ATTACHMENT 3
CHANGE IN APPROACH TO ESTIMATING WALL ROCK WEATHERING

1.0 CHANGE IN APPROACH TO ESTIMATE WALL ROCK WEATHERING

The following summarizes several changes in how the dynamic systems model (DSM) of the Continental Pit handles chemical weathering of the pit wall, as well as the reasoning behind them. First, the objective in the chemical portion of the DSM is to estimate the amount of solutes (e.g., sulfate, hydronium, and metals) that will enter the lake from various sources (e.g., ground water, wall rock weathering and precipitation) as the pit fills and reaches steady-state.

The originally proposed (Telesto, 2005) approach was the one commonly used for pit lakes. The Davis-Ritchie model (DR) would be used with default values to predict the theoretical maximum amount of solute produced by oxidation of sulfide minerals in wall rock (weathering), and results from humidity cell tests (HCT) used to estimate how much of these weathering products are actually released to the water. This approach has been abandoned because there is no clear way to integrate the DR model for weathering and the data from the HCT in a way that is mechanistically representative of processes that occur in the field. Using the amount of solute released in a 20-week HCT to predict the fraction available for release has no mechanistic basis. The results of such an approach would be entirely dependent on what is released in a 20-week experiment, which is an arbitrary period of time with respect to filling of the pit.

A second approach was considered in which the results from the HCT would be used to derive a value for the diffusion coefficient of oxygen through the solids (D_2 in the DR model), in contrast to the diffusion coefficient of oxygen in the gas phase (D_1). This is one of the variables for which a default value would have been used. It was thought that decreases in the kinetics of sulfide oxidation during the 20-week tests would reflect on the decreasing value of D_2 caused by the buildup of oxidation products around the sulfide mineral grains. However, the tests were not run long enough to develop a significant rind of oxidation products from which D_2 could be derived. On the average, only 6% of the

sulfide originally present was oxidized at the end of the tests, which would not produce an oxidation rind that would significantly affect the magnitude of D_2.

1.1 Applicability of Davis Ritchie Model

Further consideration of applicability of the DR model to predicting field processes identified disparities with site conditions. The DR model for estimating the oxidation depth into the wall was abandoned for both theoretical and practical reasons. The theoretical problem with applying the DR model is that it was developed for oxidation in waste rock piles and chemical leaching of pulverized ore, not for intact materials of a more monolithic form like the wall rock. The critical difference is that the DR model treats all pyrite grains as if they are available for exposure to air and oxidation, whereas in wall rock some of the pyrite is entirely encapsulated within the rock matrix and inaccessible to air. Field observations show that freshly broken wall rock exposes unoxidized pyrite within the zone that theoretically should be oxidized, and that pyrite crystals are also present at the surface.

For these reasons, the DR model is inappropriate for estimating wall rock oxidation at the Continental pit. Instead of using the DR model, an approach was developed to scaling the reaction rates measured in the HCT to field conditions. The approach accounts for differences in particle size and surface area between the HCT samples and intact wall rock, and differences between the wetting/drying cycles of the HCT and pit walls. Finally, the distance into the wall rock that oxidation of pyrite occurs is estimated based on the infiltration of precipitation.

2.0 REFERENCES

Telesto Solutions, Inc. 2005. Workplan to Predict Continental Pit Lake Water Quality Following Mine Closure. Prepared for Cobre Mining Company (Hurley, NM) by Telesto Solutions, Inc. (Fort Collins, CO). December.