Great Bear Gold Project
Impact Statement

Section 17: Effects of the Environment on the Project

Table of Contents

17.0 Effects of the Environment on the Project....................17-1

17.1 Context....................17-1
17.2 Climate Change Considerations....................17-2
17.2.1 Climate Change Dataset....................17-2
17.3 Identification of Credible Hazards and Extreme Events....................17-4
17.4 Wildfires....................17-5
17.4.1 Environmental Conditions....................17-5
17.4.2 Mitigation Measures....................17-5
17.4.3 Potential Effects to the Environment, Health, Social and Economic Conditions....................17-6
17.5 Major Precipitation Events and Floods....................17-8
17.5.1 Environmental Conditions....................17-8
17.5.2 Mitigation Measures....................17-9
17.5.3 Potential Effects to the Environment, Health, Social and Economic Conditions....................17-10
17.6 Severe Wind Storms....................17-11
17.6.1 Environmental Conditions....................17-11
17.6.2 Mitigation Measures....................17-11
17.6.3 Potential Effects to the Environment, Health, Social and Economic Conditions....................17-12
17.7 Extreme Temperatures....................17-13
17.7.1 Environmental Conditions....................17-13
17.7.2 Mitigation Measures....................17-13
17.7.3 Potential Effects to the Environment, Health, Social and Economic Conditions....................17-14
17.8 Low Intensity Seismic Events....................17-15
17.8.1 Environmental Conditions....................17-15
17.8.2 Mitigation Measures....................17-15
17.8.3 Potential Effects to the Environment, Health, Social and Economic Conditions....................17-15
17.9 Climate Resilience....................17-17
17.9.1 Approach and Methodology....................17-17
17.9.2 Climate Hazards and Conditions....................17-18
17.9.3 Risk Assessment Results....................17-19
17.9.3.1 Current Time Period....................17-19
17.9.3.2 2050s Time Period....................17-19
17.9.3.3 2080s Time Period....................17-20
17.9.4 Mitigation Measures....................17-20
17.9.5 Climate Change Resilience....................17-21
17.10 References....................17-25

Tables

Table 17.8-1: Estimated Seismic Hazard....17-16
Table 17.9-1: Resilience after Mitigation....17-24

Figures

Figure 17.4-1: Previous Regional Wildfires....17-7
Figure 17.9-1: Climate Change Risk Assessment Approach....17-22
Figure 17.9-2: Number of Interactions by Risk Category and Time Period....17-23

Acronyms and Abbreviations

CCRA	Climate change risk assessment
ECCC	Environment and Climate Change Canada
EDF	Environmental Design Flood
Great Bear Resources	Great Bear Resources Ltd.
IDF	Inflow Design Flood
MNR	Ministry of Natural Resources
PA	Project Area
Project	Great Bear Project
TISG	Tailored Impact Statement Guidelines
TMF	Tailings management facility
VMF	Viggo management facility

17.0 Effects of the Environment on the Project

17.1 Context

The Great Bear Project (Project) has been designed in full consideration of its natural surroundings, and in accordance with engineering design standards which consider environmental stresses and apply a safety margin. The Tailored Impact Statement Guidelines (TISG; Appendix A-1) require that the Impact Statement consider and describe how environmental conditions, including credible natural hazards and extreme environmental events could adversely affect the Project, and how these could result in major effects to the environment if they occur. Credible hazards and events that have a reasonable probability of occurrence and that could result in major adverse environmental effects without careful management, are considered in this section consistent with the TISG.

17.2 Climate Change Considerations

Climate change has the potential to change future precipitation and temperature regimes, which would modify how weather-related hazards could affect the proposed Project. Therefore, understanding the current climate and the future climate trends is important when evaluating the robustness of the Project design. The following assessments related to climate change were complete to support this understanding for the Impact Statement:

- Development of a climate change dataset for the Project (Appendix W-3)
- Completion of a climate change risk assessment (CCRA; Appendix W-4)
- Climate roadmap (Appendix W-5) which demonstrates how climate change was considered throughout the Impact Statement.

Knowledge gained through these assessments has been fully considered in the Project design and in evaluating the credible hazards and extreme environmental events that may affect the Project.

17.2.1 Climate Change Dataset

The site-level detailed climate change dataset (Appendix W-3) was developed to support operations and design activities at the Project. This appendix summarizes the existing available local and regional climate data related to the current climate and projected future climate. This dataset was used throughout the Impact Statement to facilitate a consistent consideration of future climate conditions in the various assessments. Baseline climate statistics are established using representative data sources to provide an overview of the current climate conditions from which future projections have been created.

Downscaled global climate model outputs were then used to describe how current climate conditions may change in the future. Recognizing the inherent uncertainty with projections, the results were based on multiple projections from multiple models and scenarios, or a multi-model ensemble, as recommended by the Intergovernmental Panel on Climate Change (2021). The projections across the multi-model ensemble were summarized in terms of percentiles where the 50th percentile represents the median value and higher percentiles (i.e., 90th and 95th percentiles), represent extreme projections for the site. As climate science is continuously improved and new models and scenarios for future climate are released, the detailed climate change dataset completed for the Project acts as a basis for continuous improvement at the site.

The CCRA provided in Appendix W-4 and summarized in Section 17.9, aims to understand where climate change risks may occur and how these risks can be managed to demonstrate the resilience of the Project to a changing climate over its planned lifetime. A CCRA has been prepared to estimate climate change associated risks for the proposed Project and identify how potential risks may be managed by the Project phases including after closure.

The CCRA aligns with the Strategic Assessment on Climate Change Revised, October 2020 (ECCC 2020) as well as the Draft Technical Guide Relating to the Strategic Assessment on Climate Change: Assessing Climate Change Resilience (ECCC 2022), which provides a technical guidance for how proponents pursing a project under a federal impact assessment can consider the resilience of their project. The CCRA also considers A Guide on Incorporating Climate Change Adaptation into Decision Making for the Mining Sector (MAC 2021). This Guide provides a stepwise approach that mining facilities such as the Project may apply to incorporate climate change adaptation into decision-making and to increase climate resilience.

