PRODIGY GOLD INCORPORATED

Magino Gold Project

MAGINO GOLD PROJECT

Finan Township, Algoma District, Ontario

ENVIRONMENTAL IMPACT STATEMENT

CHAPTER 9: EFFECTS OF THE ENVIRONMENT ON THE PROJECT

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9.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

Section 6.3.8 of the EIS Guidelines for the Preparation of an Environmental Impact Statement for the Magino Project requires Prodigy to provide details of planning, design and construction strategies intended to minimize the potential environmental effects of the environment on the Project. The purpose of this Chapter is to satisfy this requirement. The natural environment has the potential to affect the Project through meteorological, climatological, and seismological events. These events could include:

- Flooding or drought;
- Larger than expected temperature fluctuations (summer and winter)
- Storms (rain, ice, snow, and wind storms);
- Forest fires; and
- Earthquakes.

These effects occur due to the variable nature of climate and the random nature of other events such as forest fire or earthquakes. With the exception of earthquakes, the frequency or duration of these events are projected to change due to global climate change.

The effects of the environment on the Project considers the projected future climate and the future climate trends and is described in Section 4 and in more detail in TSD 10 which provide the climate normal and climate trends and analysis.

The sections below describe how the Project might be affected by these events and how the effects of these events will be mitigated and/or managed in an adaptive manner, so as not to affect the viability of the Project or increase the potential for environmental effects.

9.1 Potential Effects of Flooding or Drought

Flood and drought conditions occur and will continue to occur throughout the life of the Project. How these are accommodated by the Project design and operations is described in Chapter 6.0, and in the tables below.

As a result of climate change, the frequency of both floods and droughts is projected to increase in the future with expected increase in the frequency of extreme weather events. For example, it has been projected that there will likely to be an increase in the amount of rain and the severe rain event for the study area. The total annual precipitation is expected to increase. Precipitation trends could vary spatially resulting in drought in some locations.

The potential effects from drought and flooding on the Project and corresponding mitigation and adaptive management measures are summarized in Table 9-1.

Table 9-1: Potential Effects of Flooding and Drought on the Project

Hazard	Potential Effects on the Project	Mitigation By Design	Proposed adaptive management measures	
			Inspection/ Surveillance	Contingency Actions
Drought Conditions	• Increased dust on-site. • Reduced availability of water for mining operations. • Require increased intake from the lake.	• The surface water supply available to the mine is ample even during 1-in-100 year severe drought conditions as described in TSD 7 (SLR, 2016)[2]. • Operate the Project in accordance with a Water Management Plan (WMP) that provides pre-determined measures to deal with drought conditions. • Implement fugitive Dust Control plans for haul and access roads.	• Monitor the water levels of the freshwater withdrawal lake.	• If necessary, the amount of water stored in the TMF could be increased in order to accommodate the water supply needs during the low flow conditions in the streams and lake.

Hazard	Potential Effects on the Project	Mitigation By Design	Proposed adaptive management measures	
			Inspection/ Surveillance	Contingency Actions
Flooding	• Flooding of the pit. • Overflow of the water quality control ponds. • Flooding of culverts and roads resulting in road washout. • TMF spillway overflow. • Site access by public roads could be cut off for several days due to road wash out/blockage.	• Design facilities to handle excess water in extreme weather events. • As discussed in Chapter 6.0, the TMF capacity will be maintained to accommodate the 100-year wet event as will the water quality control ponds. • Design the TMF spillway to handle the most probable precipitation event (refer to TSD 6). • Reduce mining activities and secure vulnerable mining equipment, if pit becomes flooded. • Size the site Water Quality Control Pond to accommodate large storm events (i.e., 100-year 24-hour flood event). • Ensure adequate storage of supplies on-site to outlast potential period of site isolation.	• Routinely monitor water levels in the TMF and the Water Quality Control and detention ponds to assure they continually meet prescribed operating guidelines. • Inspect damage from flooding on infrastructure such as roads, spillways and culverts, and repair as necessary.	• Increase the height of berms around ponds and spillways. • Construct TMF embankment stages earlier and higher if necessary. • Enlarge culverts and place them deeper below the road surface. • Raise road surfaces and other infrastructure higher to prevent inundation by flood waters.

