6th March 2019

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Adrian,

SUBJECT: Geotechnical Evaluation of Proposed Taking of Unsupported Plunges In LW103A Block

Mine Advice have been engaged by Moolarben Coal Operations (MCO) to undertake a geotechnical evaluation of the proposed "Plunge Panel" within the south-west extent of LW103 that is approved for Longwall extraction. This letter summarises previous assessments and the proposed 103 Plunge Panel to be included in the UG1 LW101 -103 Extraction Plan amendment.

Background

MCO UG1 Longwalls 101 to 103 Extraction Plan (Extraction Plan) was approved by the Department of Planning and Environment on 21 September 2017. Since the Extraction Plan approval, an igneous intrusion (plug) and associated dykes have been identified and defined near the southwestern end of the approved Longwall 103 footprint. The intrusions prevent viable resource extraction by longwall mining.

MCO proposes to make two adjustments to the operations in LW103 to maximise resource extraction within the approved LW103 footprint..

1. Relocate the LW103 install face immediately outbye the area impacted by the intrusion.
2. Establish 103 "First Workings Plunge Panel" by utilising continuous miners to extract coal in areas where longwall extraction is not viable.

MCO proposes to modify the approved Extraction Plan (Figure 1) to reflect the revised mine plan and incorporate the alternative mining "First-Working Plunge Panel" methodology where longwall extraction is not viable (Figure 2). The First-Working Plunge Panel aims to maximise resource recovery, whilst causing minimal subsidence; enabling the surface to remain 'long-term stable and non-subsiding'. This report provides a summary of Mine Advice's assessments of the Plunge Panels, with the changes to Longwall subsidence impacts due to the relocated LW103 installation face being assessed by others.

Geotechnical Evaluations

The Plunge Panel layout that was evaluated consists of a series of what are termed herein as "long run-outs" that are yet to be formed by roadway development, as well as a series of isolated unsupported "plunges" either side of the run-outs that are separated by solid coal, this being clearly evident in Figure 3. It is understood that breaker-line supports (BLS's) will not be used during plunging this being the primary reason why plunges are being isolated from each other.

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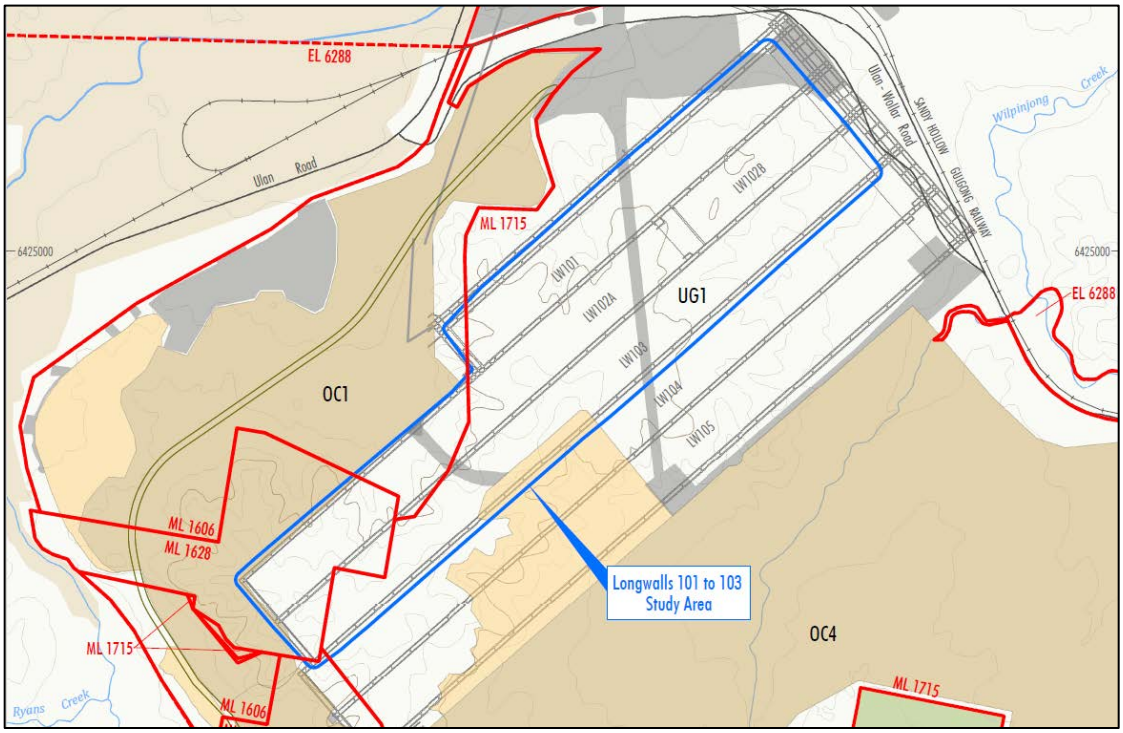