17.3 Identification of Credible Hazards and Extreme Events

The TISG does not specify the hazards and events that require consideration in the Impact Statement. A range of sources was therefore used to identify potential natural hazards and extreme events that could interact with the Project, in consideration of the local conditions and following sources:

- Impact Assessment Agency of Canada Registry: past environmental assessments in northwestern Ontario (reviewed for topics considered)
- Canada Disaster Database
  - https://cdd.publicsafety.gc.ca
- Earthquakes in Canada
  - https://www.earthquakescanada.nrcan.gc.ca/historic-historique/caneqmap-en.php
  - https://www.earthquakescanada.nrcan.gc.ca/hazard-alea/simphaz-en.php#ON
- Northern Tornadoes Project:
  - https://westernu.maps.arcgis.com/apps/dashboards/19460b79cf24493680e5792f5247f46d

The following credible natural hazards and extreme events were identified that may interact with the Project based on historic and anticipated events:

- Wildfires
- Major precipitation events and floods
- Severe wind storms
- Extreme temperatures
- Low intensity seismic events.

The following natural (meteorological or geological) hazards are not considered credible hazards or extreme events for the Project: avalanche, drought, hurricane, landslide, major earthquake, major tornado, storm surge, tsunami and volcanic eruption.

17.4 Wildfires

17.4.1 Environmental Conditions

Forest fires are part of the natural regeneration cycle in Red Lake Forest Management Unit where the Project is located. The stand-replacing fire cycles ranging between 50 and 187 years (Crins et al. 2009). Timber on a large portion of the Great Bear Property (Property) has been previously harvested by the Sustainable Forest License holder; however the Property location is within a region that is heavily forested. Portions of the Project Area (PA) and overall Property which has not been recently harvested, is dominated by upland deciduous-mixed wood forest, upland coniferous forest and coniferous swamp communities. Project components are therefore vulnerable to wildfire as there is forest fuel available locally which could cause a natural or person-caused fire to spread to the PA.

Figure 17.4-1 provides a summary of the documented wildfires. A major 1980 fire affected approximately 50% of the Property, including the majority of the PA west of Tuzyk's Road, and north of the LP Central pit. This area has however regrown where not subsequently harvested.

17.4.2 Mitigation Measures

The Project is susceptible to wildfires from all directions. The larger Project-related facilities will contain native or processed materials (i.e., overburden, mine rock, ore and tailings) and are not susceptible to fire until revegetated during operations or at closure. The tailings management facility (TMF), stockpiles and open pits will act as a natural fire breaks during the construction and operations phase, providing some protection from wildfires from the west through north to southeast directions (Figure 5.2-1), respectively.

Larger, permanent buildings will primarily be constructed of steel, concrete and other materials that are less or non-combustible. There will however be buildings, facilities and infrastructure that are more susceptible to fire. These may include:

- Stick built sheds, pumping stations and similar
- Power line poles (transmission line and distribution lines)
- Pipelines
- Trailers and prefabricated structures
- Select storage tanks and containers
- Core sheds.

The overall effect of climate change on wildfires is challenging to estimate, as the conditions favorable for wildfire result from multiple drivers interacting with each other (e.g., weather conditions in recent days, overall climate conditions, type of vegetation and amount of underbrush or dead fall). It can be conservatively assumed that fire intensity may increase due to warmer temperatures in the longer term, in addition to frequency increasing from additional electrical (lightning) storms and longer fire seasons each year.

The Canada Fire Weather Index is projected to increase into the mid-century (i.e., 2041 to 2070), with little additional change into the later century (Appendix W-4). The wildland fire season in Ontario extends from April 1 to October 31 each year.

The Ministry of Natural Resources (MNR) operates a forest fire management program to identify and control fires in Ontario, with an aim to reducing their potential magnitude and extent in accordance with the Wildland Fire Management Strategy (MNR 2014). An interactive, geographic information system-base forest fire information map is maintained and is accessible to Great Bear Resources personnel from the government website MNR (2025). Communication will be established by Great Bear Resources with the MNR early in each fire season. Project personnel will be assigned to monitor the fire season and propose safety programs for the Project, so that there is an early warning and rapid response can be made to any wildfire threat. As such, safe evacuation of the site will be possible if needed, without leaving facilities in an environmentally insecure condition.

Potential risk for the Project associated with wildfires will be managed through design criteria and management controls. Design criteria for Project infrastructure and facilities incorporated fire protection as appropriate in accordance with the National Building Code and the National Fire Code of Canada (NRCC 2020a,b), and the Ontario Building Code (MMAH 2012), as well as applicable legislation and regulations such as related to occupational health and safety. An additional fire break may be established adjacent to critical facilities in the PA in discussion with the MNR. This is not expected to extend the PA boundary, pending MNR guidance.

Firefighting capabilities, including trained personnel and appropriate equipment will be maintained on site, and kept at a high level of training and readiness during the fire season. Fire suppression systems will also be installed to protect key infrastructure including buildings, power supply, and fuel storage areas and support the safety of personnel. Remote buildings will be equipped with portable extinguishers to expedite response. Emergency equipment and measures will be in place to quickly control and support or extinguish a small wildfire proximal to the Project in communication with MNR.

