Anglesea Mine Hydrology and Hydrogeotechnical 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, impacts on internal/external infrastructure, 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 hydrology and hydrogeotechnical aspects is required.

The Revegetation, Geotechnical and Slope Stability aspects of the final Mine Closure Plan will be fully evaluated through separate technical studies, however it is anticipated that as applicable data becomes available, it will be shared across all 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 hydrology, hydrogeological, chemistry and geochemistry implications within the Alcoa Anglesea mine area consistent with allowing the mine to recharge either by natural groundwater recovery and/or by diverting Salt Creek back into the mine and filling the mine void at higher rates.

Expected Outcomes

- Provide a baseline model of the current aquifer and interactions with other aquifers and surface water and waterways, inclusive of chemistry/water quality.
- Complete hydrogeological evaluation and groundwater modelling to determine mine void fill times and system time to reach equilibrium under various scenarios, including under climate change, and over various time periods.
- Provide geochemical modelling and assessment of key water quality parameters and potential risks during filling of the mine void, and showing long term equilibrium quality parameters and risks.

- Identify potential beneficial uses, and risks, at the estimated long term equilibrium water quality of the proposed lake.
- Identify any potential strategies and options that may assist with water quality management (where appropriate) during filling the void inclusive of advantages/disadvantages and risks and also identify potential strategies and options (where appropriate) for long term lake water quality management.
- Establish potential 'Completion Criteria' for monitoring the above proposed outcomes that indicates that long term stability has been reached and that the monitoring program can cease.

Hydrology and Geotechnical Study Scope of Work

The considerations and Scope of Work include:

- Termination of groundwater pumping within the pit sump and from groundwater extraction wells (completed March 11th 2016).
- Filling of the pit to establish a pit lake and stable landform either by natural groundwater recovery, and/or by diverting Salt Creek back into the mine and filling the mine void at higher rates, and/or via a re-diverted Salt Creek flooding event (i.e. 1:50 year event). The options will include the pit lake as standalone (captured storage) or with connectivity to Salt Creek and to the Anglesea River.
- Considers impacts on water balance in waterways if creeks are diverted and/or additional water diverted into the Anglesea River and any subsequent impact on water levels/flows and other environmental values.
- Ensure the Technical Study is developed with a thorough understanding of the regional context regarding both groundwater and surface water, together with any interaction between the two.

1. General

Studies to assess historic information, confirm the current baseline, and to identify any relevant legislative requirements associated with the hydrological / hydrogeological / chemistry aspects.

1. Review of all relevant historic data, groundwater level, water quality and other relevant studies (also to encompass background groundwater and surface water/catchment data to establish an accurate baseline) to enable all applicable local and regional aspects to be used to contextualise and support this Technical Study.
2. Identification of groundwater users, including the environment, potentially at risk from the proposed mine closure design.
3. Highlight any gaps for any study areas below and provide recommendations to address those gaps, inclusive of any additional field work and laboratory testing.
4. Provide a baseline model of the current aquifer, inclusive of chemistry/water quality, to be used in the community consultation process.
5. 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.

6. Investigate any potential legislative requirements or frameworks pertaining to the aquifer management, including the potential re-diversion of Salt Creek to the mine and subsequent connection of outflow to the Anglesea River.
7. In the event that a suitable legislative framework is adopted, develop an initial scoping document, a 'White Paper' on legislative components of mine/lake rehabilitation and a more detailed aquifer recovery project management plan and associated approval process.
8. In the event that a suitable legislative framework is not adopted, develop a 'White Paper' on legislative components of mine/lake rehabilitation and a more detailed aquifer recovery project management plan.
9. Establish potential 'Completion Criteria' for monitoring the above proposed outcomes that indicates that long term stability has been reached and that the monitoring program can cease.
10. Establish potential "Completion Criteria' for the proposed lake water balance (level and quality) including both seasonal and climate change. This should include an assessment of the lake rehabilitation and closure and groundwater beneficial use criteria to be met in defining completion of the rehabilitation.
11. Establish a potential post closure monitoring plan for the groundwater level and water quality for the long term management of water resources, including monitoring locations, instrumentation and assessment methods. This will be required for the land manager to undertake long term site environmental management.

2. Hydrogeology Studies

Studies to assess the potential timeframes for pit filling and recharge of groundwater levels, involving a series of hydrogeological and geochemical evaluations associated with pit filling and recharge of underlying aquifer systems.

1. Groundwater and surface water monitoring, sampling and analysis.
2. Analytical pumping test analysis to provide hydraulic parameters for the upper aquifer and aquitard separating the upper and lower Eastern View Formation (EVF) to facilitate estimation of pit filling times.
3. Development of a detailed groundwater / surface water conceptualisation (water model) including interactions at the site to understand the potential benefits of recharge of deep and shallow aquifer systems.
4. Undertake geochemical modelling of pit and surface water quality to assess potential for clogging of the aquifer during recharge.
5. Complete hydrogeological evaluation and groundwater modelling to determine potential mine void fill times and system time to reach equilibrium under various scenarios, including climate change, seasonal factors, and over various time periods (1, 2, 5, 10 , 20 years etc.) as agreed, groundwater movement, groundwater/surface water interactions, and stabilisation against recharge timing.
6. Modelling shall provide a water balance for all potential inflows to and outflows from the water body and should be completed to include Salt Creek and other local catchments that may drain to the mine. The water balance should assess seasonal variability of inflows and outflows from the water body.
7. Provide models with at least minimum monthly time steps such that the temporal view of water levels and quality over time may be understood.

3. Chemistry and Geochemistry Studies

Studies to assess the chemical interactions of mine water body with groundwater and determination of any (appropriate) management strategies for water chemistry during filling and until a natural self-sustaining system is established. This would include water quality evaluations to support assessment of the potential impacts of aquifer recovery, suitability of proposed lake water for future beneficial uses, risks, and water treatment and management requirements (where appropriate).

1. Provide a baseline of current mine, ground and surface water quality in the region surrounding the mine.
2. Literature review of the chemical behaviour, remediation and management strategies for surface coal mine pit lakes particularly for any similar situations within or external to Australia.
3. Complete supplemental sampling of pit water and surface water (upstream water quality) where required and a screening assessment of potential human health and ecological risks.
4. Provide geochemical modelling and assessment of key water quality parameters and potential risks during filling of the mine void, including any discharge to waterways (to aquifer permeability and deeper aquifer systems), considering long term equilibrium quality parameters and risks.
5. Develop any initial pH correction strategies for the pit that may be appropriate to help support the long term equilibrium outcomes, inclusive of supporting documented rationale and associated calculations and methodology.
6. Provide models with at least minimum monthly time steps such that the temporal view of water levels and quality over time may be understood.
7. Identify any potential strategies and options that may assist with water quality management (where appropriate) during filling the void inclusive of advantages/disadvantages and risks.