Crawford Nickel Project Impact Statement

Chapter 31 Assessment of Potential Effects of Potential Accidents or Malfunctions

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Acronyms and Abbreviations

CoPC	chemicals of potential concern
EPRP	Emergency Preparedness and Response Plan
H:V	Horizontal : vertical slope
LSA	Local Study Area
m^3	cubic metres
Mm^3	million cubic metres
PA	Project Area
RSA	Regional Study Area
TMF	Tailings Management Facility
VC	Valued Component

31 Assessment of Potential Effects of Potential Accidents or Malfunctions

In accordance with Section 13 of the Tailored Impact Statement Guidelines (TIS Guidelines) and section 22(1)(a)(i) under the *Impact Assessment Act*, 2019, the impact assessment of a designated project must address the effects of accidents or malfunctions that may occur in connection with the Project.

'Accidents' and 'malfunctions' are events that occur outside the normal planned function or activity of the Project. These Project-related unplanned events may be caused by technological malfunctions, human error, or exceptional natural events (e.g., flooding, earthquake, forest fire) and have the potential to affect the environment. Potential effects associated with minor events that are expected to occur (i.e., minor spills, road accidents) are addressed within the Valued Component (VC) chapters (Chapters 10-28).

Through good planning and design and the adoption of safety measures, the risks of accidents and malfunctions can be prevented, reduced, or controlled. An Emergency Preparedness and Response Plan (EPRP) will be developed to help mitigate the effects of accidents or malfunctions should they occur.

31.1 Approach

The following approach was used to identify and assess potential Project-related accidents and malfunctions:

- Identify plausible accident or malfunction scenarios that could occur during Project phases, including construction, operation, and decommissioning and closure.
- Screen plausible accident or malfunction scenarios to determine which may have an interaction with VCs.
- Assess the effects of those scenarios that were determined to potentially have an interaction with VCs:
  - identify the preventive measures that will be implemented to reduce the likelihood of each plausible accident or malfunction scenario occurring
  - identify the emergency response measures that would be implemented to manage the potential consequences of each accident or malfunction scenario, should one occur
  - describe the potential residual adverse effects (i.e., after preventative or response measures have been implemented) on VCs that may result from each accident or malfunction scenario
- Assess the risk associated with each identified plausible accident and malfunction scenario that was screened in.

31.1.1 Identification of Accident and Malfunction Scenarios

The TIS Guidelines require that the Impact Statement identify hazards for each project phase that could lead to Project-related accidents and malfunctions.

Hazards are identified through the identification of plausible accident and malfunction scenarios. Section 31.2 describes each accident or malfunction that was identified as being a plausible worst-case scenario that could occur over the life of mine. The accident and malfunction scenarios were identified based on the design of the Project, professional judgement, experience from other mining projects, as well as direction from the TIS Guidelines.

31.1.2 Spatial and Temporal Boundaries

The spatial boundaries for the effects assessment associated with accidents and malfunctions are the same as the spatial boundaries established for each VC (see Chapters 10-23).

The temporal boundaries include all phases of the Project, including construction, operations, and decommissioning and closure.

31.1.3 Preventive Measures

The Project is being designed, and will be constructed and operated, according to accepted standard practices for health, safety, and environmental management, to reduce the risk of potential Project-related environmental, health, social and economic effects, and effects to Indigenous nations, including those that could result from accidents or malfunctions. Safety and preventive measures will be implemented to reduce the potential for accidents or malfunctions by following best management practices based on professional expertise and local knowledge/experience, including:

- Canada Nickel will use accepted standard management practices for carrying-out the Project while controlling permitted or allowable releases to the environment and consequently limit effects
- Canada Nickel will incorporate safety and reliability into the design of Project components, and application of principles and practices of process and mine safety management
- Canada Nickel will maintain equipment to be in good working order and implement careful maintenance and monitoring of all equipment to reduce emissions and the risk of spills or leaks of petroleum-based products.
- Canada Nickel will maintain a supply of emergency response equipment, including spill pans, absorbent material, and Safety Data Sheets
- Canada Nickel will dispose of waste material in an environmentally responsible manner, and in accordance with provincial, territorial, and municipal legislation
- Canada Nickel and any construction and contractor personnel will be prohibit from harming, harassing, or feeding wildlife
- Canada Nickel will develop and apply procedures and training aimed at safe operation of the Project that reduce or prevent the potential conditions that may lead to accidents or malfunctions

- Canada Nickel will provide training in operational procedures and emergency response procedures, including safety measures, to reduce or prevent accidents or malfunctions
- Canada Nickel will develop and implement Management Plans for the Project to outline the proposed safety and mitigation measures and commitments to be carried out by Canada Nickel and their contractors

31.1.4 Emergency Preparedness and Response Plan

An EPRP will be prepared to describe actions to be carried out in the event of an accident or malfunction, and procedures/protocols to provide rapid response to these events. The EPRP will be advanced prior to construction and will outline incident reporting and investigation procedures. The purpose of the EPRP is to:

- facilitate prompt and efficient response actions for addressing emergencies or compliance issues
- identify the organization, responsibilities, and reporting procedures of the emergency response team
- define appropriate communications protocols, including procedures to contact relevant regulatory agencies related to an accident or malfunction event and follow up actions that will be taken
- provide site information on the facilities and contingencies in place should an emergency or compliance issue occur
- provide support and information on available resources, facilities and trained personnel in the event that an emergency occurs

Emergency response measures will be prepared in accordance with federal and provincial legislation and guidelines, and corporate policies and procedures for the protection of human health, the environment, and property. Measures include emergency response planning, training, responsibilities, cleanup equipment and materials, and contact and reporting procedures.

The EPRP will be refined as the Project advances.

31.1.5 Effects Assessment

Section 31.2 provides a qualitative analysis of the potential residual adverse effects of each plausible accident or malfunction scenario that was determined to have an interaction with VCs. This analysis includes consideration of engineering and technical studies prepared for the impact assessment and relies on the expertise of the Project team.

The effects assessment includes a description of preventive measures (i.e., design safety and mitigation measures) to reduce potential adverse effects of accidents or malfunctions, emergency response measures, and an assessment of effects on specific VCs that are most likely to be affected by each identified plausible accident or malfunction scenario that was determined to have an interaction with VCs to help characterize the risk associated with each accident and malfunction scenario. For scenarios that have been determined to have a potential interaction with VCs, those VCs are discussed in more detail in the effects assessment subsections. For scenarios that were determined to not have an interaction with a VC, a rationale is provided as to why no residual effects are anticipated for those scenarios.

31.1.6 Risk Assessment

Finally, Section 31.2 provides an assessment of the risk associated with each identified plausible accident or malfunction scenario for those scenarios that were determined to have a potential interaction with a VC. Risk is determined as a function of the likelihood of a hazard/adverse event occurring (frequency of occurrence) and the severity of its consequences (magnitude, duration and extent of the damage or harm). This determination is based on the evaluation of the severity of potential residual adverse effects (i.e., effects that remain after implementation of mitigation measures) and the likelihood of the event occurring. Once the potential residual adverse effects associated with each accident or malfunction scenario are identified, the risk is determined based on the method described below.

The likelihood and severity of consequences are determined based on the experience and judgment of qualified professionals. Determinations of likelihood and severity of consequences consider the lifespan of each Project component (as required by the TIS Guidelines).

The potential **likelihood** of an event occurring is defined as follows:

- **Very Low**: Not expected to occur during the life of the Project, with no or limited previous examples of occurrence in similar projects.
- **Low**: Limited potential to occur in exceptional circumstances during the life of the Project with limited but consistent occurrence in some similar projects.
- **Moderate**: May occur during the life of the Project, with an established trend of occurrence in most similar projects.
- **High**: Expected to occur during the life of the Project, with frequent occurrence in similar projects.
- **Very High**: Almost certain to occur during the life of the Project.

The **severity of consequences** of an event is defined as follows:

- **Very Low**: Localized effect, readily remediated, recovery within a few weeks or months.
- **Low**: Localized effect, predictably remediated, recovery within the life of the Project.
- **Moderate**: Widespread effect, predictably remediated, recovery within the life of the Project.
- **High**: Widespread effect, uncertain remediation, may not be recoverable within the life of the Project.
- **Very High**: Widespread effect, unlikely to be completely remediated, not recoverable within the life of the Project.

Section 31.3 summarizes the potential likelihood and severity of consequence for each identified accident or malfunction scenario. Once the likelihood and severity of consequence are determined, the risk matrix presented in Figure 31.1. and Figure 31.2 is used to determine the risk associated with each identified plausible accident or malfunction scenario.

31.1.7 The Influence of Consultation and Engagement on the Assessment

Canada Nickel has engaged with potentially affected Indigenous nations, regulators, landowners, and stakeholders. Table 31.1 provides a summary of the topics, key information including Indigenous knowledge, and concerns that Canada Nickel identified as part of their engagement efforts that relate to potential accidents and malfunctions, as well as a summary of the influence that the outcomes of this engagement had on the assessment.

This information was considered when evaluating whether Canada Nickel's planned mitigation will effectively manage the identified potential interactions, or whether additional or refined mitigation is warranted.

Table 31.1 Summary of Key Information, Indigenous Knowledge, and Concerns for the Project Related to Potential Accidents and Malfunctions

Topic	Key Information, Indigenous Knowledge, and Concerns	Influence on the Assessment	Where Information is Addressed in the Impact Statement
Identification and Screening of Accident or Malfunction Scenarios	• Apitipi Anicinapek Nation, Flying Post First Nation, Métis Nation of Ontario – Region 3, and Taykwa Tagamou Nation recommend baseline studies on species at risk, particularly in relation to accidents and malfunctions, and the need for associated mitigation measures. • Taykwa Tagamou Nation expressed concern regarding the potential for increased road accidents, including those associated with wildlife collisions.	• Baseline studies have been conducted as part of the VC-specific chapters. • Considered in the development of preventive and response measures and supported scope of issues assessed. • Change in wildlife mortality is addressed in Chapter 19 of the Impact Statement (Assessment of Potential Effects on Wildlife and Wildlife Habitat). • Informed the assessment on Indigenous interests in Chapters 25 to 28 of the Impact Statement (Assessment of Potential Effects on Indigenous Interests). • Canada Nickel's responses to mitigation recommendations made by the Indigenous nations are provided in Chapters 25 to 28 of the Impact Statement (Assessment of Potential Effects on Indigenous Interests).	• Chapter 31 (Accidents and Malfunctions), Section 0 • Chapters 10 to 23 (VC Chapters) • Chapters 25 to 28 (Assessment of Potential Effects on Indigenous Interests)

Topic	Key Information, Indigenous Knowledge, and Concerns	Influence on the Assessment	Where Information is Addressed in the Impact Statement
Accident or Malfunction Scenarios	• Apitipi Anicinapek Nation, Flying Post First Nation, Matachewan First Nation, Mattagami First Nation, and Métis Nation of Ontario – Region 3 recommend measures to prevent and avoid accidents, including release of hazardous materials, spills, transportation and storage of dangerous goods, tailings, dam breach, and forest fires (from increased rail traffic); and details of plans to notify, involve and communicate with residents, including Indigenous residents and in Indigenous languages. • Apitipi Anicinapek Nation expressed concern regarding impacts from accidents and malfunctions during the life of the Project that could affect the natural environment and physical and mental health of Apitipi Anicinapek Nation members. • Flying Post First Nation, Matachewan First Nation, Mattagami First Nation, Métis Nation of Ontario – Region 3, and Taykwa Tagamou Nation recommend mitigation measures for effects to birds, migratory birds, and their habitat from accidents. • Matachewan First Nation expressed concern regarding contamination of the local waterways emanating from tailings and settling ponds, as well as machinery spills or accidents that would negative affect waterways and consequently the fish and animals that Matachewan First Nation members consume. • Taykwa Tagamou Nation recommends a transportation strategy for dangerous goods. • The Environmental Community Committee expressed concern about the impact the dam may have for the Local Study Area/Regional Study Area.	• Considered in the development of preventive and response measures and supported scope of issues assessed. • Transportation of hazardous materials and reagents required for Project operations will be transported following applicable federal and provincial regulations (e.g., Transportation of Dangerous Goods Regulations), as appropriate. • Informed the assessment on Fish and Fish Habitat in Chapter 17 (Assessment of Potential Effects on Fish and Fish Habitat). • Informed the assessment on Birds and Bird Habitats in Chapter 18 (Assessment of Potential Effects on Birds and Bird Habitat). • Informed the assessment on Wildlife and Wildlife Habitat in Chapter 19 (Assessment of Potential Effects on Wildlife and Wildlife Habitat). • Informed the assessment on Health in Chapter 21 of the Impact Statement (Assessment of Potential Effects on Health). • Informed the assessment on Indigenous interests in Chapters 25 to 28 of the Impact Statement (Assessment of Potential Effects on Indigenous Interests). • Canada Nickel's responses to mitigation recommendations made by the Indigenous nations are provided in Chapters 25 to 28 of the Impact Statement (Assessment of Potential Effects on Indigenous Interests).	• Chapter 31 (Accidents and Malfunctions), Sections 0, 31.2.4 • Chapter 17 (Assessment of Potential Effects on Fish and Fish Habitat). • Chapter 18 (Assessment of Potential Effects on Birds and Bird Habitat). • Chapter 19 (Assessment of Potential Effects on Wildlife and Wildlife Habitat). • Chapter 21 (Assessment of Potential Effects on Health) • Chapters 25 to 28 (Assessment of Potential Effects on Indigenous Interests)

Where made available by Indigenous nations through engagement, information gathering, and voluntary information sharing, Indigenous knowledge has been considered and incorporated into the Impact Statement, as applicable. Refer to the Description of Engagement with Indigenous Peoples (Chapter 7 of the Impact Statement) for detailed methods regarding the incorporation of Indigenous knowledge to the Impact Statement.

