Objection to Moolarben Stage 1 MOD 15 20 October 2019

Moolarben Coal mine Complex (MCC) Modification 15 application seeks approval to locate and install 4 expanded dewatering sites above Underground No. 4 Mine (UG4). This would involve the drilling of a cluster of 3 de-watering boreholes (nominal diameter ~700mm) per site plus associated clearing for installation and access tracks in an existing biodiversity offset area.

The location of the northern bore sites - opposite The Drip GDE[1], and approximately 250 metres from the Goulburn River is of major concern considering the close proximity to significant natural features, cultural sites and the potential interception and depressurisation of the Triassic/upper Permian groundwater system. Construction of the northern dewatering sites is predicted to occur approximately 3 years after the southern sites - in or around the year 2026.

MCC has provided an inadequate 2 page groundwater review that is predicated on 2011 approval (Stage 1 MOD 7) for a dewatering borefield based upon questionable 2006 groundwater modelling (Dundon, 2006). The MOD 15 groundwater review has not considered the latest groundwater monitoring since the commencement of Underground No.1 Mine (UG1) in mid-2016 and a subsequent extensively '*recalibrated*' groundwater model (HydroSimulations, 2017).

There has been a more than 6 fold increase in actual mine water-make (1 ML/day to > 6.8 ML/day) compared to the earlier predictions of groundwater inflows (Middlemis and Fulton, 2011) (HydroSimulations, 2017). The source of this extra inflows has not been adequately investigated but in my professional opinion is from the interception of additional groundwater sources above the coal seam - from Triassic and upper Permian water bearing strata. This is supported by groundwater monitoring (since 2016) which show a significant decline in standing water levels in all water bearing strata at a number of monitoring sites 2-4 kms from UG1 (above UG4 PZ179, PZ191, 192 and PZ193 - Figure 1). Figures 2 and Figure 3 show the decline in upper groundwater levels (mAHD) in monitoring bores PZ179, located ~ 2 kms NE of Moolarben CC UG1 mine and PZ192, PZ193 located >4 kms from UG1, between January 2016 and February 2019 following development of UG1 in late 2016.

Protection of valuable aquifers – exceedance of AIP threshold

MCC has frequently reported that groundwater within the UG4 footprint is low quality and of limited value. The salinity and pH of groundwater monitored at PZ103 and PZ105 located within the UG4 (Figure 1) demonstrates the presence of high quality, potable water sources in all three water bearing strata - the median range of salinity EC levels 235 - 580 µS/cm, with a potential yield in excess of 4L/s (Table 1). The characteristics of these groundwater sources should trigger the Aquifer Interference Policy (NSW Office Of Water, 2012). There is also evidence based on hydrochemical characteristics and behaviour of the SWLs in response to mining of some connectivity between the water bearing strata (see Piper plot - Figure 5). Groundwater rainfall recharge is most likely occurring along the alluvial drainage basin marked by tea-tree riparian heathland (Hill, 2000) in the eastern and northern areas of UG4.

[1] Groundwater Dependent Ecosystem

Approval in 2007 and failure of the groundwater modelling

The 2007 Independent Hearing and Assessment Panel (IHAP) (Galvin *et al*., 2007; Mackie, 2007) stated they lacked confidence and had serious reservations about the development of the Moolarben Stage 1 UG4 mine. They were **'***unable to comprehend with sufficient certainty, the magnitude and extent of impacts likely to prevail upon aquifer systems as a result of longwall mining operations'***.**
IHAP concerns regarding the predicted impacts of mining on regional groundwater systems included:

- Limited knowledge and sensitivity of the important Triassic aquifer system and its interaction with the Goulburn River
- Potential for measurable depressurisation of groundwater systems within the Triassic aquifers
- Lack of confidence in the computer numerical models used to predict impacts and validity of those predictions depends on how well the models approximate field conditions including the 'unusual' regional hydraulic properties.

The 2007 IHAP concluded that "*Sub-surface fracturing impacts need to be confirmed by monitoring of ground behaviour and groundwater response …" and i****f mining is found to impact upon the Triassic aquifer system, the mine layout may need to be modified.***

The Moolarben CC groundwater model has assumed subsidence cracking of the strata above the coal seam would be restrained to under 122 metres from the surface and thus the upper Triassic[2] aquifers would not be depressurised and drained (Mackie, 2007). This differs significantly from the Ulan Coal Mine experience that has recorded complete dewatering of Triassic strata. MCC's claim is also disputed by other subsidence experts (Tammetta, 2015; Mackie, 2007).