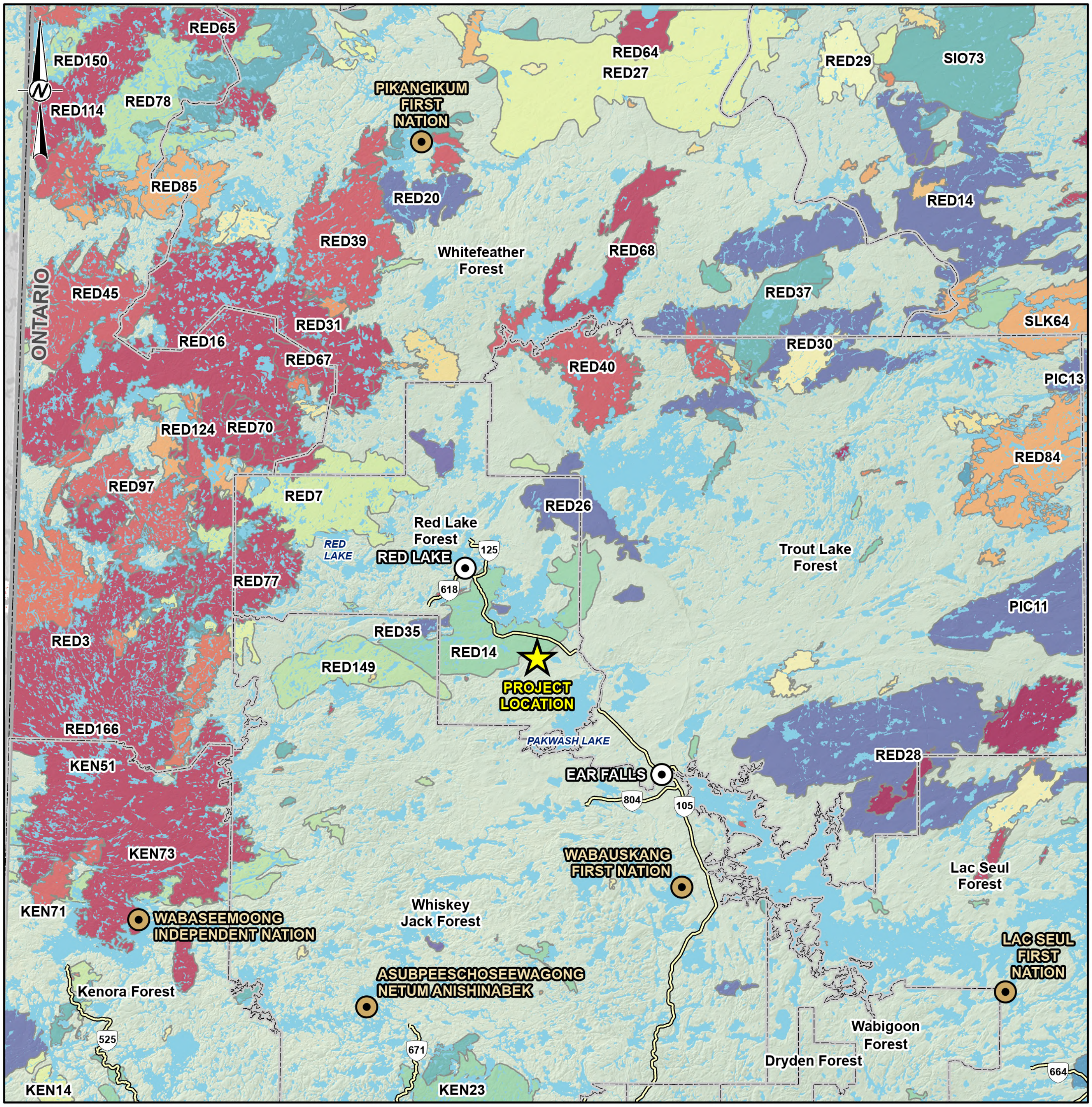
Great Bear Resources acknowledge that these measures are unlikely to be effective for a large regional wildfire. Evacuation plans will be developed to support the safe transportation of people from area using the main access road to Highway 105, or forestry trails if for any reason the main access road is not available. Key systems will be shutdown as practical prior to evacuation to protect the environment.

After reclamation is completed during the closure phase, the site will interact in the same manner with wildfire as the surrounding environment, and additional environmental effects are not predicted.

17.4.3 Potential Effects to the Environment, Health, Social and Economic Conditions

A wildfire may have an effect on the Project and cause it to cease operation, but it is not expected to result in an additional major environmental effect. As personnel will be evacuated, no health effects are anticipated that would be specific to this Project.

Local wildfires may require a temporary cessation of work in small area or the entire Property to support safety of workers, including from indirect smoke effects. For a large regional wildfire, operations are anticipated to cease until such time as the fire is under control, and infrastructure is available for safe access and to provide power to re-start operations. Until a primary source of power is available again (transmission line or gas pipeline), processing operations will be curtailed, as will the associated economic benefits to the region. There are no anticipated generational effects associated with the effects of a wildfire on the Project.



NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

0 10 20 40

1:1,200,000 KILOMETRES

LEGEND

- PROJECT LOCATION
- TOWN
- FIRST NATION RESERVE
- HIGHWAY
- WATERBODY
- PROVINCIAL BORDER
- FOREST MANAGEMENT UNIT

FIRE YEAR

1960	1980	1994	2013
1961	1981	1995	2014
1963	1982	1997	2015
1964	1983	1999	2016
1967	1984	2002	2017
1970	1986	2003	2018
1974	1987	2006	2019
1976	1988	2009	2020
1977	1989	2010	2021
1978	1990	2011	2022
1979	1993	2012	2023

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N

CLIENT
GREAT BEAR RESOURCES

PROJECT
GREAT BEAR PROJECT

TITLE
REGIONAL WILDFIRES

CONSULTANT

wsp

YYYY-MM-DD	2026-03-31
DESIGNED	----
PREPARED	MD/DB
REVIEWED	----
APPROVED	SD

PROJECT NO.	CONTROL	REV.	FIGURE
CA0031271	0001	A	17.4-1

17.5 Major Precipitation Events and Floods

17.5.1 Environmental Conditions

A major precipitation event could result in wetter conditions and higher water levels in a watershed. Flows and water levels in Dixie Creek and local minor tributaries could increase outside the predicted flow range, causing localized flooding of PA. During year(s) of substantially increased precipitation, there would be more contact runoff entering the water management system, potentially requiring increased water storage capacity to be established, depending on the volume already in the system.

In a 1:100-year wet annual climate condition, the mine site is projected to receive up to 1,026.9 mm of total annual precipitation, which is approximately 1.6 times the average annual precipitation of 633 mm (Appendix W-3). The water management system has been designed to provide sufficient capacity to accommodates year to year variations in precipitation and runoff to alleviate the potential for situations with unusual climatic conditions (Appendix I-2).

In future climate projections, extreme precipitation is also anticipated to increase which can contribute to increased instances of flooding. The annual amount of precipitation on wet days, and annual maximum precipitation amounts are projected to increase. Additionally, the number of heavy and very heavy wet days suggest that precipitation intensities may increase. The majority of these projected changes are estimated for mid-century (2041 to 2070) nearer the end of the project mine life, with a small but continued change for the late century period (Appendix W-3).

Overall climate projections indicate a potential increasing trend in precipitation, with more intense and frequent extreme precipitation events. Looking at the ensemble of projections, annual total precipitation is projected to increase by 4% in the 2050s (2041 to 2070) and 6% in the 2080s (2071 to 2100) at the 50th percentile. Increase in precipitation in the winter months may lead to more snowfall and snowpack; however this may also be impacted by temperature. With this overall increase in total precipitation amounts, only a small change to the frequency of wet and dry years is projected. Wetter conditions along with greater temperature extremes may lead to higher variability in drought and flooding conditions at the site.