31.2 Description and Effects Assessment of Accident and Malfunction Scenarios

Based on the design of the Project, professional judgment, and experience from other mining projects, as well as direction from the TIS Guidelines, a list of plausible accidents and malfunction scenarios were identified as having the potential to occur in connection with the Project. These scenarios are identified in Table 31.2.

Environmental sensitivity mapping has been developed to identify pathways and areas within the Project Area (PA) that may be sensitive to these accident and malfunction scenarios (e.g., wetlands and watercourses). A sensitivity map (Figure 31.3 Construction Scenario) is provided for a visual representation of areas that may be more sensitive to hazards.

Table 31.2 Plausible Accidents or Malfunction Scenarios

Plausible Accident or Malfunction	General Description
Tailings Management Facility (TMF) Malfunction	Malfunction of the TMF could lead to the release of untreated tailings.
Release of Untreated Contact Water	Malfunction of water management infrastructure (e.g., seepage/contact water collection system, including ponds) could lead to the release of untreated contact water.
Release of Fuel or Hazardous Materials	Malfunction of fuel farm equipment or operational error may result in the release of petroleum-based products. Failure of on-site storage and handling facilities for hazardous materials could result in the release of these materials (e.g., reagents, solvents, hydraulic fluid, and other hazardous chemicals). Collision or mechanical malfunctions involving equipment or vehicles may result in the release of hazardous materials such as mill reagents, hydraulic fluid and fuel, or other non-hazardous materials such as construction material. Train derailment or a rail transfer incident could result in the release of fuel or hazardous materials.
Open Pit Slope Failure	Slope failure in the Open Pit could result in adjacent areas slumping into the Open Pit, and potential unintended expansion of the Open Pit.
Stockpile Slope Failure	Failure of stockpile (e.g., ore Stockpiles, Impoundment Facility, crushed ore Stockpiles) slope could result in the release of stockpiled materials (e.g., ore, rock, clay, sand, overburden) outside of storage areas.
Over Blasting Incident	Uncontrolled or unmanaged blasting could result in the force of the explosion being greater than intended and cause damage resulting from dust and fly rock extending beyond defined boundaries and result in excess noise and vibration.

Plausible Accident or Malfunction	General Description
Accidental Fire	A fire may result in damage to Project infrastructure, vegetation, or natural features in or beyond the PA, and the release of smoke, combustion gases and ash.
Water Diversion Failure	Failure of the water diversion channel (e.g., North Driftwood River Diversion) could result in erosion, the release of sediment to downstream watercourses and lakes, and potential damage to downstream road crossings and adjacent utilities.

Exceptional natural events (e.g., flooding, earthquake, forest fire) that could cause effects are assessed in Chapter 30 of the Impact Statement (Assessment of Potential Effects of the Environment on the Project). The plausible accidents and malfunctions identified in the above table are further described in the following sections.

31.2.1 Summary of Interactions between Valued Components and Accident and Malfunction Scenarios

Table 31.3 presents the potential interactions between VCs and the previously described plausible accident and malfunction scenarios.

Table 31.3 Potential Interactions between Valued Components and Indigenous Interests, and Identified Accident and Malfunction Scenarios

Plausible Accident or Malfunction	Geology and Geological Hazards	Soil	Atmospheric Environment	Acoustic Environment	Groundwater	Surface Water	Vegetation, Riparian and Wetland Environments	Fish and Fish Habitat	Birds and Bird Habitats	Wildlife and Wildlife Habitat	Climate Change	Health	Social Conditions	Economic Conditions	Indigenous Interests
TMF Malfunction	-	✓	-	-	✓	✓	✓	✓	✓	✓	-	✓	-	-	✓
Release of Untreated Contact Water	-	✓	-	-	✓	✓	✓	✓	-	-	-	✓	-	-	✓
Release of Fuel or Hazardous Materials	-	✓	-	-	-	✓	✓	✓	-	-	-	✓	-	-	✓
Open Pit Slope Failure	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stockpile Slope Failure	-	✓	-	-	-	✓	-	✓	-	-	-	-	-	-	✓

Plausible Accident or Malfunction	Geology and Geological Hazards	Soil	Atmospheric Environment	Acoustic Environment	Groundwater	Surface Water	Vegetation, Riparian and Wetland Environments	Fish and Fish Habitat	Birds and Bird Habitats	Wildlife and Wildlife Habitat	Climate Change	Health	Social Conditions	Economic Conditions	Indigenous Interests
Over Blasting Incident	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Accidental Fire	-	-	✓	-	-	-	✓	-	✓	✓	✓	✓	-	-	✓
Water Diversion Failure	-	✓	-	-	-	✓	✓	✓	-	-	-	-	-	-	✓
Note: - = no interaction ✓ = potential interaction															

Six of the eight plausible scenarios were identified as having potential interactions with VCs, if they occurred, and are therefore further assessed in the following sections. The other two scenarios are also discussed, and a rationale is provided as to why no residual effects are anticipated for those scenarios.

As presented in Table 31.3, no interactions are anticipated between the identified plausible scenarios and Geology and Geological Hazards, the Acoustic Environment, and Climate Change.

In the case where an accident or malfunction resulted in Project operations to be temporarily suspended, there is potential for a ‘low’ magnitude ‘adverse’ effect to economic conditions through effects to wages, government revenues, and depending on the length of the suspension, gross domestic product. There may also be increased localized spending with short-term benefit to nearby communities, including businesses supplying goods and services in support of the emergency responses. Effects to economic conditions would be ‘short-term’ in duration and likely ‘reversible’ within a month, therefore, residual effects to economic conditions from an accident or malfunction are not discussed further.

While emergency response capabilities at the mine site (e.g., firefighting and health care) will be appropriate for most accidents, a major accident may require support from surrounding communities. However, such support would not be frequent and would not put an excessive demand on emergency response capacity. Effects to social conditions would be ‘short-term’ in duration and likely ‘reversible’ within a month; therefore, residual effects to social conditions from an accident or malfunction are not discussed further.

31.2.2 Tailings Management Facility Malfunction

The TMF will be built to store mine waste in the form of thickened tailings from the Process Plant. The TMF site selection process was carried out in accordance with Environment Canada's Guidelines for the Assessment of Alternatives for Mine Waste Disposal (Environment Canada 2011). The TMF site was selected in consideration of environmental constraints, including potential triggering of a Metal and Diamond Mining Effluent Regulations Schedule 2 amendment, the use of natural topography for containment, existing land tenure, the spatial footprint of the Project, and the benefits of having tailings contained in a single facility.

The TMF will be constructed south of the Open Pit and has been designed to hold 495 million (M) cubic metres (m^3) of tailings covering an area of 2,300 hectares (ha). A perimeter dam will encircle the TMF, which will be operated as a "thickened tailings cone" with tailings deposition near the centre of the TMF. The TMF will be used to house tailings until Year 18, when tailings storage will shift to the Main Zone of the Open Pit. In Year 33, tailings storage will also include the East Zone. The plausible worst-case scenario for a TMF malfunction would be a dam failure, or dam breach from the dam crest to the dam foundation causing a release of thickened tailings to the environment. This worst-case scenario would not materialize during construction (TMF will not be operational until later), nor during the early years of operations given that the volume of thickened tailings stored in the TMF will increase over time using the centerline method.

31.2.2.1 Preventive Measures

The TMF has been designed to meet the requirements of the Canadian Dam Association Dam Safety Guidelines (Canadian Dam Association 2013) and has been designed to accommodate the recommended seismic exceedance probability and inflow design flood according to the expected hazard potential classification.

A perimeter dam will encircle the TMF and will include a low permeability core, filter, and transition zones, downstream and upstream shells. The low permeability core will be covered by a layer of frost protection material (sand) to insulate the core and reduce potential for degradation from freeze-thaw action. Rip-rap erosion protection will be provided over the exposed sand slopes of the frost protection and upstream shell. The TMF tailings deposition plan is divided into four stages: start-up, starter dam, 350 Mm^3 of containment, and 495 Mm^3 of containment. At each stage, the TMF dams will be raised progressively to provide additional storage capacity. The start-up phase will accommodate 100 Mm^3 of tailings deposition within the central area of the TMF and will not require perimeter containment dams (though perimeter channels for contact water management will be in place). The starter dam phase refers to the configuration when the TMF dam has approximately 1.0 metres (m) of tailings impounded against the upstream slope.

The TMF will be constructed using proven design specifications in accordance with relevant guidelines and legislation. To achieve storage capacity requirements and to accommodate the site geotechnical conditions, the TMF will be operated as a "thickened tailings cone" with tailings deposition near the centre of the TMF. The thickened tailings technology has been adopted because it is expected to produce a steeper beach slope (relative to conventional slurry deposition), which contributes to increasing the TMF storage capacity and to limiting the perimeter dam height. In addition, the carbonation of tailings induces cementation of the particles, which greatly reduces the mobility of the tailings should a worst-case TMF dam failure scenario occur.

The perimeter dams are rockfill embankments that do not depend on the support of deposited tailings for stability. Tailings from the Process Plant (after passing through the carbon sequestration system) will be pumped to the TMF through an HDPE pipeline. In addition, a tailings outflow deflector berm will be installed north of the TMF to protect the fuel farm from water and tailings runout in the event of a worst-case TMF dam failure (north breach), thus mitigating the release of fuel to the pit and surrounding environment (see Appendix P of the Impact Statement [Tailings Dam Breach Consequence Assessment Report]). The various components within the TMF will be regularly inspected by qualified personnel that are familiar with the design and operating requirements. The results of the monitoring program will form the basis for determining maintenance and remediation measures that may be required from time to time.

With design safety and mitigation measures in place, the likelihood of a malfunction of the TMF during all phases of the Project is considered very low. Contingency planning, engineering, and quality controls during all phases of the project will be implemented to mitigate the risk of a TMF malfunction occurring.

31.2.2.2 Emergency Response Measures

In the event of a TMF dam failure, preliminary emergency response measures would include:

- stop pumping of tailings to the TMF (i.e., process plant shutdown)
- notify regulatory authorities
- use earth-moving equipment to construct temporary berms across drainage channels to capture tailings or waste materials where possible
- to the extent practicable, use on-site earth-moving equipment and local materials to reduce further loss/spread of tailings or waste materials
- deploy silt fencing and silt curtains if material has entered watercourses
- develop a specific remedial action and monitoring plan for the event and initiate remedial action
- notify authorities, emergency responders, local residents, and Indigenous nations

Additional information on emergency response measures and capacities are detailed in the EPRP for the Project. Emergency response measures have been prepared in accordance with federal and provincial legislation and guidelines, and corporate policies and procedures for the protection of human health and the environment. Measures detailed include emergency response planning, training, responsibilities, cleanup equipment and materials, and contact and reporting procedures.

Potential residual adverse effects of a worst-case TMF malfunction scenario releasing tailings into the surrounding environment are characterized below.

31.2.2.3 Effects Assessment

A dam breach and inundation quantitative modelling analysis of the TMF was completed (see Appendix O of the Impact Statement [Tailings Dam Breach Analysis]). In addition, an effects assessment of dam breach and inundation was prepared based on this modelling (see Appendix P of the Impact Statement [Tailings Dam Breach Consequence Assessment Report]). The rationale for the selection of dam breach locations was to simulate a conservative prediction of dam breach consequences, as it relates to loss of life, environmental, infrastructure, and socio-economic categories (CDA 2019).

Currently, there are no permanent or temporary residents living in the PA that would be exposed to the flood hazard associated with a worst-case TMF malfunction scenario event. The nearest larger communities are the City of Timmins (42 km to the south), Town of Cochrane (35 km to the northeast), Town of Smooth Rock Falls (50 km to the northwest), and Town of Iroquois Falls (50 km to the east).