9.2 Potential Effects of Larger Temperature Fluctuations

9.2.1 Warmer Temperatures

Climate change has the potential to amplify extreme climatic events, i.e., longer cold snaps in winter and longer heat waves in the summer. Temperatures vary seasonally, and are maximum in July, when the average daily temperature is 17.4°C (Chapter 4.0) and daily extremes can vary from 11°C to 22.8°C. Short-term extremes in the summer months can vary from -33°C (in January) to 33.2°C (in May). Minimum average daily temperature occurs in January, i.e., 14.6°C, with extremes ranging from -40°C to +4.9°C. The Project's design and operational procedures will accommodate these temperature ranges.

Over the last century, southern Canada has warmed by 0.9°C. Global Circulation Models (TSD 10) suggest that temperatures are expected to continue to increase. Most of the warming is expected to take place in the winter as there is a trend of increasingly warmer winters. Warmer winters also suggest a slight increase in the amount of precipitation that comes as rain (i.e., reduced snow pack).

These anticipated changes in temperatures may result in more frequent freeze-thaw events during the winter and spring. Although much of the Magino property will be cleared of trees to allow for mine infrastructure, the warm temperatures and changes in precipitation due to the projected climate changes will alter evapotranspiration rates. Based on evaluations presented in TSD 7, the net effect of increased precipitation and temperature will be a net increase in runoff and hence an increase in the availability of surface water supplies.

The potential effects from warmer temperatures on the Project and corresponding mitigation measures are summarized below in Table 9-2.

Table 9-2: Potential Effects of Warmer Temperatures and Forest Fires

HAZARD	POTENTIAL EFFECTS ON THE PROJECT	MITIGATION BY DESIGN	PROPOSED ADAPTIVE MANAGEMENT MEASURES	
			INSPECTION/ SURVEILLANCE	CONTINGENCY ACTIONS
High Temperatures	• Hazard to worker health and safety. • Heat damage to mechanical equipment.	• Implement an Occupational Health and Safety Management Plan to ensure worker safety. • Train staff in accordance with operating procedures and Management Plans.	• Inspect mechanical equipment after extreme temperature days for damage.	• Upgrade mechanical equipment and worker safety equipment to allow for work in high temperatures.
Freeze/thaw conditions	• Development of pot holes and/or roads breaking apart making it a hazard to driving. • Ice blockage in drainage ditches. • Reduced access to some areas of the Magino property for monitoring purposes due to thawing ground. • Freezing of temporary pipes and equipment that may be used to manage water and which are placed on the ground surface. • Cold weather hazards for workers.	• Monitor roads for damage and repair before they get too hazardous. • Routinely inspect and maintain haul and access roads. Repair as necessary. • Incorporate awareness of the risks of thaws and sudden freezes in Occupational Health and Safety Management Plan to ensure worker safety and effective Project operations. • Train staff in accordance with operating procedures and Management Plans. • Create “all-weather” access trails or roads to all critical operating and monitoring locations throughout the Project area.	• Inspect damage to roadways and other infrastructure after major freeze/thaw events in the spring.	• If necessary, reconstruct access roads to provide improved performance during thaws. • If necessary, use heat traces or otherwise protect from freezing and above-ground temporary water conveyance systems.
Forest Fires	• Danger to worker safety. • Discomfort and	• Site design has considered the safety of the proposed location	• Monitor forest fires occurring in the regional	• Increase the amount of firefighting equipment in

