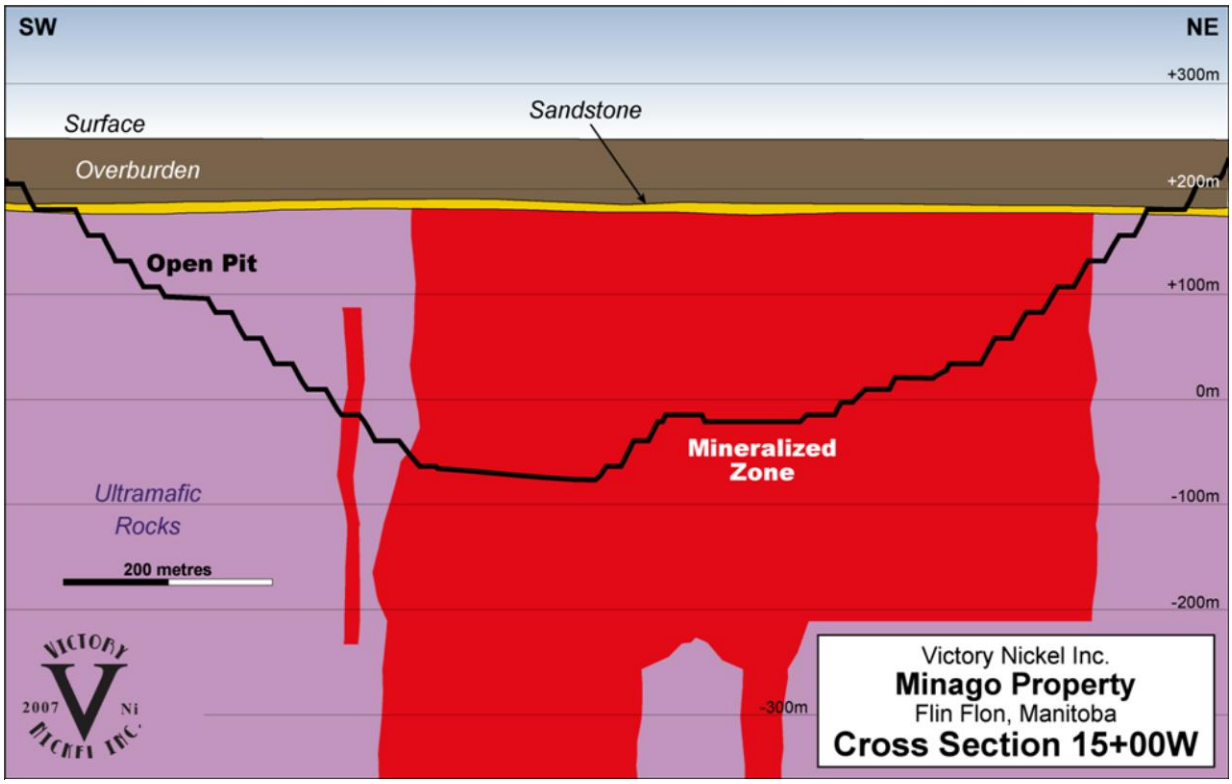

Chapter 8 – Accidents and Malfunctions TWRMF and Other Site Components

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8. ACCIDENTS AND MALFUNCTIONS

8.1 Introduction

In spite of the measures that are put in place to protect the environment, it is recognized that there is potential for accidents and malfunctions to occur during the construction, operations and post-closure periods at the Minago Project Site.

As a result of an accident or malfunction, a release to the environment could occur, and would have the potential to affect water quality, soil quality, vegetation, and/or the well-being of aquatic and terrestrial species, as well as people. The potential for these occurrences is addressed in **Section 9.3**: Spill Contingency and Emergency Response Plan, **Section 9.4**: Waste Management Plan and **Section 9.5**: Wildlife Protection Plan.

Specific malfunction and accident scenarios that have a reasonable probability of occurring during the project are summarized below by project phase VNI and its design engineers have considered likely or high risk and malfunctions into the design of the proposed facilities to ensure that the necessary contingencies are in place. The potential for additional accident and malfunction scenarios will continue to be evaluated and contingencies developed during detailed engineering, construction, throughout the life of the mine and mine closure.

8.2 Potential Scenarios by Project Phase

Various incidences are possible during the construction, operations, and decommissioning and closure phases. The probability and consequential impacts to the environment of potential accidents or malfunction occurring within the project area are summarized in Table 8.2-1.

Accident likelihood is subjectively rated from 1 ‘least likely’ to 5 ‘most likely’. Likelihood 1 events are not expected to occur more than once a year.

The consequences of accidents or malfunctions will vary depending on the potential impacts to environmental resources, rated from 1 ‘low consequence’ to 5 ‘high consequence’. A Consequence 1 event would not result in an off-site release. A Consequence 5 event would cause heavy environmental damage.

