Howe, Mark (DMITRE)

From: Eric Rooke[redacted]
Sent: Friday, 8 November 2013 2:07 PM
To: DMITRE:MiningRegRehab
Cc: Stephen; Lindsay Varcoe
Subject: RE Rex Minerals' Mining Lease Proposal for the Hillside Copper Mine, Yorke Peninsula
Attachments: 11337 ADV081113 ER1F.pdf

ATTN: Mr. Mark Howe
Mining, Regulation and Rehabilitation Branch,
Department for Manufacturing, Innovation, Trade, Resources and Energy,
GPO Box 1264,
Adelaide. 5001

Dear Mr Howe,

n behalf of and from instruction of our client, The Yorke Peninsula Landowners' Group we attach the following submission with reference to the Hillside Mining Project proposal.

Kindly acknowledge receipt.

Sincerely,

Eric Rooke Principal Hydrogeologist**BScGeo(Hons) MScHydGeo FGS MIAH**

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File No: T2951-V08
A1806653

GILBERT SUTHERLAND

8 November 2013

Yorke Peninsula Land Owners Group
[redacted]
Ardrossan SA 5571

Attention: The Chair – YPLOG Committee

Dear Madam/Sir,

Re: Rex Minerals Hillside Copper Mine project – preliminary independent technical review and comment

The Yorke Peninsula Land Owners Group (YPLOG) commissioned Gilbert & Sutherland Pty Ltd (G&S) to conduct a preliminary review of hydrogeology information contained in reports relied upon by Rex Minerals in its application to the South Australian Government (under the SA Mining Act 1971) for two leases and two licences for its Hillside Copper Mine project, Yorke Peninsula, SA.

Specifically, YPLOG asked G&S to conduct a preliminary review of the Hillside Pre-feasibility Study (Hydrogeology Report), upon which the Rex Minerals Mining Lease Proposal and Management Plan is reliant in relation to the site-specific Hillside/ Ardrossan area, and to prepare concise, Plain English written advice detailing any issues or concerns with the work as a series of dot-points to help inform its response to the SA Government's 'public consultation invitation'.

Scope and approach

This letter addresses the scope of works requested by YPLOG within the limited timeframe available to respond to the public consultation invitation. Our review of the voluminous information presented by the proponent is preliminary in nature, meaning that any and all observations stated herein recognise that additional time and resources would be required to fully investigate, interrogate, test and confirm the work we reviewed to the degree appropriate for a complete third party peer review.

The documents we reviewed were:

- *'Hillside Pre-feasibility Study – Hydrogeology'*, prepared by Mining Plus and dated 19/1/2012.

- *'Hillside Project – DFS Groundwater Investigations'*, prepared by Mining Plus and dated 9/5/2013.

Our review has not examined the following aspects of the proposed project:

- Regulatory aspects of any water take/water licences.
- Surface water hydrology.
- Tailings storage facility and any water implications to the environment.
- Waste rock dumps and their water implications to the environment.

In gathering contextual information to inform our review, we identified that the community has stated 'high concern' with the following water and water-related issues:

- Loss of arable land.
- Possibility of groundwater seepage from mine into surrounding groundwater systems, including quality impacts.
- The fate of the final pit void (lake).
- Surface water / groundwater interactions.
- Sustainable water practices.
- Potential contamination as a result of seepage from the tailings storage facility.
- Potential leakage from the buried concentrate pipeline between the mine and the port.

This review recognises the SA Government's role and authority in assessing the proposal and would welcome any enquiry its officers may wish to make in respect of the matters identified and discussed herein.

Our preliminary review findings

The Hillside Project is situated 40 metres above sea level. The reported groundwater (GW) level sits at 30-80 m below ground level and this groundwater is highly saline. Groundwater discharges east into Gulf St Vincent. The proposal states a water demand of 155 to 170 L/s required for processing water, with 70% of that demand to be met from GW.

The documents reviewed cause us to raise concerns in three key areas:

1. **Data limitations** – where the documents fails to cite or provide sufficient, fit-for-purpose data.
2. **Modelling limitations** – where the documents demonstrate that applicable and/or appropriate modelling standards, guidelines or best practice has not been followed.
3. **Reporting limitations** – where the documents make statements or assertions that are unsupported or inadequately supported.

Our dot-point summary of the issues identified within each of these areas is presented below.