The potential extent of depressurisation resulting from UG4 may be extrapolated from the measured decline in Triassic groundwater levels experienced at Ulan Coal Mine between 2001 and 2017 (shown in Figure 4). This graph demonstrates the extent, as a function of distance, of groundwater drawdown due to mine depressurisation. There is around a 15 metre decline in groundwater levels, 500 meters from Ulan Coal longwall mine No. 3.

Please note MCC UG4 dewatering bore sites are located within 250 metres of the Goulburn River and longwall panels 500 metres from The Drip and Corner gorge (see Figure 1). If a similar outcome is experienced in UG4, the groundwater depressurisation and drawdown of water bearing strata would extend well under both the Goulburn River and The Drip GDE.

MCC Approval Conditions

MCC has failed to show how 'nil impacts' on The Drip water supply and negligible impacts on the Goulburn will be achieved as required by their approval conditions (Tables 11 & 14 – Schedule 3: 78A).

The 2016 Planning Assessment Commission's report on UG1 Modification 12 required "*an additional level of monitoring, reporting and government oversight"* to ensure the adequacy of the mines predictions and there be no impacts on The Drip. Subsequent variance from

[2] This was based on the incorrect assertion that the Triassic strata above UCML 206m wide panels were not drained - MCC LW panels are 208 m wide

UG1 Modification 12 modelling and monitoring predictions should now initiate further investigation and scrutiny from an independent expert panel.

Conclusion

It is my expert opinion that outstanding uncertainties around the impacts of UG4 mine depressurisation on Triassic/Upper Permian aquifers; potential interaction with the Goulburn River, degradation of a valuable groundwater resource and interference to The Drip groundwater supply must be considered before the impact of these dewatering bores (MOD 15) can be confidently assessed. A comprehensive groundwater assessment and review of monitoring data is needed by an independent scientific organisation to inform this approval application. The proposed construction of the dewatering borefield from 2023 allows a reasonable period for this to be completed. Failure to fully assess these impacts and act on the outcomes could result in a potentially permanent and devastating degradation of the groundwater system and dependent ecosystems along the Goulburn River with the long term costs being borne by future generations breaching NSW Protection of the Environment Act ESD –intergenerational equity and the precautionary principle.

Julia Imrie BSc. Grad Dip Water Res. Dip Ed.
PhD (conferred Dec'19)
Fenner School of Environment and Society, Australian National University

