all piezometers. • Mobilize emergency pumps if needed.
3	Failure or suspected imminent failure of a dam.	Catastrophic breach and release of pond.	• Initiate chain of communications (Figure 9-3). • Stop tailings discharge and lower tailings pond by removing stop logs.

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.	• Initiate chain of communications (Figure 9-3). • Lower pond by removing stop logs. • Do not attempt construction (e.g., construction of a stabilizing berm) until the EOR is on the site (earthmoving equipment should be mobilized).
	Water vortex (whirlpool) within the tailings pond.	Indicates an internal erosion failure in progress, with potential breach of the tailings dam.	• Initiate chain of communications (Figure 9-3). • Stop tailings discharge and lower tailings pond by removing stop logs. • Check downstream area of dam for areas of increased and/or turbid seepage discharge. • Place granular filter buttress against any such areas, using emergency stockpiles. • Go directly to decant outlets if vortex is on a decant line; plug decant outlet with granular material if tailings are discharging through decant.
	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.	• Initiate chain of communications (Figure 9-3). • Stop tailings discharge and lower tailings pond by removing stop logs. • Immediately check dam toe areas/decant outlets for heavy seepage that is transporting tailings solids. • Place granular filter buttress against any such areas, using emergency stockpiles.
	Large earthquake.	Dam failure, breach and release of pond.	• Initiate chain of communications (Figure 9-3). • Carry out detailed post-earthquake inspection of the dam. • Read all instrumentation (piezometers and inclinometers).
	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.	• Initiate chain of communications (Figure 9-2). • Place stockpiled filter materials over seepage discharge area to prevent further erosion of material. • Read piezometers in area of seepage discharge.

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

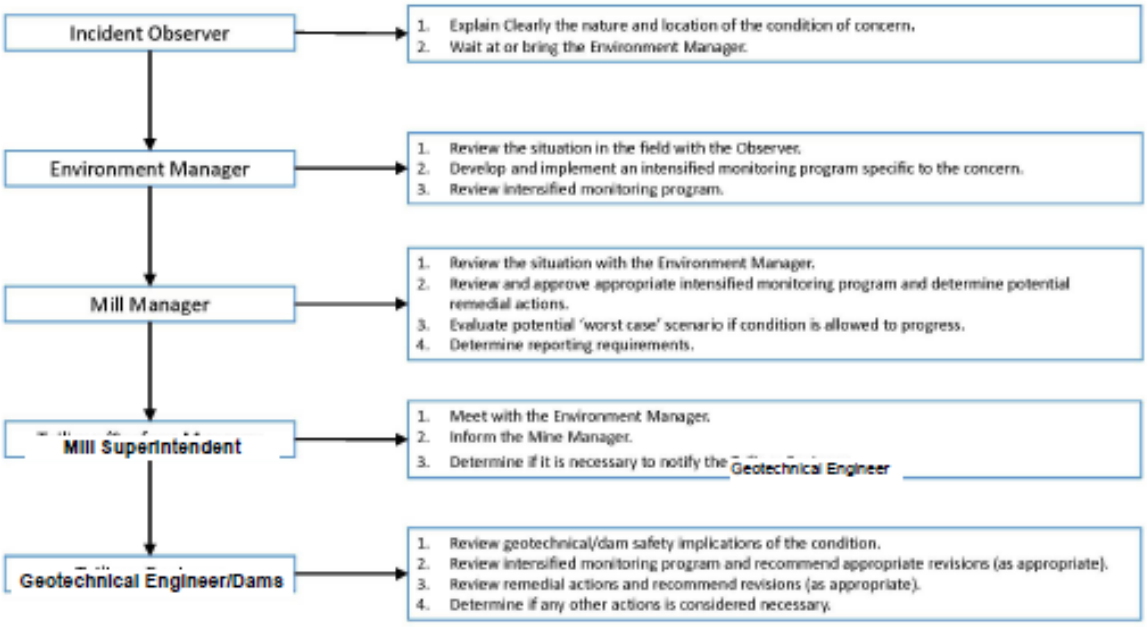
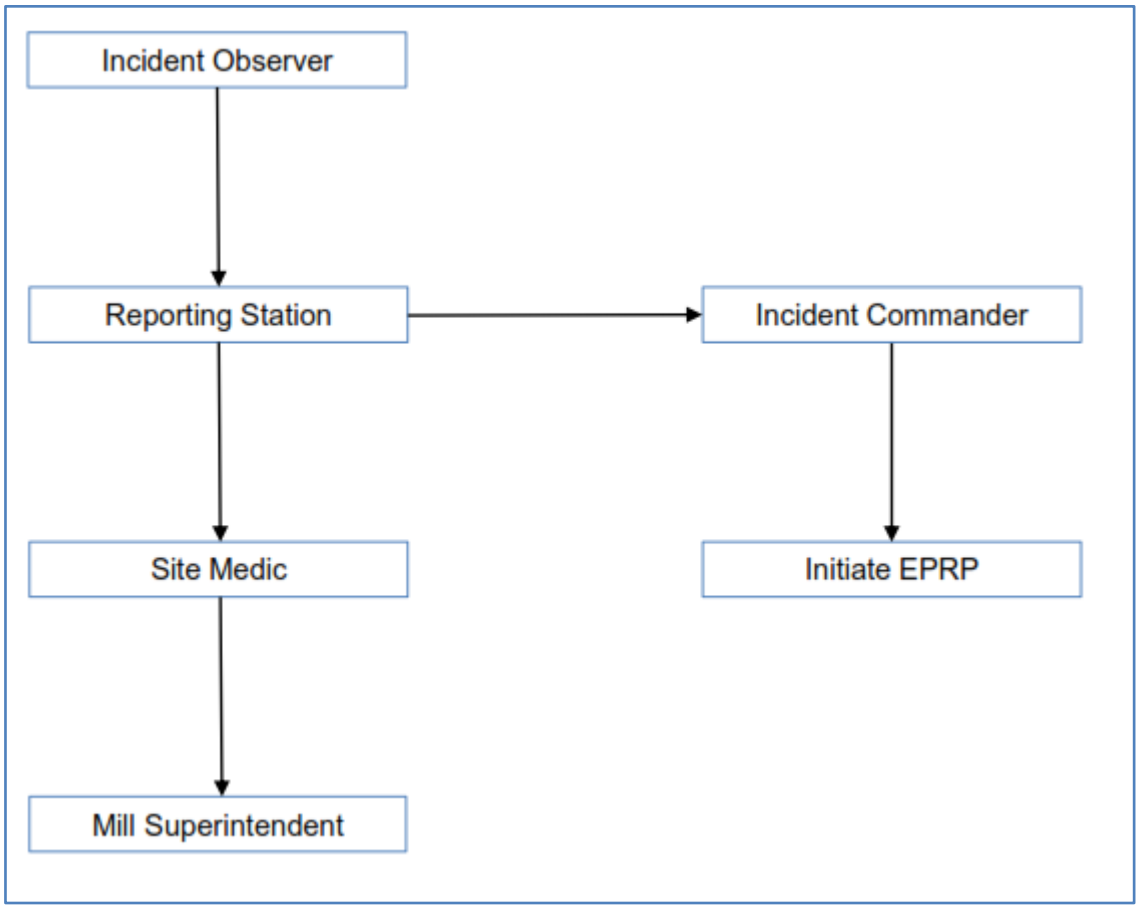


Figure 1-3; Level III Emergency Notification Procedure Flowchart



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
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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.

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