6.0 ENVIRONMENTAL IMPACT ASSESSMENT & MITIGATION PLAN

The project has been designed to be developed and operated with a minimum of adverse environmental impacts. This environmental impact assessment details the interactions between the project and the natural and human environment, and in most cases describes how adverse effects have been avoided through design.

6.1 PHYSICAL ENVIRONMENT

6.1.1 *LANDFORMS*

Physical disturbance of the site has been minimized through design by making use of existing clearings and avoiding areas that require extensive cut and fill operations to the extent possible, with the exception of a wetland area that will be partially filled during construction of the temporary access road (Figure 2.5). Cross-drains will be installed to ensure natural surface flows are maintained and grubbing will be kept to a minimum. The total area of terrestrial disturbance associated with construction of the roads and staging area is approximately 4 ha.

In consideration of the temporary nature of the project and that the road will be reclaimed, the potential for significant adverse effects on the physical elements within the project study area is therefore negligible.

6.1.2 *AIR QUALITY AND NOISE*

Emissions from the project will include the following:

- Vehicle exhaust
- Diesel generator exhaust
- Dust from quarrying and crushing
- Road dust from traffic
- Airborne dust from dewatered lake basin sediment
- Noise from construction

Exhaust emissions from vehicles and equipment will be minimized through regular maintenance of equipment and minimized idling when possible. Dust generated by quarrying and from traffic on the roads is expected to be minimal and will be managed as needed by water application. Should lake dewatering result in elevated dust levels, TANCO will consider dust control measures such as seeding of the basin with native vegetation. Elevated noise levels from heavy equipment will be evident on the mine site during construction of the roads, dike and pipeline.

Any effects of operations on the mine site air quality or noise levels will be within limits set by workplace safety. Given that effects on air quality and noise will be restricted to a localized area, that the magnitude of the effects will be within regulated limits, and that the effects will only occur over the period of construction the effects are considered to be minimal.

6.1.3 *Hydrogeology*

It is possible a drawdown of the water table adjacent to the lake could occur due as a result of dewatering. Should it occur, the effects will be temporary while the narrows dike is in place.

6.2 Terrestrial Environment

6.2.1 *Flora and Fauna*

Overall effects to the terrestrial environment, given implementation of appropriate avoidance, minimization and mitigation measures, are estimated to be not significant. All predicted effects are associated with road construction required to implement dike construction and the dewatering plan. The project will required the construction of two roads: one for the dike (745m) and one for dewatering (900m). The road rights-of-way (ROW) will be cleared with chainsaws, bulldozers, and a grader (if necessary) . The maximum width of the cleared ROW is 20 m. The clearing of a 20-m ROW for both roads will result in the alteration or removal of approximately 3.29 hectares (ha) of vegetation. An additional 0.5 ha of clearing is planned for the staging area at the narrows. TANCO will dispose of all cleared vegetation as directed by Manitoba Conservation. In the unlikely event that a listed species does occur in the area, the small amount of habitat disturbance is unlikely to have an adverse impact. In addition, the disturbance to these habitats will occur during the non-breeding season, thereby minimizing potential direct impacts to wildlife such as breeding birds.

One of the primary concerns regarding road construction is the potential for the road to act as a barrier to movement of animals, thereby resulting in habitat fragmentation (Forman and Deblinger 2000). Three factors argue against the new roads having a significant habitat fragmentation effect:

1. The roads will be temporary and, once the need for them has passes, will be decommissioned and allowed to re-vegetate;

2. The roads will not be heavily used once construction is completed, be largely unused. Non-project-related use of the roads (e.g., by hunters) is unlikely; and

3. The terrestrial environment through with the road passes is a naturally patchy environment; wildlife resident in naturally patchy environments tend to not react strongly to the creation of additional edge-type habitats (Turner et al. 2001).

Two variables typically create avoidance of roads by wildlife: high traffic volume (e.g., > 1,000 vehicles per day) and vegetation composition (i.e., barrier effect of vegetation is less than that of gravel, which is less than that of pavement) (Forman and Deblinger 2000; Trombulak and Frissell 2000). Factors 1 and 2 in the previous list minimize the potential for these two variables to affect wildlife activity patterns along the road route. In addition, when the roads are operational, project-related traffic rates will be very low (i.e., < 5 vehicles per day).