The release of water and tailings solids could result in increased water levels and effects on surface water quality, with the potential for erosion and sedimentation due to high velocity flows from the breach location. Although the TMF will not contain a significant amount of ponded water, tailings liquefaction and subsequent mud flow could infill adjacent lakes, wetlands, and watercourses. A release of solids would be localized at the breach location, with tailings solids and dam material spreading out from the breach location.

The volume of tailings that would be released during a dam failure is dependent on the volume of water in the TMF, the solids content of the mud flow and climatic conditions at the time of failure. Due to the properties of the thickened tailings, it is anticipated that once they are deposited near the center of the TMF, tailings will spread out and solidify, resembling concrete, which would reduce the potential volume and mobility of tailings released as a result of a TMF dam failure. In addition, as described in the geochemical assessment, the water and tailings are not expected to produce acidity or leach metals and are not expected to be acutely lethal (see Appendix K of the Impact Statement [Water Quality Assessment]).

In the event of a TMF dam failure, thickened tailings would be released to the environment, potentially affecting the waterways in the PA, and the surrounding area. Tailings solids could also be deposited along low lying areas extending from the breach location, potentially causing localized infilling of vegetated areas and waterbodies. Depending on the timing and extent of a potential failure, effects to soils, groundwater, surface water, vegetation, riparian and wetland environments, fish and fish habitat, birds and bird habitats, wildlife and wildlife habitat, human health, and Indigenous interests, may occur.

Soil

A TMF malfunction could result in a change in soil quality. In the event of a worst-case TMF dam failure scenario event, the sheer volume of tailings released could physically displace soils, burying fertile topsoil under layers of waste material. In the case of a TMF dam failure, emergency response procedures would be deployed to reduce adverse effects in the vicinity of the incident to contain and remediate as part of the EPRP.

Residual adverse effects on soil from a worst-case TMF dam failure scenario are predicted to be moderate in magnitude, medium-term in duration, and reversible within the life of the Project.

Groundwater

A TMF malfunction could affect groundwater quality depending upon the magnitude of the failure and the time elapsed until cleanup. Tailings solids may be deposited near the breach location and downgradient low-lying areas but will be cleaned up promptly where possible to limit infiltration and long-term effects to groundwater. If damage to terrestrial vegetation (i.e., forested areas) cannot be remediated, the potential for long-term effects to groundwater quality exists. However, vegetation within the PA will be removed to facilitate Project implementation.

Residual adverse effects on groundwater as a result of a worst-case TMF dam failure scenario are predicted to be moderate in magnitude, occur within the Local Study Area (LSA) for Groundwater, medium-term in duration, and reversible within the life of the Project.

Surface Water

A failure of the TMF dam could also result in deposition and the infilling of nearby waterbodies with solid tailings and TMF dam materials. This may, in turn, affect natural drainage patterns. Solids deposition into waterbodies may result in long-term water quality effects depending on the speed and effectiveness of cleanup activities. A TMF dam malfunction could potentially affect surface water quality and quantity of nearby waterbodies, depending on the location of the breach. If breached, the TMF could potentially release material into the North Driftwood River, West Buskegau River and Jocko Creek, with the TMF being located in the catchment area of the creek.

As described in Appendix P of the Impact Statement of the Impact Statement (Tailings Dam Breach Consequence Assessment Report), in the Mattagami River elevated suspended solids concentrations under a southern dam breach would extend to the Lower Sturgeon dam, however it is expected that suspended solids concentrations in the Mattagami River would be elevated as well. Effects of a southern dam breach on suspended solids would be expected to recover to baseline conditions at the dam or immediately downstream. No effects are predicted downstream at Smooth Rock Falls. This is similarly the case for eastern and western breaches entering the North Driftwood and West Buskegau Rivers where suspended solids concentrations would be elevated but settle out rapidly in the receiving environment with no incremental effects observed downstream in the Abitibi River.

Surface water monitoring will be carried out in the creeks downstream and around the TMF. In addition, contingency plans and the implementation of engineering and quality controls during design, construction and operational phases will be employed to mitigate potential effects on waterbodies.

Residual adverse effects on surface water quality as a result of a worst-case TMF dam failure scenario are predicted to be low to moderate in magnitude, within the LSA for Surface Water, medium-term in duration and reversible within the life of the Project.

Vegetation, Riparian and Wetland Environments

The release of tailings from a TMF dam malfunction could cause the release of tailings into local vegetation communities, which may result in native plant communities being lost or altered and/or direct loss of wetland area or change in wetland form (see Figure 31.3 for wetland habitat within the PA). Changes in water levels would have a limited effect on vegetation, as water level increases would be temporary. Tailings solids would be removed where possible, and residual solids would be stabilized and/or covered onsite, allowing for natural filtration by the vegetation itself as it reestablishes after reclamation. Depending on the magnitude of the TMF dam malfunction, it is predicted that natural vegetation will generally reestablish over subsequent growing seasons.

Residual adverse effects on vegetation and wetlands as a result of a worst-case TMF dam failure scenario are predicted to be moderate in magnitude, within the LSA for Vegetation, Riparian and Wetland Environments, medium-term in duration, and reversible within the life of the Project.

Fish and Fish Habitat

Malfunction of the TMF dam and release of tailings liquids and solids into these waterbodies could affect surface water quality and quantity, and result in sediment deposition in fish habitat, with consequent change in fish habitat, and potential change in fish health, growth, or survival due to lethal or sublethal effects (Figure 31.3) for fish habitat locations within the PA). The primary causes of effects on fish and fish habitat would be related to changes in water and sediment quality, sediment deposition, and increased turbidity. There is potential for long-term toxicological effects to fish and benthic invertebrate communities from the take up of contaminants from the sediment or water. Lake sturgeon is the only aquatic species at risk in the vicinity of the Project; lake sturgeon are known to inhabit the Mattagami River, the Abitibi River, and the Frederick House River.

If a breach were to occur during spawning, sediment deposition could also smother fish eggs, as well as potentially alter physical substrate characteristics such that substrates are no longer suitable for spawning. Benthic and aquatic plant communities may be lost, which may take a long time to recover or require rehabilitation of disturbed areas. This disturbance has the potential to affect the productivity of fish and fish habitat, depending on the magnitude and location of the release. Fish populations may eventually return to pre-breach levels (in decades) but there would likely be a persistent contamination of fish tissue and fish health due to long-term contamination of sediments.

Residual adverse effects on fish and fish habitat as a result of a worst-case TMF dam failure scenario are predicted to be moderate in magnitude, within the LSA for Fish and Fish Habitat, medium-term in duration and reversible within the life of the Project.

Birds and Bird Habitats

TMF malfunction may result in loss or alteration of bird habitat and increased mortality risk. During Project construction and operations, the PA is not expected to provide suitable habitat for most bird species as the vegetative cover will have been removed and Project activities will create ongoing sensory disturbances.

The risk of bird mortality and bird habitat loss in the event of a TMF malfunction would be reduced within the PA (since birds would unlikely be present within the PA), but adverse effects on birds and bird habitat may extend into the LSA for Birds and Bird Habitats depending upon the extent and location of the TMF malfunction. If tailings from a TMF dam malfunction reach the LSA for Birds and Bird Habitats, tailings and contaminated liquids may infiltrate low-lying areas or nearby vegetation; however, these effects would be limited with prompt reclamation and stabilization, and the vegetation would be expected to reestablish after one to two growing seasons. Bird population stability within the LSA or RSA is not expected to be affected by a TMF dam malfunction.

Residual adverse effects of a worst-case TMF dam failure scenario on birds and bird habitat are predicted to be moderate in magnitude, occur within the LSA for Birds and Bird Habitats, medium-term in duration, and reversible within the life of the Project.

Wildlife and Wildlife Habitat

A TMF dam malfunction may result in the direct loss or alteration of wildlife habitat, increased mortality risk, and/or changes to wildlife health. During Project construction and operations, the PA is not expected to provide habitat for most wildlife species as the vegetative cover will have been removed and Project activities will create ongoing sensory disturbances. With the potential for water quality to be affected in North Driftwood River, West Buskegau River and Mattagami River, waterfowl and ungulates (e.g., moose) and their habitat may be affected. The risk of wildlife mortality and wildlife habitat loss in the event of a TMF malfunction would be reduced within the PA (given wildlife was unlikely to be present within the PA), but adverse effects on wildlife and wildlife habitat may extend into the LSA for Wildlife and Wildlife Habitat depending upon the extent and location of the TMF malfunction. If tailings from a TMF dam malfunction reach the LSA for Wildlife and Wildlife Habitat, tailings and contaminated liquids may infiltrate low-lying areas or nearby vegetation; however, these effects would be limited with prompt reclamation and stabilization, and the vegetation would be expected to reestablish after one to two growing seasons. Wildlife population stability within the LSA or RSA is not expected to be affected by a TMF dam malfunction.

Residual adverse effects of a worst-case TMF dam failure scenario on wildlife and wildlife habitat are predicted to be moderate in magnitude, occur within the LSA for Wildlife and Wildlife Habitat, medium-term in duration, and reversible within the life of the Project.

Health

In the event of a TMF dam malfunction, discharges could increase the concentration of chemicals of potential concern (CoPC) in soil, water, and sediment. This can lead to increases of these chemicals in secondary environmental media including vegetation, wild meat, and fish tissue. Possible changes in water and country food quality could affect the health of local residents who may participate in hunting, trapping, and recreational activities. However, the health risks associated with this scenario are expected to be low. In the event of a TMF failure, local population would be advised of the risks (if any). In addition, remediation measures, depending on the situation, may include capping and/or removing the affected soils and treating contaminated water, thereby limiting potential contact with wildlife and associated health risks. Furthermore, the terrestrial area affected would likely be small and would represent a small fraction of the home range of larger mammals, such as moose; therefore, their exposures to affected soils and water would be limited.

As noted above, although fish populations may eventually return to pre-breach levels (in decades), there would likely be a persistent contamination of fish tissue due to long-term contamination of bottom sediments.

Residual adverse effects of a worst-case TMF dam failure scenario on human health are predicted to be low to moderate in magnitude, within the LSA for Health, medium-term in duration and reversible within the life of the Project.

Indigenous Interests

A release of tailings from the TMF has the potential to affect current use of land and resources for traditional purposes such as hunting, trapping, gathering, and fishing. Flooding and infilling caused by the release of liquid and solid tailings could temporarily restrict travel and resource use within the LSA for Indigenous Interests. This effect would dissipate once flood waters recede, and solid tailings were remediated. Residual adverse effects on vegetation and wetlands, fish and fish habitat, birds and bird habitats and wildlife and wildlife habitat could occur due to a worst-case TMF malfunction, as described in the sections above.

Potential effects on fish and wildlife habitat could result in localized reductions in fish and wildlife abundance, health or condition that could limit the quality of the fishing, trapping, and hunting resources within the LSA.

The potential for effects on heritage resources may include disruption of sites of cultural importance and would depend upon the size and location of the TMF malfunction and the proximity these heritage resources. In the unlikely event of TMF malfunction there would be localized temporary flooding, sedimentation, and erosion near the TMF.

Residual adverse effects of a worst-case TMF dam failure scenario on Indigenous interests are predicted to be moderate in magnitude, limited to the LSA for Indigenous Interests, medium-term in duration and reversible within the life of the Project.

31.2.2.4 Risk Assessment

As discussed above, the potential residual adverse effects of a worst-case scenario TMF malfunction include effects to soils, groundwater, surface water, vegetation, riparian and wetland environments, fish and fish habitat, birds and bird habitats, wildlife and wildlife habitat, human health, and Indigenous interests. The likelihood of a malfunction of the TMF during all phases of the Project has been determined to be very low. As mentioned previously, Appendices O and P of the Impact Statement (Tailings Dam Breach Analysis and Tailings Dam Breach Consequence Assessment Report, respectively) provide further details regarding the dam breach consequence assessment conducted for the TMF. Based on the effects assessment, the severity of consequences is considered to be moderate and, therefore, the risk associated with malfunction of the TMF for all phases of the Project is determined to be low.

31.2.3 Release of Untreated Contact Water

The overall Project water management concept is to divert non-contact water to reduce the amount of water to be managed at the site and to collect the contact water for conveyance to one of the collection ponds where sediment control is provided prior to its release to the environment. The contact water collection system will be designed to capture contact water and seepage from various Project components, including the Impoundment Facility, ore Stockpiles, TMF and Process Plant Area. In addition to treatment within the ponds (e.g., sediment settling), a series of modular water treatment plants will be located in-line with the collection pond outlets to provide additional treatment of contact water prior to its release to the surrounding environment.

The plausible worst-case in this scenario would include malfunction of the water management infrastructure, which could lead to the release of untreated contact water resulting in potential adverse effects on groundwater, surface water quality, vegetation, riparian and wetland environments, fish and fish habitat and Indigenous interests.