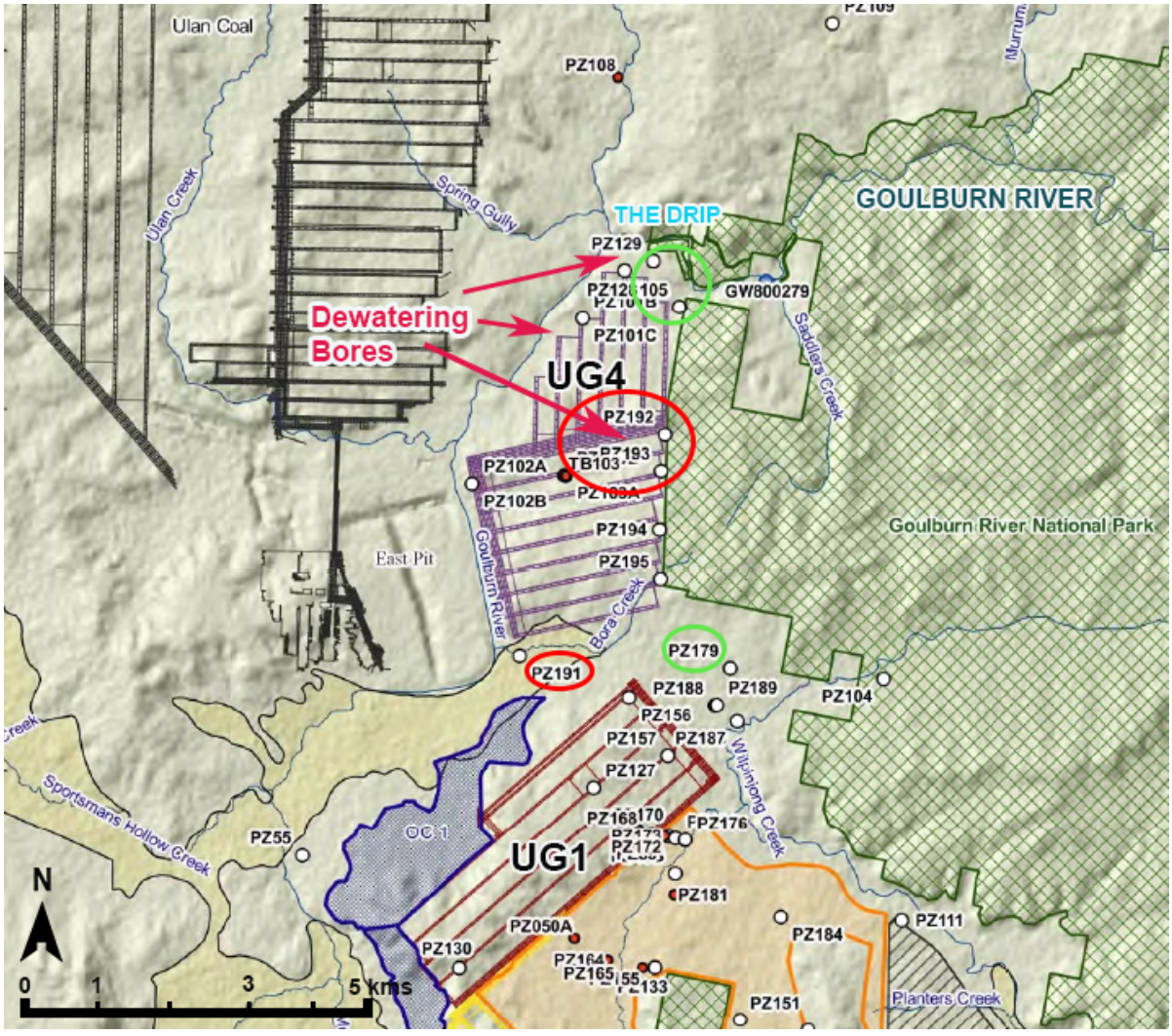

Figure 1: Location of MCC UG1 & UG2; monitoring bores PZ192, PZ193, PZ105, PZ103, PZ191 & PZ179 and proposed location of dewatering bore sites (MOD 15)

