Conceptual Water Management Model for Zeehan Zinc Ltd, Comstock Mine

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D R A F T

A Report to Zeehan Zinc Ltd

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1 Introduction

As part of a review and update of the DP&EMP, Zeehan Zinc Ltd has commissioned Technical Advice on Water to develop a water management plan for Comstock Mine in western Tasmania with emphasis on the minimisation and management of acid drainage. Due to the lack of long-term accurate flow data for the site, the water management plan at this point is a conceptual model, which will be refined and developed into a water budget for the site as additional flow information becomes available.

Water sources considered in the model include Comstock Creek, water discharged from the historic adit located on the mining lease, the acidic seeps emanating from the base of the Swansea dump, process water to be extracted from the historic adit, the tailings stream, and final discharge from the site.

The principles employed in the development of this plan include:

- Minimising impacts to Comstock Creek;
- Minimising the quantity of water used in the process circuit through the re-circulation of process water where practical;
- Maximising the benefit of the mining operation in addressing historic mining impacts through the use and subsequent treatment of historic mine water;
- Employing BPEM during the life of the mine to minimise the exposure of sulphidic rock, and to divert water away from the workings where ever practicable.

The model has been developed following a review of the following reports provided by Zeehan Zinc:

- Oceania Tasmania Pty Ltd, Comstock Mine, Zeehan Tasmania, DP&EMP February 2001 (SEMF);
- Comstock Mine Environmental Monitoring Report, 2006 (Oceania Tasmania)
- Zeehan Zinc Comstock Mine Permit Conditions, July 2001 (Zeehan Zinc)
- Oceania Tas Waste Management Plan, 2003 (Thompson & Brett)

2 Conceptual model

A diagram of the conceptual model for water management at the Zeehan Zinc site is presented in Figure 2.1, with acidic water represented by red lines, and unimpacted or alkaline waters shown in blue.

In general, the plan shows that the mine will be isolated from the Comstock Creek, with all process waters and seeps directed to the tailings dam/waste rock dump/polishing pond complex. Process water will be sourced from the historic adit, which will be treated to a high standard prior to discharge from the polishing pond back into Comstock Creek (the legal discharge point). Seeps from the existing Swansea Waste Rock dump will be directed towards the tailings pond via the tailings stream. The exact location and extent of alkali addition on site has yet to be refined, although it is recognised that treatment is required prior to use in the processing plant, and prior to discharge from the polishing pond.

The various components of the plan are discussed in more detail in the following sections.

2.1 Comstock Creek

The Comstock mine site is situated within the Comstock Creek catchment, with the Creek running along the western side of the site. Comstock Creek has been affected by historic mining operations, including discharge from the historic adit located within the Comstock mine site.

Zeehan Zinc Ltd proposes to divert Comstock Creek away from the mine by way of a short diversion from the existing creek bed to an adjacent tributary. The diversion will occur downstream of the confluence of the creek and the historic adit, thus limiting the amount of historic acid drainage entering the proposed polishing pond, which is situated on the existing creek drainage line. The Comstock Creek channel downstream of the diversion will be used to direct the discharge from the tailings pond and waste rock dump into the polishing pond.

