MACHEnergy

Mount Pleasant Operation

A JOINT VENTURE WITH JCDA Japan Coal Development Australia

Attachment 13

Geotechnical Considerations

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Mr Chris Lauritzen
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Dear Mr Lauritzen,

State Significant Development -
Mount Pleasant Optimisation Project Geotechnical Advice

1 Project Background

The Mount Pleasant Operation is situated approximately 4 km north-west of Muswellbrook, on the northern side of Wybong Road.

Construction at Mount Pleasant started in 2016 and mining began in November 2017 operating under a mine plan that had been developed as part of MACH Energy's 2016 feasibility study. Thiess Mining is contracted to provide a full mining service to the project. Mining is carried out using dozers, shovels and trucks in a strip mining configuration. Initial mining takes place along a boxcut on the eastern side of the pit where the shallowest coal is located. Overburden from the box cut is stored outside of the pit but as mining progresses and a sufficiently large in-pit void is developed, the overburden will be placed in-pit and be progressively rehabilitated.

Planned coal production is 10.5 Mtpa in 2020. The current optimisation program is being undertaken to support a request for an extension of mining to 2048 and to ramp up production to 21 Mtpa.

2 Project Geology

The project is located within the Hunter Coalfield on the western side of the Muswellbrook Anticline.

The targeted seams are all located within the Wittingham Coal Measures of Late Permian age. They occur across the whole of the project area, generally under a thin veneer of soil. To the east, the mine abuts, but does not encroach on, the Hunter River floodplain. The overburden and interburden strata consist mainly of sandstone with lesser proportions of siltstone and claystone. The non-coal strata were derived from the geological activity associated with the Hunter Bowen Orogeny to the north-east of the coalfield. During deposition, the relative proximity of the source rocks to the coal field resulted in the relatively coarse grained overburden.

The strata dip gently towards the WNW at approximately 6° to 8° in the east (closest to the anticline axis) easing to 2° to 4° in the west.

The weathering depth ranges from 10 to 35 m and is usually about 20 m.

There is some faulting and there are some minor igneous intrusions. The faulting is not expected to have a significant effect on mining except in terms of scheduling requirements and possible dilution across fault induced steps in the coal horizon elevations.

3 Geotechnical Conditions

The fresh intact sandstone which predominates the interburden strata has an average uniaxial compressive strength of 30 MPa.

The gentle strata dip, shallow overburden depth, strength of the fresh overburden, the moderately strong Edderton Seam floor and the absence of severe faulting effects combine to form a geotechnically benign mining environment.

Measurements of joint orientations indicate predominantly near vertical joints that dip in the range of 80° to 90°. The joints occur as two major sets that are orthogonal to each other; one set dips subvertically towards either the NW or SE, the second set dips subvertically towards either the SE or NW. This is consistent with expectations of jointing associated with the Muswellbrook Anticline. More recent work has indicated that the pattern of jointing is more nuanced but any adverse consequences of this will occur at the operations level and would be managed by geotechnical hazard management plans.

4 Geotechnical Stability of Operational Pit Walls

Substantial geotechnical assessments have been carried out for the Mount Pleasant Operation and were reported in 1994, 2007 and 2011 by Kevin Rosengren and Associates. Each assessment generated additional field and laboratory data. The conclusions were always the same: that operationally adequate factors of safety would be achieved in weathered strata excavated at 45° and in fresh strata with pre-split batters excavated at 70°. A 2019 review of the designs, in association with a site inspection, by Sherwood Geotechnical and Research Services also confirmed the appropriateness of the designs. These designs are being implemented and have resulted in stable walls except for a single significant lowwall failure. It occurred in January 2020 and was the result of contravening the recommended design by placing spoil too close to the lowwall. For the Optimisation Project batter angles of 45° in weathered strata, 75° in pre-split fresh endwalls and 70° in fresh overburden final highwall batters are recommended.

An aspect of the current assessment has been the stability of the Wybong Road corridor because of the cracks that appeared on the Bengalla side of the road following excavation by Bengalla Mine of a portion of its end wall. A three-dimensional numerical analysis has been carried out. Without “knowing” where the cracks occur, the model successfully predicted their location thereby providing confidence in the model. The model suggests that even after Bengalla has backfilled its northern endwall there may continue to be maintenance level movement. The Mount Pleasant endwall is sufficiently far away from Wybong Road as to not interact with it. However, the model predicts movement on the order of 30 to 40 cm at the base of the southern endwall along tuff partings within the Edderton Seam. Because of the importance of the Wybong Road corridor, recommendations for future monitoring of the Mount Pleasant southern endwall are made below.