Data limitations

- Drill depths did not exceed 200m whereas the pit is to be excavated to approximately 450m and underground operations could extend to 700m. There is no explanation in respect of why the drilling program did not include deeper wells. A deeper investigation bore(s) is required down to some 500 m below ground.
- None of the drilling targeted the 'seasonal perched Quaternary aquifer', therefore in terms of test pumping and groundwater modelling, any potential impacts to this zone is unknown. This aquifer could be a water source for stock in the area.
- Wells for test pumping only targeted the deeper aquifer (represented by groundwater model Layer 3) and appeared to be focused on attaining estimates of likely inflow to the pit wall.
- The sole long-term pump test (conducted at well WBTH005, reported in Appendix A 9.7) is neither reported nor included in the tabulation in Section 4 of the body of the DFS report. The test indicates an acceleration of drawdown with time. There is very little by way of discussion of the implications of this test, other than a brief mention that it was conducted to gain an appreciation of the pumping effects on the fractured aquifer zone. This is perhaps the most important test data within the report and it is left only in the Appendix and not addressed in the body of the report.
- Hydraulic parameters from test pumping were used to inform the Groundwater (GW) model. Recharge and groundwater levels were not used as inputs.
- No baseline data including groundwater hydrographs (i.e. groundwater level fluctuations with time) were apparently available to calibrate the model. Whilst the dilemma of the modeller is recognised, this is a serious omission. Such baseline data should have been collected at an absolute minimum over one complete year and preferably years that included drought-dominated regime and a wetter year.
- GW test pumping durations were too limited. We understand this limitation may have been a product of finite onsite storage capacities and GW discharge to the environment (regulatory restrictions).
- The PFS categorically states that wells were installed in all hydrogeological zones. This does not appear to be accurate in that there are no details of wells targeting the 'seasonal perched Quaternary aquifer'.

Modelling limitations

The groundwater modelling *per se* is generally sound. However it is limited only to the moderately deep, immediate mine site environment and does not cover the near surface nor the deep geological formations.

The groundwater modelling presented in Mining Plus – *Hillside Pre-feasibility Study – Hydrogeology* dated 19/1/2012 and Mining Plus – *Hillside Project – DFS Groundwater Investigations* dated 9/5/2013 has failed to follow standard groundwater modelling guidelines. This is a serious procedural lapse for such a large, important and environmentally sensitive project.

Other key modelling limitations include:

- The confidence in modelling outcomes is compromised by limited reporting (see below), including lack of justification for a number of modelling assumptions and little discussion of the implications of the project to the environment.
- The permeability of Layer 4 has not been defined by field investigations; it is an assumed value. It appears to be a product of the lack of very deep drilling.
- It is noted that the outputs from the model indicate that Layer 4 is sensitive to changes in permeability and storativity (standard groundwater hydraulic parameters).
- The calibration of the model is questionable as it appears to rely on five bores only; two in the Coastal Granite and three in the pit area. The model has embraced a zone of potentially fractured granites to the north and east of the proposed mine in a zone that appears to have an enhanced permeability. More discussion of this is needed.
- A number of hypothetical cut-off wells have been modelled as intercepting groundwater flows that appear to exploit this zone of higher permeability. These cut-off wells are oriented north north-east of the proposed pit area to intercept 150L/s (essentially the mine processing water use requirement). Their role appears to be to intercept any potentially contaminated underground water migrating beyond the mining lease.
- Theoretically, under the modelling scenario adopted, all underground water leaving the mine site through this zone can be intercepted except in the final two years of mine operation, wherein there is an 11% excess volume. Accordingly, in the final two years of operations, there is a threat of contaminated underground waters leaving the site that has not been addressed.
- Post-closure, the dewatering cone of drawdown does not fully recover to pre-mining groundwater levels. Essentially, the pit (lake) becomes a permanent groundwater sink. Whilst this may, in the short to medium term, assist in restricting off-site migration of any contaminated underground water, there is nonetheless a stated effect for 550 years (the duration of the post-mining model). Whether this impacts on the 'seasonal perched Quaternary aquifer' or any other perched groundwater system remains unknown. If any connections exist, this would have implications for any stock bores in the zone of influence.