FIGURE 1. UG1 Longwalls 101 to 103 Extraction Plan Current Layout

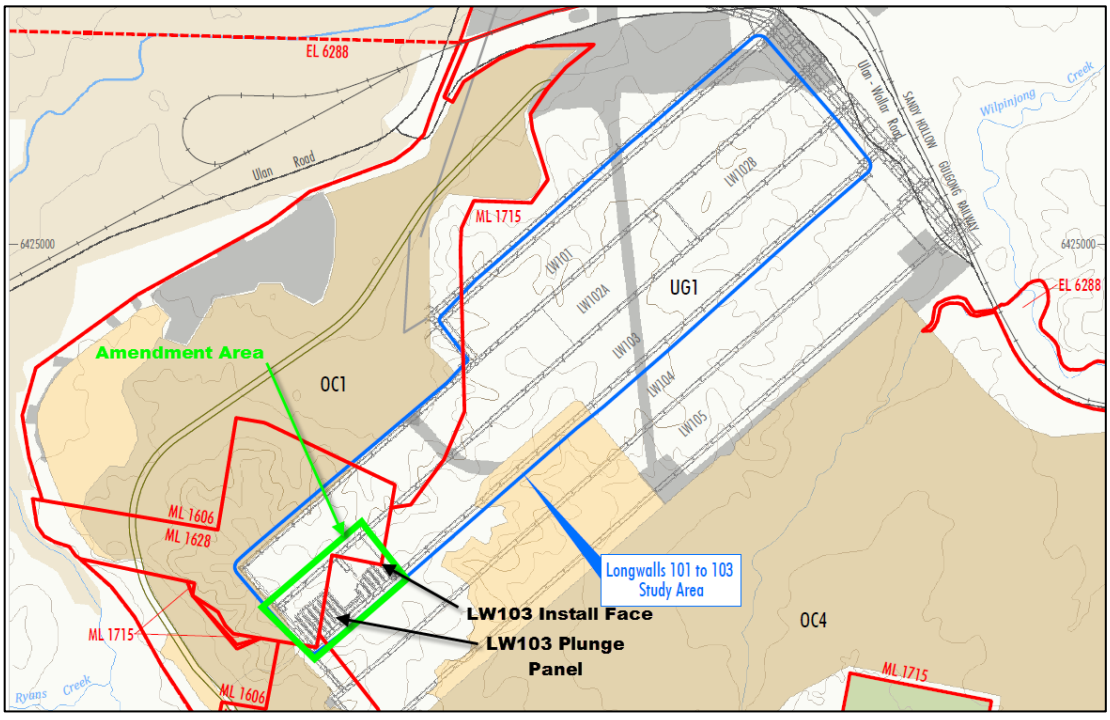

FIGURE 2. UG1 Longwalls 101 to 103 Extraction Plan Amended Layout

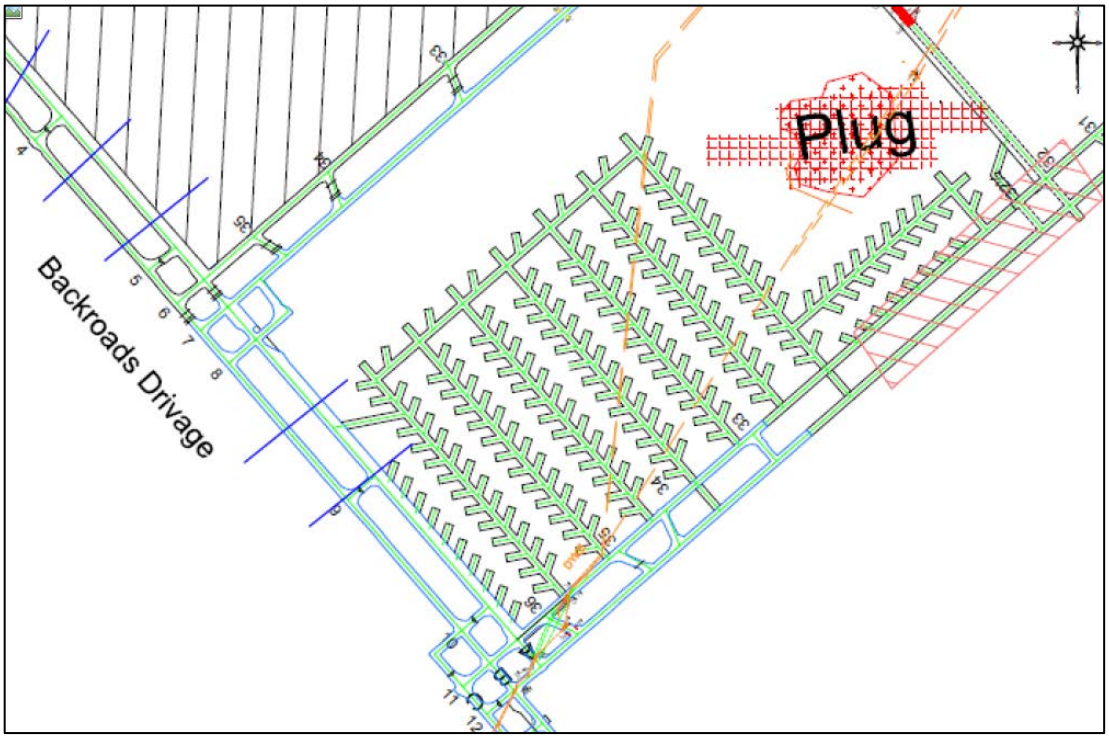

FIGURE 3. Proposed LW103 Plunge Panel Layout Evaluated

The four fundamental considerations included safety, reserve recovery, production and subsidence and associated impacts. This report focuses on the subsidence-related aspects of the evaluation. A more detailed geotechnical evaluation of the proposed "Plunge Panel" layout at the inbye (south-west) end of LW103 is outlined in report MOOLARBEN28/1 (Mine Advice 2019).

Remnant Pillar Stability

The main technical issue when evaluating remnant pillar stability is in assigning credible pillar strengths given the highly unusual shape and length of the remnant pillars post-plunging. As can be seen in Figure 3, the remnant pillars all contain unsupported plunges, meaning that none are rectangular or parallel-piped, which would otherwise allow pillar strengths to be assigned in a straightforward manner. Further, all pillar strength equations use pillar width as an input, the determination of which is not obvious in Figure 3. Therefore, a method was developed to address this design conundrum, which deliberately errs on the side of caution due to the uncertainties involved.

Individual pillar strength has been assigned by:

i) setting the maximum pillar length at 50 m even though many of the pillars are substantially longer than 50 m. This ensures that pillar strengths are not over-estimated as a result of using the actual pillar length, which is far removed from the types of pillar geometries contained within the collapsed cases databases that underpin empirical pillar strength equations.

ii) determining a credible minimum width for each pillar from the layout plans that were provided (14 m in all cases), this being used to determine the pillar strength using UNSW PDP strength equations and w/h ratio.

Figure 4 shows how, in combination with the assigned pillar length of 50 m, the minimum pillar width has been defined and used to determine the strength (and minimum w/h ratio) of each remnant pillar, the assumed pillar for strength determination purposes being significantly smaller in plan than the full remnant pillar.