Extreme precipitation is projected to increase over both the 2050s and 2080s, with potential shifts in precipitation patterns. In the 2050s, the range of projected changes is 1 to 16% with a change of 15% for the 1-day, 100-year event. In the 2080s, a range of projected changes of 0% to 20% is estimated, with a change of 18% for the 1-day, 100-year event. In the 2050s at the 50th percentile, the 1 day, 2-day, and 3-day probable maximum precipitation is projected to increase by 19%, 16% and 15%, respectively (23%, 21% and 23%, respectively for the 2080s). Projected changes in combined rainfall and snowmelt across durations and return periods range from -4% to 12% for the 2050s, and from -2% to 17% for the 2080s at the 50th percentile. Projected changes for the 1-day, 100-year event are estimated as 11% and 14% for the 2050s and 2080s, respectively.

For shorter durations from 1 to 3 days, projected changes are highest as the combined amounts would mainly consist of extreme rainfall. As the duration increases, projected decreases in combined rainfall and snowmelt are found. This is likely due to less accumulated snow due reduced snowfall and earlier melt (less accumulation) due to increasing projected temperatures. The increased temperatures may also lead to atmospheric moisture holding capacity having a larger role in extreme precipitation and probable maximum precipitation.

There is a considerable level of uncertainty in the projected changes in precipitation-based indices, with a range of increases and decreases across all durations, return periods, and climate models considered.

17.5.2 Mitigation Measures

A surface water management berm is proposed south of the LP Central pit to help protect the PA from flooding of Dixie Creek associated with a 1:100-year event. The berm will be purposefully over-built to limit any risk of environmental discharge. The berm will be constructed with a low permeability barrier and at least a 3 horizontal : 1 vertical side slopes to maintain stability. The side slopes may be reduced further if warranted by field investigations and foundation conditions. The berm will remain fully in place until the final closure period, when passive discharge from the LP Central pit lake is approved. At that time, a section of the berm will breached to allow flow from the pit lake to Dixie Creek. In the post-closure, the naturalized berm will continue to constrain Dixie Creek during extreme flooding.

Contact water ponds have sufficient capacity to withstand both the Environmental Design Flood (EDF) and the Inflow Design Flood (IDF) without discharge of untreated contact water to the environment. An EDF is a hypothetical flood (peak discharge or hydrograph) adopted as the basis in the engineering design of project components The EDF provides a basis of the safety of a structure against failure by overtopping (e.g., during a flood) and for flood control and drainage work to provide safety to downstream areas against flooding. The IDF represents the most severe inflow flood (peak, volume, shape, duration and timing) for which a dam and its associated facilities are designed; the greater of the probable maximum flood or 1:10,000 year event (MNR 2011a,b).

Contact water collection systems for the Project have been designed to the EDF, which has been defined as a 1:100-year flood event, 24-hour storm runoff or freshet (rain on snow) which is a typical requirement for mines in Ontario (WSP 2024b). This provides a large overall storage capacity that accommodates year to year variations in precipitation and runoff to alleviate the potential for major precipitation events. The water level within the Viggo management facility (VMF) will be maintained during the operations phase as needed to provide sufficient storage to manage the spring freshet or major precipitation event. The TMF has been designed and will be operated so that there is no material ponding of water against any of the dams.

Should an extreme storm event occur including the EDF or IDF that the integrated water management system cannot contain, precipitation can be directed temporarily to the LP Central pit as a contingency. The contact water or melted snow would be pumped out of the open pit in the days following a storm event as capacity becomes available in water treatment system. If such an extreme event occurred while the open pit is in operations, open pit mining would likely stop however processing of ore could continue, fed by ongoing underground mining and stockpiled ore. Later in operations when only underground mining is occurring, mining and processing would not be materially disrupted if the LP Central pit was used temporarily for excess water management.

Typically, the design of mine site water management systems in northern Ontario is governed by the spring freshet (which is a long duration event, lasting several weeks) or a summer rainstorm (which is a shorter period, ranging from several hours to several days). For the drainage ditch sizing, a short duration storm event will produce the largest peak flow and is used to govern the sizing.

Large snowfall events could temporarily impede the movement of equipment and activities on site. Infrastructure may experience increased loads from snow accumulation. The risks to facilities associated with large snowfall events and snow loads will be managed through design criteria and application of appropriate management strategies. Buildings and related facilities will be designed according to the appropriate codes, such as the National Building Code of Canada (NRCC 2020a), to withstand precipitation events and large accumulations of snow on rooftops. In the event of flooding in the building areas, it expected that water would be pumped out and minor damage would be repaired, without stoppage in Project activity or environmental effects.

The risks associated with large snowfall events and snow loads to facilities and workers will be managed through design criteria and management procedures. Snow can be removed from roofs after heavy snowfalls if needed to prevent roof damage from excessive loads. Emergency and safety procedures will be in place to address worker safety during and after large snowfalls, issuing work stop orders and restricted travel.

Major precipitation events have the potential to cause erosion of exposed unconsolidated materials. Open pit and other slopes in overburden will be progressively revegetated during the operations phase to reduce the potential for water-related erosion. Overburden and soil stockpiles will also be revegetated progressively during operations and during closure. These actions will mitigate the potential for water-related erosion. Contact water will be collected and treated during the construction, operation and closure phases, including for suspended solids resulting from water-related erosion. No major environmental effects are anticipated from a major precipitation event and associated flooding.

As the Project is accessible only by Highway 105, there is also a potential that a major regional precipitation event resulting in highway closure could temporarily restrict normal operations and shipments. Contingency storage will be provided for critical supplies needed to maintain site activities, including environmental management.

After closure, the site will be fully reclaimed and site runoff will flow by gravity passively to the environment. The LP Central pit lake will overflow by gravity through a channel to a small tributary of Dixie Creek. The VMF pit lake is projected to remain an isolated pit lake, that does not discharge to the environment. An assessment of the potential effects of climate change including extreme weather events, will be completed nearer the end of the mine life, to assess if overtopping of the pit walls has become a credible scenario in the long term. If appropriate, a channel will be constructed to connect the VMF pit lake to the LP Central pit lake.

17.5.3 Potential Effects to the Environment, Health, Social and Economic Conditions

With implementation of design standards and codes, combined with engineering best practices as proposed, major precipitation events are not considered to have the potential to substantively damage Project infrastructure or components during all phases of the Project, or result in major environmental effects. There are no anticipated generational effects associated with the effects of a flood on the Project.

