Anglesea Mine Geotechnical and Slope Stability Technical Study

Introduction

Alcoa's Anglesea mine is located at Anglesea, in south western Victoria, approximately 35 kilometres from Geelong. The Anglesea Mine supplied brown coal to the Anglesea Power Station since its inception in 1969 until shutdown in August 2015. The operation, including both mine and power station, has now entered an interim monitoring period whilst the final Closure Plan is being developed prior to implementation.

The mine is located within the Anglesea River catchment, a relatively small scale river system, with a catchment area of approximately 885ha. The two main tributaries of the Anglesea River are Marshy Creek, which flows from the north, and Salt Creek which flows from the west with its last kilometre diverted around the northern edge of the Alcoa mining area prior to the commencement of mining in the 1960's.

Alcoa has a legislative requirement to manage and ensure risks related to the mine are minimised to acceptable standards. Sources of potential risks may include mine hydrology, hydrogeotechnical, geotechnical, erosion, fire and impacts on internal/external infrastructure together with site and public safety and impact on environmental elements such as creeks and waterways.

Background

The Work Plan requires a Closure Plan that depicts the final landform at the cessation of mining to comprise a final lake void surrounded by safe and stable batters and revegetated areas. The plan also depicts the re-diversion of Salt Creek approximately back to its original path.

With the operation shutdown, the closure concept for the Mine Closure Plan now requires technical specification, and therefore a technical Study of the proposed geotechnical and slope stability aspects is required.

The hydrological and hydrogeotechnical and revegetation aspects and of the final Mine Closure Plan will be fully evaluated through a separate technical studies and hence the need to use theoretical mine water levels for the initial stages of the Geotechnical and Slope Stability Technical Study. However, it is anticipated that as applicable data becomes available, it will be shared across the three studies including at regularly scheduled data sharing meetings.

Quality Assurance

This Technical Study will be subject to a third party independent peer review prior to finalisation.

In addition to this and as part of the final submission of the Mine Closure Plan to the Department of Economic Development, Jobs, Transport and Resources (Earth Resources Regulation), it will be subject to further independent review including by the ERR's Technical Review Board.

Initial Context for the Study

To give the Technical Study context, the following provides a conceptual framework that will help inform and guide the required technical work. The Mine Closure Plan should:

- Be consistent with the key principles in the existing endorsed work plan
- Ensure that all landforms will be safe and sustainable in the long term
- Understand there will be a lake of some form, with the dimensions, quality, fill rates, etc. still to be determined
- Be consistent with the Guiding Principles (to be updated following stakeholder consultation) set out below:
  - Provide a safe and stable landform for future uses.
  - Value and complement the natural environment.
  - Support a diverse range of future uses and outcomes.
  - Honour the various cultural and heritage values of the area.
  - Complement the future of the Anglesea Region.
- Focus on landform for alternative use within the disturbed area (considerate of community feedback) rather than land use at this stage
- Be considerate of revegetation strategy consistent with alternative use, not necessarily re-vegetation to original heath but sensitive to the surrounding natural environment and local indigenous species, and so as not to exacerbate fire risk into the future
- Include consideration of two options for the lake including connectivity to Salt Creek (inflow) and also to the Anglesea river (outflow), or as captured storage
- Include that Coal Mine Road access for emergency services (at least) is required in a similar location (doesn't have to be exactly the same) to current into the future, re-routing considerate of risk (if appropriate) could be considered
- Be considerate of long term management, monitoring and maintenance requirements
  - Target 'set and forget'
  - Transition from manage to monitor based on agreed closure criteria
  - Residual risk should be no worse than 'background' risk

Using the context above, inclusive of the Guiding Principles, Alcoa requires that a Technical Study be undertaken to determine the long term geotechnical and slope stability implications within the Alcoa Anglesea mine area consistent with allowing the mine sump to recharge either by natural groundwater recover or by diverting Salt Creek back into the mine and filling the mine void at higher rates.

Expected Outcomes

- Provide a comprehensive analysis of all geotechnical and slope stability issues relating to the final Mine Closure Plan by highlighting all related risks and providing sound technical and engineering support for any recommendations.
- Provide recommendations for strategies to manage identified risks for the identified geotechnical domains through inclusion of these strategies into the Mine Closure Plan.
- Provide recommendations of preferred options for providing connectivity of the proposed mine void lake to Salt Creek and the Anglesea River, or as captured storage, into the Mine Closure Plan.
- Provide recommendations for strategies to manage any identified risks for other landform areas within the disturbed area and through inclusion of these strategies into the Mine Closure Plan.

Geotechnical and Slope Stability Technical Study: Scope of Work

Conduct a full geotechnical and slope stability analysis and provide a report detailing any potential intermediate and long term impacts on surrounding overburden areas and pit walls if the mine sump level is allowed to recover and eventually reach a theoretical final level. The theoretical maximum level of the final mine lake is to be assumed as being either RL +15.0 (captured storage) or RL+5.0 (discharges to the Anglesea River) level and all elements of the Scope of Work analysis should consider both for evaluation purposes.

Analysis will review both natural groundwater recovery processes from the upper Eastern View Formation and the possible re-diversion of Salt Creek into the mine to accelerate recharge.

