Metropolitan Coal Mine – independent review of environmental performance to 2022

Prepared by Peter Dupen, H2onestly hydrogeologist

Prepared for Nature Conservation Council of NSW (NCC), March 2023

Iron-stained flows in Eastern Tributary February 2017, photo P. Dupen

1. EXECUTIVE SUMMARY

On behalf of the Nature Conservation Council of NSW (NCC), H2onestly's hydrogeologist Pete Dupen has reviewed documents regarding the Metropolitan Coal Mine's environmental performance against planning approval expectations.

Metropolitan Mine's "300-series" longwalls are now progressively mining coal under the Woronora Reservoir valley and stored waters (Figure 1), which supply Greater Sydney and the Illawarra with vital drinking water supplies.

A number of environmental consequences have appeared in the catchments following mining-induced subsidence which were not predicted at the time the Metropolitan Mine was applying for approval and appear to be exceeding approved Performance Measures (Section 5.3);

1. The perennial Eastern Tributary has unexpectedly gone dry for a 500 m length since the end of 2016 as a result of undermining.
2. The aquifers which sit above and feed the incised valley streams are draining at rates measurably higher than pre-mining, in places rapidly and completely, due to unexpected and unpredicted formation of large-scale shear planes opening up at their base. These shear zones are inferred to be 500 m long in one location and over 250 m wide at another. Where they are developed they appear to be acting as drains centered on the undermined valley centers which now accommodate creeks and Sydney's stored drinking water (Figure 4).
3. The discharges of water diverted through these new fracture systems are emerging with high concentrations of iron, manganese, aluminum and other metals and salts. The sampled discharges to the reservoir from Eastern Tributary already appear to be breaching performance measures, and these effects can be expected to worsen significantly as unmeasurable discharges from aquifer drainage emerge at or below the axis of the valley. The long-term fate of these additional contaminants in the reservoir is currently unknown, but so far the dissolved metal concentrations have not been greatly elevated at the drinking water off-take at the northern end of the reservoir near the Woronora Dam wall.

There are numerous lines of evidence which indicate that the sub-horizontal shear planes and sub-vertical fractures, collectively termed "ridge fracture drainage" in Figure 4, are becoming a widespread but previously unrecognised subsidence impact in the Woronora Reservoir catchments. This evidence includes the unpredicted drying of all pools along a partly undermined section of Eastern Tributary (Figure 1, Section 3.5) and the recent direct connection of Piezometer T3 to the reservoir water levels (Figure 1, Section 3.3). Such widespread fracturing and surface flow water diversions were not anticipated in the planning application documents (Helensburgh Coal, 2008; 2009), and their implications are not acknowledged by the mining company nor the regulators and their expert committees, based on the documentation reviewed.

The volume of additional metals that will ultimately be leached through the diversion of surface waters and residual groundwater within the ridges is not known, but may be much greater than the already measured metal and salt loads which are discharging from undermined creeks into the Woronora Reservoir (Section 4). Risks to drinking water catchments of future long-term metallic spring discharges into surface water supplies was highlighted in recent expert committee reviews (IEPMC, 2018a; 2018b).

Numerous consequences of these subsidence effects are reported in the 2021 Environmental Performance report, presented without acknowledging that there may be an unanticipated style of subsidence impact now unfolding. Based on experience at Dendrobium and other Southern Coalfield mines, should the "ridge fracture drainage" mechanism hypothesised in Section 3.2 prove to be widespread over undermined parts of the Woronora Reservoir catchment, it appears inevitable that these hydrological, chemical and ecosystem impacts will become much more widespread in coming years and decades even if mining is immediately halted. It may be substantially worse if the remainder of the approved longwalls (orange outline in Figure 1) are extracted beneath the reservoir, creeks, swamps and forests of the Woronora Special Area catchment.

Some of the subsidence effects and impacts which are now unfolding in Woronora Reservoir catchment were expected and are considered to be consistent with the planning approval conditions. A number of the impacts appear however to exceed both the water impact predictions made in the EIS documents and the subsequent Performance Measures and Indicators (Section 5). These subsidence impacts and apparent performance measure exceedances are evaluated in this report against evidence presented in the reports referenced herein, and are summarised as follows:

- Extensive fracturing in the Hawkesbury Sandstone aquifer is leading to desaturation of the ridges around the reservoir, we well as the possibly permanent loss of ecologically important surface flows. The sub-vertical fractures and sub-horizontal shear planes induced by the Metropolitan Mine longwalls, and their implications for water quality and catchment health, are much more extensive than was envisaged by the 2009 planning application.
- The mining-induced shear planes and fractures are causing the drainage of the sandstone aquifers within the ridges that lie above the undermined creeks and stored waters. The desaturation of the aquifers through the newly imposed fracture system would permanently change the hydrological ecological and geochemical nature of the drinking water catchment.
- Changed baseflow patterns will alter catchment ecosystems which are adapted for pre-mining conditions. A likely result of these changed baseflow patterns is that a large proportion (potentially all) of the riparian, swamp and forest ecosystems on the undermined ridges will become drier and presumably less capable of filtering surface flows entering the reservoir.
- Formation of rapid subsurface flowpaths through fractures are expected to add a substantial but as yet unquantified addition of metal and salt (drinking water contaminants) discharged into this drinking water via subsurface springs created by basal shear planes. These metals are additional to the already alarming exceedance of stream water quality performance indicators (Section 4.1), contamination which has been increasing with the ongoing expansion of the mine beneath the drinking water catchments.
- The extent of unpredicted impacts suggest that the mine's geotechnical and groundwater modelling has been unduly optimistic. Assuming the conceptual model presented with evidential reviews in Section 3 are correct, the impacts now unfolding herald a previously undocumented style of catchment impact, one dominated by ridge drainage through basal shear planes hundreds of meters wide and hundreds of meters long.
- The desaturation of the ridges is occurring even though the drainage is probably not highly connected down to the depressurised and fractured zone over the collapsed longwalls. In other words, these impacts are occurring even whilst there is no concrete evidence that there is a substantial net loss of water volumes from the Woronora Reservoir catchment into underlying workings. We don't appear to be losing water, but the collected water is likely to be of much lower quality in the long term as a result of travelling through the fracture drainage system instead of through filtering soil and vegetation.
- It should be understood that a certain amount of surface water will drain into the underlying mined voids. These voids left by rock and groundwater extraction from the coal seam during mining will ultimately be filled by surface water from above – amounting to at least 17 GL from Sydney's drinking water supply, drained over an unknown time period.

- Based on the information provided through GIPA requests, it appears there has been no successful investigations to understand the long-term impacts or transfer dynamics of the additional metals and salts entering the reservoir from creek and spring discharges. We simply don't know if metals entering the reservoir and now presumed to be sitting in or on sediments on the reservoir floor are for example being mobilised by rainfall pulses and may be already affecting the average metal concentrations in the back and middle sections of the catchment. Additional metal loads, along with natural sandstone stream loads, may be building up in the reservoir and may become a long-term legacy requiring increasing water treatment in the future.
- The available performance documents provide no recognition by Peabody or their consultants that a much larger set of ridge drainage impacts are unfolding than were predicted, that in itself is an issue. If shear planes are indeed now dominating the drainage behavior of the upper aquifer, the impact predictions provided by the company can't be relied upon. The fact that the implications of the apparently extensive shear plane development over the longwalls has not been publicly discussed by the company or the regulators (neither DPE, WaterNSW nor their advisory expert committees) is deeply troubling, and explanations are sought.

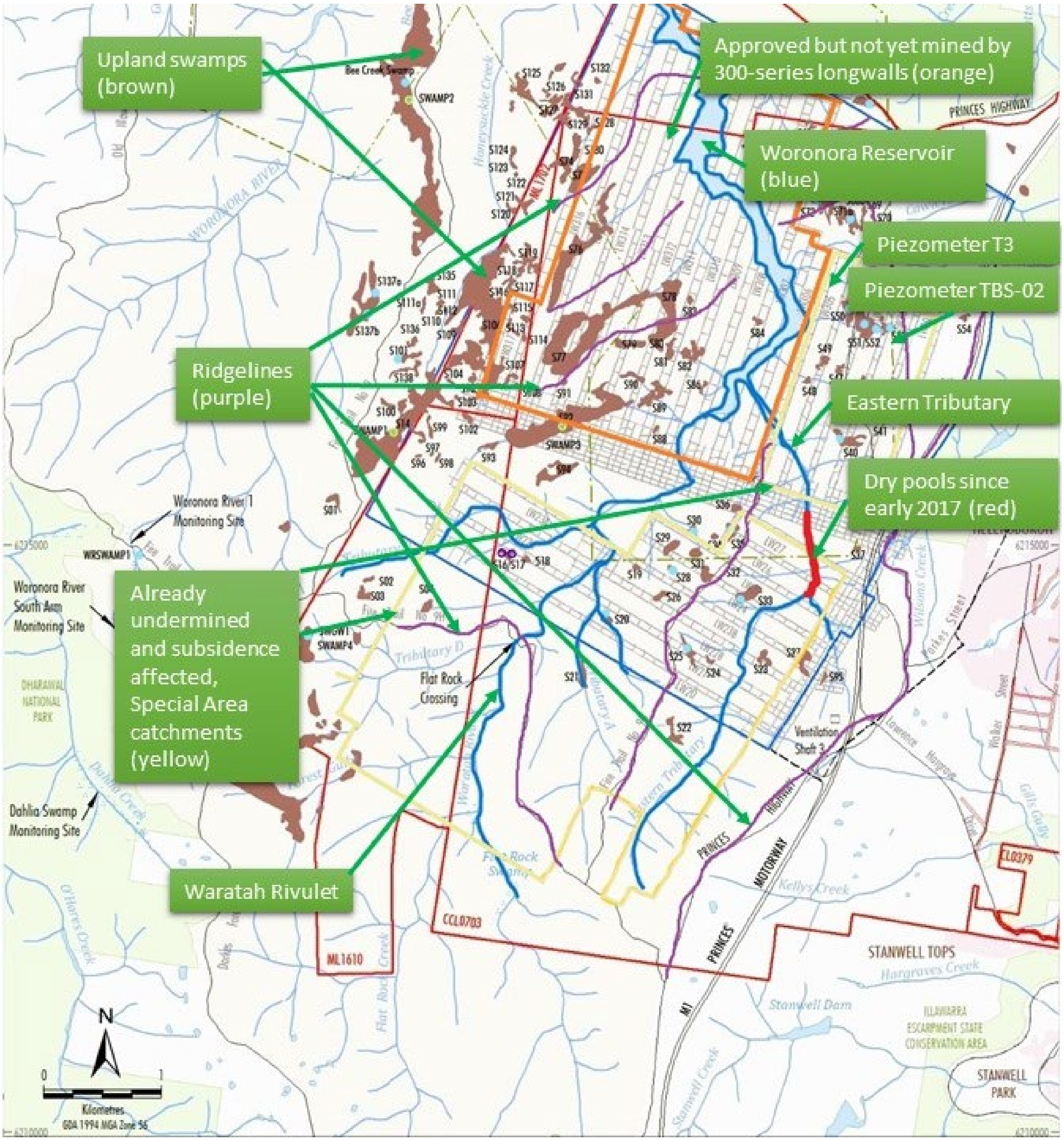

Figure 1. Key features discussed in this report, annotated in green over base figure reproduced from Metropolitan Coal 2021 Annual Report

My primary recommendation in light of these findings is that further undermining of the Woronora Reservoir should be halted until the implications of these unfolding changes on the catchments and Sydney's drinking water resources can be re-assessed.

