9.0 EFFECTS OF ENVIRONMENT ON PROJECT

The MVEIRB Terms of Reference (MVEIRB 2009) requested that information be provided on potential effects of the physical environment on the YGP. Specific issues to be considered were to include:

- *"Climate change effects;"*
- Extreme precipitation, *"the occurrence of 100-year extreme precipitation events causing greater than expected inflows into the tailings facility"* ; and,
- "Geotechnical instability due to various causes such as seismic events."

9.1 CLIMATE CHANGE AND EXTREME PRECIPITATION

General circulation models (GCMs) in combination with various population and economic growth scenarios provide simulations of climate change over the period of 2010 to 2039 for the Mackenzie Valley and by inference, the YGP area, referenced to 1961 to 1990 climate normals (Burn 2003).

Mean annual temperature over the period of 2010 to 2039 is projected by GCMs to increase in the Upper Mackenzie Valley by between 1.0ºC and 2.1ºC over the 1961 – 1990 baseline mean temperature for the region (3.4ºC at Hay River). Mean winter temperatures are projected to increase at a slightly faster, but more variable rate in the region (between 0.6ºC and 2.5ºC). Increasing temperatures, in particular during the winter, would tend to shorten the length of the snow season in the region.

For the Upper Mackenzie Valley, the projected increase in precipitation over the next 30 years is between 0.9% and 9.6% over the 1961-1990 baseline. Over the 67 year period of record at the Yellowknife Airport weather station, annual snowfall has been increasing by an average of 1.1 cm per year. Two of the largest recorded snowfall years occurred in 2007 and 2008. The record also shows that with little change to the start of the snow season, winters are becoming shorter.

The YGP lies in an area of discontinuous permafrost. Climate change may affect the existing permafrost in the vicinity of the YGP from a distribution and physical/mechanical properties perspective; however, any changes are anticipated to have little impact on the project infrastructure. The project infrastructure will be designed and constructed with minimal dependence on permafrost soils as foundations.

Roads, laydown areas and other non-critical project components will be constructed primarily using fill in any areas that may contain permafrost which will act as a thermal barrier slowing the degradation of the permafrost. The thickness of the fill required will be site-specific and designed according to the existing conditions and projected effects of the project and climate change. The removal of organics and ground disturbance will be minimized where possible.

Extreme Precipitation Event

A hydrologic analysis was carried out to determine the total runoff volume draining into Winter Lake at the proposed dams during a 100-year extreme precipitation event. The 100-year 24-hour rainfall based on the Yellowknife Airport climate station, the closest station with such information available, was determined to be 79 mm. The total drainage area of Winter Lake at the proposed dams is about 3 km^2, including 0.53 km^2 of the lake surface area. A hydrologic model was developed using HEC-HMS 3.5 to convert rainfall to runoff over the sub-catchment areas. The US Soil Conservation Service (SCS) unit hydrograph method was applied to determine the runoff hydrograph from the design rainstorm. The SCS Type II distribution was selected to define the distribution of design rainfall total over 24 hours. The catchment area was subdivided into two sub-catchments: the direct sub-catchment of the lake and the lake area receiving direct precipitation. In general, the catchment area, mainly forested area in a good condition, is underlain by stony, sandy glacial till and fluvial deposits. Most soils are well-drained and are often stony and/or shallow. Soil Type B, representing soil composed of shallow loess and sandy loam was therefore chosen for the study area. An antecedent moisture condition III (rain and low temperatures over the previous five days causing saturated conditions) was assumed. A curve number of 75 was estimated for the direct drainage area of the lake while the lake surface was assumed to be impervious in the model. Slopes, elevations and channel lengths were taken from available topographic maps to estimate the time of concentration for each sub-catchment.

During the 100-year 24-hour rainfall event, the peak inflow to Winter Lake at the proposed dams was determined to be 16.9 m^3/s, and the total runoff volume draining into the lake was determined to be about 107,000 m^3, which equates to approximately 0.2 m of water depth in the lake.

The proposed final dam crest elevation is 297 masl, which is 3.5 m higher than the proposed water cap elevation of 293.5 masl at the end of the mine operation. It is understood that a minimum freeboard of 1 m will be maintained along the proposed dams during the operation of the mine and construction phases of the dams. When no outflow is allowed in the event of accidents or malfunctions, there would be sufficient storage available to contain runoff during the 100-year 24-hour rainfall event.

9.2 SEISMIC INSTABILITY

As previously discussed in Section 4.4.5, the Yellowknife Gold Project area lies in a tectonically inactive plate zone within the Canadian Shield. The Shield area is considered relatively stable compared to more active boundary plates located to the west in the Yukon and Alaska. The highest seismicity is associated with the coastal zone (Seismic Zone 1) to the west of the Northwest Territories. Further inland, the seismicity reduction increases from Zone 2 into Zone 3. On the basis of this geotechnical instability arising from seismic events or other causes is not likely to occur in this area.