Douglas Mine Site Hydrogeological Modelling

CDM Smith Australia Pty Ltd, November 2014

Purpose of Study

To develop a calibrated hydrogeological model to predict potential groundwater impacts of continuing by-product disposal at Iluka's Douglas site.

Background

Since 2006, Iluka Resources Limited (Iluka) has been disposing of by-products from the Hamilton mineral separation plant (MSP) at the former Douglas mine site, in accordance with regulatory requirements. The approvals under which Iluka currently disposes of by-products at Douglas will lapse at the completion of processing of concentrate from Iluka's current mine at Woornack, Rownack and Pirro, near Ouyen, owing to state legislation requiring an operating mine in Victoria

Accordingly, Iluka is seeking a planning permit from Horsham Rural City Council and a Works Approval from Environmental Protection Authority to enable it to continue this disposal activity, which will support ongoing operations at the Hamilton MSP.

Disposal material may include:

- by-products from the processing of heavy mineral concentrate (HMC) at the Hamilton MSP, which are made up of sand, clay, gravel and gypsum filter cake and contain levels of naturally occurring radioactive material (NORM);
- used dust filter bags; and
- other chemically inert material contaminated with NORM including concrete and steel.

No liquid waste (slurry) is proposed to be disposed of into the void. There would be potential for natural (rainfall) recharge of the groundwater during the disposal operations period (up to 20 years), via the open pit.

Iluka has subsequently commissioned independent technical studies to investigate the environmental impact of the proposal, including:

- Groundwater Risk Assessment
- Radiological Risk Assessment
- Hydrogeological Modelling
- Particle Tracking of Seepage Water

A summary of each technical report has been prepared for stakeholders.

Scope of Works

To establish a groundwater model for Douglas, a staged approach was adopted, consistent with the recommendations of the Australian Groundwater Modelling Guidelines. This included:

- an historical data review to prepare a conceptual hydrogeological model;
- development of a regional numerical groundwater flow model using MODFLOW-SURFACT;
- use of groundwater monitoring data to calibrate the model in steady state and transient conditions; and
- use of the calibrated model to predict the potential pathways of any liquid seeping from Pit 23 to groundwater.

The predictive model was used to evaluate the impact continued disposal operations would have on:

- groundwater levels;
- water particle transport (flow paths and travel time); and
- mass balance.

Investigation

Conceptual Hydrogeological Model

Available data was interpreted to prepare a conceptual hydrogeological model, which aims to describe the current understanding of the Douglas groundwater systems and its surrounds.

Key features, illustrated in Figure 1, include:

- groundwater flow from Pit 23 is to the northwest; regionally flow varies between the north, northeast and northwest;
- the regional water table was below the depth of mining and is generally within the lower part of the Loxton-Parilla Sands hydro-stratigraphic unit;
- groundwater discharges to surface via a series of saline water lakes, the closest being McGlashin Swamp. The Glenelg River also receives groundwater discharge, though mainly from the basement aquifer; and
- in the vicinity of pit 23, there is a mound in the groundwater resulting from previous disposal of on-site tailings and the storage of stormwater in the nearby Pit 22. As a consequence, in March 2014 the groundwater level was at or slightly above the base of the Pit 23 excavation.