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LIMITATION: This report is subject to the provisions of the expert evidence provisions (Part 31 Division 2 and Schedule 7) of the Uniform Civil Procedure Rules 2005 (NSW).

Client:	Nature Conservation Council NSW (NCC)
Prepared in accordance with:	Brief dated 22 September, 2022
Prepared by	Peter Dupen, H2onestly
Version & Date	H2o012_R04 – 21 March 2023

Previous versions, key information changes	H2o012_R03 – 20 March 2023 in response to NCC review comments H2o012_R02 – 16 March 2023 in response to NCC review comments H2o012_R01 – 13 March 2023 in response to NCC review comments

2. INTRODUCTION

2.1 Qualifications

My experience and qualifications for providing this advice are detailed in my CV, reproduced in Attachment A.

In summary, I am a qualified hydrogeologist with around 40 years of experience in environmental regulation and consulting roles. Between 2015 and 2019 I was the Mining Manager for WaterNSW. During this period my team and I examined underground mining (including Metropolitan Mine) impacts on overlying catchments and aquifers in greater detail than anyone else in Australia, and probably the world.

I now run a consultancy (H2onestly Pty Ltd), which specialises in providing independent advice on environmental geoscience matters to government and community groups.

2.2 Scope of Advice

I have been asked by the Nature Conservation Council of NSW (NCC) to provide independent advice in relation to aspects of the Metropolitan Coal Mine, in particular to its environmental performance relative to planning approval conditions and predictions.

To provide further context for the environmental context of my analyses, I worked with Dr Peter Turner and NCC to prepare GIPA requests in 2021-2022 which then led to an exchange of letters between NCC, Metropolitan Coal and DPE. Copies of the 2022 correspondence with these two agencies, which form the most up-to-date advice available to me, are provided in Attachment B.

I have reviewed the Metropolitan Coal Mine's environmental performance based on my knowledge of the catchments and the documents listed in Section 7. My summary comments and interpretations are set out in the following report.

2.3 Contextual setting of Metropolitan Mine impacts in Woronora Catchment.

The layout of the Metropolitan Mine longwalls approved (Metropolitan Coal, 2009) and mining lease dimensions relative to Woronora Reservoir are shown in Figure 2.

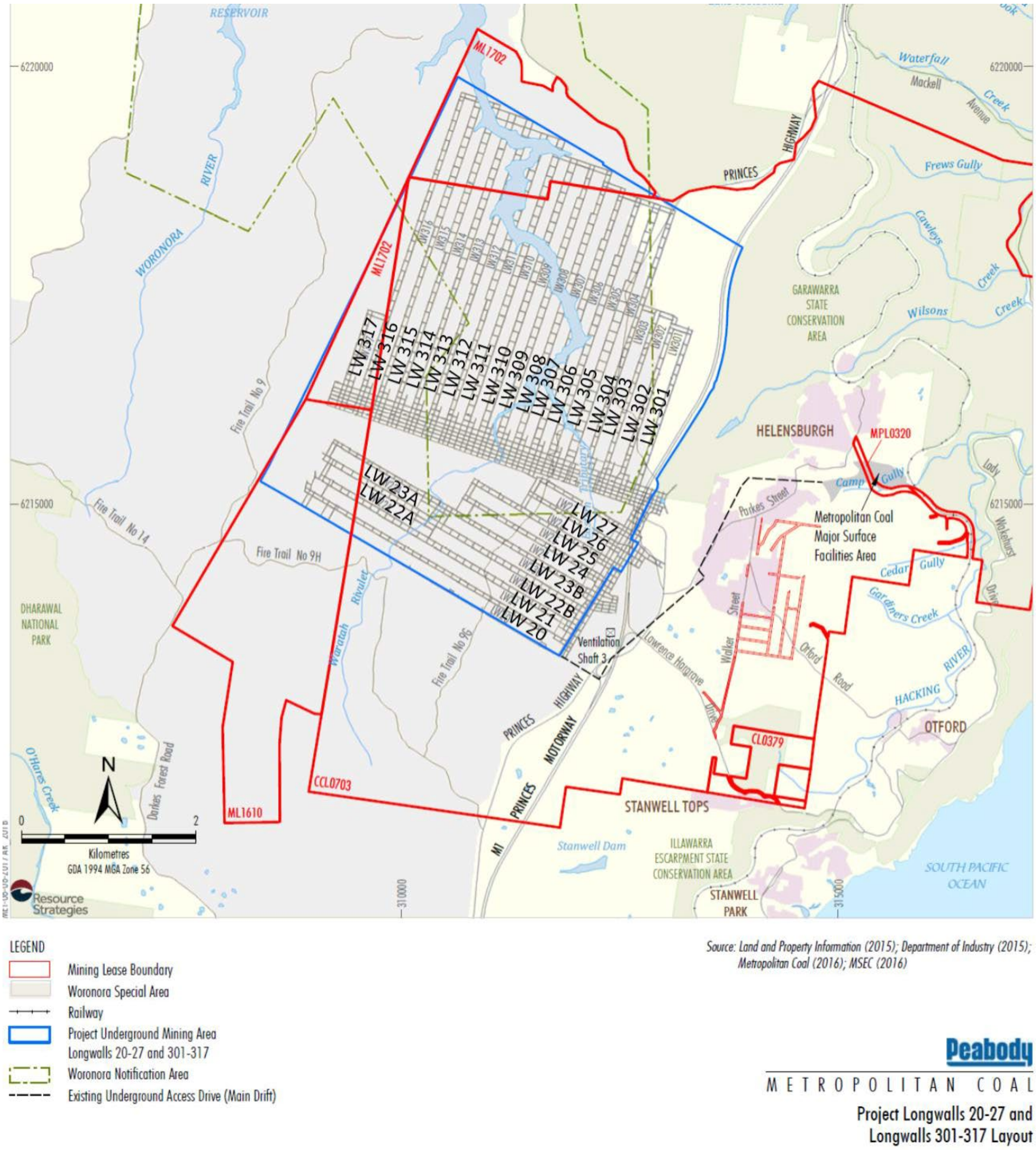

Figure 2. Catchments within Metropolitan Special Area (reproduced from Metropolitan Coal 2021 Annual Report)

2.3.1 Special Areas

Under the provisions of the *Water NSW Act 2014*, Sydney's drinking water catchments are 'Declared Catchment Areas', known as Special Areas, and are managed by WaterNSW and/or National Parks and Wildlife Service (NPWS). The Upper Nepean and Woronora Special Areas, located inland from Wollongong, includes the upper catchments of the Cataract, Cordeaux, Avon, Nepean and Woronora Rivers, which are collectively harvested to provide almost all of Sydney's current drinking water supply (Figure 2). Special Areas in NSW have been declared only for the purposes of protecting the quality of stored drinking water and for maintaining the ecological integrity of the land used to harvest and store Sydney's drinking water.

Concerns over Sydney's water supply in the 1980s and 1990s posed by major mining proposals led to two Commissions of Inquiry to examine the risks posed by mining. Numerous investigations by agencies and community groups over the past decade have confirmed that mining impacts on catchment have been worse than predicted. In 2021 the IPC decided not to approve the previous Dendrobium Mine Extension (State Significant Development application 8194) beneath the Avon and Cordeaux Reservoir catchments; that extension application has subsequently been withdrawn by South32.

2.3.2 Status of Special Areas

The condition of these Special Area catchments has been degrading over the past few decades for a range of reasons, including coal mining activities. The most recent Catchment Audit (EcoLogical, 2019) concludes that;

> *"…despite substantial improvements in catchment management since 1999, overall risks to catchment health are increasing because of climate change. Monitoring records since the 1940s indicate a long-term trend of reduced rainfall. The drought experienced over the audit period reduced water availability (surface and groundwater flows) across the Catchment and increased risks to water quality, biodiversity and human settlements." and;*
>
> *"Similar with previous audits, the primary issue of concern raised by the community related to environmental impacts from coal mining within the Special Areas of the Catchment. The community provided positive responses to the appointment of the Independent Expert Panel on Mining in the Catchment in 2018. The community also expressed support for jointly funded programs to protect and improve riparian corridors through weed and erosion control, revegetation and managing stormwater."*

2.3.3 Metropolitan Mine Operations

Hydrogeologically, the Metropolitan Mine may be viewed as a continuation of the coal mining which commenced along the Illawarra Escarpment in the 1850's (Advisian, 2016), and more specifically the Metropolitan Colliery which has been mining from the Camp Gully shaft site near Helensburgh since c1888. The age of the Metropolitan Mine may be inferred from the size of the elevator still used to ferry miners and equipment between the workings and the surface; the cage is the minimum size in which a pit pony can be accommodated.

Planning Approval for the current operations of the Metropolitan Mine (Helensburgh Coal, 2009) was granted in 2009 following a referral and review by the then Department of Planning (DoP, now DPE) and then the Planning and Assessment Commission (PAC). The development consent has been modified three times. Condition 6 of Schedule 3 of the approval for the Metropolitan Colliery (MP 08_0149) requires Metropolitan Collieries to submit post-consent packages of detailed longwall designs, now termed Extraction Plans (EP) for approval by the Department of Planning and Environment (DPE). The most recent EP approval for the extraction of Longwalls 308-310 was issued in December 2022.

Numerous unpredicted impacts centered on Waratah Rivulet between 2000 to 2005 led to critical review and revisions of the approved mine design, and narrower longwalls with wider pillars were adopted for the remainder of the "20 Series" of longwalls (Figure 2).

The presentation in 2017 of the "300 Series" Extraction Plan (EP) was met with considerable anxiety by catchment managers WaterNSW, regulatory agencies (Dams Safety Committee) and by concerned community groups such as the Nature Conservation Council, Protect Our Water Alliance and the Sutherland Shire Environment Centre. The EP proposed for the first time in over a decade to extract longwalls beneath Woronora Reservoir, a historically important, high quality and low-cost water storage which gravity-feeds to Prospect Reservoir. These concerns led to the formation and/or involvement of three expert review committees of DPE's approval or appointment (WRIS, IEPMC & IAPUM), leading to DPE's and Peabody's latest advice discussed in the next section.

2.3.4 Performance and Regulatory Reviews of Metropolitan Mine

There have been a number of recent studies and reviews of Metropolitan Mine's environmental performance and, as evidenced by the December 2022 issue of a further set of longwalls below the catchments and stored waters of the Woronora Reservoir, the primary regulators (NSW Department of Planning and Environment, DPE) appear surprisingly satisfied by the mine's environmental performance. Based on the wording in the latest Extraction Plan approval, this satisfaction is based largely on the following inferences by DPE, referred to in their approval letter:

a. The Department notes that the "Extraction Plan condition in the consent allows for staged Extraction Plans" and believes "that the monitoring programs and TARPs would allow early identification of any potential exceedances of performance indicators".

b. Mine water inflow is currently equal or less than the low inflows predicted. "The Department is satisfied that there remains a low risk of leakage from the Woronora Reservoir to the mine."

c. Under the heading of INDEPENDENT ADVISORY PANEL FOR UNDERGROUND MINING (IAPUM), the LW308-310 EP approval advises that:

   - DPE requested advice from the Panel, specifically focused "on the proposed monitoring programs, subsidence assessments and TARPs".
   - On 30 September 2022, the Panel provided its advice, which included "five recommendations pertaining mostly to swamps, geological structures and groundwater".
   - Metropolitan Collieries provided a response at the request of DEP in the form of a revised Extraction Plan, "*generally accepting all recommendations from the Panel*"

d. DPE's Approval letter further explains that on 2 November 2022, the company submitted to DPE an update report from the Woronora Reservoir Impact Strategy (WRIS) Panel (an expert panel with membership approved by DPE so notionally independent, but funded by Peabody), which stated that:

   - "No abnormal or higher than predicted water inflow to the mine workings has occurred following secondary extraction of multiple longwall panels through several faults at the mine;
   - Hydraulic conductivities were comparable to those recorded for the unfractured host rock;
   - The mine water balance confirms that there is no abnormal leakage of water from the Woronora Reservoir to the underground workings, including from Longwalls 305 to 307 which are the first longwalls to extend directly underneath the reservoir;
   - Mine water inflows have averaged 0.11 Megaliters per day (ML/day) during the extraction of Longwalls 305 to 307, which is less than the 0.2 ML/day predicted by the groundwater modelling for the Project; and
   - Mine water inflows are not materially different when mining directly below the reservoir compared to mining away from the reservoir.
   - The Panel reviewed the WRIS Panel report and provided supplementary advice which considered that based on the information provided there is little likelihood of excess inflows to the mine from the Woronora Reservoir."