The ratings assume that best management practices are employed on a routine basis, and Environmental Management Plans presented in Section 9 are followed in order to mitigate potential adverse impacts. For all project phases, only minor spills and transportation accidents are rated as Likelihood 3 or greater. Descriptions of the scenarios determined to be likely or have environmental consequences of concern are provided below.

Onsite accidents and malfunctions most likely will result in spills associated with the transportation of fuel, hazardous materials and non-hazardous materials, as well as the transfer of fuel and the operation of the fuel storage area.

Table 8.2-1 Probability and Consequence of Accidents or Malfunctions by Phase

Phase	Accident Type	Likelihood[2]	Consequence[3]
Decommissioning and Closure[1]	Building Fire	2	2
	Minor Spills	5	3
	Transportation accidents	2-5	3-4
Operations	Building Fire	2	2
	Minor Spills	5	3
	Transportation accidents	5	4-5
	Tailings slurry or effluent release	2	3
	Process or Water Treatment Plant Malfunction or Release	2	1

Notes:

1. Likelihood and consequences ratings for the construction and decommissioning and closure phases are deemed to be similar and are presented together. For any scenario that continues from the operations phase into the decommissioning phase, the risk would be similar to those described for operations.
2. Ratings: 1 = least likely; 5 = most likely
3. Ratings: 1 = no environmental impact; 5 = high environmental impact.

8.2.1 Construction Phase

During the construction phase, no unusual accidents and malfunctions other than those related to general civil construction are expected.

8.2.1.1 Building Fires

The probability of a building fire is low (2) and the consequence to the environment is also deemed to be low (2). The environmental effect would be reduced localized air quality. The buildings will be situated in cleared areas to minimize fire spread to or from adjacent vegetation. Smoking is not permitted in buildings, but open flames may occur during certain activities. Appropriate firefighting equipment will be installed in all buildings, and trained personnel will be onsite to minimize potential consequences associated with a building fire.

8.2.1.2 Spills

Light and medium oils, diesel fuel, gasoline, hydraulic fluids, lubricants, and explosives are some of the materials typically used at a mine site during the construction phase. A spill of a chemical, reagent, petroleum product, or waste rock onto land or into water will generally occur with improper handling or storage, or in the event of a vehicle accident. The consequence (average rating of 3) of such an event is dependent on the type of material and the volume released. Minor spills will typically be cleaned up efficiently and effectively and long-term environmental impacts are not anticipated. There will be no tailings in the impoundment during the early years of the construction phase.

The Spill Contingency and Emergency Response Plan (Section 9.3) documents the clean up procedures for the various substances anticipated to be onsite during the construction period. Diesel will be stored in a double-walled Envirotank located within the industrial complex area; the greatest spill risk is associated with the improper transfer and handling. VNI will implement the necessary safeguards and training procedures to minimize releases.

8.2.1.3 Transportation Accidents

During the early part of the construction phase, supplies and equipment will be brought to the site by road. The chance of incremental accidents along the PTH6 is high.

During the operational phase, the likelihood of onsite accidents will increase and the potential effects may include a fuel spill or an incident involving wildlife. A spill along the PTH6 is considered to have a moderately low consequence in the winter months as the release would be localized in area. A fuel spill near a stream crossing would have greater consequences, but with implementation of effective spill response measures, impacts would be reduced.

Accident potential will be reduced through the incorporation of road design features for internal roads (such as speed limits and passing bays). Roadside ditches within the property with regularly spaced culverts will also help to contain spills as the culverts could be blocked.

8.2.1.4 Contingency Measures

Most activities conducted during the construction phase will be completed by contractors, and overseen by the onsite management team. Contracts will outline the contractor's responsibilities with respect to environmental protection for all activities. Supplemental special provisions that describe special requirements for site specific conditions will be provided where necessary.

Contractors will be required to prepare contingency plans for the clean-up hazardous spills prior to start up and submit it, together with a list of spill abatement equipment required for job site.

Contractors will be required to immediately report any spills to the Environmental Manager/Coordinator or a designate. The contractors and emergency response team will immediately take the necessary steps to contain and remove the spill, and clean up the affected area. All areas will be restored to the satisfaction of the environmental regulatory agencies.

8.2.2 Operational Phase

During the operations, accidents and malfunctions can be broken down into the following categories based on where the incident occurs:

- outside the buildings but in the industrial complex area
- within the natural environment

Accidents and malfunctions are readily controllable within the industrial complex buildings and area as facility designs have incorporated features such as floor sumps within the buildings, secondary containment around the fuel storage farm, as well as a network of ditches and sumps around the industrial complex to collect all runoff from within the area. With these isolation and containment features in place, the scenarios considered to cause an environmental impact are located outside the industrial complex area. They include minor spills, major spills during fuel haulage, concentrate spill during haulage, a malfunction in the TWRMF or water reclaim pipelines, and transportation accidents. The effects of a building fire are similar to those stated for the construction phase.