17.6 Severe Wind Storms

17.6.1 Environmental Conditions

The comprehensive climate dataset provided in Appendix W-3 provides information regarding the magnitude and relative frequency of wind speeds across cardinal wind directions using hourly mean wind observations from Ear Falls, Ontario. The westerly wind direction is the most common, accounting for approximately 10% of the hourly wind speeds. A frequency analysis was conducted for each cardinal wind direction to estimate the wind speed associated with a set of return periods (Table 5-11 in Appendix W-3). For the 100-year statistical return period for the extreme hour mean wind speed, the greatest wind speed is estimated from the south-southwest direction with a magnitude of 12.4 m/s or 44.6 km/h.

Tornadoes have been recorded in every province and territory in Canada, but are infrequent in northwestern Ontario, and to date have all been of lower magnitude. Tornadoes are classified on the Enhanced Fujita Scale which has six intensity categories from zero to five, based on the damage they cause. Most recent data from the Northern Tornadoes Project of Western University indicate that there were tornadoes associated with two storm events in 2024 (Northern Tornadoes Project 2024), although there are limited known tornadoes prior to last year in northwestern Ontario. The associated tornadoes were categorized as lower intensity: EF1 (135 to 175 km/h) and EF2 (180 to 220 km/h). EF1 and EF2 categories are associated with moderate to considerable damage, and are not considered discretely from high wind events.

There is projected to be a potential increase in frequency and intensity of severe storms, which could include high wind. In the region surrounding the Project site the annual mean wind speeds are projected to change between 0% to 4%, while 50-year return period maximum wind speeds were projected to change between -12% to 8%. Annual average surface wind speeds are projected to decrease by approximately -3% for the 2041 to 2060 period and -5% for the 2081 to 2100 period relative to a 1994 to 2014 baseline under a high emission scenario (Appendix W-4). Notably, there is higher uncertainty associated with projected changes in severe storms compared to other climate hazards such as temperature and precipitation.

17.6.2 Mitigation Measures

Severe wind events have the potential to physically affect buildings and infrastructure present during the construction phase and operations phase, including causing wind-related erosion where exposed finer-grained materials are present. High winds could cause downed trees which could block the mine access road and damage the regional transmission line or local distribution lines, resulting in temporary power loss or reduction of power availability.

The potential effect of storms on buildings will be low as they will be designed in accordance with professional engineering and design standards and building codes to withstand extreme winds. Buildings and infrastructure for the Project will be designed in accordance with professional engineering and design standards to withstand anticipated high wind events.

Overburden and soil stockpiles, and exposed, unsaturated tailings within the TMF may be affected by high winds which could result in localized wind-related erosion. Seeding of the overburden stockpiles will occur progressively during the operations phase to help control erosion of the stockpiles. The potential for wind-related erosion of the tailings surface within the TMF will be minimized by ongoing placement of tailings during operations. As contact runoff will be contained and treated as needed during the construction, operations and closure phases, the potential introduction of additional suspended solids through wind-induced erosion, will not have major environmental effect. The overburden stockpiles and tailings surface will be revegetated at closure which will mitigate the potential for longer term wind erosion and related environmental effects.

Safety procedures will be in place during high wind events to address worker safety. These may include reducing traffic speeds, addressing road conditions and if necessary, issuing work stop orders for certain Project locations or activities. In the event of a power outage, onsite diesel generation and natural gas generation will be in place to provide backup power to safely reduce operations until the full power supply can be reinstated.

After closure, the site will be fully reclaimed and no environmental effects from high winds are projected to occur.

17.6.3 Potential Effects to the Environment, Health, Social and Economic Conditions

With the planned Project design features and mitigation measures, high winds are not considered to have the potential to substantively damage Project infrastructure or components during all phases of the Project, or cause major environmental effects. There are no anticipated generational effects associated with the effects of an extreme storm or high winds on the Project.

17.7 Extreme Temperatures

17.7.1 Environmental Conditions

Buildings and structures will be designed to withstand anticipated extreme temperatures over the life of the Project and into post-closure as applicable (Appendix W-3 and Appendix W-4). The minimum and maximum daily temperatures recorded locally over the period of record are - 6°C and 37°C, respectively. The Project will experience frequent sub-freezing temperatures, with frost and ice days making up a considerable portion of the year, and on average 200 and 127 days respectively. Summers can be comparatively relatively short, with summer days of daily maximum temperature greater than 25°C ranging from 10 to 63 days and average of 33 days over the current climate baseline.

Temperature extremes and annual average temperature are projected to increase in the future (Appendix W-4). Annual average temperature is projected to increase by 2.5°C in the 2050s and 3.4°C in the 2080s at the 50th percentile, indicating an increasing trend due to changing climate. Greatest projected changes in annual temperature are identified in the winter months. For temperature extremes, fewer frost and ice days, more summer days and greater temperature extremes (lowest minimum and maximum temperature, highest minimum and maximum temperature) are projected. Changes in temperature extremes are projected to continue further into the future. Freeze-thaw cycle occurrence is projected to increase by mid-century. The majority of the projected change is estimated by mid-century, with a small but continued change for late-century period.

17.7.2 Mitigation Measures

The facilities and infrastructure for the Project will be designed in accordance with professional standards and building codes to withstand anticipated temperatures and temperature variations. The intent of engineering design standards and codes is to maintain the integrity of the infrastructure and facilities. Therefore, with implementation of these design standards and codes, combined with engineering best practices, extreme temperatures are not considered to have the potential to substantively damage Project infrastructure or components during all phases of the Project.

As part of normal temperature changes, erosion can occur from ice formation and thawing (freeze-thaw weathering). Water enters into the material, and when temperatures drop, the water freezes and expands causes a crack to occur or widen. The ice melts and water makes its way deeper into the cracks, continuing the cycle. This process can degrade materials such as concrete, and lead to cracking and other physical damage, potentially decreasing their life expectancy.

Erosion as a result of extreme temperature fluctuation is likely to occur but is not anticipated to have an adverse effect on the Project during all Project phases due to the application of engineering design standards and planned mitigation. Erosion would be limited in extent and be repaired relatively quickly with no disruption to other Project activities or substantial damage to infrastructure. The roads will be designed for the climate and maintained to mitigate the potential for cracks and potholes due to extreme temperature fluctuations and freeze-thaw cycles.

Safety procedures will be in place during extreme temperatures to address worker safety, which may include issuing work stop orders, mandatory breaks and similar, for certain Project locations or activities.

The site will be fully reclaimed after closure and will respond to high temperatures in the same manner as the surrounding environment. No additional environmental effects are projected to occur from high temperatures.