3. EVIDENCE OF HYDROLOGICAL CHANGES IN DRINKING WATER CATCHMENTS

3.1 Subsidence impacts on streams and shallow groundwater in the Woronora Reservoir catchment

H2onestly's key findings based on our analysis of Peabody's 2021 Annual Report and documents referenced in Section 7 are set out in Section 6.1. The evidence on which the water quantity-related inferences are based is summarised in the following sections.

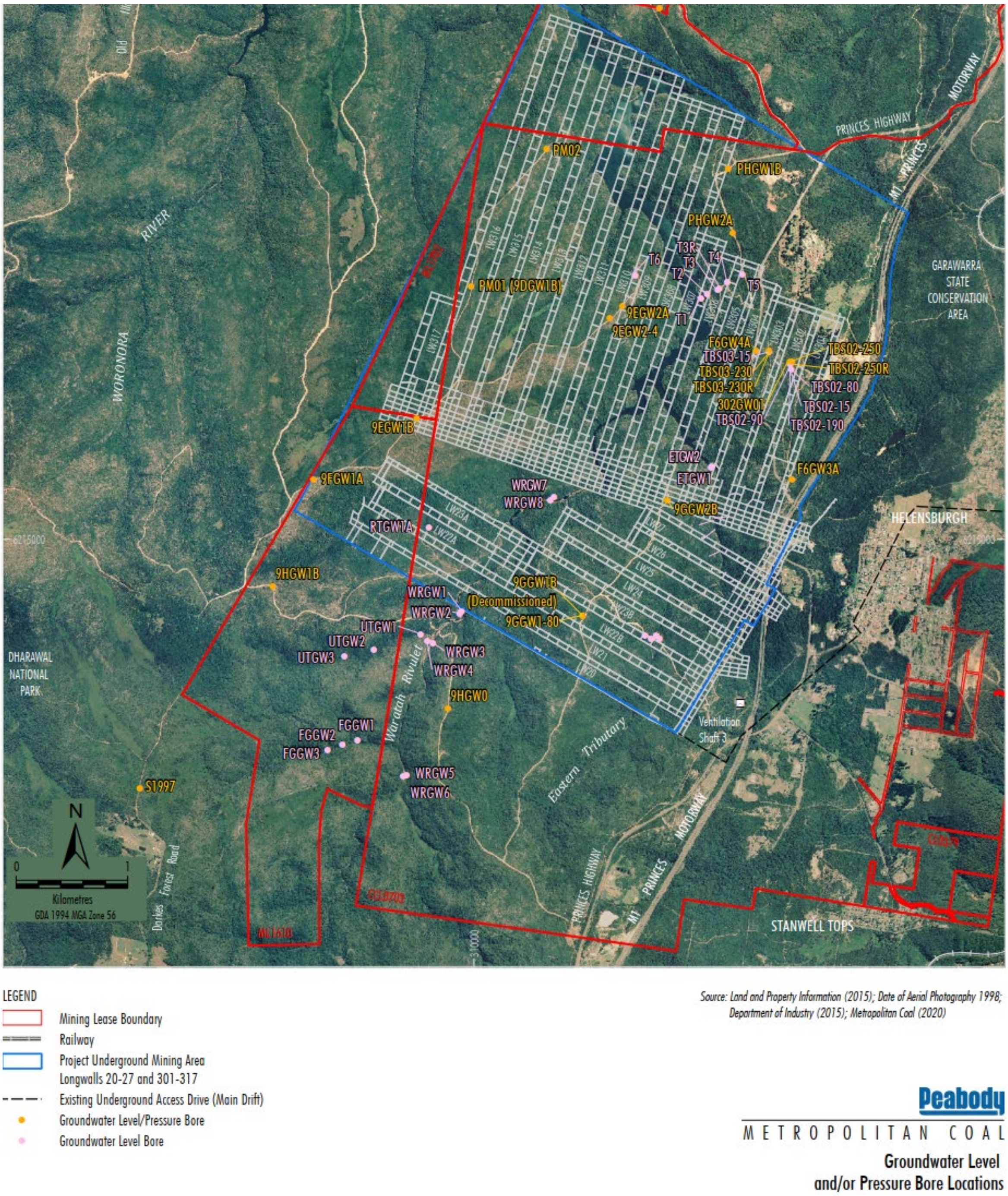

Figure 3. Locations of groundwater level monitoring locations at Metropolitan Mine (Metropolitan Coal, 2022a)

3.2 Fracturing and basal shear plane development

Basal shear planes may be thought of as sub-horizontal movement plates which form above, at or just below the level of the valley axis after it has been undermined. The shear planes are caused by contrasting stresses imposed by mining-induced subsidence of the ground surface (Figures 4 to 8).

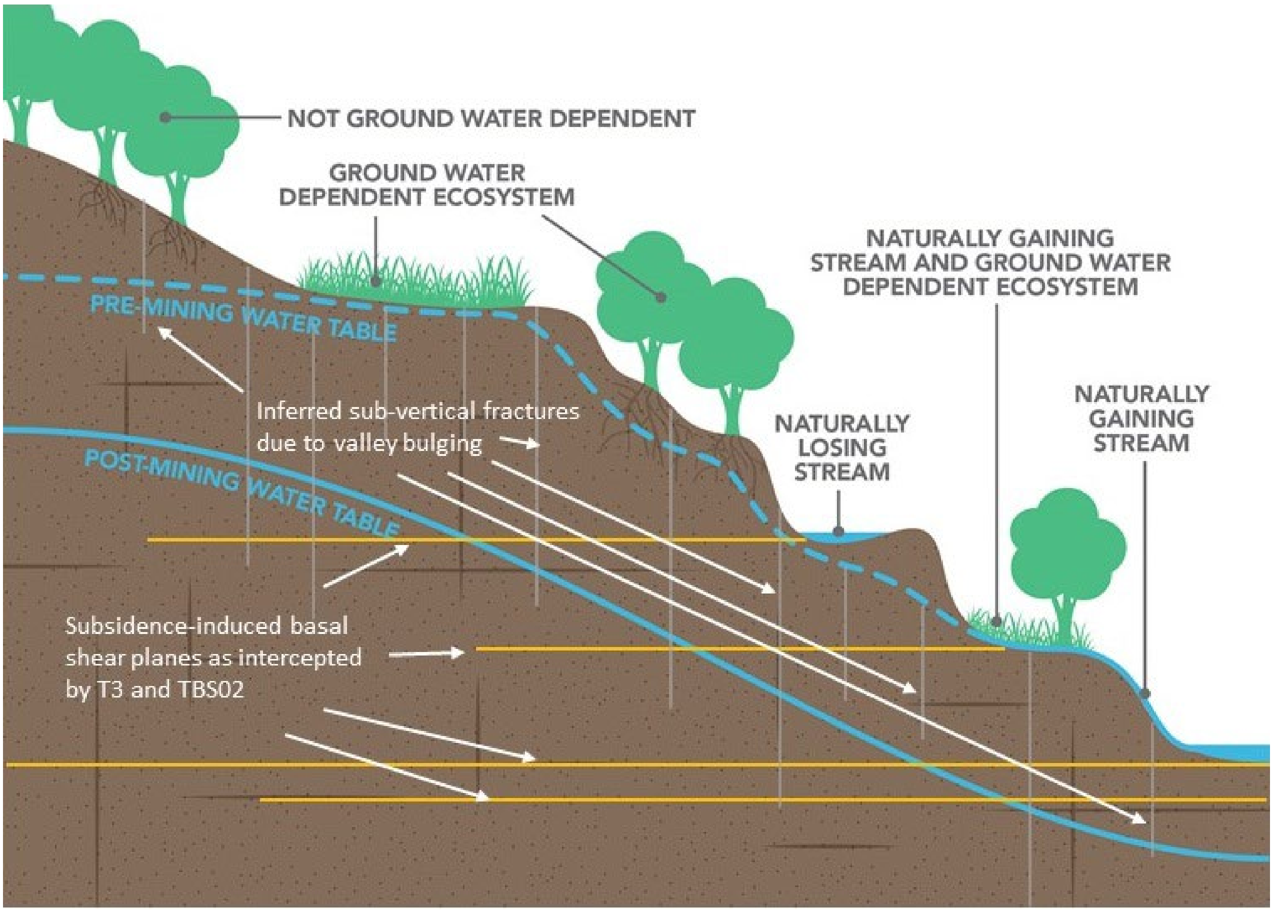

Figure 4. Schematic showing the hypothesised causes of "ridge fracture drainage", annotated here as basal shear planes (yellow) and sub-vertical stress relief fractures (grey). Base figure reproduced from Advisian, 2016.

These subsidence-induced geological shear structures have been proved by mining subsidence investigations at a number of undermined locations in the Southern Coalfields, particularly at Tahmoor and Dendrobium Mines (SCT, 2015; IESC, 2018a). Basal shear planes are formed when steep ridge-valley rocky landscapes (Figures 1, 4 and 5) are undermined and the lateral movements associated with valley bulging contrasts with the subsided but laterally constrained rocks at or below the valley base. In the Southern Coalfields, where bedding dips westward at 5-10^{o}, these shear movements frequently focus along sub-surface bedding planes where present to accommodate the strains.

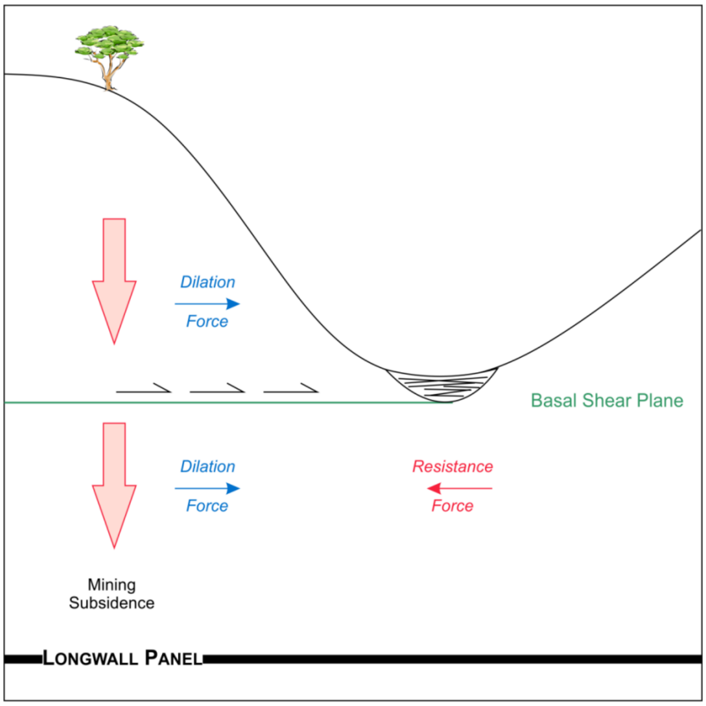

Figure 5. Conceptual cross-section showing strain forces resulting in basal shear plane formation beneath a valley in steep terrain affected by subsidence over a longwall (reproduced from SCT, 2015)

Figure 6 shows an example from a rock cutting in the Southern Coalfields where a basal shear plane has been induced by subsidence to open and move slightly along natural bedding planes.