8.2.2.1 Spills

The most likely mechanism for a spill of a hazardous material to occur outside of the mine area is in the event of a transportation accident. A spill from either a fuel or concentrate and frac sand haul trucks would be confined to the road bed area and terrestrial habitat, unless it occurred at one of the culvert crossing locations. The likelihood of a spill near a crossing is not as high as a spill to the terrestrial environment. Impacts would only have downstream consequences during the open water period.

During concentrate shipment, a spill would not be expected to create much dispersion of concentrate, since the concentrate has low moisture content as it has been dewatered. All spills would be immediately cleaned up and sufficient soils would be removed to ensure that there is no long-term contamination in the area of the release. The environmental impacts from these scenarios are considered to be moderate to high depending on the spill location, but reversible in a relatively short time period.

8.2.2.2 Tailings Slurry or Effluent Release

During the operational phase, a malfunction or an accident involving one of the pipelines used for transporting tailings slurry and reclaim water could lead to a release to the environment. Since the pipelines are not under pressure, and the pumping is readily controllable, the area of impact would likely be limited to the local area in the vicinity of incident and areas immediately downstream. Emergency response measures would include activities to contain, collect and dispose of released materials.

A malfunction or breach of the TWRMF dam may result in the release of water volumes greater than what can be collected by the seepage ditches. The TWRMF and its appurtenances are located in a portion of a valley that stretches 10km to the north and this watershed drains to the Minago River. The majority of the tailings will be trapped in muskegs; the impact on the Minago will be minimal. As high standards were adopted in the selection of design flood and earthquake criteria, a breach of the TWRMF dam is considered to be unlikely.

8.2.2.3 Process or Water Treatment Plant Malfunctions

The process plant and potable water treatment plant are located within the primary industrial complex building. A malfunction or mechanical shutdown at these plants would not be significant as there will be backup equipment in place. Nevertheless, there is adequate storage capacity within the tailings facility to accommodate a shutdown.

8.2.2.4 Polishing Pond Malfunctions

The polishing pond is designed to meet the design criteria of 7 days retention. During the operational phase, a malfunction or an accident involving the discharge pipeline used to transport effluent to the Minago watershed could lead to a release to the environment. Since the pipeline is not under pressure, and the pumping is readily controllable, the area of impact would be likely limited to the local area in the vicinity of the incident immediately downstream. In addition, the effluent being transported by the pipeline, meets discharge effluent quality criteria. Therefore, this will cause minimal environmental impact. A malfunction or breach of the PP dyke may result in the release of water to the receiving environment and impacts will only occur if the discharges do not meet regulatory guidelines. Contingency measures detailed in section 8.2.2.6 will be activated.

8.2.2.5 Transportation Accident

The environmental effects of the road are based on the potential effects of spills and wildlife encounters as previously described above in Sections 8.2.1.3 and 8.2.2.1

8.2.2.6 Contingency Measures

During the operational phase, VNI employees and the emergency response team will respond to fuel spills, floods, malfunctions, or other natural or human-caused incidences. In the event of an incident, the nature and location of the incident will be confirmed and notification and response will then be systematically implemented in accordance with Section 9.3: Spill Contingency and Emergency Response Plan.

Environmental impacts will continue to be mitigated through the implementation of effective design as well as operational practices including personnel training and job briefings. Facilities have been designed to minimize the likelihood of occurrences and provide early warning monitoring features. Once detailed engineering is complete, VNI commits to preparing operational plans (that include emergency response measures) for all facilities.

8.2.3 Decommissioning and Closure Phase

The stability of the downstream slopes of the Ultimate Dam at Closure was analyzed using a limit equilibrium method with slope stability software Geostudios Slope/W (version 7.21). The upstream slope of the Ultimate Side Dams along the dolomite ridges was also analyzed. The minimum factors of safety against slope failure were calculated using the Morgenstern-Price Method. The slope stability analyses were performed at the critical sections under both static loading and pseudo static earthquake loading conditions.

Different failure modes and mechanisms were considered in the analyses including potential shallow or deep-seated slip surfaces and optimized circular or block type slip surfaces with minimum calculated factors of safety reported.

The calculated factors of safety against dam failure for all stability analyses reported ranged from 1.3 to 1.7 and meet the requirements of the design criteria.

During the decommissioning phase, accidents and malfunctions are anticipated to have the same likelihood and consequence as those anticipated to have the same likelihood and consequence as those anticipated in the construction phase. Following the operations phase, all process plant operations will cease. Accidents and malfunctions involving ongoing water treatment in the industrial complex and a release of effluent from the tailings dam would be similar the consequences described for the operation phases. In addition, experience obtained during mining operations would reduce the potential frequency of malfunctions at these facilities.