Reporting limitations

- Whilst technically sound, the reporting of the test pumping and groundwater modelling is lacking appropriate context. It neither transparently explains the assumptions of the hydrogeological conceptualisation nor does it discuss results in terms of the wider environmental implications.
- The report neglects to address any surface water and groundwater interactions.
- The report neglects to address any near surface waters.
- Inter alia, the report does not address potential impacts to any groundwater dependent ecosystems in the zone of influence.

- It is noted that the Coastal Granites are highly fractured and productive aquifers (up to 10 L/s) and GW discharge quality, as a result of mining, may have potential to exceed the ANZECC water quality guidelines for ecosystems.
- Only the middle two layers of the GWM are verified by field investigations.
  - The deeper 4th layer assumes the rocks are tighter at depth therefore less permeable. This may not necessarily be the case as deep fractures may occur in fault zones in the Yorke Peninsula.
  - The 'seasonal perched Quaternary aquifer' has not been the subject of any field investigations. We recommend that, at a minimum, existing geotechnical logs from drill-holes and/or excavated test pits should be examined and pertinent data extracted (e.g. permeability values) to inform the groundwater modelling (Layer 1).
- Operationally, it is unclear whether the mine is to have a dedicated water supply wellfield (to be drilled east of the proposed pit location of Wells 23-27 – Coastal Granites). This again requires clarification.
- The cone of drawdown will be steep; however there may be linear extensions of less steep but more extensive drawdown along lines of enhanced permeability due to fracturing sympathetic with the regional geological faulting. No discussion of this is offered.
- The water quality in the ore body versus the granite GW systems may be different. If so, a discussion is required as to how the disposal of the dewatered water and interaction between these different quality waters would be managed.
- The reporting results in an apparent disconnect between the high yields intercepted during mineral RC drilling and dedicated water well drilling. This may be because fractures are essentially vertical and therefore wells drilled at the vertical may fail to intercept the more permeable fracture zones (as opposed to mineral holes drilled at angles that may intercept a number of sets of the fracture by their orientation). This leads to some confusion in the conceptualisation of the hydrogeology in that testing is indicating relatively impermeable conditions whilst the mineral drilling suggests that the geological zones can be highly permeability. Further clarification is required.

Specific to the Mining Plus DFS Report, dated 9 May 2013, the following comments are made.

- The well completion summary Table 1 and Figure 1 appear to be a subset of the complete program of wells drilled. No clear reason is given for not including all wells.
- The drilling and test-pumping program is aligned to the pit rock mass, hanging wall and footwall zones only. Reasons are not given for the omission of other geological zones.
- Discussion the results of the test pumping program is perfunctory. The DFS report states that all wells with airlift yield more than 1L/s were tested, but in the pre-feasibility report there were more wells stated that fit this definition. If results were selectively reported, a reason for this is not given.

Recommendations

This review recognises that the effort put into a groundwater modelling study is dependent on timing and budgetary constraints that are generally not known to us. That said, our review identifies a clear need for a third party peer review of the Proponent's groundwater assessment, including the groundwater model. It is open to us to assume that the modellers have satisfied themselves as to the impacts, but have failed to articulate their outcomes to the extent required for the public and decision makers to have confidence in the work.

There are firm guidelines for reviewing groundwater models, but not for the associated groundwater assessments. For this reason, the checklists in the Australian groundwater flow modelling guidelines should be used for both assessments. The appropriate guideline is *'Australian groundwater modelling guidelines'*, Waterlines report No 82 - June 2012, published by the Australian Government, National Water Commission ('the guidelines').

The guidelines act as a point of reference, rather than a rigid standard. They seek to provide direction in terms of the scope and approaches common to modelling projects. The guidelines seek to provide a common terminology that can be adopted by all stakeholders typically involved in modelling projects. They are directed at both non-specialist modellers and specialist modellers because they provide a view of the model development process as well as best practice guidance on topics such as:

- reporting
- data analysis
- conceptualisation
- model design
- calibration
- verification
- prediction
- sensitivity analysis and
- uncertainty analysis

to create greater consistency in approaches.

We recommend that the South Australian Government's assessment and approval bodies consider these key recommendations and defer its decision making processes until such time as such a review (conducted in accordance with appropriately defined terms) is presented by the Proponent.

We trust this is acceptable. Please do not hesitate to contact this office if you require any further details or elaboration.

Yours faithfully,

Eric Rooke
Principal Hydrogeologist
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