Figure 6. Vertical rock cutting showing mining-induced basal shear plane formation along bedding sub-horizontal bedding planes in the Southern Coalfields (reproduced from SCT, 2015).

Figure 7 shows the results from post-mining investigations (SCT, 2015) at Dendrobium Mine, which confirmed the presence of basal shear planes at a borehole 100 m from the edge of Avon Reservoir. In this instance, these shear planes were not found to persist at post-mining investigations 300 m from the edge of the Full Supply Level (FSL). Some newly-imposed vertical fracturing was however found in

Piezometer S2313, as shown in Figure 7.

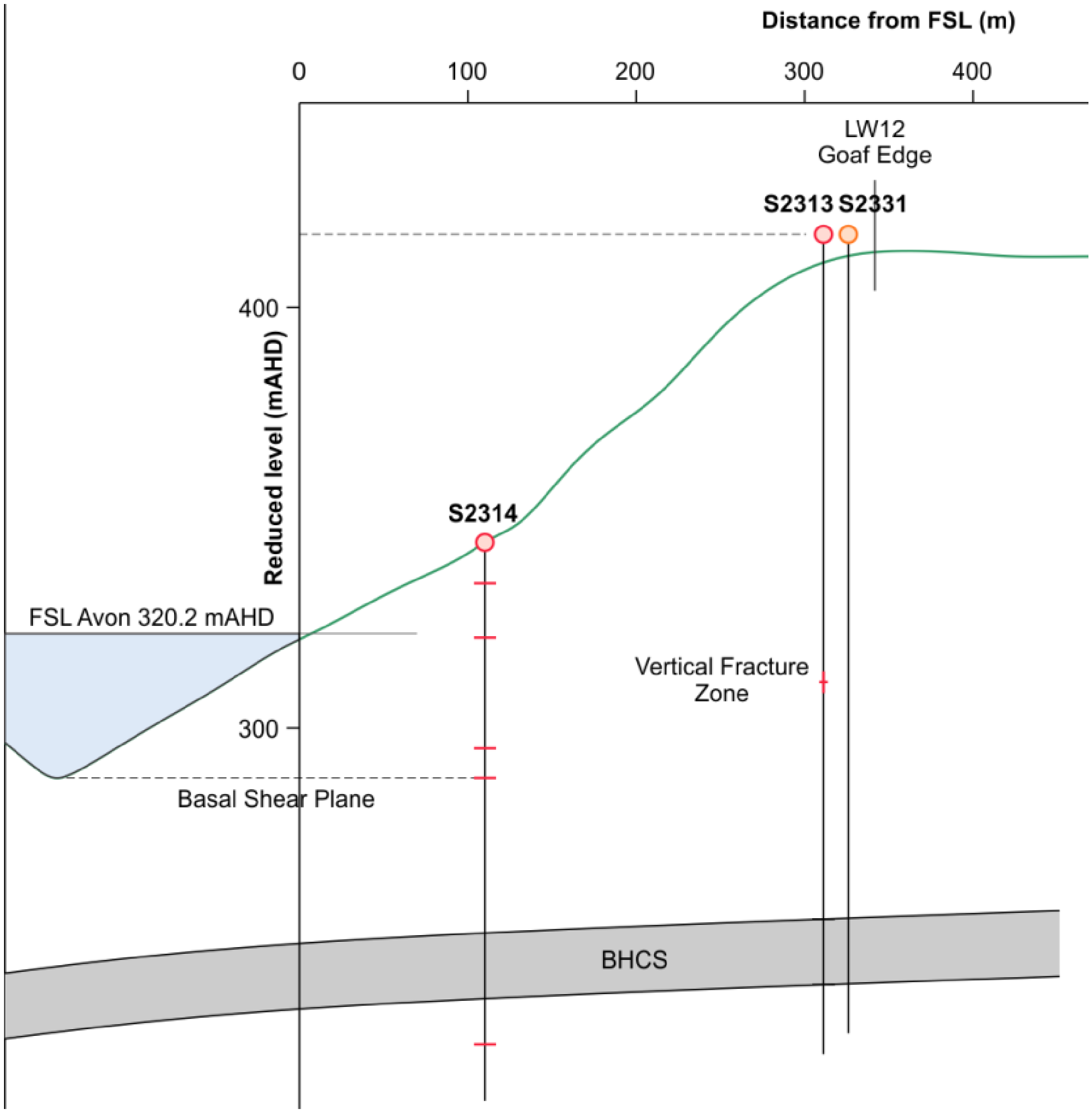

Figure 7. Cross-section view of inferred basal shear plane formation at Avon Reservoir by Dendrobium Mine (reproduced from Watershed HydroGeo, 2022). Red lines indicate visible shear planes or major fractures.

A schematic interpretation of an undermined ridgeline is shown in Figure 4, with annotations showing notional basal shear planes and sub-vertical fractures plus the influence of the reduced groundwater levels on groundwater-dependent ecosystems and/or baseflow springs along the ridge due to lowered groundwater levels beneath the ridge. For the sake of clarity, Figure 4 does not show the altered groundwater flowpaths expected to occur specifically due to the imposition of basal shear planes and interconnected sub-vertical fracturing associated with valley bulging, but these are discussed with the evidential reviews below.

3.3 Transect bore piezometers

The transect piezometers T1 - T6 provide an unusually good profile of aquifer levels through the upper aquifer (Hawkesbury Sandstone) within the ridge immediately east and west of the Woronora Reservoir

Valley (Figure 3 and Figure 8). The reported (Metropolitan Coal, 2022) groundwater level records in each piezometer are presented in Figure 9.

3.3.1 Subsidence Effects

Figure 8 shows the post-mining groundwater profile in the “transect piezometers” (T1-T6) in late 2020. All of these piezometers are located within the upper aquifer, locally represented by Hawkesbury Sandstone, adjacent to stored reservoir waters.

In their pre-mining state, the groundwater profile in the upper aquifer adjacent to stored reservoir waters would normally reflect and follow the topography of the overlying ridges and valleys (Advisian, 2016), as suggested by the solid blue line in Figure 4.

There are numerous concerning aspects of the post-mining groundwater conditions revealed by the transect piezometers. These include the long-term anomalously low water table in T5 (Figure 8 and Figure 9) and recent drops in T4 and T5 levels. Another surprising feature are the three large (+10 m) observed level surges in T5 between mid-2019 and mid-2020 (Figure 9), which are reasonably attributed by Peabody’s consultants to pressure waves affecting the aquifer as the longwalls progress beneath. If present however, any pressure waves felt at T5 should intuitively have been observed at all of the nearby wells, especially the adjacent T4 piezometer (Figure 3). The reason for this contrast in pressure wave response through the transect is not clear, but suggests a high degree of structural heterogeneity in the aquifer.

The most disturbing trend however, is that the levels in T3 dropped below its base 17 days after the commencement of Longwall 305 (Figure 3), and then sheared in December 2020 (Figure 9). The piezometer was replaced in 2021 by a deeper one at the same location (T3-R). As can be observed by the red trace in Figure 9, groundwater responses in T3/T3-R appeared sensible for its ridge position prior to mining but now the water table closely mimics the reservoir level.

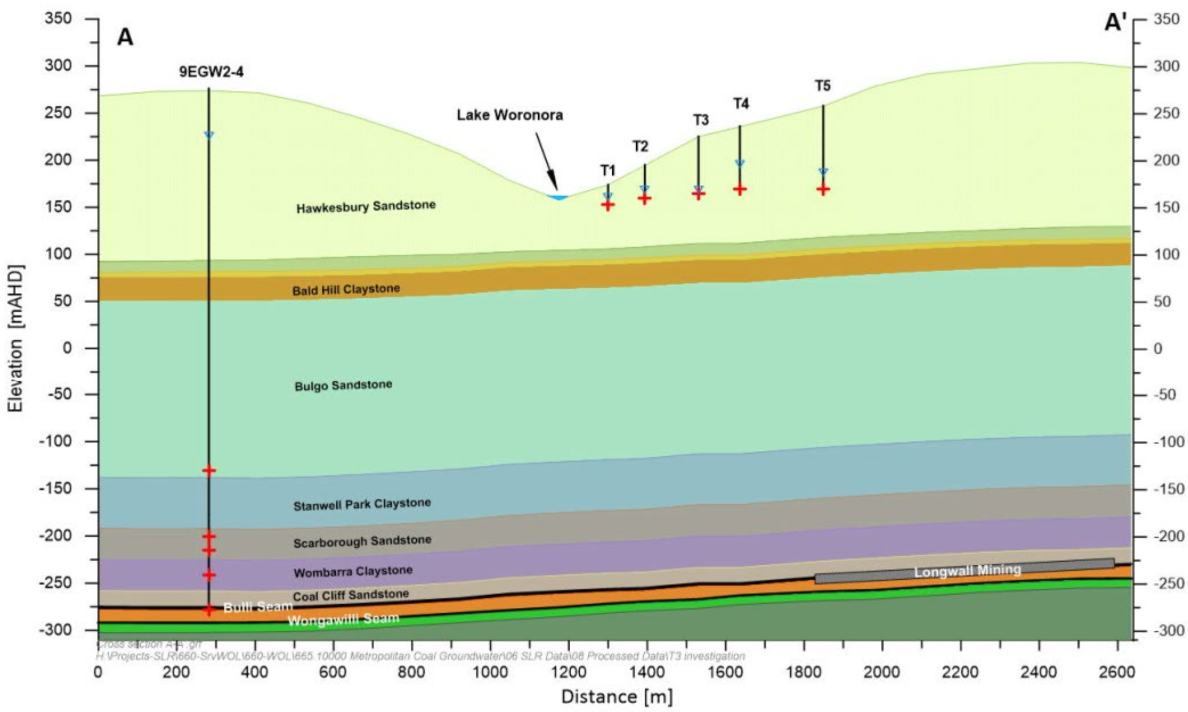

Figure 8. Cross-section view of T1-T5 piezometer transect at Woronora Reservoir, levels as reported in the Annual Review (Metropolitan Coal, 2022a).