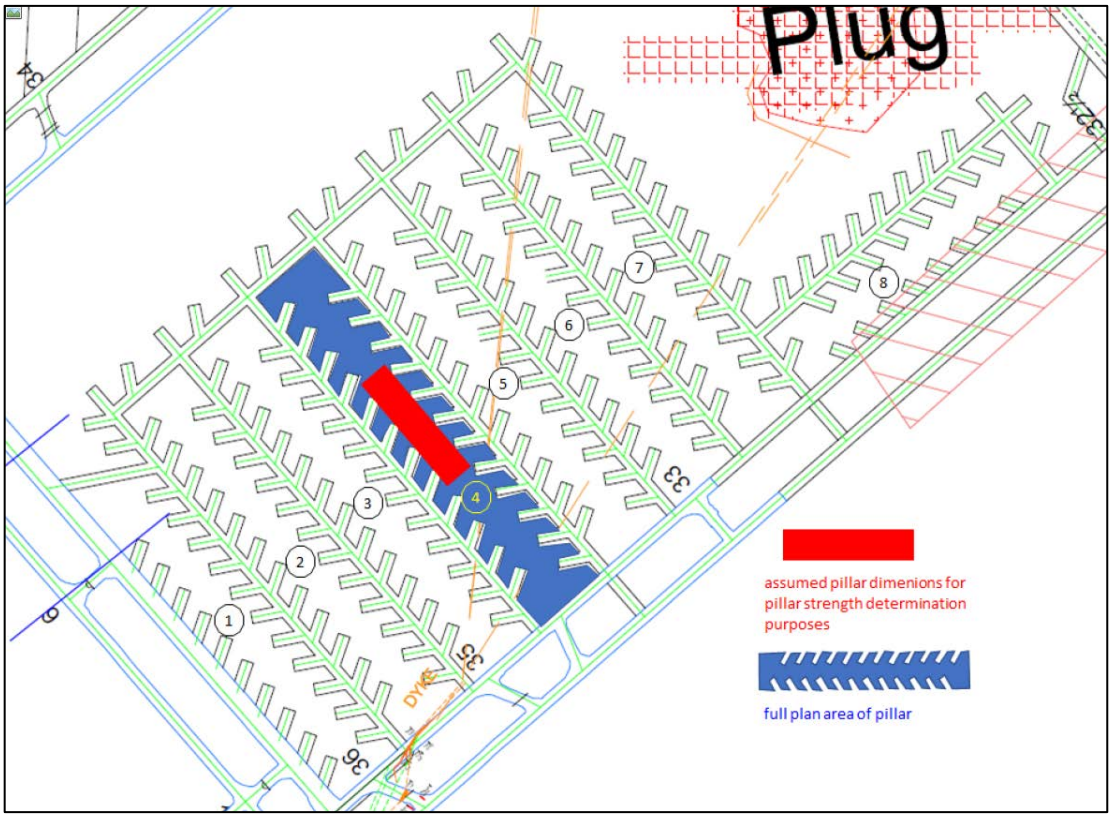

FIGURE 4. Illustration of Full Remnant Pillar Plan Shape and Dimensions As Compared to Assumed Pillar Dimensions for Strength Determination Purposes

This conservative assumption in terms of likely pillar strength (in MPa) was then applied to the total pillar area (as also indicated in Figure 4) in determining the total load-bearing capacity of the pillar (in tonnes or N). In this way, there can be no credible argument that the strength of the pillar has been over-estimated, which would inevitably be the case if the maximum pillar width were selected for use for example.

Overall, the evaluation concludes that the proposed remnant pillar system is fit for purpose in terms of having both adequate long-term stability and maintaining surface settlements below 20 mm. Even ignoring any contribution of the overburden to pillar stability due to load redistribution to the adjacent barrier pillars, Factors of Safety (FoS) for the proposed design have been determined to be no less than 2.89 under full tributary area loading. Thus the pillars can be considered as being long-term stable.

Roof Stability in Unsupported Plunges

As the proposed unsupported plunges are to be formed up at a width of 5.4 m and have a typical length of 15 m, roof stability in what will be unsupported plunges can be assessed using the Mark 1999 equation.

For normal or typical roof conditions, 15 m long unsupported plunges are likely to retain globally stable roof conditions, with any instability being limited to minor skin falls due to such drivers such as localised

jointing, sheared bedding etc. As such, it is concluded to be reasonable to plan to form-up 15 m long unsupported plunges as part of the proposed mining.

Plunge Panel Extension

The Plunge Panel footprint proposed for the LW 101 to 103 Extraction Plan amendment includes an extension to that assessed in report MOOLARBEN28/1 (Mine Advice 2019). The extension area maintains same critical stability geometries that were previously evaluated and found to be long-term stable. Given the subsidence and stability impacts have been determined on the smallest remnant pillar at greatest depth of cover in the area, the extended Plunge Panels inevitably maintain the same long-term stability and subsidence control outcomes.