HAZARD	POTENTIAL EFFECTS ON THE PROJECT	MITIGATION BY DESIGN	PROPOSED ADAPTIVE MANAGEMENT MEASURES	
			INSPECTION/ SURVEILLANCE	CONTINGENCY ACTIONS
	unhealthful working conditions due to smoke inhalation. • Potential of fire at on-site fuel storage with resultant explosive risk. • Property damage. • Loss of habitat created during progressive rehabilitation and in the Post-closure Phase. • Reduced or no access to site by public road for several days due to forest fires. • Potential evacuation of the site.	for fuel storage with a buffer between combustible materials and natural vegetation. The perimeter road around the Project site provides a buffer of depleted vegetation thus effectively limiting the spread of wildfire. • Incorporate fire hazard prevention measures on vehicles (e.g., spark accessories) and the ERSPC Plan for the Project. • Include response to fires as outlined in the ERSPC Plan. Include local and regional firefighting units in the plan. • Provide an adequate number of trained fire-fighting staff. • Participate in mutual aid programs with neighbours. • Raise awareness of smoking and other fire risks to ensure worker safety. • Ensure adequate storage of supplies on-site to outlast potential period of site isolation. • Incorporate site evacuation procedures in ERSPC Plan.	area. • Monitor the fire risk and notify Project personnel and visitors of these risks.	the Project area. • Increase the amount of co-ordination and training with the Project and local and regional firefighting units.

9.3 Storms

Extreme weather events, such as storms are anticipated to have both increased frequency and intensity as climate change continues. This could increase the risk from potential winter and spring flooding, as well as flash flooding caused by intense single event rainfall. With the predicted warmer winter and spring seasons due to climate change, the frequency of ice, wind and snow storms may increase. Extreme storm events can be hazardous to the Project due to their sudden onset and intensity. There is also the potential for damage to exposed infrastructure (e.g., power lines, exposed pipes, conveyors, etc.) either due to direct physical damage, or heavy snow or ice accretion on the infrastructure. This could potentially cause breakage or trees to fall onto the infrastructure.

The potential effects on the Project from extreme storm events and corresponding mitigation measures are summarized below in Table 9-3.

Table 9-3: Potential Effects from Storms

HAZARD	POTENTIAL EFFECTS ON THE PROJECT	MITIGATION BY DESIGN	PROPOSED ADAPTIVE MANAGEMENT MEASURES	
			INSPECTION/ SURVEILLANCE	CONTINGENCY ACTIONS
Rain and Lightening Storms	• Hazard to worker safety from lighting and potential flooding. • Dangerous driving conditions due to reduced visibility and washed out roads. • Flooding of Project area.	• Incorporate flooding awareness and responses/procedures into the ERSPC Plan to improve worker safety. • Include stormwater management in the Water MP for the Project. • Curtail mining activities, if necessary, and secure vulnerable mining facilities if the mine becomes flooded or if pit walls become unstable. • Design pit slopes to maximize slope stability during extreme storm events.	• Inspect damage from flooding on infrastructure such as roads, foundations, supports spillways and culverts and repair as necessary. • Monitor forests during lighting storms for forest fires.	• These are the same as those described under “Flooding” in Table 9-1.

HAZARD	POTENTIAL EFFECTS ON THE PROJECT	MITIGATION BY DESIGN	PROPOSED ADAPTIVE MANAGEMENT MEASURES	
			INSPECTION/ SURVEILLANCE	CONTINGENCY ACTIONS
Snow Storms	• Hazard to workers safety due to slippery conditions. • Dangerous driving conditions due to reduced visibility snow covered roads. • Infilling of drainage ditches or excessive snow pack on infrastructure. • Dangerous mining conditions due to snow covered operational areas in the pit. • Access difficulties or cut-off from external suppliers for several days.	• Provide a description of snow storm hazards and required responses/procedures in management plans to improve worker safety including hazardous weather driving. • Incorporate emergency response procedures in the ERSPC Plan. • Remove excessive snow from drainage ditches or off vulnerable infrastructure. • Reduce mining operations in severe weather conditions. • Ensure adequate storage of supplies on-site to outlast potential period of site isolation.	• Patrol access to the mine and haul roads on the mine site to provide emergency services to travelling workers and the public. • Inspect conditions or roads, the mine and other infrastructure to ensure it is safe to continue work.	• Provide more snow removal equipment on-site. • Provide more back up power sources in case of loss of power.
Wind Storms	• Dangerous driving conditions in combination with snow covered or icy roads. • Power outages from blown down hydro lines or trees falling on the hydro lines. • Structure damage to infrastructure. • Damage to environmental management	• Incorporate emergency response procedures into the Project's ERSPC Plan. • Reduce mining operations in severe weather conditions.	• Inspect damage to all infrastructure to ensure it is safe to continue work. • Repair all damages to environmental management infrastructure to ensure it remains effective.	• Further buffer vulnerable mine infrastructure from trees or other buildings and structures.