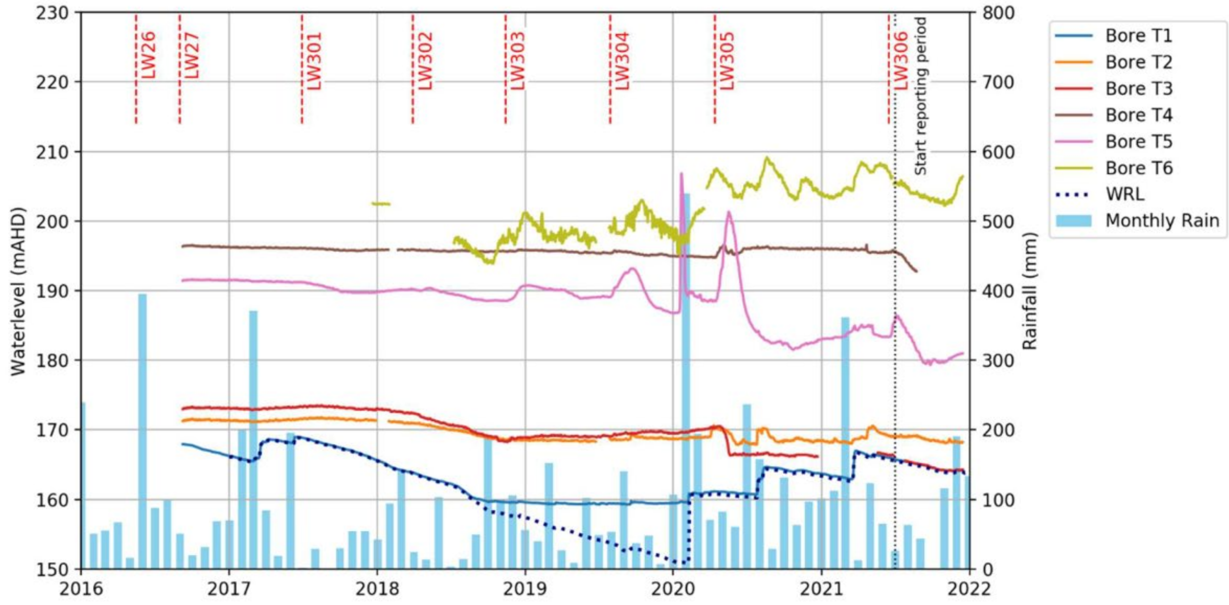

Chart 52 Groundwater Level in Bores T1 to T6

Figure 9. Groundwater levels recorded in Transect Bore Piezometers, from Metropolitan 2021 Annual Review

3.3.2 Hydrogeologically plausible hypotheses

Dr Merrick advised in his November 2021 assessment (SLR, 2021) that the T3/T3-R responses “reflect localised impact consequences and do not signal a reversal of groundwater gradient to the reservoir”, citing a continued positive head at T2 and a pressure increase at T2 with rain in March 2021. In their response to the Nature Conservation Council (see Attachment B) on this matter, Peabody advises that:

> *Since Dr Merrick’s 2021 investigation report prepared was completed, there has been a significant increase in the Woronora Reservoir levels and the monitoring data at T3-R confirms that the water level in the bore is connected to the Reservoir level, similar to Bore T1. The water level at Bore T2 remains at historical levels observed since 2019. An updated investigation report which considers the rainfall events is currently being prepared and will be provided to DPE when finalised.*

As neither DPE nor Peabody publish the investigation findings on their websites, I have no knowledge of whether this updated report has been yet provided to DPE, and if so no knowledge of its contents.

3.3.3 Evidential reasoning

Dr Merrick’s primary inference (SLR, 2021) of preserved groundwater stability post-mining is, in any case, incorrect.

The much more likely, and now virtually indisputable, conclusion from the groundwater response at this location is that the base of the original T3 piezometer was sheared by, and that T3-R now intercepts, a basal shear plane which now forms a rapid hydraulic connection to the reservoir, i.e. a groundwater drain at or around the valley’s base which extends over 250 m beneath the ridge from the reservoir (see Figure 3 and Figure 8)

I interpret the persistence of a slightly reduced groundwater level in T2 as evidence of the subsidence-affected rock fabric’s new heterogeneity – T2 does not intercept the basal shear plane that T3 does, at least not yet.

There is no compelling evidence that surface-to-seam fracture connectivity of the type which are now draining the upper aquifer over Dendrobium Mine (IEPMC, 2022b), nor of any reversals of groundwater flow from the reservoir into surrounding strata, i.e. there is no evidence that water is leaving the reservoir catchment. One hypothesis for this observed hydrogeological flow behavior is that no regional sink(s), such as the underground workings or the Illawarra Escarpment, are being intercepted by the new shear planes emplaced within the shallow aquifer. Another hypothesis worth considering is that it's an artefact of relatively scarce monitoring density, and that in some places groundwater may be moving towards these deeper sinks without yet having been detected.

3.4 Shear movements in TBS-02

Another location where basal and/or bedding shear planes are inferred to have developed due to undermining and at levels similar to the valley base is at TBS-02 (Metropolitan Coal, 2019). This vibrating wire piezometer (location shown on right side of Figure 3) was drilled in 2017 and fitted with an inclinometer to check geotechnical responses before and after LW302 was mined beneath it in 2018. Despite efforts to preserve it by using innovative glass-fiber cables in the replacement piezometer, most of the sensors were again sheared by post-mining movements at a depth of about 80 m below ground level (roughly equivalent to the valley floor level) as longwalls were extracted beneath (Metropolitan Coal, 2019). The inclinometer study (Metropolitan Coal, 2019) found the following:

> *…bedding plane shear movement (evident as discontinuous steps in the displacement graphs) at depths of 105 m, 114 m, 162 m and 202 m below surface. These higher bedding planes correspond to planes within the Hawkesbury Sandstone while the 202m bedding plane is at approximately the top interface of the Bald Hill Claystone, which is likely to represent a bedding shear plane. The extent of shear movement mobilised by the ground subsidence movements at each horizon differs slightly but is in the range of at least 20mm – 50 mm."*

3.5 Eastern Tributary flow diversions

Despite assurances that all necessary lessons had been learned by Peabody's subsidence engineers from the unpredicted diversion of the Waratah Rivulet streamflows into fractures along the rock base in the early 2000's, a 0.5 km long reach of Eastern Tributary was impacted by subsidence effects (Figure 10) in December 2016 and January 2017. Since 2017, the previously permanent Pools ETAG to ETAR (Figure 11) have been dry except for short periods following major rainfall events, and a number of the fringing pools have become intermittent (Figure 10). More recently, Pool ETG over Longwall 22B has been receding more rapidly than pre-mining trends (Metropolitan Coal, 2022a).

Figure 10. Pool ETAQ in Eastern Tributary, photographed in Jan/Feb 2017.

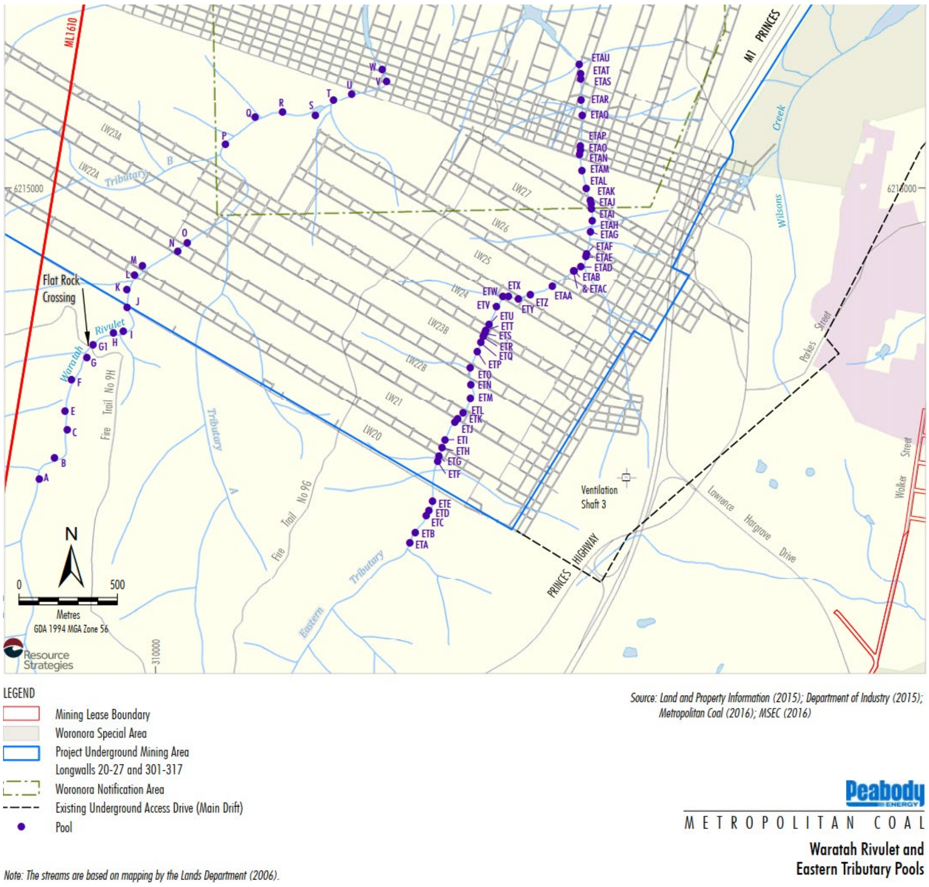

Figure 11. Recorded rock-lined pools in undermined sections of Eastern Tributary and Waratah Rivulet, south of Woronora Reservoir (figure reproduced from Metropolitan Coal, 2022a).

3.5.1 Subsidence Effects

The diverted stream water resurfaces in Eastern Tributary at Pool ETAR, just upstream of the steel v-notch flow gauge below Pool ETAU (Figure 11). This weir provides an unusually accurate gauge to measure flows entering Woronora Reservoir from the tributary. The water which re-emerges is red to orange in color and contains considerably higher metal and salt concentrations than pre-mining levels (Section 0).

Despite being diverted through a subsurface fracture network for about 500 m of its upstream length, the measured flows (blue line in Figure 12) which reappear at the lower end of the stream channel have, until recently, remained surprisingly consistent with flows predicted using pre-mining, above-ground flow records (red line in Figure 12).

As noted in the Metropolitan Coal 2021 Annual Review report, however:

> *The results for the reporting period indicate that flow has been increasingly higher than the model predictions during the reporting period.*

Peabody's report (Metropolitan Coal, 2022) suggests that they have identified several potential causes of the unexpected increased flows (i.e. faults in the hydrological prediction model, hazard reduction burns and flume and/or weir movement), but does not suggest the more obvious possibility that it reflects an increase in local baseflows due to undermining.

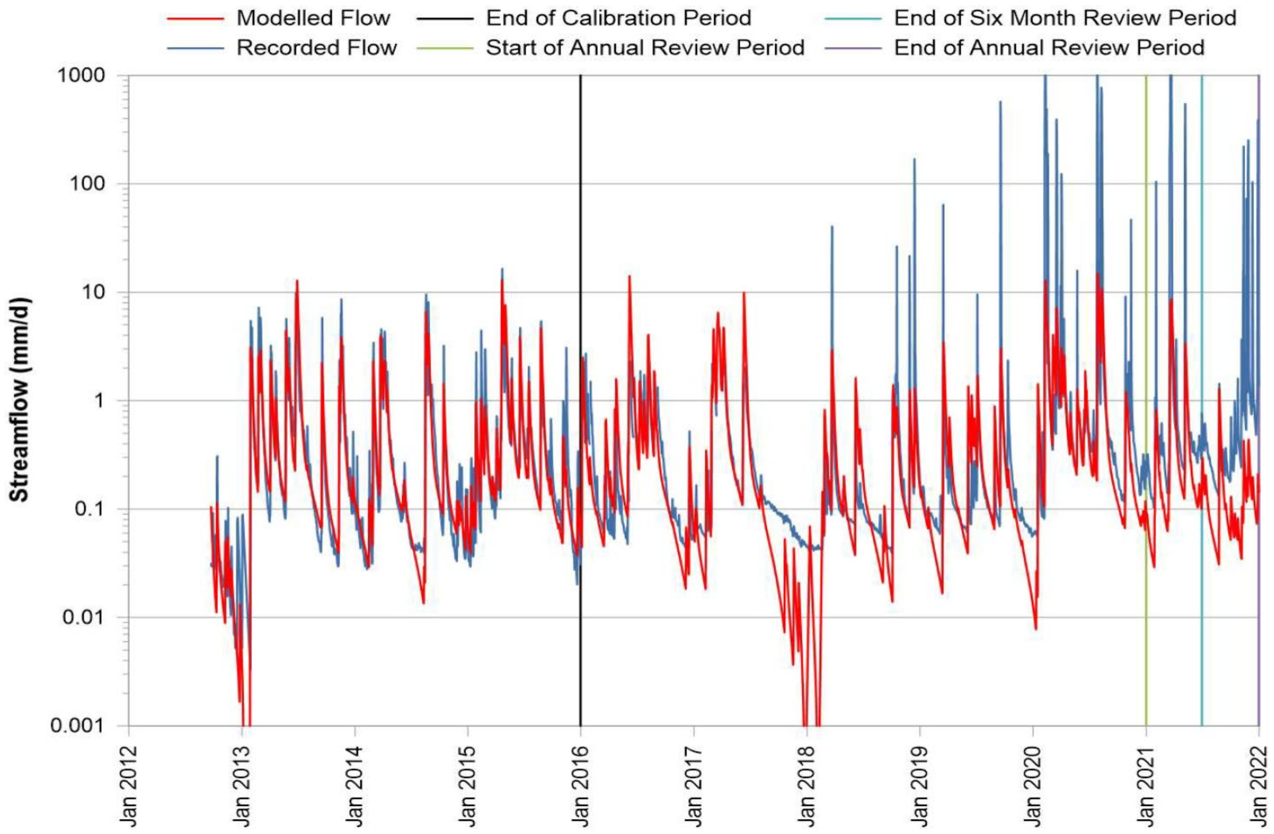

Figure 12. Monitored and model-predicted flows – Eastern Tributary upstream of Woronora Reservoir