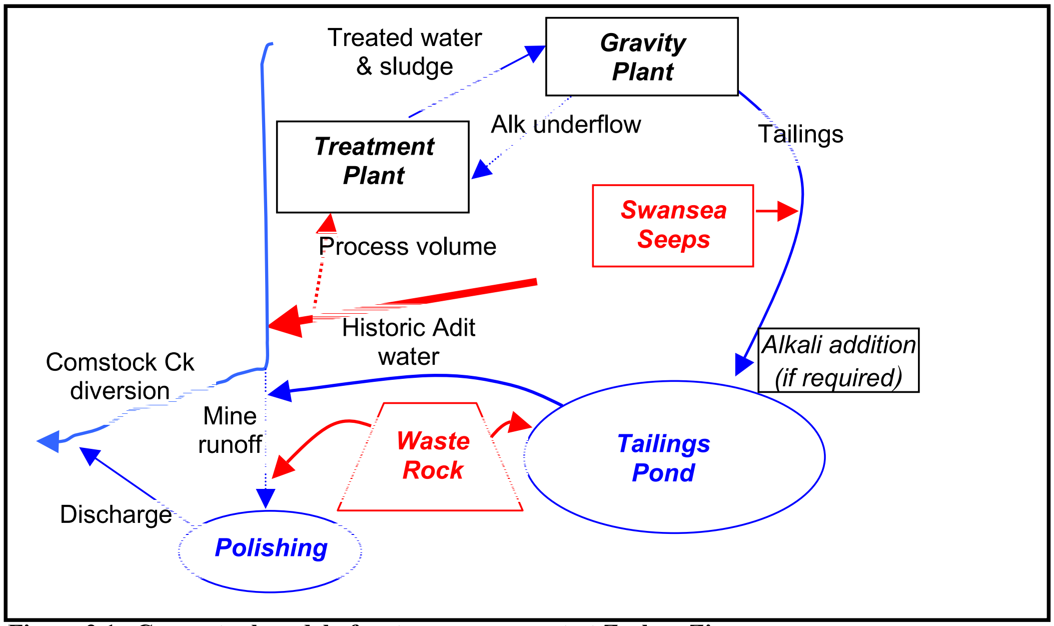

Figure 2.1. Conceptual model of water management at Zeehan Zinc.

2.2 Historic adit water

An historic adit cuts through the mining lease in the area of the South Comstock Open Pit. Although accurate flow records are not available, Zeehan Zinc personnel indicate that flow from the adit is relatively stable due to a predominantly groundwater source, with flows of up to about 50 l/s (D. Tanner, P. Heath, pers comm.). The present quality of the adit water is poor, with pH values generally in the range of 3.0 – 4.0, with elevated levels of aluminium, cadmium, arsenic, iron, manganese, lead and zinc.

Zeehan Zinc Ltd plan to extract process water as required from this source, with the amount of water dependant on the process requirements at the time, which will in turn be linked to the volume of ore being processed, and the degree of water recycling incorporated into the process circuit (discussed in Section 2.3).

The amount of adit water drawn into the process circuit will also be controlled based on the impact the Comstock mining operation has on the discharge water quality of the adit due to earth works in the open cut. When and if there is degradation of the quality of water exiting the adit, additional water will be extracted and treated such that the total metal flux entering Comstock Creek from the adit does not increase during the life of the mine. Due to the paucity of historic flow data for the site, establishing the present metal 'load' from the adit into Comstock Creek will be difficult, and may require hydrologic modelling. Ideally, the 'target' loads will vary by season.

As part of the commitment to improving adit water quality, Best Practice Environmental Management (BPEM) will be used during the mining operation, with clean water sources diverted where ever possible, and contaminated sources directed towards the tailings dam complex. It is expected that as mining progresses deeper in the South Comstock open pit, a better understanding of the source of the adit water will be gained, which will assist with management.

2.3 Process water

The historic adit water will be at least partially neutralised prior to use in the process plant to protect the process circuit infrastructure. At this stage it is envisaged that a neutralisation plant will be situated near the water adit water off-take. The size, neutralising reagent, and target pH for the plant have yet to be determined. From the neutralisation plant, the treated water and all metal hydroxides resulting from the water treatment will be directed towards the gravity separation plant. There may be a small holding dam associated with the gravity plant, however storage of neutralised water would lead to the settlement of metal hydroxides in the pond and require on going management.

Once the treated adit water is used in the gravity plant, the water and contained tailings will be directed towards the tailings dam. Depending on the resultant pH of the tailings stream, a portion of the tailings underflow *may* be recycled within the water treatment loop where residual alkalinity in the solid tailings could be used for the initial treatment of the historic adit water and/or the process water overflow could be recycled back into the gravity separation process. A greater understanding of the final pH and alkalinity of the tailings stream is required before any recycling could be adopted.

2.4 Swansea waste rock dump seeps

Seeps from the Swansea waste rock dump are relatively low volume (~4 l/s, D. Tanner, P. Heath pers comm.), and highly acidic (~1-5 g/l acidity), containing elevated levels of zinc, aluminium, iron, manganese, lead, nickel and copper. Once processing activities begin on site, the seeps will be mixed with the (alkaline?) process tailings and directed towards the tailings dam. Due to the high acidity contained within the seeps, additional alkali may need to be added to the combined tailings/seep stream prior to discharge into the tailings pond. The degree of alkali addition will depend on the remnant alkalinity of the tailings stream, the degree of water recycling within the gravity processing plant and the quality and quantity of seepage from the waste rock dump. Detailed information on the quality and quantity of process water is required to refine this element of on site water management.