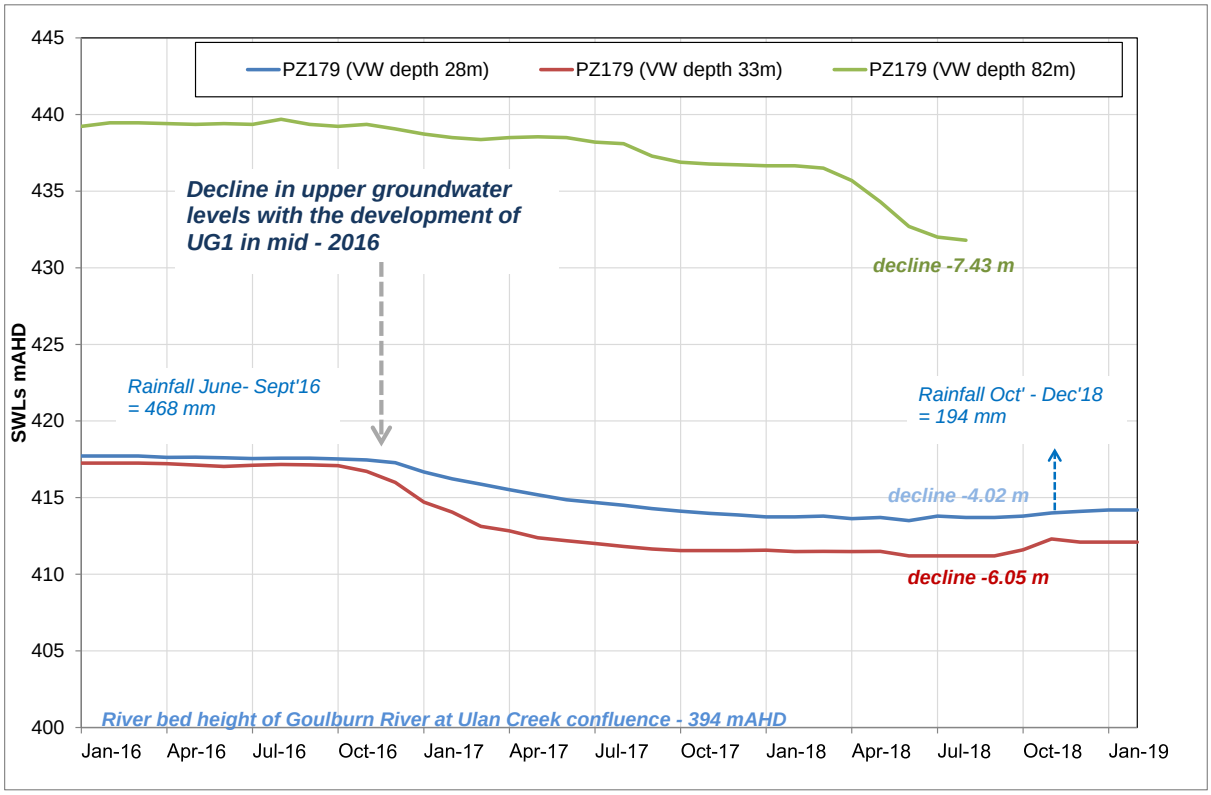

Figure 2: Decline in upper groundwater levels (mAHD) in monitoring bores PZ179, located ~ 2 kms NE of MCCs UG1 mine Jan'16- Feb'19 following development of UG1 in late 2016 despite significant rainfall June-Sept 2016.