In attributing the cause(s), and thus significance, of the widespread stream desiccation and recent divergence between modelled and measured flows, the following evidence should be closely considered:

- Despite the stream being almost continuously dry between Pools ETAG to ETAR (see Figure 11) following undermining, there are few fractures which appear to be fresh, subsidence-induced in the rock base and little obvious fracturing in the rock bars (Figure 10). This fracturing style appears to contrast with the subsidence effects observed in Waratah Rivulet for example, where surface fracturing and compression displacements (termed "upsidence" in MSEC, 2018) were visibly widespread in the dried pool bases and intervening rockbars.
- There is little evidence that the Eastern Tributary pool drying event may be attributed to "rock-bar throughflow", as envisaged by Peabody's consultants (Figure 14). This mechanism, in which water in an upstream pool is able to seep through the fractured fabric of the intervening rock bar (e.g. the sub-vertical rock face in background of Figure 10), was a frequently observable feature of the subsidence impacts which occurred in Waratah Rivulet in the early 2000's (Advisian, 2016). It is worth noting that, if shear planes have indeed been widely developed beneath the valley axis as hypothesised in Section 3.2, the remedial design that was used with considerable success at Waratah Rivulet may not be successful in restoring surface flows to Eastern Tributary.
- Again unlike the Waratah Rivulet impacts (and WC21 over Dendrobium Mine), the desiccation event occurred not gradually and progressively following undermining, but over a relatively short time period after most of the 20-series longwalls had already been mined. The wholly unpredicted drying event was first reported in November 2016 and by February 2017, over 500 m of the previously permanently flowing creek was frequently or permanently dry.

- Another unexpected feature of the Eastern Tributary pool drying event is that much of it has occurred over areas in which very little subsidence occurred as they lie over unsubsided "first workings" or unmined rock (Figure 11).
- Subsidence monitoring showed that valley closure effects in the area of the dried pools were mostly within the "conservative" valley closure threshold hypothesised by subsidence consultants MSEC (2008). MSEC's subsidence impact predictions suggest that no more than 10% of stream beds should be cracked as long as valley closure is less than 200 mm, measured across the axis of a valley). On this basis, the widespread flow diversions experienced in Waratah Rivulet were not expected to be repeated in Eastern Tributary (Metropolitan Coal, 2022b).
- A prosecution case was prepared by DPE in relation to the mining-induced desiccation of Eastern Tributary in 2017 but, for never-disclosed reasons and after several hundred thousand dollars in taxpayer funds had been paid to consultants, the case was withdrawn. I understand from speaking to some of the consultants that the results of their investigations were alarming but, despite many attempts by WaterNSW and others to gain access to the reports, DPE has refused to release them.

3.5.2 Hydrogeologically plausible hypotheses

There are only two hydrogeologically plausible hypotheses that I can think of which could account for the above behaviors in streamflow affected by subsidence.

1. The bedrock base of Eastern Tributary has been crushed by "non-conventional" subsidence effects (particularly the subsidence-induced valley closure mechanism) resulting in a relatively small (say 50-100 m in cross-section) "tunnel" of shallow fractures induced along and below the valley axis between Pools ETAG to ETAR. This conceptual model (summarised in Section 5.3.2) was the same one employed to explain the sub-surface diversion of flows in Waratah Rivulet, as well as WC21 and some other streams over the Dendrobium Mine nearby.

   It is difficult to comprehend using this conceptual model however, how sub-surface flows through a 500 m long, poorly interconnected "crush zone" of compressive fractures can have mimicked above-ground catchment flow responses as closely as shown in Figure 12 since the desiccation event in 2016/2017. I also struggle to identify a plausible mechanism for the increasing flows observed since about October 2021 using this conceptual model.

2. Whilst some non-conventional valley closure effects may well have contributed, the primary cause of flow diversion is the impositions of a mechanism termed here as "ridge fracture drainage" (Figure 4); the opening of widespread and interconnected basal shear planes beneath the base of the valley between Pools ETAG to ETAR, combined with sub-vertical drainage along and below the ridge surfaces. If these subsidence effects are indeed substantial, ridge fracture drainage presents a risk to the catchments that has not previously been recognised, and the implications for future longwalls should be urgently re-considered.

   This conceptual failure mechanism in the upper (Hawkesbury Sandstone) aquifer appears to be operating without necessarily compromising the integrity of the "constrained-zone" between the upper and lower aquifers (Figure 8). The potential draining of the upper aquifer into underlying workings via connective fracture networks through the constrained zone termed "connective cracking", such as has now been confirmed at Dendrobium Mine, was the primary mechanism of concern raised during Metropolitan Mine's planning application (Helensburgh Coal Pty Ltd, 2009) and remains the mechanism focused on in recent performance (Metropolitan Coal, 2022a) and approval (DPE, 2023) documents. There is as yet no convincing evidence that connective cracking between deep and shallow aquifers is occurring at Metropolitan but it is not the only, and may not even be the worst, mechanism by which the drinking water catchments may be degraded by mining.

3.5.3 Evidence supporting "ridge fracture drainage" hypothesis

Basal shear planes may have developed in an extended stress-relieving, 500 m long movement between November 2016 and February 2017, which would explain the relatively sudden desiccation in parts of the creek that had already been undermined but where diversion of flows had not been detected until then.

A large, widespread set of interconnected basal shear planes beneath the valley axis would also help to explain how sub-surface groundwater flows were able to remain so consistent with pre-mining predictions of above-ground stream flows – the basal shear planes are likely acting as a rapid and highly interconnected conduit allowing rapid flows beneath the dry creek base.

This conceptual model could also explain why the flows in the 2021 Annual Report period have significantly and increasingly exceeded model flows since mid-2020 (Figure 12). Where present the subsidence-induced basal shear planes are likely to now be acting as lateral drains, allowing shallow groundwater in the Hawkesbury Sandstone ridges to rapidly (by local standards) migrate towards the valley axis.

In summary, the imposition of basal shear planes due to subsidence appears to be changing the hydrology and shallow hydrogeology of the reservoir catchment in two important ways:

1. Groundwater within the ridges now appear to be draining out, heterogeneously but in some places quickly and completely.
2. Shallow stream flows along the valley centers are being highly and possibly permanently diverted by these shear planes, mechanistically focused along valley centers.

On the basis of the evidence compiled above, the most likely conclusion is that the Woronora Reservoir catchment is being radically and permanently altered by the imposition of large-scale ridge fracture drainage caused by subsidence from the Metropolitan Coal longwalls.

3.6 Broader desaturation of Hawkesbury Sandstone aquifer

The limited number and nature of the groundwater monitoring installations over Metropolitan Mine, and the high number of failed instruments, may be preventing a comprehensive understanding of impacts and consequences of the mining.

Nevertheless, sensors in piezometers F6GW4A, 9EGW2A, 9GGW2B and 302GW01-TB02-250R indicate a significant and persistent desaturation of the undermined upper aquifers. The performance indicators identified in the Trigger-Action-Response-Plan (TARP) are interpreted by Peabody to be satisfied as long as no reversal in groundwater gradient, i.e. no net losses from the Woronora Reservoir catchment (Metropolitan Coal 2022b).

Widespread pressure reductions in shallow groundwater were not expected of the relatively conservative longwall design and depths of the Metropolitan Mine (Metropolitan Coal, 2008). Significant and persistent desaturation of the aquifer is not identified or even hypothesised by Peabody's hydrogeologists (SLR, 2021), but is consistent with my inferences explained in Section 3 that the undermined ridges around the Woronora Reservoir are draining more rapidly and unevenly than prior to mining. These subsidence effects, evidenced by a dry Eastern Tributary and shear movements in numerous locations (Section 3), can be expected to continue to degrade the catchments if approved Metropolitan Mine longwalls LW308-316 are allowed to proceed as planned.

3.7 Surface ecosystem responses to changed catchment hydrology

Where infiltrating rainfall intercepts the subsidence-induced fractures in the shallow aquifers which support the reservoir levels, one impact will be the downward diversion of runoff and infiltrated water along the rock-soil interface. Sub-vertical fractures oriented parallel to the ridge aquifers are frequently observed in the soils and tracks overlying undermined parts of the Special Area catchments (Advisian, 2016). The risk that large proportions of overland and sub-soil flows may be diverted through these surface fractures is not discussed or contemplated in any of the documents listed in Section 7, perhaps because without basal shear planes the extent of lateral flow from the base of the sub-vertical fractures would be expected to be small.

If the ridge fracture drainage mechanism is indeed occurring at scales of hundreds of meters, the environmental consequence of this diversion is that the ecosystems which utilise surface and shallow groundwater along the undermined slopes and catchments will slowly become desiccated relative to pre-mining conditions. Terrestrial and riparian ecosystems around Woronora Reservoir are likely to be permanently altered by the post-mining hydrogeological and fracture regimes.

Ecosystems will inevitably degrade due to the diversion of surface and near-surface flows, as they have been found to do at several monitored sites along the Eastern Tributary (Bioanalysis, 2021). These effects may become widespread due to the nature of the mining and the local topography and geology, potentially drying out all undermined upland swamps (Figure 1), eucalypt forests and riparian zones along creeklines.

Hydrological and ecological investigations at the Dendrobium Mine where impacts were more severe due to surface to seam interconnective fracturing (IEPMC, 2018a), demonstrate how slowly these changes in groundwater and inter-dependent ecosystems tend to unfold – frequently taking many years to become manifest and measurable. In coming decades, the undermined ecosystems around Woronora Reservoir would slowly adapt to drier surface conditions. The important water-filtering capacity of these catchment ecosystems would presumably, noting that the author is not an ecologist and has not applied exhaustive analysis, diminish by an unpredictable extent.

3.8 Volumetric loss calculations

The methods used by Peabody's consultants to calculate the mining-imposed changes in surface water resources in the Woronora Reservoir are a combination of groundwater model prediction of baseflows and hydrological modelling at key flow gauges (Metropolitan Coal, 2022). Consideration was given to improving the precision of these methods by conducting a catchment water balance analysis (Metropolitan Coal, 2018), but this option has not been pursued.

The 2016 Catchment Audit, a periodic independent review of WaterNSW's performance in managing the Special Areas, highlighted the "emerging issue of unquantified loss of surface flows associated with the cumulative impacts of underground coal mining activities."

