9-40. LEACHATE MIGRATION FROM TSF

Concern: The native groundwater flow direction from the TSF is misreported; existing groundwater contouring is not well explained; evidence of leachate migrating from the TSF is presented, however, the fate of leachate if it reaches the water table has not been demonstrated. Considering these factors, further investigation of leachate is warranted.

This concern responds to the following SEARs for SSD 5765:

- A description of the existing environment likely to be affected by the development, using sufficient baseline data;
- A description of mitigations and
  - Whether these are best practice and represent a full range of measures
  - Whether they will be effective / key performance indicators
  - Contingency plans for residual risks / monitoring and reporting on environmental performance
- An assessment of the likely impacts of all stages of the development, including any cumulative impacts, taking into consideration any relevant legislation, environmental planning instruments, guidelines, policies, plans and industry codes of practice;
- A summary of commitments
- Part 3: Any interference with an aquifer caused by the development does not exceed the respective water table, water pressure and water quality requirements specified for item 1 in columns 2, 3 and 4 of Table 1 of the *Aquifer Interference Policy 2012* for each relevant water source listed in column 1 of that Table.
- Part 3: impacts to significant water resources or threatened species are minimised to the greatest extent practicable
- Assessment of Lawsons Creek and Price Creek
- Assessment of likely impacts to aquifers; detailed site water balance, management of excess water and reliability
- DRG, Attachment 2A requires rehabilitation methods including
  e) monitoring for rehabilitation
  i) details of triggering intervention
  k) details of post-rehabilitation management
  l)i) assessment of rehabilitation techniques against objectives
  l) ii) assessment of potential acid mine drainage
  l) iii) processes to identify and management geochemical risks throughout mine life
  m) iii) groundwater assessment for final water level in any tailing storage facility void
  o) consideration of controls
- DRE/DPE requires a Water Management Strategy that considers
  - the existing surface and groundwater qualities
  - a robust baseline
  - a description of how groundwater and aquatic ecosystems will be monitored, Trigger Action Response Plan and trend identification

DISCUSSION

This query considers the migration of contaminants from the proposed tailings storage facility (TSF). Unlike changes in groundwater level, contamination can take years before being detected a kilometre away.

The principal planned barrier to TSF leakage is 0.45 m of $5x10^{-10}$ m/s hydraulic conductivity clay beneath the decant pond. Even if this barrier is constructed as designed, it may not stop the migration of heavy metals such as antimony and arsenic from migrating (ATC Williams, 2020) over the next 500 years. This concern seeks more information about how contamination will be controlled considering the post-mine approach suggested in the EIS. There is no discussion on the likelihood for under-liner groundwater pressure to breach the planned clay liner before the TSF fills. Local rock hydraulic conductivity estimates are based on measurements taken from core and differ by a factor of 10,000 (four orders of magnitude) (ATC Williams, 2020). This uncertainty could be better discussed in the EIS.

Post-mining, the EIS describes plans to allow a pit to fill with surface water run-off (and rainfall) as well as groundwater influx. The 'base case' rate of groundwater influx is 3 ML/d at the end of mining (year 16). Considering Figure 1, the uncertainty range indicates that it may take 50-300 years for the pit to fill, depending on the connectivity of groundwater with the pit. Groundwater that is not in good hydraulic connection with the pit would largely continue to flow in the same direction as pre-mining. In the case of the TSF area, this may be to the west and southwest (Figure 2).