31.2.3.1 Preventive Measures

Runoff from disturbed areas will be collected in gravity ditches and conveyed to ponds. The ponds have been designed as settling ponds with a permanent water depth to aid in removing total suspended solids prior to discharge to the receiving environment. In addition to treatment within the ponds (e.g., sediment settling), a series of modular water treatment plants will be located in line with the collection pond outlets to provide additional treatment of contact water prior to its release to the surrounding environment. The exact design and location of these modular water treatment plants will be determined as the Project progresses, but the units are intended to provide supplemental treatment, including total suspended solids removal. These treatment plants will have a capacity to treat up to approximately 28,000 cubic m^3/day.

A key Project design to prevent release of untreated water is the use of the Open Pit as storage in case of collection ponds overflowing. The required volume of the collection ponds is based on the storage required to attenuate the design inflows (1:10-year, 24-hour storm) and runoff from a mean average monthly precipitation, assuming release to the environment is limited to 28,000 m^3/d (i.e., the capacity of the modular treatment plants).

Contact water will be conveyed to five ponds; three ponds will service the various stockpile facilities and other mine components, while two ponds will be dedicated to the TMF. The design configuration of the collection ponds is as follows:

- Collection Pond 1 will be constructed in conjunction with the east segment of the rock impoundment facility to manage runoff from that facility. It is envisioned that the pond will be constructed in stages and be expanded to match the required runoff management as the rock impoundment facility footprint expands.
- Collection Pond 2 will be constructed to manage runoff from the western segment of the rock impoundment facility, once the highway is re-aligned. This pond will also serve to manage water from the western stockpile.

- Collection Pond 3 will manage contact water from the eastern stockpile. Due to topographic constraints, capturing runoff from the entire stockpile into a single pond utilizing gravity is not feasible. An excavated sump at the southwest corner of the eastern stockpile will be required to capture runoff from a portion of the facility. A pumping system will convey accumulated runoff to Collection Pond 3 for treatment.
- TMF Northeast Collection Pond will be constructed to service the TMF area.
- TMF Northwest Collection Pond will be constructed to service the TMF and Process Plant Area.

Wherever contact water is stored, there exists potential for seepage. Seepage will be collected into perimeter diches that will channel seepage by gravity to the collection ponds. Regular maintenance and inspection of perimeter ditches will be implemented to prevent excessive growth of vegetation or blockage such as beaver dams. A maintenance program for the collection ponds will also be implemented.

With in-design safety and mitigation measures in place, the likelihood of the release of untreated contact water during all phases of the Project is low. Contingency planning and engineering and quality controls during all phases of the Project will be implemented to mitigate the risk of the release of untreated contact water.

31.2.3.2 Emergency Response Measures

In the event of the release of untreated contact water due to failure of the contact water collection system, where feasible, preliminary emergency response measures include pumping water back into the collection system and repairing the containment structure.

Additional information on emergency response measures and capacities are detailed in the EPRP for the Project. Emergency response measures have been prepared in accordance with federal and provincial legislation and guidelines, and corporate policies and procedures for the protection of human health and the environment. Measures detailed include emergency response planning, training, responsibilities, cleanup equipment and materials, and contact and reporting procedures. Potential residual adverse effects of a worst-case release of untreated contact water scenario are characterized below.

31.2.3.3 Effects Assessment

Given that the water collection system is located throughout the PA, including near waterbodies, a release of untreated contact water to the environment has the potential to adversely affect groundwater, surface water, vegetation, riparian and wetland environments, fish and fish habitat and Indigenous interests, as characterized below for each potentially affected VC.

Soil

A release of untreated contact water could result in a change in soil quality and soil quantity due to water erosion. Soil erosion can result in changes to soil cover material depth and loss in soil chemical parameters such as total soil organic matter.

Residual adverse effects on soils from a worst-case release of untreated contact water scenario are predicted to be low in magnitude, occur mainly in the PA but may extend to the LSA for Soil, short-term in duration and reversible.

Groundwater

A release of untreated contact water has the potential to affect groundwater quality, depending upon the magnitude of the failure and the time elapsed until cleanup. A release of untreated contact water has the potential to affect groundwater and surface water quality where groundwater discharges to surface water.

Residual adverse effects on groundwater from a worst-case release of untreated contact water scenario are predicted to be low in magnitude, occur mainly in the PA but may extend to the LSA for Groundwater, short-term in duration, and reversible.

Surface Water

A release of untreated contact water has the potential to affect surface water quality through accidental release of contact water from collection ditches and/or from contact water collection systems, including collection ponds. The magnitude of adverse effects would depend on the location of the release and quantity of contact water discharged. As mentioned previously, in the case of collection ponds overflowing, the Open Pit would be used as storage to prevent release of untreated water to the environment. The geochemical assessment of tailings indicate that tailings have low acid generation and low long-term metal leaching potential. Standard mitigation measures are proposed to reduce potential effects on surface water related to seepage (e.g., collection of runoff and groundwater seepage from the TMF). Contact water will be treated to meet applicable federal and provincial regulatory requirements prior to discharge to the environment.

Residual adverse effects on surface water from a worst-case release of untreated contact water scenario are predicted to be low in magnitude, localized to the LSA for Surface Water, short-term in duration, and reversible.

Vegetation, Riparian and Wetland Environments

A release of untreated contact water has the potential to affect vegetation and wetlands (see Figure 31.3 for wetland habitat within the PA) for wetland habitat within the PA), depending upon the magnitude of the failure and the time elapsed until cleanup. Effects may include direct loss or alteration of native vegetation communities, species of conservation concern or traditional use plant species. There is also potential for direct loss or alteration of wetland area or alteration of surface or groundwater flow patterns. A release of untreated contact water would be addressed by the implementation of containment measures and the restoration of affected areas and the cleanup of released material, if feasible. Affected vegetation and wetlands would reestablish over time through natural dispersion from unaffected portions of either the same community, or adjacent wetland communities, usually within one to two growing seasons, depending on the scale of the release.

Residual adverse effects on vegetation, riparian and wetland environments from a worst-case release of untreated contact water scenario are predicted to be low in magnitude, occur mainly in the PA but may extend to the LSA for Vegetation, Riparian and Wetland Environments, short-term in duration, and reversible.

Fish and Fish Habitat

A release of untreated contact water would not be expected to result in lethal or sub-lethal effects on fish due to changes in water quality. Depending on the volume of contact water released, there is potential for the physical disturbance of fish habitat (see Figure 31.3 for fish habitat locations within the PA), including alteration of existing habitat due to erosion of bank material and the suspension and deposition of eroded material. Fish, including eggs, if present during the event, could be affected by sedimentation, temporary changes in benthic community composition, and/or alteration of the availability of benthic food sources. Potential effects are considered temporary, because benthic and fish communities would be expected to recover from such an event. Waterbodies that could potentially be affected include the North Driftwood River and West Buskegau River watersheds and Mattagami River, and associated tributaries.

Residual adverse effects on fish and fish habitat from a worst-case release of untreated contact water scenario are predicted to be low in magnitude, limited to the LSA for Fish and Fish Habitat, short-term in duration and reversible.

Health

A release of untreated contact water could increase the concentration of CoPC in soil and water, which could in turn lead to increases of these chemicals in secondary environmental media including vegetation, wild meat, and fish tissue. Possible changes in water and country food quality could affect the health of local residents who may participate in hunting, trapping, and recreational activities. However, the health risks associated with this scenario are expected to be low. Preliminary emergency response measures would include pumping water back into the collection system and repairing the containment structure, thereby limiting potential contact with wildlife and associated health risks.

Residual adverse effects of a a worst-case release of untreated contact water scenario on human health are predicted to be low magnitude, within the LSA for Health, short-term in duration and reversible.

Indigenous Interests

A release of untreated contact water has the potential to affect current use of land and resources for traditional purposes such as hunting, trapping, gathering, and fishing. This scenario could affect terrestrial vegetation and aquatic ecosystems, potentially increasing health risks for people who harvest these terrestrial and aquatic foods. However, the health risks associated with this scenario are expected to be low. Preliminary emergency response measures would include pumping water back into the collection system and repairing the containment structure, thereby limiting potential contact with wildlife and associated health risks.

The potential for effects on heritage resources may include disruption of sites of cultural importance and would depend upon the size and location of the release of untreated contact water and the proximity to these heritage resources. Should this unlikely scenario unfold, there could be localized temporary flooding, sedimentation, and erosion near the location of the release.

Potential effects on fish habitat could result in localized reductions in fish abundance, health or condition that could limit the quality of the fishing, trapping, and hunting resources within the LSA.

Residual adverse effects on Indigenous interests from a worst-case release of untreated contact water scenario are predicted to be low in magnitude, within the LSA for Indigenous Interests, short-term in duration and reversible.

31.2.3.4 Risk Assessment

As discussed above, the potential residual adverse effects of a release of untreated contact water to the environment include potential effects to groundwater, surface water quality, vegetation, riparian and wetland environments, fish and fish habitat, and Indigenous interests. The likelihood of a release of untreated contact water has been determined to be low. Based on the effects assessment, the severity of consequences is considered to be low and, therefore, the risk associated with release of untreated contact water for all phases of the Project is determined to be low.

31.2.4 Release of Fuel or Hazardous Materials

Collisions, mechanical malfunctions, or operational error involving construction equipment, mining equipment, or transport trucks may result in the release of fuel or hazardous materials. Train derailment or a rail transfer incident may also result in the release of fuel or hazardous materials.

The primary type of fuel used during all mine phases will be off-road dyed diesel. During the construction phase of the Project, diesel fuel will be used to power generators for electricity production (until such time as the site's electrical power distribution network is connected to the grid), as well as heavy equipment. The plausible worst-case scenario during construction would be related to leaks from generators or possible spills during refuelling of generators.

During the operations and decommissioning and closure phases of the Project, diesel fuel will be limited to the operation of heavy equipment. Over the life of the mine, 2,222 thousand m^3 (2.2 billion litres [L]) of diesel will be consumed. Fuel will be transported to the Project site by licensed third-party contractors. Gasoline will also be used on site during all phases of the Project to power vehicles and light duty equipment. The consumption of gasoline is estimated to be 47 million litres (ML) and diesel exhaust fluid (DEF) to be 76 ML.

Fuel will be stored on site in 'fuel farm' bulk tanks, which will be located next to the south exit from the Open Pit. The fuel farm will be developed in two phases – the initial stage will include a single 80 m^3 capacity tank for dyed diesel, clear diesel and gasoline and will be expanded to include four tanks for dyed diesel. At peak mine production, 13 tanks for dyed diesel and a single tank for each of gasoline and DEF will be stored in the fuel farm. It is estimated that the maximum amount of fuel that could be accidentally released (i.e., worst-case scenario) within an on-site storage facility or area is roughly equal to the amount of fuel stored in a single tank. Incidents involving fuel may also take place at the process plant or other storage area on site.

A fuel release or the release of hazardous materials on-site could also occur as a result of a malfunction in the fuel transfer process and/or human error. The frequency at which fuel and hazardous materials will be handled increases the probability that a release could occur. Hazardous materials that will be used on site include chemicals such as reagents, solvents, and hydraulic fluid.

Project-related vehicle traffic will occur during all phases of the Project and all times of the year to facilitate movement of equipment, supplies, materials, and personnel to and from the Project site and along Highway 655 and road networks leading from the PA. A vehicle collision could occur on roads leading to or from the Project or in the Project site and result in the release of hazardous materials into the terrestrial or aquatic environment, among other effects. The primary substance that may be released as a result of a vehicle collision is fuel, however other contaminants being transported at the time of collision may also be released. The amount of fuel or hazardous materials released would be a function of the size of the vehicle involved in the collision.

31.2.4.1 Preventive Measures

On site, all fuel storage equipment will comply with applicable legislation, including the *Technical Standards and Safety Act,* 2000 and the applicable regulations thereunder, and will be constructed to recognized industry standards. Hazardous materials and reagents required for Project operations will be transported to and from, and stored at, the Project site following applicable federal and provincial regulations (e.g., Transportation of Dangerous Goods Regulations), as appropriate.

All fuel tanks will be located within a containment area sized to contain the contents of the fuel farm in the event of spill. Tanks will be installed on a concrete pad to facilitate clean up and reduce potential contamination of soil and groundwater. Storage tanks will be provided with physical protection to guard against possible vehicular collisions. Operational procedures proposed to reduce the potential for accidents or malfunctions at the fuel storage area include:

- daily inspections of fuel tanks and associated infrastructure
- weekly inventory calculations
- fuel tanks are not to be filled above 90 percent (%) of capacity to allow for expansion

Fuel will be stored away from watercourses, waterbodies, and other sensitive environmental features to lessen the probability that an unplanned release would result in effects on the environment. A minimum setback of 100 metres (m) from these features and secondary containment for storage tanks will be used.