The most recent Catchment Audit report (EcoLogical, 2019) offers the following advice about WaterNSW's progress in addressing these concerns:

> *WaterNSW has been working with several stakeholders to improve understanding of the volumes of surface water being diverted from the Special Area by mining. In 2018, in collaboration with Dr Paul Tammetta (a leading groundwater hydrologist), WaterNSW completed an assessment of two independent methods aimed at calculating water losses in undermined catchments.*
>
> *This research report (Tammetta 2018) was peer-reviewed by a UNSW academic and provided promising results but required further analysis to reduce the considerable uncertainties. The Independent Expert Panel for Mining in the Catchment (IEPMC), formed partly in response to the*

2016 Catchment Audit, completed its Final Report in late 2019 and recommended that WaterNSW 'continue its program of work towards determining the significance for the Greater Sydney water supply of different thresholds of surface water loss due to mining'.

As such, WaterNSW has been focusing on implementing both assessment methods to quantify cumulative impacts incurred by both longwall and pillar extraction mining in the Metropolitan and Woronora Special Areas. The results of this assessment are close to being finalised and will be subject to peer review and review by the IEPMC.

The unpublished surface water loss methodology report (Tammetta, 2018) offers a simple and elegant means of calculating the volume of water which will ultimately be transferred from surface waters into groundwater, called the Volume Conservation Method. This method states that the volume of surface water which must ultimately be diverted to groundwater is equal to the volume of coal plus water removed by mining, minus the volume of the "subsidence trough" in the overlying ground surface. Whilst the volumetric approach is accepted by WaterNSW, IEPMC and Peabody (or at least no scientific objection has ever been raised by these groups as far as I am aware), it cannot be used to calculate the rate of transfer. In very simple terms using this method, I estimate the following:

- Volume of rock removed due to mining with a conservative cutting height of 3 m and a total area of approved longwalls from LW1 to LW305 of around 7.5 km^2 is around 22 x 10^6 m^3.
- Volume of the subsidence trough, using a rough average of measured vertical subsidence of 1 m, is around 7 x 10^6 m^3.
- Volume removed (22 x 10^6 m^3) minus subsidence trough volume (7 x 10^6 m^3) = 15 x 10^6 m^3
- Volume of water removed by mining is reputedly very small due to the remarkably low volume of mine inflows, an average of 110 ML/year over past five years (Metropolitan Coal, 2022). In 28 years of operation, it may be conservatively surmised that at least 2 GL of groundwater has been pumped from the workings over the mine's life to date.

In other words, we can reliably predict that over an unknown time period the Metropolitan Mine will "take" more than 17 GL of surface water to replace the void it has created since LW01. Although some of this void may be alternatively replaced with mine tailings where longwall stability permits (Metropolitan Coal, 2022), it appears unlikely at this stage that this will reduce the total by more than 1 or perhaps 2 GL. It should also be noted that the 17 GL minimum is estimated only up to LW305, and that Metropolitan is only one of several interconnected mine voids in the area which will continue to deplete surface water resources in the Special Area catchments for decades or centuries to come.

3.9 Causal analysis

A new and much more powerful methodology for analysing and understanding complex systems, such as the mechanisms which control the diversion of surface water to groundwater or the transport of metallic contaminants through the various water and sediment compartments of a steeply dipping, narrow valley reservoir, is now available in Causal Science (Pearl, 2009). Rather than attempt to understand systems using data correlations as causal proxies, the new inference paradigm pioneered by Judea Pearl (2009) allows us to investigate and mathematically refine the causal relationships which are acting in a system directly. Once the causal laws operating on the system are known (or are adequately approximated), it becomes a relatively simple computational process to predict what will happen under varying conditions. As causal predictions are made mechanistically and not probabilistically, the levels of uncertainty relative to current methods such as the groundwater and surface water modelling can be greatly reduced through causal science.

In making this recommendation, I recognise that this report has not followed a causally sound epistemology because I am not enumerating all hypotheses for all dimensions of the catchments nor impacts, nor rigorously falsifying any of the hypotheses against evidence - unfortunately there has not been an opportunity to use causal science directly in the time and budget allocated for this report. I strongly recommend however, that consideration should be given to applying causal science to the analysis of volumetric and water quality changes discussed in this report, in order to truly understand the impacts of what is now unfolding in the catchments of Sydney's water supply due to Metropolitan's proposed progress towards the deepest parts of the catchment.

4. CURRENT AND POTENTIAL WATER QUALITY CHANGES IN DRINKING WATER CATCHMENTS

4.1 Stream water quality degradation

Stream water quality in the Special Area catchments of Avon, Cordeaux, Cataract and Woronora Reservoirs has been severely impacted by underground mining subsidence. The highly visible changes in overlying creeks' water quality is due to cracking of riverbeds and rockbars and consequent diversion of surface water into subsurface routes in the sandstone creek beds.

Figure 13. Iron oxides in creek over Dendrobium Mine, similar to that observed in Eastern Tributary since undermining

At the currently operating longwall mines in the Special Areas, Dendrobium in the Avon Reservoir catchment and Metropolitan under the Woronora Reservoir catchment, highly mineralised waters can often be observed returning to streams downstream of undermined zones. The subsurface flow in the shallow fractured sandstone aquifer causes the chemical composition and water quality to change as an effect of water-rock molecular exchanges. Iron, manganese and many cation and anion concentrations increase in the downstream discharges, whereas oxygen is depleted. Mobilisation of barium and strontium from the rock mass indicates fast chemical dissolution reactions between the subsurface flow and carbonate minerals. Other metals mobilised include zinc, cobalt and nickel (Advisian, 2016; IEPMC, 2018a; IEPMC, 2018b).

Dissolved iron, and manganese to a lesser extent, tend to precipitate on re-entry to oxygenated environments, and thus tend to accumulate in sediments. The hydrochemical behavior of many trace metals, e.g. aluminum and arsenic, is more complex. The relatively low concentrations of these metals measured within the water stored water columns and at supply intakes near the dam walls is used to infer that the additional metals contributed by diverted surface waters through cracked rock channels is not a significant problem. However, the true volumes accumulating in sediments on the reservoir beds have never been studied other than in a cursory way (Hebblewhite et al, 2019), and the potential for these metals and salts to episodically migrate down the reservoir channels is not currently known by the companies or the agencies.

Water quality discharged from the still-flowing lower end of Eastern Tributary has been consistently affected by high levels of iron, manganese and aluminum (Metropolitan Coal, 2022a). There has been a long-running regulatory failure (since 2016) where monitoring results routinely exceed performance indicators and are sent to Prof. Barry Noller, a University of Queensland academic who pronounces them negligible, with no further investigations required.

In 2020 a more serious exceedance of manganese and aluminum was yet again waved aside as within the relevant Performance Measure (Metropolitan Coal, 2022a). I disagree that the sustained manganese increases (in particular) in the Eastern Tributary can legitimately be labelled as negligible.

4.2 Groundwater discharge quality degradation

As well as impacted stream waters, a further currently unquantified contribution of metal oxides into the adjacent stored waters is inferred to be the direct discharge of fracture-diverted groundwater to the base of the valley. The process of groundwater seeping from the ridges occurs naturally as stream "baseflow", but becomes much more rapid where basal shear planes develop below and around the axis of the closing valley. Basal shear planes were detected through post-mining investigations extending at least 100 m beneath the eastern flank of Avon Reservoir (Figure 7), and have now been detected at even greater distances from the Full Supply Level (FSL) at Metropolitan Mine (Section 3.3). Based on the evidence presented in Section 3, I infer that the aquifers which sit above and feed the incised valley streams are now draining out into the adjacent valleys, heterogeneously but in places very rapidly, due to unexpectedly widespread formation of subsidence-induced basal shear planes.

The implication for water quality is that highly mineralised groundwater will be permanently seeping at increased rates directly into the base of the reservoir, without necessarily being measured or seen as the discharges are below the water line. These subsurface groundwater contributions of metal and salts into the reservoir are additional to those in the stream discharges such as Eastern Tributary (Figure 13). There is no recognition or intention in the Water Management Plan (Metropolitan Coal, 2022b) to control or even account for them.

5. ENVIRONMENTAL CONSEQUENCES

5.1 Environmental consequences of undermining – Water Quantity

5.1.1 Hydrological changes in Woronora Reservoir Catchment

The groundwater flowpaths induced by sub-vertical stress relief fractures are expected to result in increased infiltration of rainfall runoff from undermined ridge surfaces and soil-rock interfaces (including baseflows to swamps, streams and broader forest communities) down into the deepened water table, followed by relatively rapid lateral discharge along sub-horizontal shear planes imposed around the base of the valley.

Basal shear planes are not intuitively expected to persist beneath ridge centrelines (SCT Operations, 2016), and for this reason they are not expected to lead to enhanced groundwater losses into adjacent catchments. Some increase in vertical drainage beneath the base of the valley is a likely consequence of the subsidence-induced fracturing, however. There always remains a risk too that groundwater may be diverted away from the storage catchment if deeper, broader fractures and faults connected to regional sinks are intercepted by the shallow groundwater flowpaths.

5.1.2 Hydrogeological changes in Woronora Reservoir Catchment

As evidenced in the transect bores and piezometers near TBS02, the undermined bulk rock permeability now appears to be highly heterogenous, meaning there will be a wide range of flowpaths and travel times within the undermined ridges. Over decades however, groundwater will find its way to the new fracture-enhanced pathways and the initial groundwater depressions are likely to become widespread and more uniform. The final equilibrated groundwater levels in at least some parts of the undermined ridges is likely to be only slightly above reservoir water levels, as we observe at T3 (Section 3.3).

5.2 Environmental consequences of undermining – Water Quality

If the above inferences are correct, most of the fracture-diverted near surface waters are expected to return to the base of the valley containing much higher proportions of salts and metals dissolved from the newly opened fractures. In at least some cases these "iron springs" (Figure 13) will not be observable or measurable due to their occurrence below the reservoir water surface.

The elevated concentrations of metals discharged from both streams and as groundwater baseflow above and potentially below the reservoir waters are not yet resulting in high concentrations being detected at the dam end of the reservoir where the supply offtake is located, other than a small increase in manganese over the past 20 years.

Most of these metals are presumed to now be accumulating as a precipitated sludge on and within the sediments on the reservoir floor. Despite some attempts by WaterNSW (Sydney Catchment Authority, 2013) to collect sediment samples in the early 2000's without ever finalising the analysis report, the truth is that no one currently knows or can even make an informed prediction about what the distribution, state or mobility of the metals are. The metals and possibly other compounds may therefore be inferred to comprise an unmeasured but accumulating legacy of mining in a critically important drinking water reservoir. If so, no compensation is being provided by the company so future generations will likely have to pay for in increased water treatment or remediation costs.

The argument proposed by Metropolitan Mine (Metropolitan Mine, 2008) essentially suggests that, as the metals being discharged from cracked streambeds are not being detected at high concentrations in the stored waters below, no compensation is required to offset future treatment costs and drinking water quality degradation. H2onestly believes that these are big and optimistic assumptions that should be tested by a comprehensive analysis of what metals are accumulating at what concentrations in the reservoir sediments and what potential pathways (e.g. colloidal transport following wet periods) may ultimately present risks to Sydney's water quality.

5.3 Environmental performance assessment

5.3.1 Environmental performance relative to Approval Conditions

Table 1 sets out a subset of the Performance Measures identified in the amended approval (Helensburgh Coal, 2009) and the Performance Indicators as set out in the post-approval Water Management Plan (Metropolitan Coal, 2022b), limited to those within my areas of expertise (Section 2.2).