17.7.3 Potential Effects to the Environment, Health, Social and Economic Conditions

Extreme temperatures are not considered to have the potential to substantively damage Project infrastructure or components or cause major environmental effects with the planned Project design features, ongoing maintenance and mitigation. There are no anticipated generational effects associated with the effects of an extreme temperatures on the Project.

17.8 Low Intensity Seismic Events

17.8.1 Environmental Conditions

The Project is located within the Red Lake greenstone belt of the Uchi subprovince of the Canadian Shield which underlies approximately two-thirds of Canada. Information regarding seismic events that have occurred in Canada is contained in publications of Earthquakes Canada of Natural Resources Canada, and their predecessor organizations. The Project is situated in a low risk seismic hazard zone (NRCan 2021). A seismic zoning map for Canada has been developed on the basis of these studies and is used in the National Building Code (NRCC 2020a) to help design and construct buildings that are appropriate for a given region.

The Geological Survey of Canada provides ground motion parameters (peak ground acceleration and spectral accelerations for various return periods) for locations within Canada. Peak ground acceleration is a measure of how hard the earth shakes and is measured in units of acceleration due to gravity. The ground motion parameters are published in the 2020 National Building Code of Canada and made available through an online seismic hazard calculator tool (NRCC 2020c).

17.8.2 Mitigation Measures

The Project and related facilities and infrastructure will be designed to the applicable standard in consideration of the maximum credible seismic event for the region. The National Building Code (NRCC 2020a) provides for sufficient factors of safety to account for seismic activity and form the basis of the design and construction of the Project-related buildings and structures. In addition, all applicable facilities have been designed in accordance with the Canadian Dam Safety Guidelines (CDA 2013, 2019) and the provincial regulatory requirements under the *Lakes and Rivers Improvement Act* (MNR 2011a,b,c) using the maximum credible earthquake criteria (NRCC 2020c).

Seismic hazard values obtain from the National Building Code of Canada have been used to analyse the stability of the dams, stockpiles and open pit slopes for the Project. The peak ground acceleration values obtained from the online calculator are summarized in Table 17.8-1. Analysis for the stockpiles and open pit slopes used a maximum design earthquake equivalent to a 1:2,475-year seismic event (WSP 2023) and for the TMF dams and ancillary infrastructure is either the maximum credible earthquake or a seismic event with a return period of 1:10,000 years, whichever has greater intensity (WSP 2024). In addition, construction of the TMF dam including both initial construction and subsequent dam raises will be completed under the supervision of a qualified geotechnical engineer to confirm that calculated factors of safety are maintained through the construction process. By using these standards based on the level of risk for a seismic event of a magnitude up to the maximum credible event in the design, seismicity is not considered to have the potential to substantively damage Project infrastructure or components during all phases of the Project.

Climate change is not considered in the discussion on low intensity seismic events, as there are no credible climate-related effects on seismic events in the region.

17.8.3 Potential Effects to the Environment, Health, Social and Economic Conditions

There is no expected environmental effects resulting from seismic events. There are no anticipated generational effects associated with the effects of low intensity seismic events on the Project.

Table 17.8-1: Estimated Seismic Hazard

Probability of Exceedance	Return Period (years)	Peak Ground Acceleration (gravity)
0.0021	1:475	0.0239
0.001	1:1,000	0.0449
0.004	1:2,475	0.0911
0.0001	1:10,000	0.2900

17.9 Climate Resilience

The CCRA provided in Appendix W-4 aligns with the Strategic Assessment on Climate Change Revised, October 2020 (ECCC 2020) as well as the Draft Technical Guide Relating to the Strategic Assessment on Climate Change: Assessing Climate Change Resilience (ECCC 2022), which provides a technical guidance for how proponents pursing a project under a federal impact assessment can consider the resilience of their project. The CCRA also considers A Guide on Incorporating Climate Change Adaptation into Decision Making for the Mining Sector (MAC 2021). The following sections provide an overview of the CCRA, including a brief description of the approach and methodology, and results of the assessment.

Note that the CCRA provided as Appendix W-4 follows the approach and terminology in ECCC (2022), which uses the language of treatment and adaptation measures to achieve climate change resilience. The treatment and adaptation measure terminology presented in the CCRA report has been replaced by the term mitigation measures in the main text of the Impact Statement including this section, consistent with the TISG and *Impact Assessment Act*.

17.9.1 Approach and Methodology

The following tasks were completed to assess the potential climate change risk for the Project:

- Climate hazards and components: identified relevant climate hazards and Project's infrastructure components, and the interactions between them (known as interactions)
- Physical risk assessment: completed a physical risk analysis and evaluation using the consequence of a given climate hazard interaction, and the likelihood of the interaction to occur based on the current Project description
- Identification of mitigation measures: assessed how climate change risk will be mitigated or has been considered in design and identify potential treatment and adaptation measures; based on this, expected resilience to climate change after treatment is provided.

Figure 17.9-1 outlines the assessment approach taken to evaluate the resilience of the Project to future climate conditions.

As an initial step, the assessment identified relevant Project infrastructure components that could be impacted by climate hazards. Project infrastructure components were identified and categorized into infrastructure categories by reviewing Project documentation. Only infrastructure components present during the operations phase and post-closure were considered in this assessment. The construction phase and closure phase were not considered in this assessment as they will extend short periods of time (Section 6.5). Climate hazard variations within these timeframes would be within interannual variation rather than long-term variation due to climate change. As well, updated climate observations and projections will be available ahead of the closure planning and design, and will be examined at that time.

Next, climate hazards that could impact the infrastructure were selected. This was done by considering what climate hazards may be applicable to the Project region, and what physical characteristics of the Project could be impacted by climate.

Likelihood was used to describe the frequency at which an interaction may occur between climate hazards and the Project infrastructure. A likelihood scale was used to define categories that describe this frequency (details of which can be found in Appendix W-4). For each climate hazard, a related climate indicator was used to estimate the likelihood of an interaction. An example of a climate indicator could be average annual total precipitation, used to describe increasing precipitation as a climate hazard.

Consequence scores were used to describe the expected impact of a given climate hazard interaction if it was to occur. That is, how impactful an interaction will be if it happens. Consequence impacts for each interaction were assessed across three main categories, which include dollar impact, licence to operate, and safety. This consequence scale was adopted from the Great Bear Resources internal risk management frameworks (see Appendix W-4 for more information).