The *Technical Standards and Safety Act,* 2000 includes provision for automatic shut-off valves for all fuel dispensing equipment. Safe operating procedures will also be in place and all staff involved will have appropriate training. Operational procedures relevant to fuel dispensing locations that are likely to mitigate the probability of a release during dispensing include:

- fuelling procedures to be posed at all dispensing stations, and on mobile dispensing equipment
- constant attendance during fueling
- daily inspection procedures for dispensing areas and equipment, including hoses and couplers

Fuel dispensed outside the fuel storage facility via portable dispensing equipment will occur at locations that provide a minimum 30 m setback from environmentally sensitive features and/or will be within contained features (e.g., the Open Pit). The main fuel dispensing location will have lined compacted gravel or concrete containment pads with drive-on facilities capable of capturing minor releases during fuelling. Standard operating procedures, as summarized above, will also serve to reduce the quantity of fuel that would likely be released during on-site dispensing.

Hazardous materials will be stored within a containment area with sealed floors and/or drains and/or sumps. The drains and/or sumps will collect any spilled material and transfer it to retrieval or storage locations (e.g., collection tanks). The design process will incorporate the spill storage capacity necessary to contain the volume of spilled material. All staff handling chemicals will have appropriate training as to their storage, handling and use (e.g., Workplace Hazardous Materials Information System [WHMIS]). All chemicals used on-site will have a Material Safety Data Sheet, which will also be used in the training programs for personnel. Fuel and other hazardous materials are transported safely throughout the region and across Canada on a daily basis. Only properly licensed companies will be permitted to transport fuel and other hazardous materials to the Project site and all drivers will have appropriate licensing and training. Contractors will be required to adhere to applicable legislation and handling procedures. Storage facilities will be sited in locations that represent a relatively low risk and afford opportunity for containment during emergency response. Applicable regulations and Material Safety Data Sheets for material handling and storage will be compiled for reagents, explosive components, and other hazardous materials.

Several traffic safety measures will be implemented to reduce the potential for spills from vehicle accidents in connection with the Project. These include, but are not limited to, the following:

- Project vehicles will be driven by licensed and trained drivers who will use approved routes. All drivers will be required to have training in incident response and management.
- Highway laws will be obeyed, including seasonal weight restrictions, speed limits, traffic signage and requirements for permit for oversized loads.
- Project vehicles will be manually inspected on a daily basis to confirm there are no problems.
- Mine roads will be properly constructed and maintained.
- Speed limits will be posted and monitored on site access roads. Canada Nickel will follow up with contractors on any reports of transport trucks travelling at excessive speeds (e.g., in excess of posted limits or in excess of 'safe' limits given road conditions) along the transport route.
- Mine vehicles will be required to have flagging.
- Fuel delivery services to the Project site will only be contracted with vendors with active service agreements with regionally based Ministry of the Environment, Conservation and Parks (MECP) licensed emergency incident response contractors.

Therefore, with in-design safety and mitigation measures in place, the likelihood of a release of fuel or hazardous materials as a result of this scenario is low.

31.2.4.2 Emergency Response Measures

All fuel and hazardous materials will be transported to site by licensed third-party contractors who will operate under their own emergency procedures. These contractors will be responsible for first-level response and reporting.

Canada Nickel will maintain containment and clean-up supplies in a state of readiness on site. The emergency procedure for potential releases of fuel and hazardous materials in the EPRP will facilitate response to emergency situations that occur at the Project site, which include spills and the releases of hazardous substances, including petroleum products, and accidents involving hazardous substances.

For fuel released on site, potential ignition sources will be removed (if safe to do so), and the release will be stopped or slowed. The appropriate authorities will be notified. During winter, frozen ground and snow will act to absorb and contain any release. Countermeasures during the winter could include such things as establishment of a collection berm downslope if the release is spreading, use of absorbent materials, and buckets or pumps. If the release occurs on ice, snow berms (possibly lined with plastic) can be created to reduce the spread and avoid cracks in the ice. A release on land that is not frozen will be stopped and prevented from contacting water (e.g., berming with earth, trenching or otherwise placing a barrier to stop or at least slow movement of the released fuel) if possible. Once the release is stopped, the fuel and other contaminated materials will be collected and stored in containers until proper disposal is possible. If a release enters a watercourse or waterbody either directly or indirectly, best efforts will be made to contain the released fuel using floating booms and/or absorbent pads depending on the magnitude of the release until mobilization of a more fulsome response is possible. Released fuel, contaminated soil and snow will be collected and managed in accordance with regulatory requirements. Following the release, will cooperate with local officials in the incident investigation process and conduct an internal incident investigation and an incident report and other documentation will be prepared, as required. The report will include a plan for restoration activities, if required.

Fuel storage and refueling activities will be within designated areas in the PA. Should a spill occur, the spill will be immediately contained and cleaned up using spill kits available on site. Soils in the vicinity of a spill location will be tested for hydrocarbons and excavated as required. The storage and handling of hazardous materials will also be limited to the PA. Should a spill occur, the spill will be immediately contained and cleaned up using appropriate absorbent materials. Spills would have a limited potential to affect groundwater, as they would be confined to the soils within the timeframe of a cleanup response and be appropriately contained and excavated before migrating to the groundwater table.

Additional information on emergency response measures and capacities are detailed in the EPRP for the Project. Emergency response measures have been prepared in accordance with federal and provincial legislation and guidelines, and corporate policies and procedures for the protection of human health and the environment. Measures detailed include emergency response planning, training, responsibilities, cleanup equipment and materials, and contact and reporting procedures. Potential residual adverse effects of a worst-case release of fuel or hazardous materials scenario are characterized below.

31.2.4.3 Effects Assessment

Should a vehicle malfunction or collision occur, a spill could result in the release of a hazardous substance, depending on the contents of the vehicles or the nature of the failure. The potential for adverse effects is dependent on the collision or failure location as well as the materials being released into the environment. A vehicle malfunction or collision could have a localized adverse effect on surface water and fish and fish habitat should the collision or failure occur close to a waterbody, especially if the topography and soil conditions facilitate the flow of the released materials into the waterbody.

The plausible worst-case scenario for a hazardous material spill would be a spill of petroleum hydrocarbons into a waterbody during the winter and summer low flows. When water flow is slow, hydrocarbons can spread out more widely and form thicker layers. This slower movement means aquatic life and shorelines are exposed to the spill for a longer period. Slower water movement also hampers the natural dispersion and dilution of the spilled substance, resulting in higher concentrations of contaminants in localized areas. Given the general floating characteristics, the petroleum hydrocarbons would be transported downstream into connecting waterbodies and to riparian areas. Some fuel constituents are hydrophobic and could likely move from the water to the sediment environment. The extent of the spill is dependent on fuel type, weathering (evaporation and emulsification), and watercourse flow rates. The rates of evaporation are greatest immediately after the spill, then slow considerably over time.

Currently, a worst-case estimate for a hazardous substance spill resulting from a vehicle malfunction or accident has not been made. Such estimates will be part of the detailed engineering design and contingency planning process. However, the volume of hazardous material is anticipated to be limited based on the requirements of the Project and regular deliveries on an ongoing basis. In the event of a spill, hazardous materials will be contained and remediated as part of the EPRP. In case of a spill, the EPRP will guide the containment and remediation of hazardous materials. If a spill were to reach a waterbody, an assessment would be conducted, and a site-specific remedial action plan would be developed in collaboration with regulators to restore the waterbody.

Soil

A vehicle collision or mechanical failure resulting in a spill of fuel or hazardous material could result in a change in soil quality. In the event of a vehicle malfunction or collision, emergency response procedures would be deployed to reduce adverse effects in the vicinity of the spill event. In the event of a spill, hazardous materials will be contained and remediated as part of the EPRP.

Residual adverse effects on soils from a worst-case release of fuel or hazardous materials scenario are predicted to be low to moderate in magnitude, short-term in duration and reversible, but may extend downstream from the collision site.

Surface Water

A vehicle collision or mechanical failure resulting in a spill of fuel or hazardous material could cause a localized change in surface water quality if the event occurred near a waterbody. In the event of a vehicle malfunction or collision, emergency response procedures would be deployed to reduce adverse effects in the vicinity of the event, including releases of hazardous materials into watercourses or waterbodies.

Residual adverse effects on surface water from a worst-case release of fuel or hazardous material scenario are predicted to be low to moderate in magnitude, short-term in duration and reversible, but may extend downstream from the collision site.

Vegetation, Riparian and Wetland Environments

A vehicle collision or mechanical failure resulting in a spill of fuel or hazardous material within the PA could potentially affect vegetation and wetlands, depending upon the phase of the Project, the location of the failure and the time elapsed until cleanup. Effects could include direct loss or alteration of native vegetation communities, species of conservation concern or traditional use plant species. There is also potential for direct loss or alteration of wetland area (see Figure 31.3 for wetland habitat within the PA). During operations, Project-related transportation is not expected to interact with Vegetation, Riparian and Wetland Environments because vegetation clearing will occur at the site preparation stage of construction for the entire PA. A spill within the PA would be captured and treated by the seepage and contact water collection system around the perimeter of the PA. No releases to the environment or residual adverse effects on VCs are anticipated in the case of a vehicle collision within the PA.

A vehicle collision or mechanical failure resulting in the release of fuel or hazardous material outside the PA could have localized effects on Vegetation, Riparian and Wetland Environments, depending upon the location of the failure and the time elapsed until cleanup. Depending on the location of the collision, this could include the release of fuel or hazardous materials into watercourses, which could carry contaminants downstream before cleanup activities are started and potentially affect vegetation, riparian and wetland environments. Emergency response times should be adequate to contain and remediate downstream effects, since hazardous materials would only be transported in limited quantities.

Residual adverse effects on vegetation, riparian and wetland environments from a worst-case release of fuel or hazardous material scenario are predicted to be low to moderate in magnitude, short-term in duration and reversible, but may extend downstream from the collision site.

Fish and Fish Habitat

A vehicle collision or mechanical failure resulting in a spill of fuel or hazardous material near fish habitat (see Figure 31.3 for fish habitat locations within the PA) may lead to localized fish mortality. Fish mortality could range from a few fish (not affecting the sustainability and productivity of a fishery) to larger scale levels of fish mortality (which could have a temporary effect on localized fish populations), depending on the location of the event, the size of the spill and the toxicity of the materials being transported. Chronic or acute toxicity to fish populations can result in changes in fish health, growth, or survival (e.g., number of fish mortalities, fish tissue metal concentration, fish community composition). Fish populations affected by mortality from contaminated material are anticipated to reestablish themselves within one or two generations.

Residual adverse effects on fish and fish habitat from a worst-case release of fuel or hazardous material scenario are predicted to be low to moderate in magnitude, short-term in duration and reversible, but may extend downstream from the collision site.

Health

In the event of a spill from a vehicle, discharges could increase CoPC concentrations in soil, water, and sediment. This can lead to increases of these chemicals in secondary environmental media including vegetation and fish tissue. Potential changes in water and country food quality may affect the health of human receptors who live in the region and who may engage in fishing and recreational activities. Although fish populations may eventually return to pre-spill levels (in one or two generations), there is potential for persistent contamination of fish tissue and fish health due to long-term contamination of sediments. Canada Nickel will develop contingency planning and implement engineering and quality controls during the design, construction, and operational phases to mitigate affected fish and fish habitat.

Residual adverse effects on human health from a worst-case release of fuel or hazardous material scenario would be low to moderate in magnitude, medium-term in duration and reversible, but may extend downstream from the collision site.

Indigenous Interests

In the event of a vehicle collision or mechanical failure resulting in a spill of fuel or hazardous material may affect the viability of, restrict access to, or cause loss of areas used for recreation or traditional use (such as fishing, trapping or hunting) in the area surrounding the spill site, should the affected area be used for recreational or resource use activities. Residual adverse effects on vegetation communities, fish and fish habitat, and surface water could occur due to the spill of fuel or hazardous material. These effects could in turn affect current use of land and resources for traditional purposes in the PA and potentially the LSA. An effect on fish and fish habitat could result in localized reductions in fish abundance, health or condition that could limit the quality of the fishing within the PA. However, land and resource use are not anticipated within the PA during Project construction and operation. Fish populations affected by mortality from contaminated material may reestablish themselves within one or two generations. Effects would be temporary and localized, with limited effect on overall fishing within this VC’s LSA.

The potential for effects on heritage resources may include disruption of sites of cultural importance and would depend upon the size and location of the spill and the proximity to these heritage resources. Should this unlikely scenario unfold, there could be localized temporary effects near the location of the release.

Residual adverse effects on Indigenous interests from a worst-case release of fuel or hazardous material scenario are predicted to be low to moderate in magnitude, short-term in duration, and reversible, but may extend downstream from the collision site.

