Penrice Quarry Angaston

Hydrogeological Update
Hugh Middlemis, Aquaterra

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Introduction

- Review of hydrogeological investigations completed to date
- Summary of hydrogeological setting
- Findings of Mine (Quarry) Closure Investigation by Aquaterra
- Proposed future works
Groundwater Investigations to 2009

- Hydrogeological Assessment for Mine Closure Planning – Aquaterra (July 2009)
- PIRSA/DWLBC providing consultation and review of all investigations
Hydrogeological Setting

- Quarry located east of the Barossa Basin - in fractured rock
  - Barossa Basin – 3 aquifers (Upper & Lower; and very deep Fractured Rock)
  - Quarry (east of Basin) – 1 aquifer (Fractured Rock)

- 3 aquifer systems hydraulically connected – recharge to Upper and Lower aquifers mainly laterally from Fractured Rock Aquifer

- Mica-Schist zone in Fractured Rock between mine and basin – inferred barrier to flow (ignored for mine closure studies thus far as a conservative assumption)
Hydrogeological Setting

Penrice Quarry

Mica-Schist fault
(inferred barrier to groundwater flow)

Pre-mining water table in Fractured Rock

North Para River

Quaternary clay

Upper Aquifer

Fractured Rock Aquifer

Lower Aquifer

Groundwater flow

Depth (m)
Groundwater Levels 2001
Hydrogeological Setting

- Pre-mine water depth – 20-30 mbgl
- Current water depth – ~100 mbgl
- Groundwater salinity within Fractured Rock Aquifer – 500 to 3,000 mg/L (potable/irrigation quality)
- Groundwater flow east to west
- Quarry stays within Fractured Rock to planned depth (140+ mbgl); fractured rock extends well beyond planned depth of quarry
Proposed Mine Plan
(to 240 RL, by 20 years; may go deeper if mine planning studies indicate feasibility)
Penrice Water Use

- Pumping out of groundwater inflows to quarry to allow ‘dry’ mining
- Penrice have 2 approved Water Licences:
  - Licence 3778 – 102.2 ML/yr (source = quarry dewatering)
  - Licence 3724 – 25.6 ML/yr (source = 2 licensed bores and quarry dewatering)
- Groundwater used for dust suppression and quarry product preparation
Post Mining Impacts

- Future mine life at least 20 years (maybe 30-50 years)

- Pit void will remain at completion of mining:
  - Insufficient waste to backfill
  - Cost to backfill prohibitive

- Groundwater levels in Fractured Rock will begin to recover on completion of mining/dewatering – eventually forming a lake in the open pit void
Post Mining Impacts

▼ Level of lake dependant on balance between groundwater inflows and evaporation

▼ 3 potential hydrogeological environments can develop on mine closure in general:
   ▼ Groundwater sink (likely for Penrice)
   ▼ Groundwater throughflow
   ▼ Groundwater recharge
Post Mining Impacts

Hydrogeological Environments for Mine Voids

Case 1: Groundwater sink

Case 2: Groundwater throughflow

Case 3: Groundwater recharge

Penrice long term future?

Figure reference: Johnson and Wright, (2003).
Post Mining Impacts

Penrice Quarry – results of a simple analytical groundwater flow model indicate:

- Groundwater sink post-mining
- Groundwater will flow into open void from Fractured Rock Aquifer – no net groundwater flow out of the pit void
- Water level will recover to ~ 80 mbgl (~ 60 m below pre-mining level)
- Water level in Fractured Rock Aquifer will remain lowered around the pit
Post-Mining Initial Assessment

Penrice Quarry

Mica-Schist fault (inferred barrier to groundwater flow)

Pre-mining water table in Fractured Rock

Post-mining water table
Post Mining Impacts

- Recovery >60 yrs
- Final pit lake 40+ m deep – dependant on final depth of quarry

Salinity assessment indicated:
- Salinity of water in pit lake will increase over time due to evaporation
- Increase in salinity slow, ~7-8 times more saline in 100 yrs than current day
- Conservative estimate and likely to be little or no impact on the regional groundwater quality
Future Investigations

• More detailed studies on groundwater impacts post-mining
• Further assessment of groundwater impacts to the end of mining, esp. to investigate effects of Mica-Schist;
  – a pumping test on existing irrig bore
  – more intensive monitoring & analysis
• Installation of a climate station in-pit to record pit evaporation and prove-up models