Once the climate projections were gathered, the climate interactions were identified and likelihoods and consequences completed, potential future risks were calculated. This was completed to understand where potential climate change related risks exist, in order to better inform treatment and adaptation measure identification. Each interaction identified was categorized into high, moderate, and low risk to help with prioritization of adaptation planning.

In the final step of this assessment, and in alignment with the ECCC (2022), potential mitigation measures were identified for all estimated climate risks. Mitigation measures were identified to be applicable to multiple interactions that had similar impacts. Treatment and adaptation measure were identified to mitigate or reduce the climate impacts or likelihood of occurrence associated with each infrastructure component. The resulting expected resilience of infrastructure to climate hazards was then completed. Note, as the Project is still in the planning phase, the objective of this analysis was to understand how these potential climate-related risks can be managed, and at what point in the life of the Project they should be considered for further evaluation and / or treatment. The proposed risk mitigation measures identified form the basis of how the Project can be resilient to a future climate, and how climate change can be considered as part the continuous improvement process throughout its life.

17.9.2 Climate Hazards and Conditions

Interactions were identified between relevant climate hazards and Project components. The climate hazards considered included: temperature increase, extreme heat, evapotranspiration, drought, extended cold spells, freeze-thaw cycles, precipitation increase, extreme precipitation changes, fluvial flooding, snowfall, freezing rain, high winds and wildfire.

The impact of these climate hazards was considered for Project infrastructure in the operations phase of the Project and post-closure, which were broken down into the following categories:

- Mining and aggregate infrastructure
- Tailings management
- Buildings and supporting infrastructure / systems
- Integrated water management system
- Power supply
- Roads
- Fish compensation areas
- Post-closure.

A total of 198 climate hazard-infrastructure interactions were assessed. Refer to Appendix W-4 for more information.

17.9.3 Risk Assessment Results

The climate risk analysis was completed without the consideration of future mitigation measures to understand where climate risk may exist. Additional information is provided in Appendix W-4. Each interaction identified was categorized into low, moderate and high risks across three time periods. Figure 17.9-2 presents the number of interactions by risk level and time period, to illustrate the distribution of risk levels and changes in climate risks over time. The current and 2050s time periods have the greatest number of interactions, since these time periods include operating infrastructure. In the 2080s, only closure and post-closure infrastructure will remain, resulting in a lower number of interactions and risks.

17.9.3.1 Current Time Period

Likelihood scores for the climate risks during the current time period were set to be unlikely or rare, with the exception of for wildfire, where likelihood level was assigned as possible.

Only one high risk identified for the current time period, related to wildfire interacting with tailings management infrastructure. This remains a high risk in the 2050s time period.

Medium risks in the current time period were driven by infrastructure interacting with extreme precipitation and flooding. Although the likelihood scores associated with these climate hazards were assessed as rare, the consequences associated with extreme precipitation and flooding interactions were more severe, resulting in medium risks. Other medium risks identified in the current time period were a result of various climate hazards such as extreme winds, freezing rain and evapotranspiration. These climate interactions also had likelihood scores of rare but had more severe consequences. In addition, these climate hazards had lower confidence associated with the projections.

17.9.3.2 2050s Time Period

High risks were estimated in three infrastructure categories for the 2050s period: mining and aggregate infrastructure, tailings management infrastructure, and integrated water management infrastructure. These risks are driven by climate change increasing the likelihood of interactions with wildfire, flooding and extreme precipitation, and freeze-thaw cycles. Wildfire and freeze-thaw cycles have lower confidence levels in the projection data. As there is less certainty in these risks results, flexible treatment and adaptation measures allow for updates as more information about the interactions or confidence in the projections becomes available. For wildfire, damage to infrastructure such as buildings, facilities, pipelines, power lines, can be consequential across the site independent of the infrastructure types. In addition, wildfires could be associated with localized environmental contamination depending on the affected component, together with health and safety issues notably through poor air quality and potentially deaths in case of a catastrophic event. Firewater tanks or equivalent water storage will be maintained on the site to support local fire fighting and an emergency response plan will be in place including evacuation procedures.

Notably, Great Bear Resources is actively integrating climate projections into water management designs for the Project which will help manage high risks associated with extreme precipitation and flooding. When comparing medium risk between the current and 2050s periods, the risks remain relatively consistent related to the smaller changes in the projection data for the relevant climate hazards.

Consequence categories that have contributed to the highest risks across all climate hazards for operating infrastructure (current and 2050s time periods) were health and safety, environmental, additional costs and Project schedule delay. Consequence drivers were used to support the identification and development of treatment and adaptation measures.

17.9.3.3 2080s Time Period

Most of the operating infrastructure will be removed before the 2080s time period based on the current Project schedule, resulting in a lower number of interactions and risks associated with post-closure infrastructure. For post-closure infrastructure, six interactions were estimated to be high risk driven by higher precipitation and flooding. Integrating climate projections into post-closure infrastructure design and maintenance as proposed will help manage these high risks by proactively considering potential future climate conditions.

Unlike earlier periods, wildfire was estimated to have moderate risk interactions. There are fewer interactions with the post-closure infrastructure resulting in lower consequence impacts. This is also true for snowfall and freezing rain, which have lower estimated risk interactions.

Since post-closure infrastructure will not be in place until the second half of the century, there is more time to integrate climate change treatment and adaptation measures into the design and management of post-closure infrastructure. Resilient post-closure infrastructure can be achieved by considering future climate impacts during planning, following mining sector guidelines and regulations, and utilizing existing risk management and adaptation plans.

17.9.4 Mitigation Measures

As part of the final step, mitigation measures were identified for high, medium and low climate-related risks. Appendix W-4 summarizes the interactions by pre-mitigation risk level for each infrastructure category and suggestions for potential mitigation measures to manage climate change related risk for the Project throughout its lifetime. Mitigation measures were provided for all climate risk levels. Below is a summary of the type of mitigation measures identified for each climate risk level:

- For potential high risks, mitigation measures should be the highest priority for consideration and should be considered in the detailed design and construction phases as well as infrastructure management plans and procedures. These measures involve the development of design criteria and management strategies that incorporates the projected changes in climate so that infrastructure is resilient to future changes.
- For potential moderate risks, mitigation measures should be considered the next priority of implementation and / or be incorporated in best management practices plans along with some design considerations as noted. The Great Bear Resource policies to regularly update the best management practices to account for observed conditions, operational and changes in likelihood are incorporated.
- For potential low risks, existing codes and standards for the infrastructure types as well as the current mitigation measures that will form part of the operating, surveillance and monitoring plans that will be developed in the operations phase and post-closure are sufficient to manage these risks in both the short and long term. Great Bear Resources

policies require that these plans to be regularly updated so that observed conditions and operational experience are incorporated.