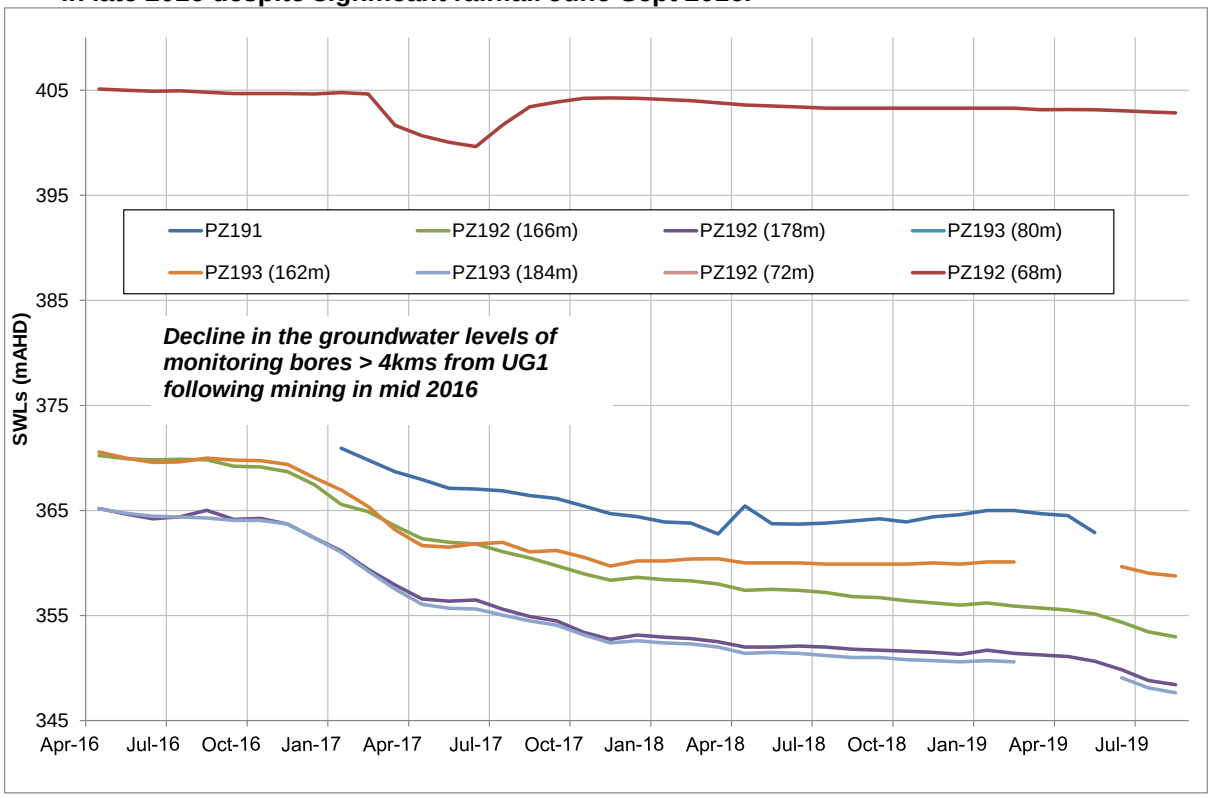

Figure 3: Decline in groundwater levels (mAHD) following development of UG1 in late 2016 in monitoring bores PZ192, PZ193 located >4 kms from UG1 and PZ191 Jan'16 - Feb'2019 (MCC, 2017; MCC, 2018).

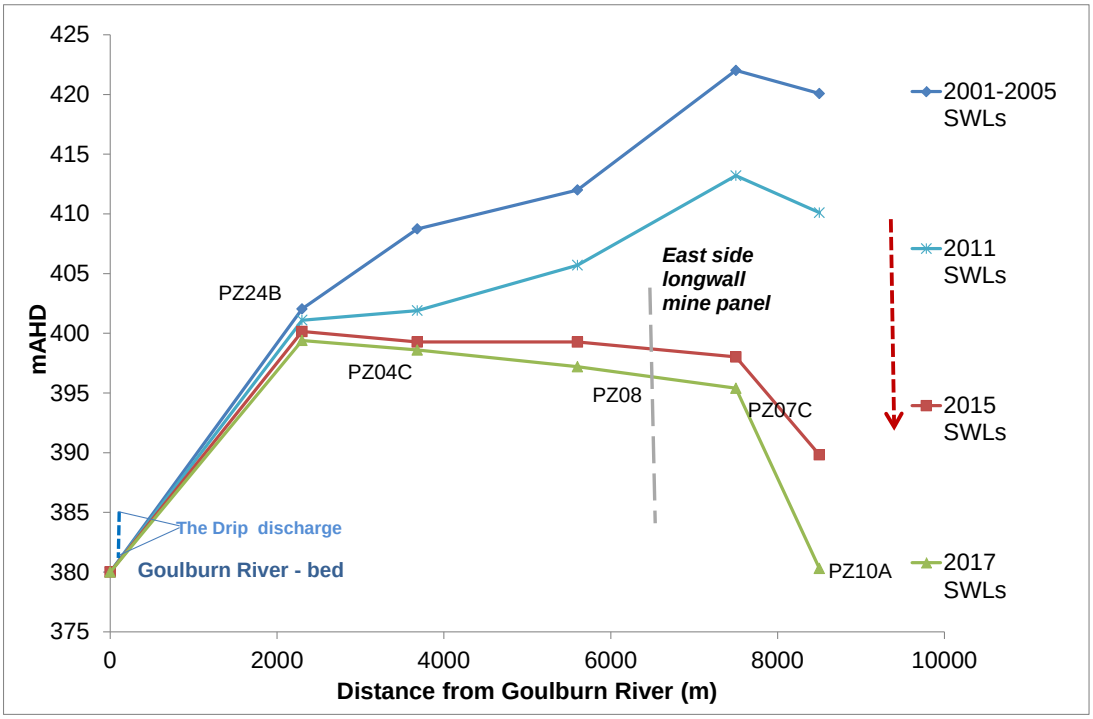

Figure 4: Shows the decrease in SWLs (mAHD) of bores monitoring the Triassic groundwater as a function of distance from the Goulburn River over time (2001 – 2017) with a reversal of the hydraulic gradient away from the river, towards the depressurised underground mine, and >15m drop in SWLs within 500 metres of the edge of the longwalls (AEMR UCML 2001-2017)(UCML, 2017; UCML, 2015)

Table 1: Water quality of monitoring piezometers located in UG4. For location see Figure 1 (2017 MCC AMR)

MCC UG4 Piezometer	Lithology	Median EC	Median pH
PZ103C	Lower Triassic	350	6.6
PZ103B	Upper Permian	438	6.7
PZ103A	Ulan Seam	580	6.5
PZ105C	Lower Triassic	265	6.1
PZ105B	Upper Permian	235	5.6
PZ105A	Ulan Seam	317	6.2