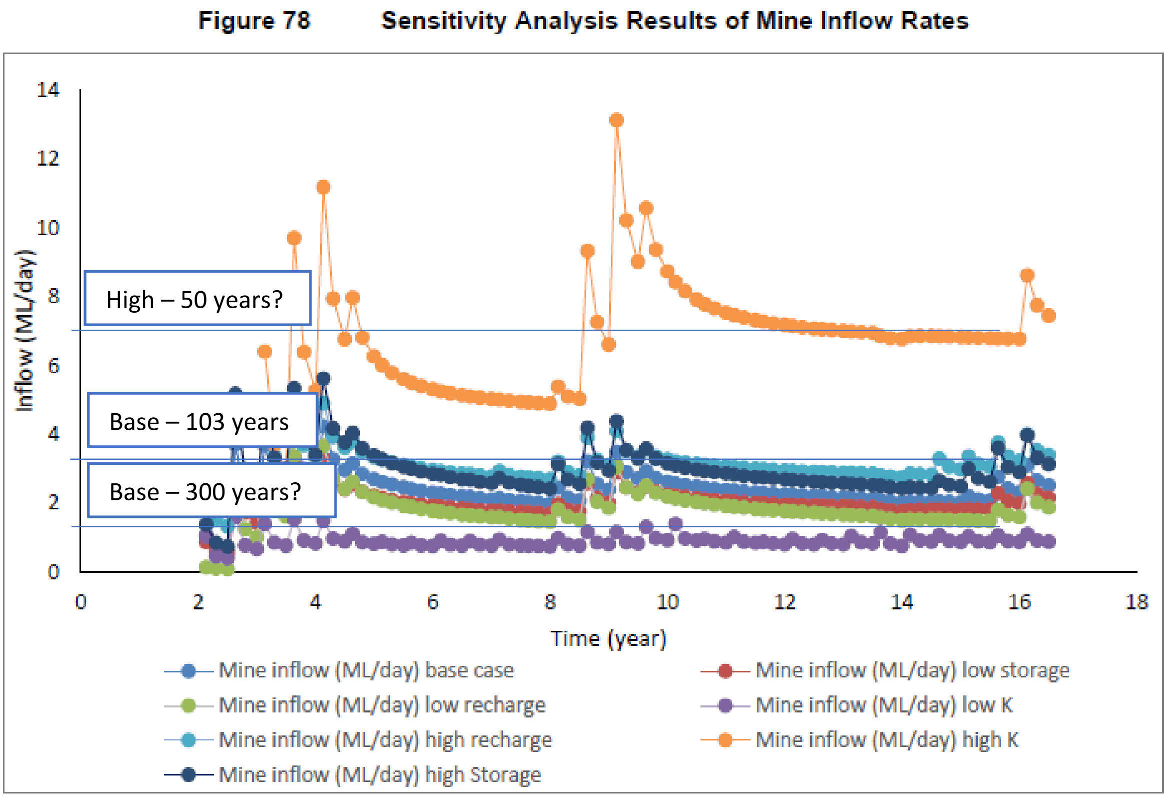

Figure 1: Mine inflow rates from (Jacobs (Australia), 2020)

Section 4.7.5.5 (R. W. Corkery & Co. Pty. Limited, 2020, pp. 4-161) states that final pit lake water level will be 566.5-572.5 mAHD under some climate change assumptions. The estimate in the surface water report and the groundwater modelling considers a final level of the pit lake between 571 – 577 mAHD with an average elevation of 574 mAHD (WRM Water and Environment Pty Ltd, 2020, pp. 6-106). If using the lower estimate of the final pit lake water level under some climate change assumptions, the inferred groundwater flow changes are shown in Figure 2 and Figure 3.

Average evaporation from the site is estimated at 309 ML/a in WRM (2020) and 180 ML/a post mining in Jacobs (2020) for an unspecified period. The evaporation rates, especially seasonal evaporation rates and resultant changes in groundwater flux, are a large uncertainty.

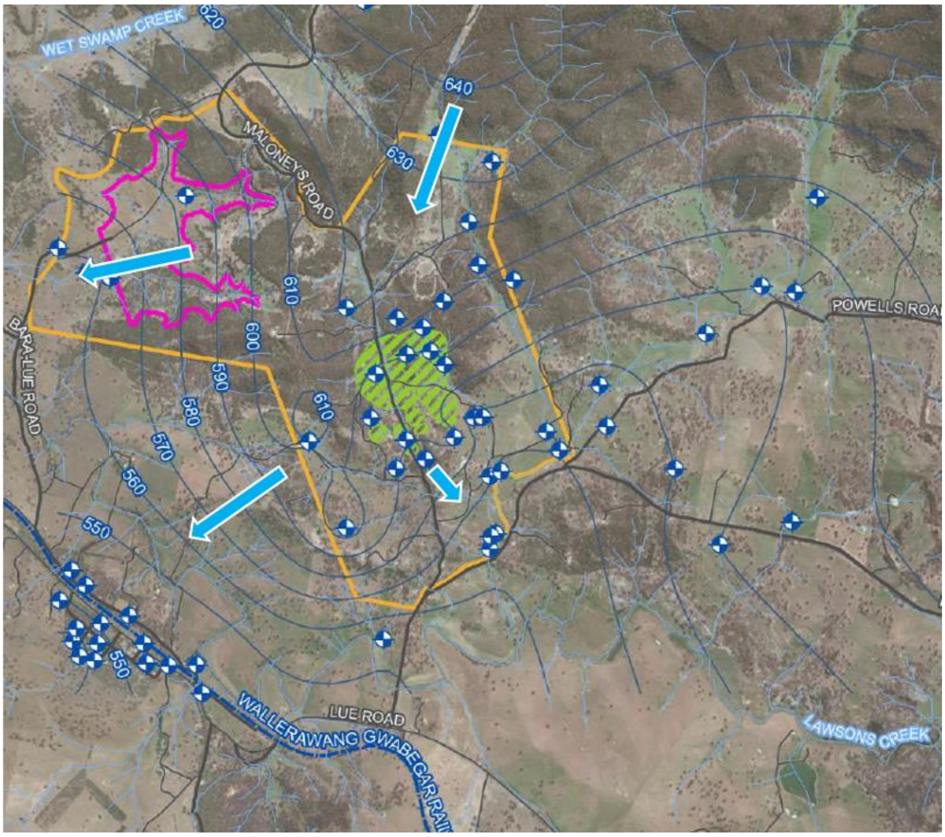

Figure 2: Pre-mining groundwater contours, showing inferred groundwater flow directions, adapted from (Jacobs (Australia), 2020)