31.2.4.4 Risk Assessment

The likelihood of a release of fuel or hazardous materials has been determined to be low. Based on the effects assessment above, the severity of consequences is considered to be low and, therefore, the risk associated with a worst-case release of fuel or hazardous materials for all phases of the Project is determined to be low.

31.2.5 Open Pit Slope Failure

The Open Pit includes two discrete, though overlapping, ore bodies – the Main Zone and the East Zone. There is the potential for an Open Pit slope failure to occur in the Open Pit walls as a result of improper Open Pit design, unanticipated geologic conditions, or operational procedures, such as blasting.

Slope failure in the Open Pit would result in adjacent areas slumping into the Open Pit, and potential unintended expansion of the Open Pit. A plausible worst-case scenario event would be a catastrophic collapse of a pit wall that could cause the pit perimeter to enlarge rapidly and potentially post a hazard to the immediately surrounding environment. Improperly designed or operated pits could result in a catastrophic collapse. Open pits generally are not subject to the catastrophic release of rock pressures such as rock bursts.

The Main Zone has been designed to be 3,400 m by 1,700 m in area with a depth of 690 m below grade, and the East Zone to be 3,800 m by 1,500 m in area with a depth of 615 m below grade. The total size of the Open Pit will be 4,400 m by 3,100 m in area with a depth of 690 m below grade.

Stability criteria for the overburden pit slopes were developed at the feasibility level, considering various soil layers and groundwater levels. These analyses included both short-term (during excavation) and long-term stability assessments, incorporating the area's seismicity. Results indicated that overall pit slopes in clay should have a maximum 6H:1V inclination, while those in sand and till should have a maximum overall inclination of 5H:1V. Bench designs for excavation are based on these slope guidelines.

An Open Pit slope failure could occur due to unanticipated geologic conditions or extreme weather events such as overland flooding. Canada Nickel will undertake regular slope stability inspections during operation to monitor slope performance. Slope failure would be confined to the PA and may affect Project operations or infrastructure; however, residual adverse effects on VCs would not occur and no further effects assessment is required.

31.2.6 Stockpile Slope Failure

Ore, rock, clay and sand will be stockpiled on site in the following storage areas during the operations phase of the Project: two ore stockpiles including the East Stockpile and West Stockpile; Impoundment Facility with rock, sand and till, and clay impoundment facilities; and two Crushed Ore Stockpiles. A plausible scenario is one in which stockpile slope failure results from slumping, releasing material from the stockpiles. Stockpile slope failure is anticipated to be localized to the LSA due to the proposed volume of materials to be stored.

The East Stockpile will occupy 253 ha and will have a peak storage volume of 100.4 Mm^3, a designed height of 100 m in Year 20 (operations phase 2), and an average height of 50 m. The West Stockpile will occupy 439 ha and will have a peak storage volume of 165.4 Mm^3, a designed height of 70 m, and an average height of 30 m over its 37-year active life.

The Impoundment Facility will include the rock impoundment area, which has been designed to cover 1,801 ha, reach 115 m in height and 1,438 Mm^3 in capacity/anticipated volume; sand and till impoundment area, which has been designed to cover 252 ha, be 50 m in height, 182 Mm^3 in capacity/anticipated volume and have a slope of 6:1; and clay impoundment area, which has been designed to cover 1,078 ha, be 34 m in height and 205 Mm^3 in capacity/anticipated volume, and have a slope of 2:1 (internal) and 6:1 (external).

The two Crushed Ore Stockpiles (Run of Mine) will be able to hold enough ore to allow the Process Plant to process 60 kilotonnes per day (kt/d).

31.2.6.1 Preventive Measures

Side slope angles have been designed to provide long-term geotechnical stability and benches at regular intervals will be used to shorten slope run and the potential of a slope failure. To mitigate the potential of a major stockpile slope failure and minor slumping, the East and West Stockpiles, Impoundment Facility, and Crushed Ore Stockpiles have been designed to exceed design specifications as it relates to material storage with applicable regulations (Ontario *Mining Act*) and to include the following:

- Slope designs proposed will be achieved by completing regular as-built slope and stability surveys throughout the life of the mine. Where deviations from the proposed design are noted during surveys, a plan will be developed and implemented to address the issue.
- Size of the materials being stored will be appropriate to avoid the build-up of hydrostatic pressure.

Ample storage space is available to allow placement in interior locations to allow for toe preparation works to be carried out. Stability criteria for the Impoundment Facility was developed with consideration of various soil layers and groundwater levels and are based on existing guidelines and recommendations, with deformation analyses assessing the impact of the rate of rise on stability. The design accounts for pore water pressure build-up in the clay foundation, with maximum rates of rise of 5 m per year for the rock impoundment and 2.5 m per year for the other facilities. The Impoundment Facilities are located at safe distances from the Open Pit and other structures and water ponds.

The likelihood of a major stockpile slope failure is very low and minor slumping at a bench scale is low as a result of protection measures implemented in the design of Stockpiles, including benching and setbacks.

31.2.6.2 Emergency Response Measures

In the event of a minor slumping on an individual bench, the general emergency procedure will be to immediately cease the deposition of materials in that area and dispatch site personnel to conduct an inspection from a safe vantage point. A remediation plan will be developed, which will determine the most appropriate management strategy(s) for addressing the minor slumping event in consideration of ensuring overall long-term bench and stockpile integrity. The plan will likely include steps necessary to re-shape and stabilize the area where slumping occurred.

In the event of a major stockpile failure, the general emergency procedure would be to immediately cease the deposition of materials in that area and dispatch site personnel to conduct a safety and preliminary damage assessment. Appropriate government agency personnel and Indigenous nations would be contacted, dependent on the extent of the impact. In the short-term, steps would be taken to verify structural integrity of the area and any immediate potential threats to the environment would be contained as quickly as possible. The medium- and longer-term plan for the slope failure area would be developed and implemented in concert with government agencies and Indigenous nations, as appropriate, to determine an appropriate course of action. Such actions could include one or more of: no action, clean-up debris, restore or otherwise reconfigure the stockpile, and/or restore damaged habitat.

Additional information on emergency response measures and capacities are detailed in the EPRP for the Project. Emergency response measures have been prepared in accordance with federal and provincial legislation and guidelines, and corporate policies and procedures for the protection of human health and the environment. Measures detailed include emergency response planning, training, responsibilities, cleanup equipment and materials, and contact and reporting procedures. Potential residual adverse effects of a worst-case stockpile slope failure scenario are characterized below.

31.2.6.3 Effects Assessment

No potential adverse effects are anticipated as a result of a minor slumping event, which would be repaired without deposition beyond the PA. Some reshaping of the stockpile could be required, but no environmental, health, social or economic effects, or effects on Indigenous interests are anticipated.

A plausible worst-case scenario where a major stockpile failure event occurs could, however, result in adverse effects to soil and to surface water, fish and fish habitat, and Indigenous interests if the failure results in a release into lakes and streams. In this unlikely scenario, a large-scale slope failure would have to occur past the perimeter ditch that collects contact water and migrate beyond the PA.

Soil

Small scale slumping or sloughing of the sand and till impoundment area within the Impoundment Facility has the potential to affect the use of these materials for progressive rehabilitation and future closure activities. Reclamation cover soil will be replaced on approximately 6,475 ha of land disturbed by mining at closure (Chapter 11 of the Impact Statement [Assessment of Potential Effects on Soil]). The loss of any materials within the sand and till impoundment area may result in a deficit of cover soil required for close out of the Project site.

A larger scale failure of stockpiles could result in slumping and overprinting of soils in the LSA where stockpile boundaries are located near the perimeter of the PA. Material could be removed unless it was anticipated that removal would cause further disturbance. Failures of stockpiles internal to the PA are unlikely to impact new areas of soil and would be limited by the location of Project components such as site roads, water management systems and the Open Pit. Residual adverse effects on soil from a worst-case stockpile slope failure scenario are predicted to be low in magnitude, limited to the LSA for Soil, short-term in duration, and potentially reversible.

Surface Water

Release of materials from a large-scale stockpile slope failure has the potential to affect surface water quality if released into lakes and streams in the immediate vicinity mine site. Given that lakes and streams are not in close proximity to stockpiles, it would be unlikely that released materials would reach waterbodies other than through run-off. Analysis of the results of preliminary geochemical testing indicate that the Project will not generate mine rock that could have the potential for acid rock drainage (ARD). The release of materials into surface water may lead to temporary localized turbidity and suspended sediments.

Residual adverse effects on surface water from a worst-case stockpile slope failure scenario are predicted to be low in magnitude, localized to the LSA for Surface Water, short-term in duration, and reversible.

Fish and Fish Habitat

An unexpected increase in suspended solids from a plausible worst-case stockpile slope failure into a water body has the potential to cause acute mortality of fish, with localized turbidity and sediment deposition resulting in potential effects to spawning habitats. Mortality of fish would be a one-time event and risk of mortality is not anticipated to persist over time. Furthermore, fish communities would be anticipated to recover over time. In the event of a plausible worst-case slope failure, emergency response procedures would be undertaken; however, material may be left in place if it may cause further disturbance during the removal of material. If left in place, it is anticipated that fish habitat could be restored to ecologically functional habitat naturally or through remedial measures.

Residual adverse effects on fish and fish habitat from a worst-case stockpile slope failure scenario are predicted to be low in magnitude, limited to the LSA for Fish and Fish Habitat, short-term in duration, and potentially reversible.

Indigenous Interests

A stockpile slope failure could affect fishing for recreational and traditional purposes and trapping (e.g., aquatic furbearers) in a localized area, should the affected area be used for such activities. Access to fishing and trapping areas outside of the PA may be limited for a short duration while the area is cleaned up, if remedial activities are proposed, and fish and aquatic furbearer populations may be temporarily disrupted. If materials are left in place, fish and aquatic furbearer habitat will be restored to their natural state through remedial measures, which would limit the localized effect on fishing and trapping over the long term.

Residual adverse effects on Indigenous interests from a worst-case stockpile slope failure scenario are predicted to be low in magnitude, limited to the LSA for Indigenous Interests, short-term in duration, and reversible.

31.2.6.4 Risk Assessment

The likelihood of a plausible worst-case stockpile slope failure has been determined to be low. The potential residual adverse effects of such a scenario include short-term duration and localized effects to surface water quality, fish and fish habitat, and Indigenous interests. Therefore, the severity of consequences is considered to be low, and the risk associated with stockpile slope failure is determined to be low.

31.2.7 Over Blasting Incident

The Open Pit will be developed in a series of benches based on the pit design parameters with drilling and blasting completed on each bench. Blasting will be a regular part of the Project and will be conducted in accordance with the Explosives Management Plan that will be developed for the Project, occurring daily during the work week (up to a maximum of five times per week), with multiple patterns blasted on a single blast day. A blast setback zone around the Open Pit, where entrance by personnel is prohibited during blasting, will be developed with the mine engineering team, taking into account the anticipated typical blast size.

An over blasting incident refers to situations where the force of the explosion is greater than intended. This can lead to a number of hazardous outcomes, one of which is the generation of fly rock, which refers to fragments of rock that are ejected from the blast site beyond the established clearance zone. This poses potential hazards to personnel, project infrastructure, natural features in the PA, and nearby structures. The clearance zone is the designated area around a blast site beyond which all personnel and equipment must be evacuated before initiating the blast.

Although blasting operations will be carried out in such a manner and in accordance with necessary regulations to limit the potential for an uncontrolled explosion, the PA was developed to include a 500 m safety limit around the Open Pit to isolate VCs from the potential effects of fly rock, and the explosives storage facility will be located based on minimum distance requirements. The location of the explosives storage facility was chosen in accordance with the *Explosives Act*. Furthermore, explosives and their components will be stored in compliance with the *Ontario Occupational Health and Safety Act* R.S.O, 1990, Ontario Regulation 69/23 Mines and Mining Plants, and the federal *Explosives Act.* However, the technology under consideration for the Project would result in explosives only being sensitized (i.e., prior to sensitizing, the product is inert) when injected with a gassing agent in the bulk delivery truck used to charge the holes. As a result, materials stored on site will not be considered explosive.

An inspection procedure will be developed by the explosives contractor that confirms the effectiveness of the explosives storage and manufacturing facilities, which includes maintaining an inventory of explosives, as well as their handling, transportation, and application, which complies with established safety systems throughout the life of the Project. Disposal of domestic and hazardous waste will follow the Waste Management Plan for the Project.

A plausible worst-case over blasting incident could result in damage resulting from dust and fly rock extending beyond defined boundaries and result in excess noise and vibration to the surrounding properties. Although over blasting could create a larger blast and more noise than a controlled explosion (since regular blasting in the Open Pit would be performed by drilling and blasting successive benches with appropriate controls in place), noise and vibration effects from an uncontrolled explosion would be short-term in duration, and it is not expected to occur within waterbodies. Canada Nickel will develop and implement a Noise and Vibration Management Plan to monitor and manage the effects of the Project on ambient noise and vibration in accordance with regulatory guidance levels.

