5-37. RISKS TO SIGNIFICANT SPECIES IN SPRINGS AND WATER COURSES

Concern:
Potential groundwater dependent ecosystems (GDEs) are identified around the site. Protected Murray Cod, Silver Perch, Southern Purple Spotted Gudgeon, Trout Cod, Murray Crayfish and Eel Tailed Catfish may exist within the area, as well as species within springs (modified or not). The locations and risks to these protected species should be clearly shown and evaluated in the EIS

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 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
  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

After significant sampling and analysis, Section 4.5.12.4 (Jacobs (Australia), 2020) does not clearly preclude groundwater support for the area's springs and potentially unique or significant ecosystems that may exist within these gaining wetlands. The EIS states that reductions in baseflow/pool depths in Hawkins and Lawsons Creeks occur 28-34 years after mining commences but does not list when and by how much spring water levels will drop. The sustainability of these waterbodies without groundwater support is not discussed. It is unclear whether there are several permeable zones in BGW38 which is an example of unclear hydrogeological descriptions near the springs. After listing endemic species in the springs, their sustainability could be analysed by creating a local hydrogeological model including seasonal water levels and qualities. Such an analysis would also provide a line of evidence to support any suggestion that springs are not groundwater fed.

At least one spring (Battery Creek Spring) near BGW16 is inferred to be sourced from (deeper) groundwater (Jacobs (Australia), 2020, pp. 5-67). Biodiversity results from surveys of other springs are not included as they have been deemed to be modified. The influence of rainfall on the chemistry of gaining wetlands (springs) is expected, however, more detail on the contribution of groundwater to the sustainability of significant species is anticipated in the report before the springs can be impacted.

The degree of uncertainty of the modelled predictions is high considering the heterogeneity observed in the data gathered. The discussion below presents one such aspect for further investigation: the hydrostratigraphic interpretation between the proposed activity and Lue village.

Groundwater can flow through the pore spaces of geological units and fractures in brittle rock such as the volcanic rocks in the region. The geological units in the local area are shown in Table 1, including Geoscience Australia map codes used in Figure 1.

Table 1: Map codes and geological descriptions from (Colquhoun, et al., 1999)

Map Code	Name (youngest to oldest)	Geological Description
Qa	Cainozoic units	Alluvial silt, clay and sand
Ma	Mesozoic igneous	Fine grained, mid-grey phonolite
Rn	Sydney Basin - Narrabeen Group	Pebbly lithic-quartz sandstone, red-brown to green mudstone
Pi	Sydney Basin Illawarra coal measures	Lithic sandstone, mudstone, tuff
Ps	Sydney Basin - Shoalhaven Group	Conglomerate, sandstone, shale, siltstone
Pr	Sydney Basin - Rylstone Volcanics	Rhyolite, sandstone and tuff
Ccg	Pyangle Pass Granite	Biotite granite, aplite, pegmatite
Std	Dungeree Volcanics	Rhyolite to dacite lava
Stdt	Dungeree Volcanics	Volcanic conglomerate and lithic sandstone
Ocd	Coomber Formation	Volcanics, siliceous mudstone and limestone blocks
Oa	Adaminaby Group	Fine volcanics - quartz sandstone, slate and chert

The Coomber Formation and Adaminaby Group are from the Ordovician Period of the Palaeozoic Era, deposited 444-448 million years ago, and are assumed to form the basement in this area.

The principal rock type is fractured volcanic. While some weathering of shallower sequences may cause a decrease in fracture permeability, zones where groundwater can reasonably be expected to flow (aquifers) and those where groundwater is unlikely to flow (aquitards), are highly variable. No significant barriers to flow have been identified.

Based on review of the data, where conductive fractures are present, the majority of rock has low to moderate yield (0.5-3 L/s) with electrical conductivity of 150 to 800 µS/cm (potable water quality). Exceptions to this are GW802779 (20 L/s yield) and GW802778 which yielded 20 and 15 L/s respectively from fractured volcanics between 20 and 140 m below the natural surface (BNS). Despite being less than 1km apart, the electrical conductivities were 800 and 2000 µS/cm respectively in these bores which suggests they are not well connected. Both of these bores are located on the proposed mine site, with GW802779 shown in Figure 1.

The yields of overlying alluvial aquifers are generally reported as low (0.1-2 L/s). These porous aquifers include younger Cainozoic units which are primarily deposited along water courses.