5 Final Landforms

At the end of mining, a final void will remain and, it is predicted, that the water level will rise to about 90 mAHD as shown in Figure 5-1. To achieve long term landform stability the excavated walls and in-pit overburden will be substantially re-shaped from their operational profiles to flatter, and more naturalistic profiles. The GeoFluv design method has been used to produce the final proposed landform. The overburden dumps will have been re-shaped progressively during mining operations and substantially flattened from angle of repose batter angles of 37° as shown by the magenta line in Figure 5-1.

When considering appropriate factors of safety (FoS) a typical minimum value for a geotechnical slope where the public is exposed is 1.5. As described below, the final void landform meets or exceeds this value.

On the highwall side, stable mining slopes will have been flattened to a slope comprised of segments at various angles but with an overall angle of about 18°. The lower part of the highwall will consist of fresh overburden rock configured as a buttress. The minimum factor of safety (FoS) for the highwall side of the void is about 1.5 for a shallow circular surface that passes only through the rock buttress and not any intact rock. From this it is concluded that the fresh broken rock buttress and the slopes that it notionally supports are in a geotechnically, acceptable configuration.

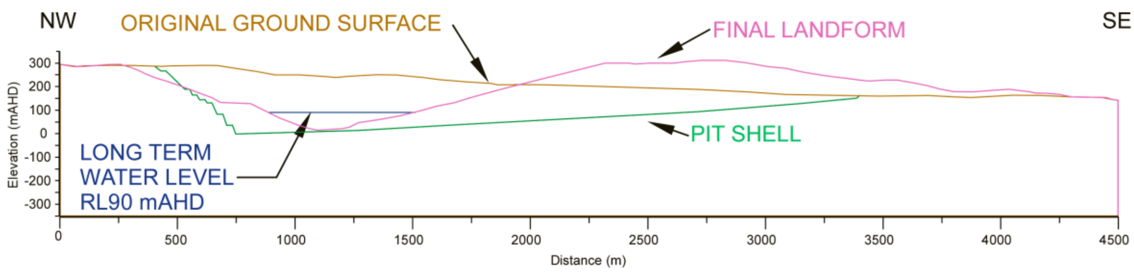

Figure 5-1. Representative cross section through final void showing final landform design.

The overburden dumps will consist mostly of fresh medium strong sandstone. The void-side in-pit spoil is designed for an overall slope angle of about 13°. The outer spoil, facing the Hunter River, is designed to have an overall slope angle of about 6°. The minimum FoS for the inner dump face is about 2.0 and for the outer dump face is 5.2. The reason that the inner dump face has a much lower FoS is that (a) the overall slope angle is steeper and (b) lower shear strengths are used for saturated overburden located beneath the level of the final void lake. The calculated FoS values substantially exceed accepted minimum required values.

There are two stability aspects to consider for final voids: geotechnical stability and landform stability. Invariably, the surface gradient requirements for landform stability ensure geotechnical stability as expressed by a factor of safety. The Mount Pleasant Optimisation final void is no exception. To address the question of landform stability others have carried out landform designs based on principles implemented in the GeoFluv system and tested using the SIBERIA numerical code to simulate long term landform development. It is understood that the final void design conforms to recommendations from these studies and consequently, as well as being geotechnically stable, the final void will be a landform that is stable in the long term well after mining has ceased.

6 Recommendations for Monitoring and Management

The following recommendations are made for geotechnical monitoring during operations. This is not an exclusive list as currently unknown conditions may be encountered that require additional monitoring, but the list is regarded as a minimum requirement.

- Ground water pressure in the Wybong Road corridor using vibrating wire piezometers. The results should be used to verify the geotechnical modelling that has been carried out.
- Deflection data using time domain reflectometry cables installed in the piezometers. This is a cheap method to identify where subsurface movement occurs but not the quantum.
- Survey data using both prisms and laser scanners. Laser scanners are more convenient but prisms will provide more precise and more accurate data. This data will indicate whether subsurface movement is occurring.
- Structural geological information obtained by routine mapping either manually or by any of the various photogrammetric methods that are now available. These data should be used to carry out kinematic stability analyses and predict where structural features are headed.
- A formalised program of visual inspection which is usually part of a geotechnical principal hazards management plan.

7 Conclusion

Extensive geotechnical assessments have led to design recommendations for operationally stable slopes that have been verified from current mining. The slope designs result in slopes that have factors of safety greater than 1.2 unless there is a low strength, unknown geological structure present in an adverse location.

During operations a program of monitoring and mapping will be carried out to verify the design assumptions and inform any changes if they are required.

The final void configuration is geotechnically stable and is predicted to be a stable landform in the long term.

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