Blasting operations will be carried out in accordance with applicable regulations to reduce the potential for over blasting and the PA was developed to include a buffer around the Open Pit to buffer VCs from the potential effects of fly rock. Furthermore, monitoring to evaluate blast peak particle velocity and overpressure to protect fish will be conducted. Therefore, no residual adverse effects on VCs are anticipated, and no further effects assessment is required.

31.2.8 Accidental Fire

An accidental fire may occur as the result of an accident associated with the activities of the Project, including equipment malfunction or human error. In addition, rail traffic has the potential to result in accidental fire through the generation of sparks, depending on the conditions surrounding the location where this scenario occurs.

Fires arising from non-Project causes such as lightning strikes, offsite forest fires or undefined causes, are assessed as an effect of the environment on the Project in Chapter 30 of the Impact Statement (Assessment of Potential Effects of the Environment on the Project).

31.2.8.1 Preventive Measures

During Project construction, vegetative cover will be removed to facilitate Project implementation. With vegetation removal, the likelihood of an accidental fire is greatly reduced. As such, any increase in the risk of forest fires is expected to be negligible.

The new spur line that will be constructed to facilitate the transport of materials to and from the mine will be owned by Ontario Northland Railway, a Crown agency reporting to the Ministry of Transportation. The potential for fire from rail traffic will be reduced through Ontario Northland Railway’s regular inspection and maintenance, including regular clearing of vegetation and other combustible materials (e.g., rail ties) from the right-of-way of the rail line. By maintaining a clear area around the rail line, the risk of fires starting and spreading will be substantially reduced.

With preventive measures in place, the likelihood of a worst-case accidental fire scenario during all phases of the Project is considered very low.

31.2.8.2 Emergency Response Measures

Safety orientations will be mandatory for new employees, and provided training will include fuel handling, equipment maintenance, and fire prevention and response measures. Fire prevention and suppression systems will be maintained on-site, including water supplies, sprinklers, fire extinguishers, and other firefighting equipment. Flammable material (such as fuels and explosives) will be carefully managed at the Project.

Additional information on emergency response measures and capacities are detailed in the EPRP for the Project. Emergency response measures have been prepared in accordance with federal and provincial legislation and guidelines, and corporate policies and procedures for the protection of human health and the environment. Measures detailed include emergency response planning, training, responsibilities, cleanup equipment and materials, and contact and reporting procedures. Potential residual adverse effects of a worst-case accidental fire scenario are characterized below.

31.2.8.3 Effects Assessment

A fire may result in damage to Project infrastructure, vegetation or natural features beyond the PA, and the release of smoke, combustion gases and ash. Depending on the timing and extent of a fire, effects to air quality, vegetation, riparian and wetland environments, birds and bird habitats, wildlife and wildlife habitat, greenhouse gases, human health, and Indigenous interests, may occur.

Atmospheric Environment

In the unlikely event of a worst-case accidental fire scenario event, there is potential for temporary effects to air quality. Such a fire event could release large amounts of particulate matter ($PM_{2.5}$ and PM_{10}) and gaseous pollutants, including carbon monoxide (CO), nitrogen oxides (NOx), and volatile organic compounds into the atmosphere. These emissions can degrade air quality, leading to increased health risks for nearby communities. Additionally, the fire could spread to surrounding areas, exacerbating the impact on air quality and potentially affecting a larger population. The smoke and pollutants from the fire could also impair visibility and disrupt outdoor activities.

Residual adverse effects on air quality from a worst-case accidental fire scenario are predicted to be low to moderate in magnitude, within the LSA for the Atmospheric Environment, short-term in duration and reversible.

Vegetation, Riparian and Wetland Environments

There is potential for temporary effects on vegetation, riparian and wetland environments as a result of a worst-case accidental fire scenario, should it occur. Such a fire could lead to the destruction of plant life, including trees, shrubs, and ground cover. Wetlands, which serve as important habitats for various species and act as natural water filters, could also be adversely affected (see Figure 31.3 for wetland habitat within the PA). The fire could alter the structure and composition of wetland vegetation, potentially leading to a loss of species richness.

Residual adverse effects on vegetation, riparian and wetland environments from a worst-case accidental fire scenario are predicted to be low to moderate in magnitude, within the LSA for Vegetation, Riparian and Wetland Environments, short-term in duration and reversible.

Birds and Bird Habitats

A worst-case accidental fire event could lead to the destruction of nesting sites and foraging areas, which are crucial for the survival and reproduction of various bird species. The immediate loss of vegetation can result in a reduction of available food sources, such as insects and seeds, impacting bird populations. Additionally, the smoke and heat from a fire can cause direct harm to birds. However, during Project construction and operation, the PA is not expected to provide suitable habitat for most bird species as the vegetative cover will have been removed and Project activities will create ongoing sensory disturbances. The risk of bird mortality and bird habitat loss in the event of a worst-case accidental fire would be reduced within the PA (since birds would unlikely be present within the PA), but adverse effects on birds and bird habitat may extend into the LSA for Birds and Bird Habitats depending upon the extent and location of the fire. In addition, many bird species are resilient and can adapt to changes in their environment and would likely leave the affected area.

Residual adverse effects on birds and their habitats are expected to be low in magnitude, within the LSA for Birds and Bird Habitats, short-term in duration, and reversible.

Wildlife and Wildlife Habitat

In the unlikely event of a worst-case accidental fire scenario, there is potential for temporary effects on wildlife and their habitats. This worst-case fire event could lead to the destruction of critical habitats, including nesting sites, dens, and foraging areas, which are essential for the survival and reproduction of various wildlife species. The immediate loss of vegetation can result in a reduction of available food sources, impacting wildlife populations. Additionally, the fire could cause direct harm to animals. However, during Project construction and operations, the PA is not expected to provide habitat for most wildlife species as the vegetative cover will have been removed and Project activities will create ongoing sensory disturbances. The risk of wildlife mortality and wildlife habitat loss in the event of a worst-case accidental fire would be reduced within the PA (given wildlife is unlikely to be present within the PA), but adverse effects on wildlife and wildlife habitat may extend into the LSA for Wildlife and Wildlife Habitat depending upon the extent and location of the fire. In the unlikely event of an accidental fire that spreads and becomes a forest fire, there could be temporary effects on wildlife and their habitats.

Residual adverse effects on wildlife and their habitats are expected to be of low in magnitude, within the LSA for Wildlife and Wildlife Habitat, short-term in duration, and reversible.

Climate Change

In the event of a worst-case accidental fire that spreads and becomes a forest fire, there could be implications for climate change. Such fires release large amounts of carbon dioxide (CO_2) and other GHGs into the atmosphere, contributing to global warming. The combustion of vegetation and organic matter also releases particulate matter and black carbon, which can further exacerbate climate change by absorbing sunlight and heating the atmosphere. Additionally, the destruction of forests reduces the capacity of these ecosystems to sequester carbon, thereby diminishing their role as carbon sinks. However, with the implementation of effective fire suppression and mitigation measures, adverse effects on climate change are expected to be reduced.

Residual adverse effects on climate change from a worst-case accidental fire scenario are expected to be long-term and lasting beyond the duration of the Project. This is because, the effects on climate change due to the release of GHG in the atmosphere are by definition persistent and long-term. Similarly, with climate change effects by definition only being realized globally, the release of GHG emissions due to a worst-case accidental fire scenario event is characterized as being a global effect. Finally, in the event of a worst-case accidental fire that spreads and becomes a forest fire, the release of GHG emissions would be irreversible, since once GHGs are released to the lower atmosphere, there is currently no mechanism by which they can be mitigated.

Health

A worst-case accidental fire scenario event could potentially have health effects on nearby communities. Exposure to smoke and fumes from burning materials could lead to respiratory issues, including bronchitis and exacerbation of asthma. Additionally, possible changes in country food quality could affect the health of local residents who may participate in hunting, trapping, traditional and recreational activities.

Residual adverse effects of a worst-case accidental fire scenario on human health are predicted to be of low to moderate in magnitude, within the LSA for Health, short-term in duration and reversible.

Indigenous Interests

In the unlikely event of a worst-case accidental fire scenario event, there could be implications for Indigenous interests, since a fire could affect the viability of, restrict access to, or cause loss of areas used for recreation or traditional use (such as gathering, trapping, or hunting) beyond the PA. This scenario could affect terrestrial vegetation, potentially increasing health risks for people who harvest these terrestrial foods. Residual adverse effects on vegetation and wetlands, birds and bird habitats and wildlife and wildlife habitat could occur due to a worst-case accidental fire, as described in the sections above. Given the potential for bird and wildlife mortality and habitat loss, these potential adverse effects on birds and wildlife could result in localized reductions in their abundance, health, or condition, which in turn could affect the quality or availability of trapping and hunting resources within the LSA.

The potential for effects on heritage resources may include disruption of sites of cultural importance and would depend upon the size and location of the fire and the proximity to these heritage resources.

Residual adverse effects on Indigenous interests from a worst-case accidental fire scenario are predicted to be low to moderate in magnitude, within the LSA for Indigenous Interests, short-term in duration and reversible.

31.2.8.4 Risk Assessment

The likelihood of a plausible worst-case accidental fire scenario has been determined to be very low. The potential residual adverse effects of such a scenario include short duration and localized effects to air quality, vegetation, riparian and wetland environments, birds and bird habitats, wildlife and wildlife habitat, GHGs, human health and Indigenous interests. The severity of consequences is considered to be moderate, and, therefore, the risk associated with a worst-case accidental fire is determined to be low.

31.2.9 Water Diversion Failure

Non-contact water diversions, including the North Driftwood Diversion Channel, are part of the water management system for the Project. Non-contact water diversions will generally be installed along the perimeter of the site to divert flows away from Project components. The North Driftwood Diversion Channel will involve excavation and clearing along new and existing channels and will be susceptible to erosion during construction before the channel is stabilized.

The plausible worst-case water diversion failure scenario could result from a precipitation or snowmelt event that exceeds the design capacity, causing the loss of channel form due to erosion, or damage to watercourse crossings downstream of the diversion. Failure could also result from the premature operation of the channel.

A failure of the North Driftwood Diversion Channel could result in erosion of the construction channel and related habitat features, and sedimentation to downstream waterbodies. This could result in potential adverse effects on surface water features and fish and fish habitat. The potential also exists for effects on Indigenous interests, including current use of land and resources for traditional purposes due to a water diversion failure. No disturbance to archaeological resources would be expected within the PA since potential resources will be cleared prior to construction.

31.2.9.1 Preventive Measures

The principles of natural channel design will be used to guide the development of the new diversion channel. Natural channel design is based on using a functioning stream system near the Project site as a reference for the design of the new channel. The design is developed through an understanding of the geomorphic processes (e.g., flow regime, sediment regime, valley type) shaping the reference stream. The North Driftwood River will be used as the reference stream for the new diversion channel. The potential effects of climate change, such as substantial precipitation events, will be addressed through the design of the channel and its associated floodplain. Risks associated with extreme events can be mitigated by designing a channel with the appropriate pattern, dimension, and profile and by providing effective floodplain access.

There is limited risk of failure during construction because the new channel will be constructed with no connection to watercourses or fish habitat. Erosion and sediment control measures (e.g., silt fence, sediment traps, sediment basins) will be included and monitored to prevent sediment from leaving the construction area, per the Erosion and Sediment Control Plan that will be developed for the Project.

The potential for failure during commissioning will be limited by implementing the natural channel design principles noted above, as well as by having the design engineer available as required during construction. This will help confirm that the instream and bank protection unique to natural channel design are constructed properly.

The potential for failure during commissioning will be limited by implementing the natural channel design principles noted above. Once the new channel is constructed, flow will be released into the new channel incrementally, in a controlled manner. The potential for failure will be reduced as vegetation establishes and stabilizes the streambank and streambed. A worst-case scenario, substantial failure would only be expected as part of an unanticipated extreme precipitation event beyond the conservative case considered in Project design. The likelihood of a plausible worst-case water diversion failure scenario event is very low.

31.2.9.2 Emergency Response Measures

The North Driftwood Diversion Channel will be monitored on a regular basis and adaptive management will support long-term stabilization. If a breach occurs, repairs will be completed when it is safe to do so. In the event of a structural failure in which habitat was permanently damaged, additional offsetting measures may be required in accordance with relevant legislation.

Additional information on emergency response measures and capacities are detailed in the EPRP for the Project. Emergency response measures have been prepared in accordance with federal and provincial legislation and guidelines, and corporate policies and procedures for the protection of human health and the environment. Measures detailed include emergency response planning, training, responsibilities, cleanup equipment and materials, and contact and reporting procedures. Potential residual adverse effects of a worst-case water diversion failure scenario are characterized below.