Additional concerns with road construction include the potential for vehicle collisions with wildlife, increasing predator access, and attracting wildlife to roads by creating browse in newly cleared areas. Although the road building may increase access for mammalian predators as is it using an existing ROW, the overall use of the area by predators is likely low due to the mining activity. The low traffic rates and low maximum speed limit will minimize the potential for such collisions to occur. Clearing an additional 3.79 ha of potential browse opportunity for ungulates in a browse-rich landscape will not create significant additional collision risk.

As the Project is located to the south of the current (2000-2010) range of the Owl-Flintstone caribou herd, no negative effects are predicted.

6.2.2 *Wetlands*

A primary concern with the proposed plan relates to the potential for sedimentation in the wetland(s) from the dewatered volume. The pumping during the winter months is expected to produce relatively sediment-free water because of the ice cover on Bernic Lake and because initially the surface layer of the lake will be pumped. This expectation is supported by recent monitoring data near the current effluent discharge bay at the TANCO mine indicating that total suspended solids (TSS) concentrations are on the order of 10 mg/L (range of 5.5 to 14 mg/L); a reference site in the east basin was measured to have TSS concentrations on the order of 5 mg/L (range of 1 to 23 mg/L). However, as the lake volume decreases and the ice cover melts and breaks up, it is expected that wind-driven waves will suspend sediment from the lake bed. The concentration of sediment in the lake water will vary in response to the following influences:

- Lake bed sediment composition
- Consolidation of the lake bed sediment
- Bathymetry of the lake
- Climatic conditions

Until more detailed information is available, it is assumed that a sediment concentration of one percent (10,000 ppm) can serve as an initial upper-bound estimate of the sediment concentration. If this concentration is applied only to the lower half of the volume stored in the west basin of Bernic Lake, the total volume of sediment pumped from the lake would be 49,000 m^3. This estimate does not account for any sediment in the direct surface runoff to Bernic Lake.

Assuming the entire volume of sediment pumped into the wetland is retained, the average depth of sedimentation would be approximately 0.5 m; if only half of the sediment is retained, the average sedimentation depth would be approximately 0.25 m. Since there appears to be less than one meter of relief between Bernic Lake and Bernic Wetland, such depths of sedimentation may be too excessive to allow for positive downstream flow. An alternative would be to discharge the pumped water into the Horseshoe Wetland. Assuming the entire volume of sediment pumped into this wetland is retained in the wetland, the average depth of sedimentation would be approximately 0.1 m; if only half of the sediment is retained, the average sedimentation depth would be approximately 0.05 m.

While the magnitude of the sediment retention is currently unknown, and the depths estimated herein represent an expected upper bound, more precise calculations can be made if data addressing sediment concentrations and sediment gradations are collected through the geotechnical investigation. The sediment concentration data can provide a better estimate of the total volume entering the wetland. The sediment gradation data can be used to estimate settling velocities, and based on estimates of flow velocities through the wetlands, the percent of sediment retained in the wetland (by size fraction if necessary).

Once the sediment loads and retention in the wetlands are estimated, depths of sedimentation can be estimated. This depth is important because greater depths of deposition may require stabilization to prevent future erosion and transport of the sediment into the Bird River. It is expected that relatively shallow depths of sedimentation will be naturally stabilized by vegetation. However, localized depths of sedimentation may require stabilization using mechanical or bioengineering measures.

6.3 Aquatic Environment

The proposed dewatering plan, making use of wetlands adjacent to Bernic Lake, is expected to provide the opportunity to mitigate the loading of phosphorus and sediment delivered to the Bird River.

6.3.1 *Surface Hydrology*

It is expected that the proposed pumping rates on are the order of peak flows during the spring freshet. Therefore these natural flow paths to the Bird River are expected to have sufficient capacity to convey the dewatered volumes at the expected pumping rates. It is further anticipated that the dewatering will provide a continuous (although variable) discharge to Bernic Creek and downstream wetlands. The greater duration of the "peak" flows could destabilize the stream channels; although it is expected that the gradient through the wetlands is too low to cause substantial instabilities and the surficial geology along the creeks indicates it is relatively resistant to hydraulic erosion.

The proposed pumping rates, when delivered to the Bird River, will have the effect of increasing the base flow over the duration of the dewatering. It is not expected that the flow volumes will substantially affect flows in the Bird River, but a more detailed analyses may be warranted, particularly during the spring freshet, to ensure no negative impacts associated with flooding.