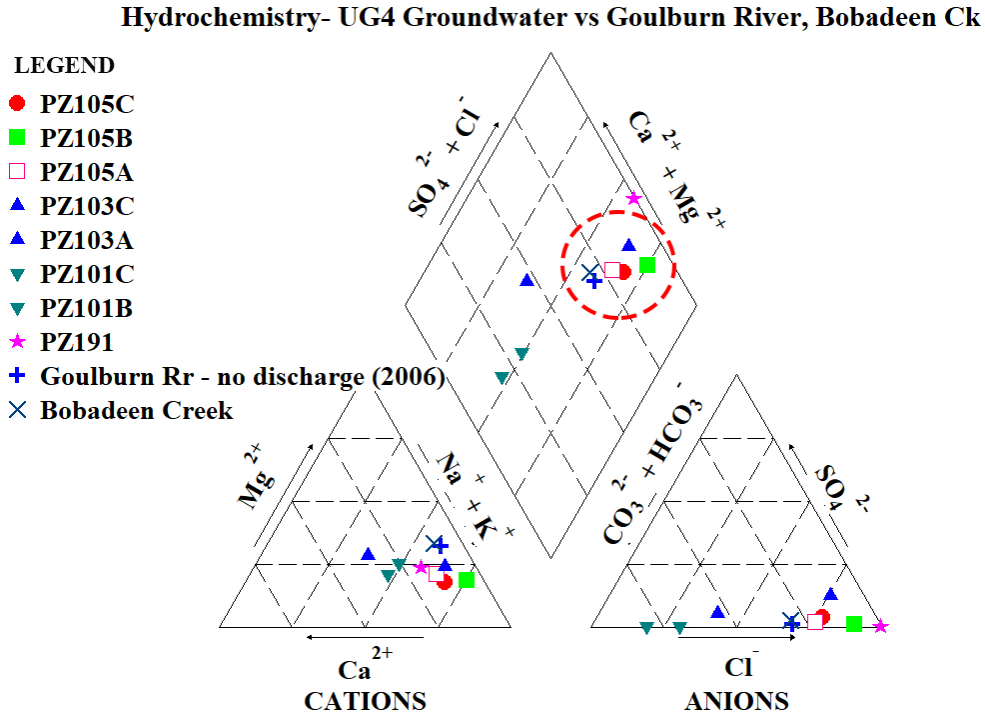

Figure 5: Piper diagram hydrochemistry (mg/L) of groundwater and surface water sites UG4 mine. Triassic and Permian groundwater from PZ105ABC and PZ103C are similar to surface water in the Goulburn River and Bobadeen Creek.

References

Dundon, P. J., 2006. *Appendix 5 Groundwater Assessment* Moolarben Coal Mines Pty. Ltd.,

Galvin, J. M., Mackie, C. D. and Karantonis, P., 2007. *Report for the Independent Hearing and Assessment Panel for the Moolarben Coal Project*, Prepared for the Director General Department of Planning New South Wales.,

HydroSimulations, 2017. *Moolarben Coal Open Cut Optimisation Modification Groundwater Assessment: Appendix I*, Moolarben Coal Operations Pty Ltd., YANCOAL, Australia,

Mackie, C. D., 2007. *Moolarben Coal Mine Groundwater Assessment: Report to Independent Planning Assessment Panel*, Mackie Environmental Research Pty Ltd,

MCC, 2017. *Moolarben Coal Complex Open Cut Optimisation Modification 14. Environmental Assessment - Appendix E Site Water Balance and Surface Water Assessment*, Moolarben Coal Operations Pty Ltd; YANCOAL, Australia,

MCC, 2018. *Moolarben Coal Complex (MCC) Annual Review - Appendix A-142* Yancoal Australia Group,

Middlemis, H. and Fulton, A., 2011. *Moolarben Coal Complex Stage 2 Preferred Project Report Appendix E - Groundwater Impact Statement.*, Hansen Bailey On behalf Moolarben Coal Mine,

NSW Office Of Water, 2012. In *NSW Aquifer Interference Policy*.

Tammetta, P., 2015. Estimation of the Change in Hydraulic Conductivity Above Mined Longwall Panels, *Groundwater*, **53**(1): 122-129. Available at: http://dx.doi.org/10.1111/gwat.12153 (accessed

UCML, 2015. *Attachment D: Groundwater Monitoring Report*

UCML, 2017. *Ulan Complex Annual Review*, GLENCORE, Mudgee, NSW.