A summary of this analysis as well as the resulting predicted resilience associated with each climate risk level after mitigation measures are applied is presented in Table 17.10-1.

All estimated Project climate risks are anticipated to be managed through proposed risk mitigation measures based on this assessment.

17.9.5 Climate Change Resilience

Through the CCRA, it was identified that climate interactions have a range of potential physical climate risks, from low risk to high risks. Mitigation measure considerations have been identified that could be implemented throughout the Project to manage these climate risks. Many of these mitigation measures are consistent with already developed best management practices that are in place as part of the Great Bear Resources corporate responsible mining principles.

As described above, climate risks were first assessed without the consideration of future climate in the design. This was completed to understand what potential climate risks could result in the largest impacts on the Project, and then identify potential mitigation measures that can manage those risks effectively so that the Project is resilient to future climate. Identification of risk mitigation measures was completed systematically, evaluating each climate interaction risk identified by considering the underlying impact associated with each interaction, and its estimated pre-treatment risk level, so that the mitigation measure intervention matched the associated perceived risk to the Project. Finally, an evaluation of how resilient infrastructure may be to a future climate if treatment and adaptation measures were implemented for associated infrastructure.

As a part of the continual improvement process, an ongoing monitoring program will be implemented for the Project, including as described in Section 20. The results of the monitoring will be used to support the decision-making process, if action needs to be taken to improve climate resilience and manage unexpected outcomes. By following this continual improvement approach and with the implementation a proposed mitigation including as summarized in Appendix W-4, the Project will be expected to be resilient to a changing climate over its planned lifetime.

Figure 17.9-1: Climate Change Risk Assessment Approach

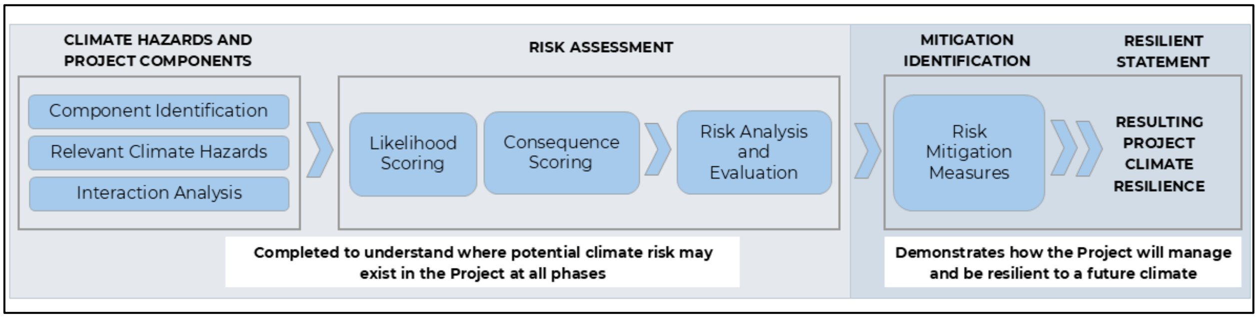


Figure 17.9-2: Number of Interactions by Risk Category and Time Period

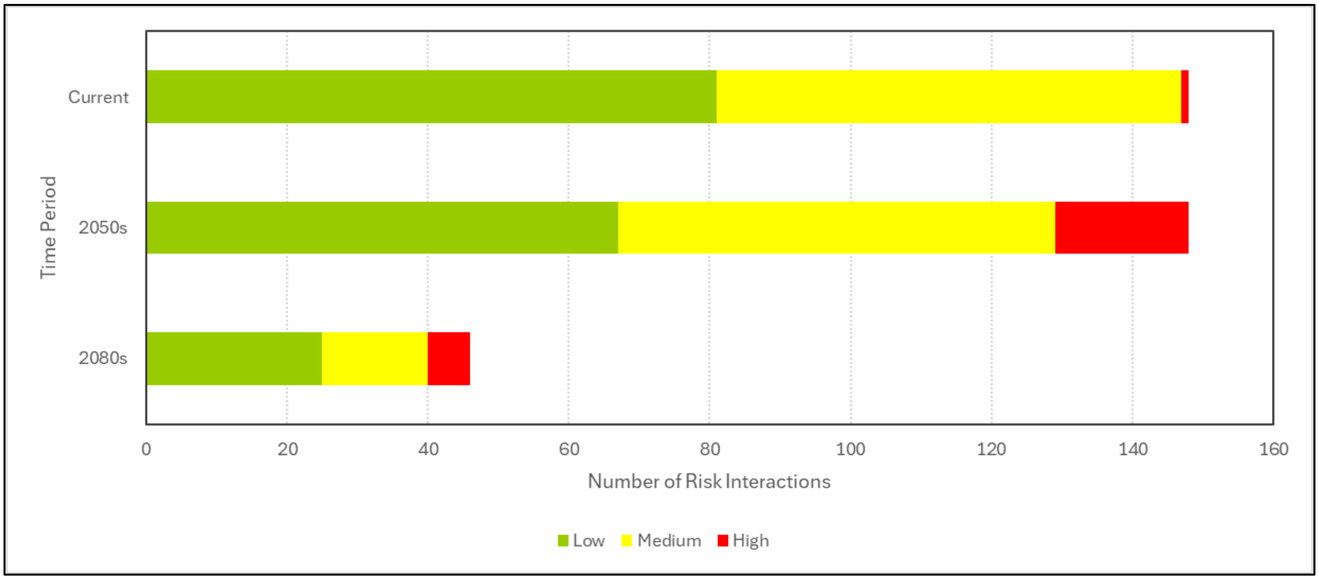


Table 17.9-1: Resilience after Mitigation

Climate Change-related Risk Level (Prior to Mitigation)	Infrastructure Categories Potentially Impacted	Resilient Statement after Mitigation
Potential high risks	• Power supply • Integrated water management system • Building and supporting infrastructure • Tailings management • Mining and aggregate infrastructure • Post-closure	• Consideration of future climate conditions in infrastructure design and operations will provide resilience to future climate conditions
Potential medium risks	• Other infrastructure • Fish compensation areas	• Consideration of future climate conditions in design and operations will provide resilience to climate related risks • Implementation of best management practices will adapt to manage future climate conditions
Potential low risks	• Other infrastructure	• Implementing existing procedures will manage low climate risks to Project infrastructure

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