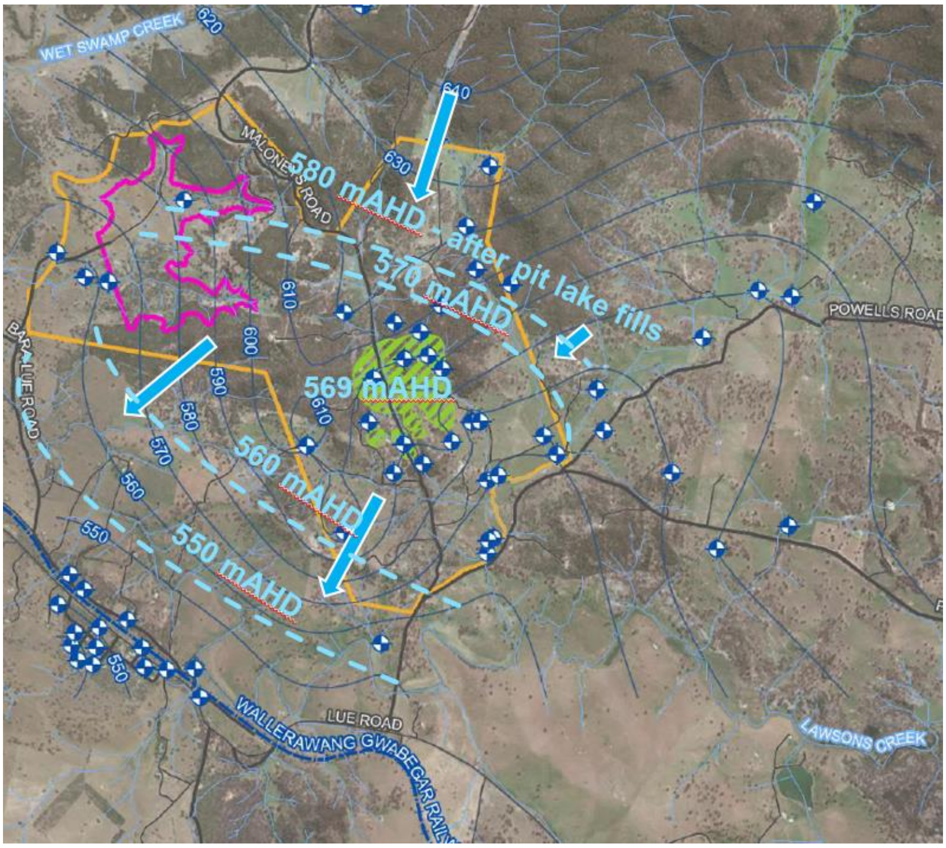

Figure 3: Post-mining groundwater contours, showing inferred groundwater flow directions, adapted from (Jacobs (Australia), 2020)

TSF monitoring designed to detect migrating contamination (requested by M. Isaacs, DPI, 12 Dec 16) nor actions / triggers to remediate migrating contamination have been provided in the EIS. A description of measures to monitor environmental performance is part of the SEARs.

- Waste generation and disposal under *Waste Avoidance and Resource Recovery Act 2001* – leaching and leak detection is not presented in the EIS, rather, bunding according to AS NZS 4452:1997 is proposed.
- A site-specific water quality trigger has not been proposed to clarify when pollution occurs. Selection of triggers should be made considering water quality objectives.

DPE also request a description of the effectiveness of the measures to mitigate the likely impact of a development on the environment. Industry best practice can be found at the Cloudbreak mine in WA. While the approach proposed in the EIS might be called leading practice, the lack of best practices has not been discussed.

REFERENCES

ANZ Guidelines, 2020. *Guideline values for water/sediment quality.* [Online]
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ATC Williams, 2020. *Tailings storage facility preliminary design,* Melbourne: Bowdens Silver Pty Limited.

Bowdens Silver, 2020. *Monitoring.* [Online]
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R. W. Corkery & Co. Pty. Limited, 2020. *EIS Bowdens Silver Project,* Sydney: Bowdens Silver Pty Limited.

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