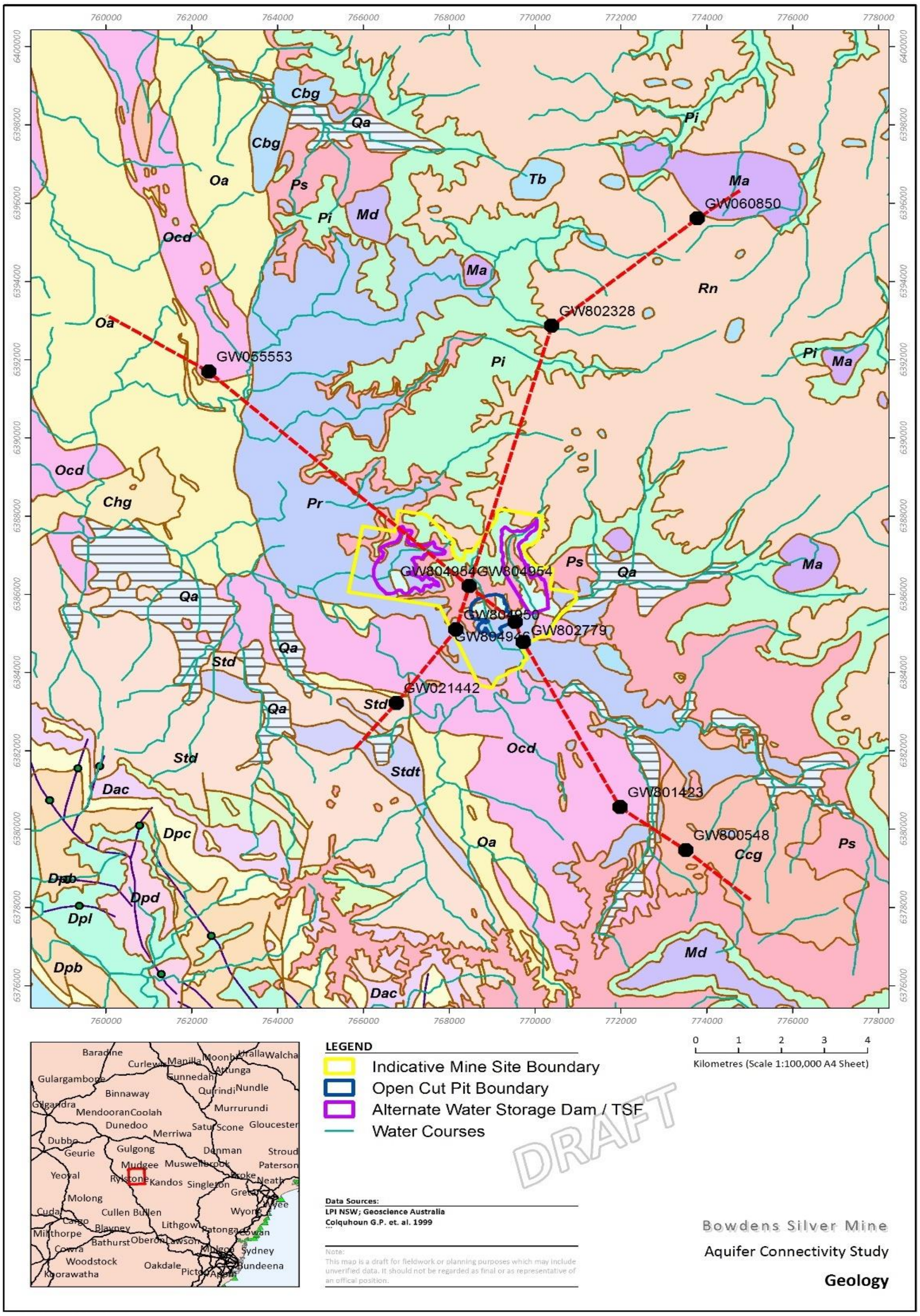

Figure 1: Suggested cross section transects for the EIS and surface geology (Source: Geoscience Australia)

When this information is compared to the EIS interpretation (Figure 2) and while faulting can be inferred, the mapped outcrop of Late Ordovician-Early Silurian age Ocd (Coomber Formation) near Lue village north west of GW021442 is not presented in the EIS. Suggested cross section transects are shown in Figure 1.

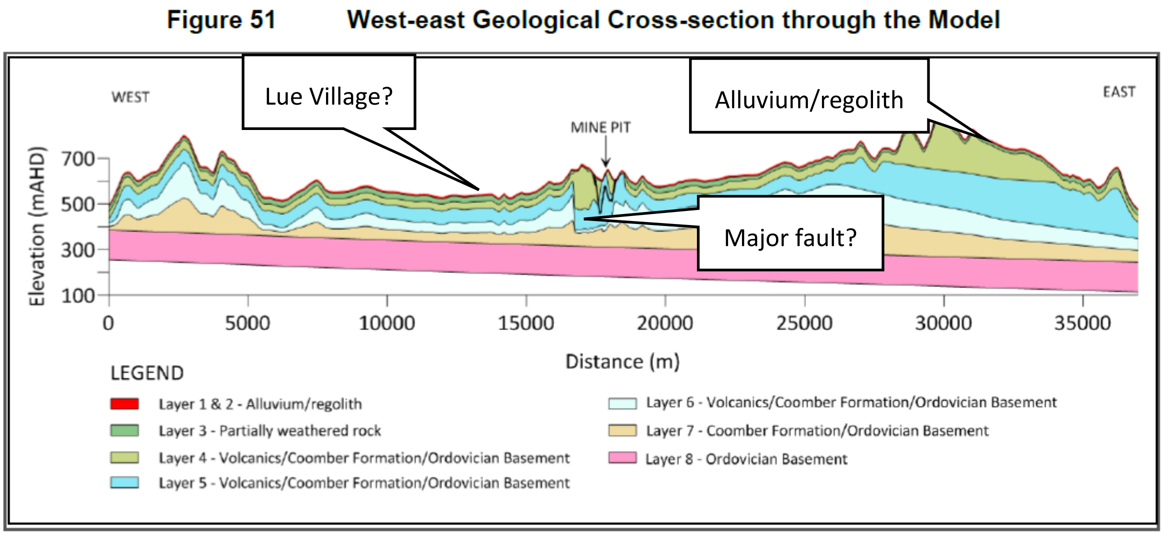

Figure 2: West-east modelled cross section. Source: Adapted from Figure 51 from (Jacobs (Australia), 2020, pp. 5-143)

This discrepancy (a lack of Ocd outcrop on Figure 2) highlights an area for future focus to adequately represent the hydrogeology in the alluvium near Lawsons Creek proximal to Lue Village bores and the associated significant species.

Without a good hydrogeological understanding, the assumptions used in the impact assessments regarding impacts to springs and watercourses in the EIS may be invalid. This is an example of how the significance of the assumptions underpinning the large-scale simulation modelling should be better explained in the EIS to make it effective if it is to be used at the local scale. In addition, studies of unique or endemic species of gaining wetlands (springs) should be undertaken to determine their significance.

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