HAZARD	POTENTIAL EFFECTS ON THE PROJECT	MITIGATION BY DESIGN	PROPOSED ADAPTIVE MANAGEMENT MEASURES	
			INSPECTION/ SURVEILLANCE	CONTINGENCY ACTIONS
	infrastructure, such as sediment control fences, stockpile covers, and physical or mechanical dust controls.			
Ice Storms	• Hazard to workers safety due to slippery conditions. • Dangerous driving conditions due to reduced visibility and icy roads. • Power outages due to ice on hydro lines or ice laden trees falling on the hydro lines. • Dangerous mining conditions due to ice covered operational areas in the pit. • Damage to infrastructure due to ice accretion or tree falls. • Site access could become limited or cut-off from external suppliers for several days.	• Provide a description of ice storm hazards and required responses/procedures in management plans to ensure worker safety including hazardous weather driving. • Incorporate emergency response procedures in the Project's ERSPC Plan. • Reduce mining operations in severe weather conditions. • Ensure adequate storage of supplies on-site to outlast potential periods of site isolation.	• Inspect damage to power lines and trees surrounding power lines after an ice storm to prevent the possibility of accidents and power loss. • Inspect conditions or roads, the mine and other infrastructure to ensure it is safe to continue work.	• Have de-icing equipment on-site not only for de-icing roads but also for de-icing mining equipment.

9.4 Seismic Activity

Seismic activity in eastern Canada is associated to regional stress fields (pressures within the plate) rather than being directly associated with plate interactions since eastern Canada is part of a stable interior North American plate. According to Natural Resources Canada, only two earthquakes of magnitude 2.5 or greater have been recorded in northern Ontario from 1970 to 1999. Because of the low frequency of earthquakes in northern Ontario, including the study area, the project is considered to have a very low level of seismic activity (NRCan, 2013).

The potential effects from a seismic event on the Project and corresponding mitigation measures are summarized below in Table 9-4.

Table 9-4: Potential Effects from Seismic Activity

HAZARD	POTENTIAL EFFECTS ON THE PROJECT	MITIGATION BY DESIGN	PROPOSED ADAPTIVE MANAGEMENT MEASURES	
			INSPECTION/ SURVEILLANCE	CONTINGENCY ACTIONS
Earthquake	• Slight damage to infrastructure. • Loss of water and/or water supply. • Rock slides in the pit. • Material unraveling on MRMF slopes. • Potential impacts on worker safety.	• All infrastructure will be built to the Canada Building Code. • The pit has been designed to perform in a stable manner under the design earthquake. • Monitor stability of pit walls and rock stockpiles regularly, including stability measures such as slope flattening (pit) or compaction (MRMF) or slope unloading (pit).	• Inspect damage to roads, equipment, buildings, and other mining infrastructure and repair as necessary.	• Upgrade building and road structures to withstand larger earthquakes. • Provide for backup power for critical infrastructure.

9.5 Implications of Climatic Change Trends

Taking into account the mitigation by design measures and the adaptive management measures proposed above, Table 9-5 summarizes the key climate change trends identified for the Project study areas (TSD 10), evaluates their implications for Project design and operations, and discusses any implications for the conclusions of the environmental assessment.