2.5 Seeps from combined tailings / waste rock storage facility

As designed, waste rock and tailings will be co-disposed, with non-acid producing rock used to cover acid producing rock, and create the tailings dam embankment. Seeps (acidic or alkali) from the waste rock will be captured by the tailings dam or the polishing pond, where solids will settle, and the water will mix with the process water.

2.6 Advantages of proposed water management design

The water management plan in conjunction with the co-disposal of tailings and waste rock has the following advantages:

- Mining activities are isolated from Comstock Creek through diversion of the Creek;
- Only one discharge point allows rapid detection and management of potential water quality issues;
- The use of adit water for processing will result in the neutralisation of a large portion of the historic flow during the life of the mine which will improve water quality in Comstock Creek;
- The water management plan provides flexibility for re-using water, utilizing alkalinity contained in the host rock, treating historic adit water and treating the Swansea dump seeps.

2.7 Development of detailed water balance for site

To progress the water management conceptual model to a detailed water balance for the site, additional flow and water quality information associated with the adit water, process circuit and tailings stream needs to be collected. The required information includes (but is probably not limited to):

- Detailed flow records for the historic adit are crucial for establishing the pre-mining metal flux from the adit, and determining what portion of adit water will be used in the process circuit;
- Daily (?) flow estimates of Comstock Creek, possibly based on catchment modelling of rainfall / runoff, are required to establish the final discharge water quality targets from the polishing pond;
- Investigation of various neutralisation options to establish which achieves the required environmental outcome most cost effectively, including where and in how many stages alkalinity is added to the adit water to protect process infrastructure and provide sufficient buffering for the Swansea seeps;
- Water quality monitoring of adit and Swansea seepage water needs to include sulphate so that the potential for gypsum formation can be evaluated with

respect to the process circuit and the storage capacity of the tailings storage facility;

- The pH and alkalinity of the tailings stream needs to be determined and the potential for re-use needs to be evaluated;

3 Water quality targets

3.1 Point source discharge

Water quality targets will be derived for the point source discharge from the polishing pond, and at least initially will reflect, or be of a higher quality than the present water quality in Comstock Creek upstream of the mine site. Due to the very high levels of dissolved zinc in the water, a pH target of ~7.0 or greater will be required to achieve the necessary level of metal removal. This will be accomplished through alkali addition at one or two points (prior to processing, and prior to entry to the tailings pond), and possibly the utilisation of alkali contained in the tailings. The exact target values for discharge from the pond can only be established once a water balance is obtained for the site and there is a greater understanding of the flow regime in Comstock Creek.

3.2 Diffuse discharges

The water management conceptual model has been designed to minimise diffuse discharge from the site through the collection and direction of all seeps from Swansea dump and the planned waste rock storage facility to the tailings dam and polishing pond. These sources will be managed as part of the overall tailings dam water quality.

Diffuse sources associated with mining activities in the South Comstock Open Pit will be managed through BPEM, with clean water diverted where ever practical and contaminated waters directed to the tailings pond and polishing pond. Diffuse sources associated with mining will also be managed through monitoring of the historic adit discharge. If fluxes from the adit increase once mining is initiated, then an appropriate volume of additional adit water will be directed through the neutralisation plant and process circuit such that the flux from the adit into Comstock Creek is not increased through the operation of the mine. As previously discussed, this management approach requires a good flow record, which currently is unavailable.

4 Close out options

A detailed close out design for the site will need to be developed as the water budget and waste management strategies for the site are refined. However, the proposed conceptual water management model contains elements which provide benefits and flexibility for close out, including:

- Containment of all long-term diffuse water sources within one catchment with all water sources reporting to the tailings dam or polishing pond;
- Only one permanent discharge point from the site, which will reflect all diffuse sources following close out;

- The potential to discharge the historic adit water into Comstock Creek (as will occur during mining) or towards the polishing pond,
- The potential to stockpile alkali waste rock for the establishment of passive water treatment options during the close out of the site;
- A better understanding of the sources of water to the historic adit will be gained during mining which could lead to the identification of management options;
- The remnant Comstock Creek channel can be used to collect and passively treat acidic sources, with the polishing pond used to settle solids;
- The final shaping of the combined waste rock and tailings storage facility will allow water shedding with surface waters to be directed away from potential acid sources.