31.2.9.3 Effects Assessment

Minor areas of erosion are common during the first few years as the new channel makes some minor adjustments to its pattern, dimension, and profile. These areas of erosion are generally small and produce only minor increases in turbidity. In most cases, these areas of erosion resolve themselves and are considered part of the natural geomorphic process.

A failure of the North Driftwood Diversion Channel could have a localized effect on soils, surface water, fish and fish habitat and Indigenous interests. Since a failure would be linked to a severe precipitation event, the extent of effects on these VCs would be short-term and not likely to impede the use and access of land and water resources for recreational and traditional uses beyond the disruption from natural flooding and erosion. The effect would be predictably remediated.

Soil

A failure of the North Driftwood Diversion Channel could result in a change in soil quality and soil quantity due to water erosion. Soil erosion can result in changes to soil cover material depth and loss in soil chemical parameters such as total soil organic matter.

Residual adverse effects on soils from a worst-case water diversion failure scenario are predicted to be low in magnitude, limited to the LSA for Soil, short-term in duration and reversible.

Surface Water

A failure of the North Driftwood Diversion Channel could result in a change in surface water quality in the North Driftwood River. This watercourse would experience the highest flow and sedimentation, potentially leading to further erosion beyond the extent of the constructed diversion. High flows and sediment releases would be caused by a precipitation event and would be expected to cease shortly following the storm. Following the sediment release, water quality of affected watercourse would return to normal conditions, as sediment is washed downstream and deposited in waterbodies.

Residual adverse effects on surface water from a worst-case water diversion failure scenario are predicted to be low in magnitude, localized to LSA for Surface Water, short-term in duration and reversible.

Vegetation, Riparian and Wetland Environments

A failure of the North Driftwood Diversion Channel has the potential to affect vegetation and wetlands. Effects may include direct loss or alteration of native vegetation communities, species of conservation concern or traditional use plant species. Affected vegetation and wetlands would reestablish over time through natural dispersion from unaffected portions of either the same community, or adjacent wetland communities, usually within one to two growing seasons.

Residual adverse effects on vegetation, riparian and wetland environments from a worst-case failure of the North Driftwood Diversion Channel scenario are predicted to be low in magnitude, occur mainly in the PA but may extend to the LSA for Vegetation, Riparian and Wetland Environments, short-term in duration, and reversible.

Fish and Fish Habitat

A variety of habitats exist for fish within the North Driftwood River. Sedimentation, particularly if it is composed of fine sized particles, could negatively affect fish including fish eggs, if present. Effects on adult fish would likely be short-term in duration. Adverse changes to the quality of fish habitat would be expected to reverse following the sedimentation event. Additional remedial measures may be required to restore the quality of fish habitat in the constructed channel.

Residual adverse effects on fish and fish habitat from a worst-case water diversion failure scenario are predicted to be moderate in magnitude, limited to the LSA for Fish and Fish Habitat, short-term in duration and reversible.

Indigenous Interests

A failure of the North Driftwood Diversion Channel would result in increased sedimentation and flow downstream through the North Driftwood River, however the effects from a failure would not increase substantially beyond the natural effects of a severe precipitation event. This would result in a temporary disturbance to fishing and navigation, which would be cleared naturally following the weather event. If a failure occurred that required restoration, use would be restricted until restoration was completed.

The potential for effects on heritage resources may include disruption of sites of cultural importance and would depend upon the size and location of the failure and the proximity to these heritage resources. Should this unlikely scenario unfold, there could be localized temporary flooding, sedimentation, and erosion near the location of the failure.

Residual adverse effects on Indigenous interests from a worst-case water diversion failure scenario are predicted to be moderate in magnitude, limited to the LSA for Indigenous Interests, short-term in duration and reversible.

31.2.9.4 Risk Assessment

The likelihood of a plausible worst-case water diversion failure has been determined to be very low. A potential failure of the North Driftwood Diversion Channel would have a localized effect on surface water and fish and fish habitat. Since failure would be linked to a severe precipitation event, the extent of effects on these VCs would be short-term and not likely to impede the use of and access to land and water resources for recreational and traditional uses beyond the disruption from natural flooding and erosion, unless restoration is required, in which case use would be restricted temporarily. Therefore, the severity of consequences is considered to be low, and the risk of a plausible worst-case water diversion failure scenario event is determined to be negligible.

31.3 Summary

As described in Section 31.1.6, the assessment of the potential risk of effects resulting from accidents and malfunctions involves the use of a risk matrix, where risk is determined based on the likelihood and severity of consequences of that specific accident or malfunction scenario. Where a range of risk ratings could occur for a particular accident or malfunction scenario, a conservative approach was taken whereby the highest rating was considered. The results of the risk assessment are summarized in Table 31.4.

Table 31.4 Summary of Accidents or Malfunctions Risk Analysis

Accident/Malfunction	Likelihood of Event	Severity of Consequences of Event	Risk
TMF Malfunction	Very Low	Moderate	Low
Release of Untreated Contact Water	Low	Low	Low
Release of Fuel or Hazardous Materials	Low	Low	Low
Stockpile Slope Failure	Low	Low	Low
Accidental Fire	Very Low	Moderate	Low
Water Diversion Failure	Very Low	Low	Negligible
Note: *Accidents associated with an over blast incident or Open Pit slope failure were screened out as there would be no residual effects.			

Residual adverse effects from accidents and malfunctions to VCs are characterized in Section 0 with the risk of each plausible worst-case scenario that was considered summarized in Table 31.4. The Project is planned and designed to prevent accidents and malfunctions primarily through adherence to accepted design codes and standards. Preventive measures will be implemented to reduce the likelihood of occurrence of each identified plausible worst-case accidents and malfunction scenarios. An EPRP will be prepared and implemented to effectively respond to accidents and malfunctions and to reduce the severity of consequences of such events. This plan includes internal and external communications, roles and responsibilities, training requirements, and mitigation/response measures in the event of an unplanned event or emergency.

As a result of preventive measures, as well as emergency response measures, the results of the risk analysis indicate that the risk associated with each identified plausible worst-case accident or malfunction scenario ranges from negligible to low.

31.4 Prediction Confidence

Prediction confidence part of the assessment of accidents and malfunction scenarios is based on professional judgment, prior experience, modelling, and scientific certainty relative to:

- quality and quantity of data and the understanding of the effect pathways
- known or estimated effectiveness of the proposed mitigation measures

Accidents or malfunctions are events that occur outside the normal planned function or activity of the Project. Nevertheless, through the implementation of design safety and mitigation measures identified in this Chapter, the likelihood of occurrence of these identified plausible worst-case scenarios can be reduced, while having emergency response measures in place can reduce the severity of consequences associated with each accident or malfunction scenario should they occur; thus, reducing the risk associated with each scenario.

Therefore, prediction confidence has been determined to be moderate to high since the environmental effects mechanisms are well-understood and many of the mitigation measures identified above are standard practice and have been implemented in previous mining projects.

31.5 References

Canadian Dam Association (CDA). 2013. 2007 Dam Safety Guidelines. 2013 Edition.

CDA. 2019. Application of Dam Safety Guidelines to Mining Dams. Canadian Dam Association.

Singer, A.C., I.P. Thompson, and M.J. Bailey. 2004. The tritrophic trinity: a source of pollutant-degrading enzymes and its implications for phytoremediation. Current Opinion in Microbiology, 7: 239-44.

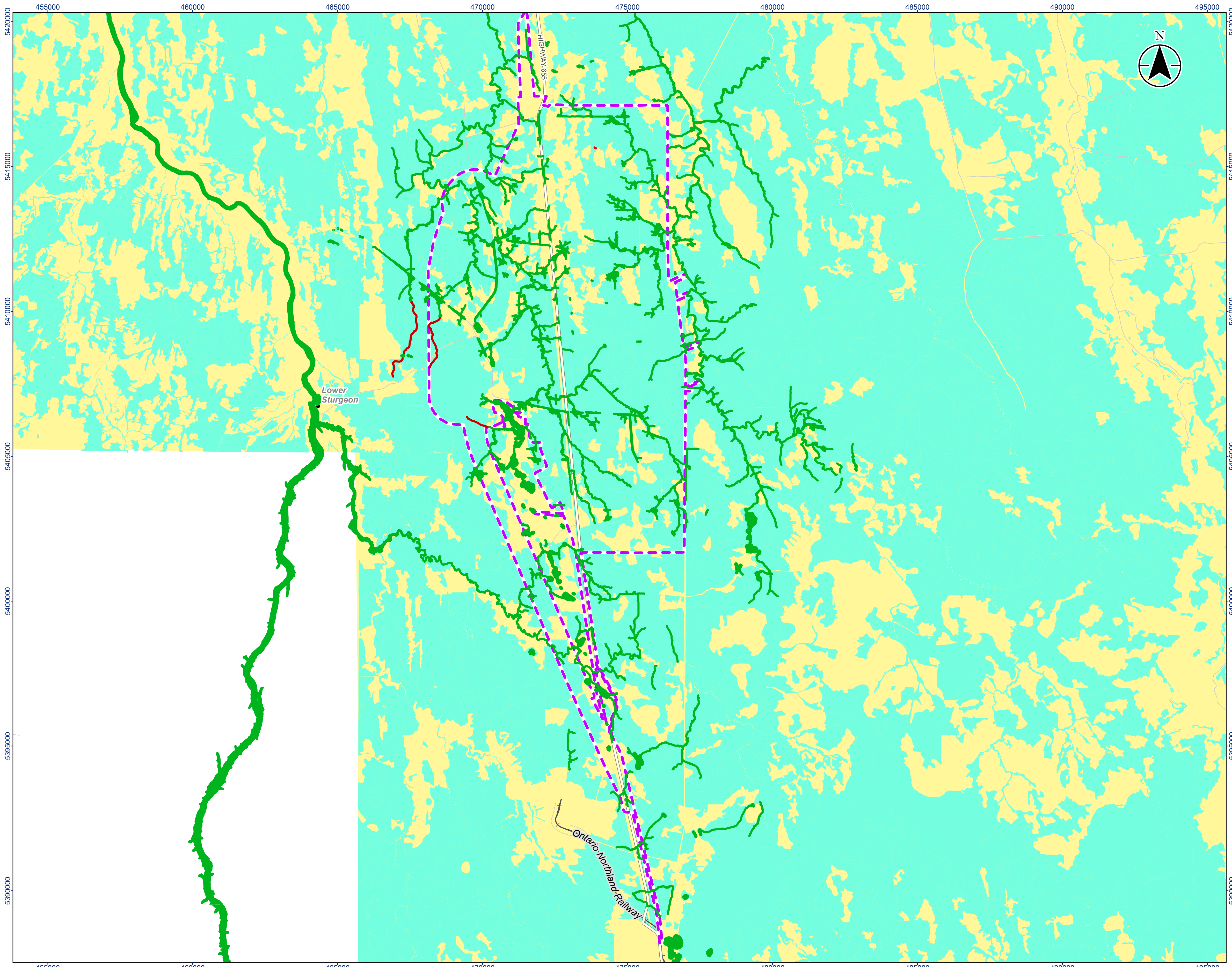
31.6 Figures

Figure 31.1 Risk Matrix

		Severity of Consequences				
		Very Low	Low	Moderate	High	Very High
Likelihood	Very Low	Negligible Risk	Negligible Risk	Low Risk	Low Risk	Moderate Risk
	Low	Negligible Risk	Low Risk	Low Risk	Moderate Risk	High Risk
	Moderate	Low Risk	Low Risk	Moderate Risk	High Risk	High Risk
	High	Low Risk	Moderate Risk	High Risk	High Risk	Very High Risk
	Very High	Low Risk	Moderate Risk	High Risk	Very High Risk	Very High Risk

Figure 31.2 Risk Level Legend

	Negligible	Risk is negligible; risk events do not require further consideration.
	Low	Risk is acceptable; additional controls likely not required.
	Moderate	Risk may be acceptable; if warranted, additional controls required to reduce risks to lower levels.
	High	Risk is unacceptable; high priority for additional control measures.
	Very High	Risk is unacceptable; additional controls immediately required.



Stantec

CANADA NICKEL COMPANY

Legend

- Project Area
- Major Road
- Minor Road
- Railway
- Fish Habitat
- Not Fish Habitat
- Wetland Habitat
- Not Wetland Habitat

0 2 4 km

1:135,000 (At original document size of 11x17)

Notes

1. Coordinate System:NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © King's Printer for Ontario, 2023.

Project Location
Timmins, Ontario

160930456 REVA
Prepared by tcoghlan on 2024-09-20

Client/Project
Canada Nickel Company (CNC)
Crawford Nickel Project

Figure No.
31.3

Title
Environmental Sensitivity