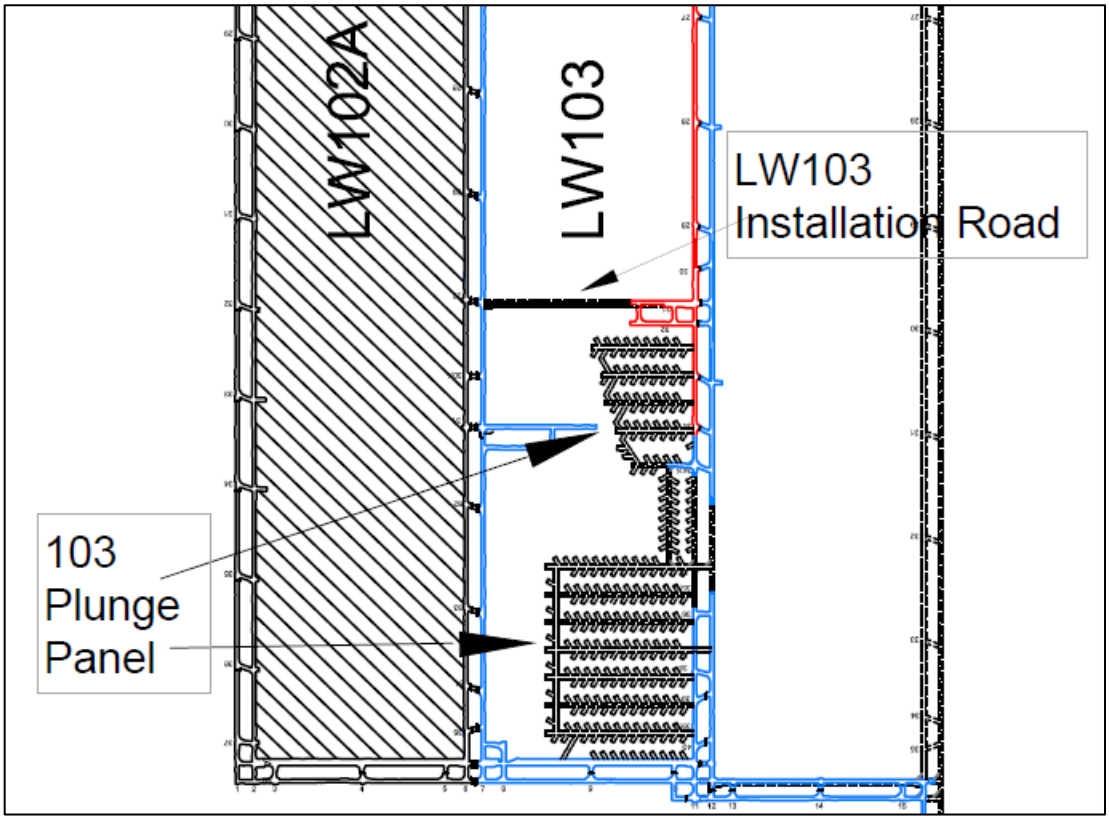

FIGURE 5. UG1 Extraction Plan Amendment - 103 Plunge Panel Layout

Summary

The geotechnical evaluation of the LW103 Plunge Panel has conservatively assessed that the proposed geometry will provide a long-term stable pillar environment, with subsidence limited to less than 20mm. It is also concluded that heights of fracturing above the formed roadways within the Ulan Seam will be minimal given the first working nature of the mining method and global stability of the plunges and associated formed intersections.

The proposed 103 Plunge Panel affords a level of coal resource recovery where geological constraints prevent viable longwall extraction. Given the area is already approved for full longwall extraction, the Plunge Panel represents a reduction in environment impacts from that which is currently approved.

Please contact the under-signed should you require anything further in this matter.

Yours faithfully,

Russell Frith
Senior Principal Geotechnical Engineer

References

Mark, C. (1999). Application of the Coal Mine Roof Rating (CMRR) to Extended Cuts. In Mining Engineering 51(4).

Mine Advice (2019). Geotechnical Evaluation of Proposed Taking of Unsupported Plunges in LW103A Block. Commercial consulting report MOOLARBEN28/1 to Moolarben Coal.