6.3.2 *Water Quality*

Natural wetlands reduce nutrients through a combination of physical, chemical and biological processes that include plant uptake, bacterial and algal fixation, sedimentation, and by adhering or sorbing nutrients to sediments (Lee et al. 1975, Karr and Schlosser 1978, Khalid et al. 1977, Mitsch et al. 1995). Treatment efficacies, however, vary widely in natural wetlands compared to constructed wetlands, likely due to the diversity of geological background and historic nutrient loading. Factors that determine nutrient retention include sediment oxygen content, hydraulic retention time and loading rates, and vegetation processes (Fisher and Acreman 2004). Sediment oxygen availability determines the reduction and oxidation (redox) potential, which in turn determines the types of chemical reactions that take place in the soil. Phosphorus in upland soils is less available than submersed soils because the solubility of phosphorus in the latter increases with reduced conditions (Savant and Ellis 1964). A wetland's capacity to remove phosphorus declines with time due to soil saturation and reduced capacity to produce enough soil for binding sites (Nichols 1983, Richardson 1985). In the autumn, nutrient retention is reduced and the transport of soluble phosphorus is increased due to plant senescence (natural dormancy) and reduced uptake (Schlosser and Karr 1981; Raisin and Mitchell 1995). In fact, under certain circumstances of high plant decay, for example, phosphorus output can exceed phosphorus input during the autumn (Gehrels and Mulamoottil 2006), particularly in temperate climates.

A numerical hydraulic model will be developed to simulate travel times for various flows through the wetlands. The travel times will be used to estimate the potential reductions in sediment and phosphorus in the flows delivered to the Bird River. Final pumping rates will be determined by adjusting the modelled flow to fully utilize the wetlands and meet Manitoba Water Quality Standards, Objectives and Guidelines following wetland treatment upon discharge to Bird River.

Mitigation requirements would be developed after sufficient design details became available to predict post-project conditions, and by comparing post-project conditions to baseline conditions. It is anticipated that, at minimum, focused soil stabilization efforts at areas most prone to erosion would be needed, along with revegetation in areas where substantial sedimentation or erosion had occurred. Active restoration measures may be needed in the streambed to restore aquatic habitats and morphological features.

6.3.3 Fish and Fish Habitat

Effects on fish and fish habitat will include the temporary loss of natural habitat within the west basin of Bernic Lake and in Bernic Creek during and after dewatering and the loss of fish within the west basin due to the inability to conduct a fish out in December. This loss is mitigated by the preservation of habitat and fish populations within the east basin and the construction of a permanent dike closer to the mine which reduces the loss from over 200 ha to less than 50 ha, as per conceptual alignment. After the temporary dike (2-4 years) has been decommissioned and the lake allowed to refill, the fish population preserved in the east basin will recolonize the west basin.

Potential effects on carmine shiner, a rare fish species that has been observed in the Bird River 16 km downstream of the project, will be avoided by maximizing the period of dewatering to minimize flow additions to the Bird River and by utilizing the treatment wetlands to settle sediment and treat phosphorus before entering the Bird River.

6.4 Human Environment

6.4.1 Local Economy

As a major employer in the region, closure of the TANCO Mine due to failure of the crown pillar would have a significant effect on the communities surrounding the mine including Lac du Bonnet, Pinawa, and Powerview/Pine-Falls. The workforce of Lac du Bonnet (defined by Statistics Canada as being over the age of 15) is 455. Of this number, 59 residents and their families from the Town depend on the TANCO mine for employment and thus direct financial benefits. In addition, the mine contributes $28 million dollars annually to the community and province which indirectly benefits a much larger population. Continuation of the mining operation, in addition to the workers required for this project, will continue to generate indirect employment and financial benefits for local hotels, restaurants, and supply stores.

6.4.2 Heritage Resources

There are five archaeological sites within/adjacent to the local study area. Four of these sites are upstream of the confluence of Bernic Creek and the Bird River. One site is located on a peninsula in the east basin of Bernic Lake. The site, a human effigy, was field inspected and was observed to be more than 1.5 m above the high water level of Bernic Lake. As the temporary dike will be constructed with only 1.5 m of freeboard, it will not be possible for flooding related to the dike to occur and affect the effigy site.

6.4.3 *Land and Resource Use*

Access to Bernic Lake will continue to be limited to the security controlled mine gate. Trapping may be temporarily affected while the temporary access roads are in place. Any restrictions on trapping will be discussed with the affected trappers. Hunting in the area will continue to be restricted around the mine site.

Aboriginal peoples in Manitoba use land across the province for hunting, fishing and gathering. No traditional uses within the proposed project site have been identified Sagkeeng First Nation. TANCO will continue to communicate with the local Aboriginal communities to assess the potential for any project-related interference with traditional land uses.