Table 9-5: Overall Implications of Climate Change Trends

CLIMATE FACTOR DESCRIPTION (GOLDER, 2016)		TREND (ADAPTED FROM GOLDER, 2016)	IMPLICATION OF CLIMATE CHANGE TRENDS		
			FOR PROJECT DESIGN	FOR PROJECT OPERATIONS	FOR THE ENVIRONMENTAL ASSESSMENT
Rain	Drought	Increasing	• Maximum recycling and reuse of process water is incorporated into the design. • Over 95% of the Project's water needs are driven by processing needs and will not increase due to drought conditions.	• This is not expected result in any changes to the Project operations. • Environmental monitoring systems should include lakes and streams outside of the area of influence of the Project, so that climate change effects can be distinguished from Project effects.	• This trend does not change the conclusions of the environmental assessment. • This trend has been evaluated in TSD 10 (Golder, 2016) and there is no change expected in the effects on the Project.
	Amount of rain	Increasing	• The potential increases in rainfall are readily accommodated by the design floods selected when designing Project facilities such as ditches, culverts, ponds, spillways, etc. These facilities are typically designed for extremely intense rainfalls that may only occur once every 100 years or more.	• This is not expected to result in any principal changes to the Project operations since they will accommodate rain events. Increases in rainfall intensities, however, may increase requirements for maintenance and erosion control measures.	• This trend does not change the conclusions of the environmental assessment. • This trend has been evaluated in the TSD 7 (SLR, 2016). In this document and the changes in the projected effects on stream flow and lake levels is small and well within the range of natural fluctuations. Furthermore, because of the projected increase in precipitation and runoff lake levels and flow conditions in the Project area will likely improve slightly because of climate change.
	Frequency of rain events	Increasing	• Since the project is designed for rain events irrespective of their frequency, this will not change the design.	• This is not expected to result in any principal changes to the Project operations since these will accommodate rain events.	• This trend does not change the conclusions of the environmental assessment.
	Amount of rainfall per event	Increasing	• As described under "amount of rain" the Project will be designed to accommodate extreme high rainfall events.	• Increases in rainfall per event may increase requirements for maintenance and erosion control measures.	• This trend does not change the conclusions of the environmental assessment. • Project facilities will be designed for extreme rainfall in any events (i.e., of the order of the one-in-100 year events).
Snow	Changes in snowfall	Decreasing	• Since the Project will be designed for an extreme snowpack this will not change the design.	• This may reduce the requirement for snow removal at the Project facilities.	• This trend does not change the conclusions of the environmental assessment.
	Changes in snowpack	Decreasing	• Since the Project will be designed for an extreme snowpack and for an extreme freezing depth, this will not change the design.	• This may result in less need for snow clearing during operations. The potential for deeper freezing depth due to less insulation by the snow pack will likely be offset by increased winter temperatures, increased exposure to wind, sunlight, etc.	• This trend does not change the conclusions of the environmental assessment.
Temperature	Freeze-thaw events	Increasing	• This trend will not likely affect the design, since the facilities will be designed to accommodate any number of freeze-thaw events.	• More frequent freeze-thaw cycles may reduce the efficiency of the work force since these are periods when access to various parts of the site and the pit are the most difficult.	• This trend does not change the conclusions of the environmental assessment.
	High temperatures	Increasing	• Project facilities will be designed to accommodate a temperature range that includes changes projected through climate change.	• No increase in the effect on Project operations is expected.	• This trend does not change the conclusions of the environmental assessment.
	Warmer winters	Increasing	• No special considerations are required.	• Winter operations may become slightly easier.	• This trend does not change the conclusions of the environmental assessment.
	Heat waves	Increasing	• There may be an increased need to provide measures such a shading, consumption of fluids, work breaks, etc. for outdoor workers.	• No special considerations are required.	• This trend does not change the conclusions of the environmental assessment.
Other Events	Increase in storms	Increasing	• Project facilities will be designed for extreme events.	• Operational procedures will accommodate extreme storms in any event.	• This trend does not change the conclusions of the environmental assessment.
	Increase in ice storms	Increasing	• Project facilities will be designed for extreme ice conditions, i.e., include drainage systems to prevent	• Project will incorporate operational procedures to deal with icing conditions in dry event.	• This trend does not change the conclusions of the environmental assessment.

CLIMATE FACTOR DESCRIPTION (GOLDER, 2016)		TREND (ADAPTED FROM GOLDER, 2016)	IMPLICATION OF CLIMATE CHANGE TRENDS		
			FOR PROJECT DESIGN	FOR PROJECT OPERATIONS	FOR THE ENVIRONMENTAL ASSESSMENT
			water buildup and ice formation, safety berms to control vehicle skidding, etc.		
Wind	Wind speeds	Decreasing	• No special considerations are required.	• No special considerations.	• This trend does not change the conclusions of the environmental assessment.
	Large scale circulation	Decreasing	• No special considerations are required.	• No special considerations.	• This trend does not change the conclusions of the environmental assessment.

9.6 References

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