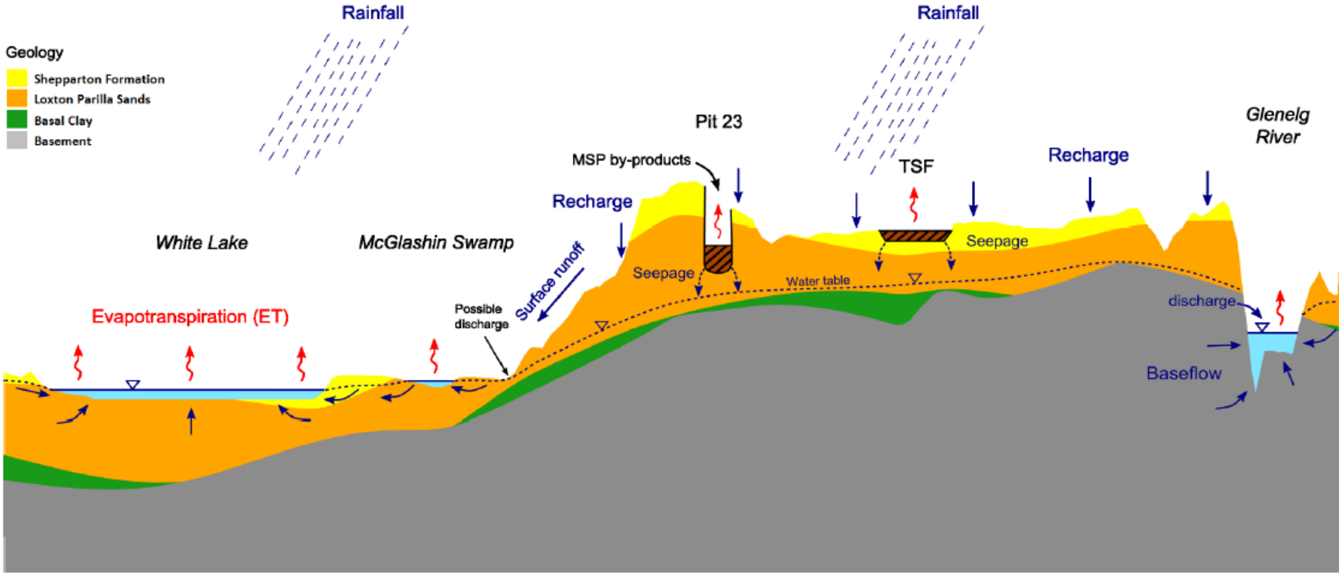

Figure 1 Schematic hydrogeological cross-section (not to scale) [CDM Smith, 2014]

Groundwater Model Development

A 3D numerical groundwater model was developed in MODFLOW-SURFACT. It was:

- informed by an extensive borelog dataset sourced from exploration and groundwater bore drill programs;
- generated from a regional geological model developed in Leapfrog Hydro;
- calibrated to a steady state (pre-mining) and transient conditions, to be capable of replicating the response of the water table to natural (rainfall) and human induced recharge; and
- assessed against a set of calibrated model acceptance criteria and deemed fit for purpose.

Water particle tracking using MODPATH software code was undertaken to simulate the transport of water particles from Pit 23.

Model Predictions

The calibrated model was used make predictions under two future scenarios:

(1) Continuation of by-product disposal.
(2) No future by-product disposal.

The predictive model evaluated the parameters shown in Table 1 for each scenario.

Table 1: Summary of groundwater impacts for continuing by-product disposal

Parameter	Outcomes
Groundwater level	• Predicted to rise by 1.3m at Pit 23 under continued disposal scenario due to higher rainfall recharge rates in the open pit. • No long term residual effects are predicted on groundwater levels.
Water particle flow paths	• Both scenarios show flow paths are to the northwest, with discharge to McGlashin Swamp and a drainage line that runs to that swamp. • There is no predicted discharge to stock/domestic bores or the Glenelg River.
Water particle travel times (See figure 2)	Estimated minimum water particle travel time from Pit 23 to McGlashin Swamp is 285 years under the continued disposal scenario, 310 years without.
Predicted mass balance	• Recharge is slightly higher in the proposed continued disposal scenario, reflecting the extended period of potential rainfall recharge over Pit 23. • Discharge volumes would be the same between both scenarios.

Results

- The fate of water emanating from Pit 23 is predicted to remain the same whether or not the disposal of by-products is continued.
- Water particles from Pit 23 are not predicted to reach existing stock and domestic bores; or the Glenelg River.
- No long term residual effects are predicted on regional groundwater levels.
- Water particles from Pit 23 are predicted to migrate to the northwest and discharge to McGlashin Swamp in an estimated 285 to 500 years.
- There is potential for some water discharge to a surface water course (drainage line that runs to McGlashin Swamp) prior to reaching the swamp. This is predicted to occur in approximately 195 years.
- By continuing disposal operations for the 20 year period, groundwater levels may rise at Pit 23 by 1.3m, due to higher rainfall recharge rates in the open pit.
- The higher groundwater level may result in a faster water particle travel time to surface discharge (McGlashin Swamp) by 8%.
- The groundwater levels within the mine site are predicted to rise by up to 2.5m during the post-closure period; however this is due to the assumed ongoing presence of the freshwater dam and not in-pit disposal operations.

Conclusion

The model predicted the impacts on groundwater of continued disposal of by-products at the Douglas site compared to no future disposal, would be:

- a shorter water particle travel time by 8% due to a localised groundwater mound at Pit 23 (1.3m groundwater level rise), which is caused from higher rainfall recharge during disposal operations; and
- no variation to water flow path, surface discharge locations, fate of contaminants or quantity of water discharged.