The study and subsequent report shall include:

1. Undertake a desktop review and gap analysis of all applicable data required to complete this technical study.
2. Review geological data and plans and establish conceptual geological/geotechnical models.
3. Facilitate, inclusive of Alcoa, a Risk Assessment process consistent with AS/NZ ISO 31000:2009) that documents and assesses each potential risk or impact identified through this Scope of Work.
4. Based on this risk assessment develop and recommend appropriate risk mitigation strategies suitable for the long term. This should also specifically include any recommendations as an option to 'relocate' existing public infrastructure inclusive of Coal Mine Road route and Barwon Water infrastructure to help alleviate any identified risk issues.
5. Review the need for any additional field work such as geological/geotechnical mapping and field investigation (e.g. test pits/drilling) to be undertaken to support model development.
6. Review the distribution of material property results to determine if there is sufficient representative data coverage within the formations across the minesite.
7. Analysis should break the mine into the geotechnical domains based on the outcomes of the gap analysis. Domains should include the mine floor to assess potential stability risks from groundwater level recovery during pit flooding and interaction with pit slopes.
8. Evaluation of potential impacts on the lower overburden disposal areas by analysing the likely forms of failure and whether any failure mechanism (such as lower level slumping) has an impact on any surrounding batter, but especially south wall integrity. Outcomes to be considered in any modelling.
9. Review of the various materials that constitute the proposed final walls and the subsequent implications for failure mode e.g. slumping through wave action. Refer to previous analysis regarding seismic analysis, including liquefaction etc. Outcomes to be considered in any modelling.
10. Review of the various materials contained in the overburden areas and the subsequent implications for failure mode (e.g. slumping through wave action). Consideration shall also be given to the long term erosion potential of the material. Outcomes to be considered in any modelling.
11. Appropriate analysis and modelling shall use theoretical mine sump levels at 5 metre increments above the starting sump level of RL-40 extending to the theoretical maximum RL +15.0 and detail the potential geotechnical impacts and risks for each of those increments. If there is no variation in the risk at the various water levels, then this needs to be supported and validated through analysis. Appropriate analysis and modelling shall include technical

supporting evidence for the use of that particular modelling (e.g. sufficiency of 2D limit equilibrium modelling or when 3D finite modelling may be considered).

12. Key focus area will be the appropriate geotechnical modelling of the South Wall to evaluate Factors of Safety (FoS) for base case with no toe buttress condition (conservative theoretically lowest FoS value prior to failure), the current condition with toe buttress material added, and again for the varying water levels associated with recharge up to the theoretical maximum.
13. Repeat the above for the remaining domains or provide technical support based on risk as to why this may or may not be required.
14. Having developed the FoS above and dependent on the outcome of that analysis, develop a sensitivity analysis and outcome table that amongst other variables, increases that FoS in increments of 0.1 (up to a FoS of 2.0) against both the corresponding volume of additional toe buttress (and associated placement strategy) and the overall changed design batter angle slope that accords with that FoS. Sensitivity analysis should include such things as lower quartile shear strength, parameters, fluctuating water levels (long term and short term) and seismic analysis (based on the presence of the water body).
15. Provide a technical justification relating to the recommended FoS given the long term nature of the final Mine Closure Plan versus the risk profile and considering any relevant Australian or overseas guidelines for stating final mine closure FoS requirements with similar circumstances. This should include specific examples from other sites and locations to support any recommendations.
16. Review the potential for change in material properties in the buttress/s and mine batters (relative to the slope stability analysis) with rising groundwater levels as the water body fills.
17. Detail any potential impacts or risks associated with the south wall given its proximity to public assets such as Coal Mine Road and Barwon Water infrastructure. Analysis shall consider (as a minimum) the various aspects of the south wall, including the two re-entrants, proximity to supporting west wall and eastern overburden mass (i.e. either end of the south wall) and any proposed batter angle changes.
18. Evaluate the options and implications of filling the mine void via a natural groundwater recovery process, through accelerated filling via the re-diversion of Salt Creek from normal flow, or via a re-diverted Salt Creek flooding event (i.e. 1:50 year event).
19. Detail any treatments that may be utilised to minimise erosion through wave action (or erosion via other means), such as using rock ballast.
20. Provide details of optimum batter angles for areas where current faces can be readily modified through cut and fill earthworks i.e. west and north quadrants.
21. Consider and develop the strategy and options to re-divert Salt Creek in a planned manner to the Mine, and for the Mine to discharge to the Anglesea River at the most appropriate point. This should include technical justification of the elements of the proposed connectivity strategy.
22. Develop an erosion management plan to cover the entry of all anticipated main water flows from outside the mine boundary to where they intersect with the final water body.
23. Provide estimated volumes of material, proposed options to source any material, and high level implementation strategy for any and all earthworks associated with the various options and recommendations made as a result of this technical study.
24. Develop a potential post closure monitoring plan for ground stability for the long term slope stability, including monitoring locations, instrumentation and assessment methods. The system will most likely be an updated version of the existing system, plus any expansions deemed necessary as an outcome of this Slope Stability Technical Study and considerate of the final Mine Closure Plan e.g. flooded void.

25. Establish potential ‘Completion Criteria’ for the monitoring above that indicates that long term stability has been reached and that the monitoring program can cease.
26. Develop a Trigger Action Response Plan (TARP) to cover all actions associated with the final Mine Closure Plan design for the mine.