Selected (within expertise) Approval Performance Measure	Post-approval Performance Indicator	Peabody's interpretation of performance against Trigger-Action-Response-Plan (TARP) thresholds (from Table 9 of 2021 Annual Review)	H2onestly's interpretation of environmental performance
Negligible reduction to the quantity of water resources reaching the Woronora Reservoir	Changes in the quantity of water entering Woronora Reservoir are not significantly different post-mining compared to pre-mining, that are not also occurring in the control catchment(s).	Peabody assessed this Performance Measure only on measured vs baseline flows at Waratah Rivulet gauging station. Their assessment is that the median of flows is within 35th percentile of baseline measurements, and their self-assessment for this Performance Measure was at TARP Level 1.	The lack of assessment of the Eastern Tributary flows in Table 9 of the 2021 Annual Review is inappropriate and misleading. My interpretation of the reported trends (Section 3.5) is that flows in Eastern Tributary and probably other undermined streams are currently being affected by increased draining of the undermined ridges through basal shear planes. Once a new equilibrium is established, quicker and smaller baseflows may reduce overall flows to the Reservoir. A full causal analysis would be required to make a meaningful prediction against the counterfactuals of natural catchment efficiencies.
Negligible reduction to the quality of water resources reaching Woronora Reservoir	Changes in the quality of water entering Woronora Reservoir are not significantly different post-mining compared to pre-mining concentrations that are not also occurring at control site WOWQ2	Peabody assesses this Performance Measure in terms of iron, manganese and aluminum concentrations measured at Waratah Rivulet and Eastern Tributary. Dissolved manganese at the Eastern Tributary discharge point remained at TARP Level 3 throughout the reporting period, and for this reason was further evaluated by Prof. Noller at University of Queensland, who yet again pronounced the exceedance insignificant.	The water quality reaching the Reservoir from Eastern Tributary is visibly impacted by its interactions with fresh fracture faces below the stream surface (Section 3.5). Whilst the additional concentrations of metals being measured in two major Woronora Reservoir tributaries are being monitored, there remains unacceptable knowledge gaps about the metals' long-term fate in the reservoir sediments and water column, and about the additional contributions through basal shear plane discharges below the full supply level.
Negligible environmental	No change to the natural drainage	Peabody reports that there has been no measurable impact on the rockbar which houses the Eastern	Contrary to Peabody's interpretation, my conclusion from the review reported herein is that a diversion of around

Selected (within expertise) Approval Performance Measure	Post-approval Performance Indicator	Peabody's interpretation of performance against Trigger-Action-Response-Plan (TARP) thresholds (from Table 9 of 2021 Annual Review)	H2onestly's interpretation of environmental performance
consequences over at least 70% of the stream length (that is, no diversion of flows, no change in the natural drainage behavior of pools, minimal iron staining, and minimal gas releases) on the Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26	behavior of Pools ETAS, ETAT and ETAU. Analysis of water level data for Pool ETAU indicates the water levels are above that required to maintain water over the downstream rock bar.	Tributary flow gauge (ETAU) or the few pools just above it.	500 m of virtually all surface water flows via subsurface channels (Figure 1) constitutes more than a negligible environmental consequence, and therefore an exceedance of the Performance Measure. The Performance Indicators now used to enable evaluation of Performance Measure success in respect to Eastern Tributary are unfortunately not useful for evaluating the environmental consequences of basal shear planes developing beneath the stream surface, a mechanism which was not predicted nor yet publicly recognised. The Environmental Indicators provided in the 2021 Annual Review are focused instead entirely on the important role of protecting the integrity of the flow gauge at Rockbar ETAU.
Negligible leakage from the Woronora Reservoir	Various Performance Indicators are used to assess this PM, based on whether a groundwater gradient towards the reservoir level is maintained at selected piezometers.	Assessments of groundwater gradients relative to reservoir levels show some level of desaturation is occurring in aquifers, as particularly evidenced at T3 which reached TARP Level 3 and was consequently subjected to a review by Dr Merrick (SLR, 2021), who considered it only a "localised depressurisation".	There is ample evidence to support the hypothesis that mining-induced fracturing is now causing the desaturation, effectively the draining, of the upper aquifer around Woronora Reservoir. There is no obvious evidence at this stage that water falling within the catchment is being diverted outside the catchment, other than the minimum 17 GL of surface water which must ultimately replace the rock and groundwater removed for mining (Section 3.8). The desaturation of the undermined ridges hypothesised in Section 3 is likely to continue for some years or

Selected (within expertise) Approval Performance Measure	Post-approval Performance Indicator	Peabody's interpretation of performance against Trigger-Action-Response-Plan (TARP) thresholds (from Table 9 of 2021 Annual Review)	H2onestly's interpretation of environmental performance
			decades to come even if mining is stopped at this point. If mining is allowed to continue for the remainder of the approved longwalls, the draining of the ridges around Woronora Reservoir is predicted to become much more widespread.
Negligible impact on Threatened Species, Populations, or Ecological Communities	Impacts to riparian vegetation are expected to be localised and limited in extent, similar to the impacts previously experienced at Metropolitan Coal.	TARP level 2 has been reached in regard to riparian vegetation dieback at several locations (MRIP02, MRIP05, MRIP09 and MRIP12) along the Eastern Tributary. TARP level 2 has been reached in regard to significantly altered macroinvertebrate assemblages found at two Eastern Tributary monitoring locations (ET2 & ET4 in BioAnalysis, 2021).	Riparian ecosystem impacts along the Eastern Tributary are expected due to the radical change in flow behavior between Pools ETAG to ETAR (Figure 11). The long-term forecast for these ecosystems is poor unless current remedial tests are successful at restoring flows to the stream.

Table 1. Comparison of Peabody's and H2onestly's interpretation of Metropolitan Mine's environmental performance against planning approval conditions – Performance Measures and post-approval Performance Indicators

5.3.2 Environmental performance relative to planning application predictions

The information and predictions on which the current Metropolitan Mine was approved are contained in two weighty documents (Helensburgh Coal 2008; 2009). The original mining proposal of 2008 was revised to a smaller subsidence footprint in response to recommendations by Department of Planning and Planning Assessment Commissioners into the "Preferred Project", which was subsequently approved in 2009 by the NSW Planning Minister.

Most of the prediction details in relation to subsidence, groundwater and surface water responses are held in the relevant appendices (MSEC, 2008; Heritage Computing, 2008; and Gilbert & Associates, 2008, respectively). It is worth noting at the outset of this section that the subsidence assessment (MSEC, 2008) recognised "conventional" (formation of a subsidence trough) and "non-conventional" (how steeply incised valley-ridge systems respond to the subsidence). The non-conventional subsidence impacts include valley walls moving towards each other (valley bulging) and the consequent compression and localised fracturing and uplift of the land surface at the axis of the valley, i.e. the streamline.

The effects on the rocky stream base of Waratah Rivulet had already been observed and investigated by 2008, and the conceptual model used to explain the impacts is shown nicely by Figure 5.2 of MSEC (2008), reproduced as Figure 14. The primary type of flow diversion envisaged in the Environmental Assessment (Helensburgh Coal, 2008; 2009) was the cracking of rockbars causing flows to be shallowly diverted through, rather than over rockbars, as frequently observed at Waratah Rivulet.

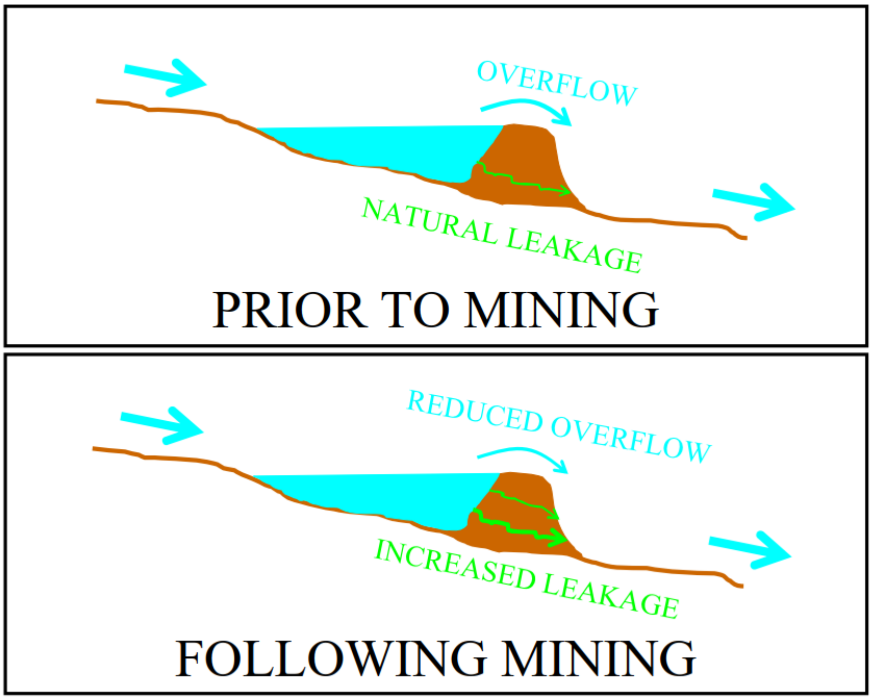

Figure 14. Conceptual model of rockbar through-flow presented in MSEC (2008).

The EA's groundwater assessment (Heritage Consulting, 2008) provides an expanded conceptual model of the type of near surface fracturing that was envisaged at the time by the project's designers:

> *A stream bed with an exposed rock base can experience cracking in response to subsidence to a depth of 10-20 meters. There will be no permanent loss of shallow water to a deep mine because there will be no continuity of fractures from the surface to the mine. There will be diversion of a portion of surface water flows through the rock fractures beneath the stream bed, which will move as underflow through the aquifer immediately beneath the stream, with emergence farther downstream.*

In other words, Peabody's hydrogeologists envisaged a zone of compressive fracturing centered on the stream base, with a radius of up to 20 m of possibly interconnected fractures was the predicted landscape response to the modeled closure movements across the undermined valleys.

Section 6.1.3.3 of the EA groundwater assessment (Heritage Consulting, 2008) is titled "*Effects on Surface Ecosystems*" is devoted entirely to considerations of draining of superficial aquifers in upland swamps, without discussing (or presumably predicting) any riparian or broader catchment ecological consequences.

In summary, there is no recognition of the potential for widespread formation of widespread, continuous or highly interconnected basal shear planes in the 2008 Environmental Assessment, nor of the risk from broad-scale diversion of runoff and near-surface water flows to be diverted by shallow, cross-gradient, sub-vertical fracturing (Figure 4) to be imposed by subsidence of these catchments. This is important because the conceptual models used by the specialists became the assumptions used in their numerical models. As the conceptual model used by these specialists then and now have become so inconsistent with the impacts and consequences which now appear to be unfolding in the Woronora Reservoir catchment, I suggest that model predictions need to be urgently reviewed by independent specialists.

In the absence of clear predictions about the extent of catchment change in the Statement of Commitments (Helensburgh Coal, 2009), the most relevant statement in the EA may be the following:

> *Permanent mining-induced changes in the groundwater levels of shallow aquifers in connection with streams and ecosystems at the Metropolitan Colliery have not been observed to occur.*

My conclusion is that there is sufficient evidence to say that permanent, widespread mining induced changes **have** now been observed to occur in the Woronora Reservoir catchment, though not in the style that was conceptualised when the EA was being developed. We do not appear to be losing the water to underground workings, but rather the catchment's water paths are being diverted through shear zones and fractures at the base of the valleys, a phenomenon which might be termed "ridge drainage fracturing" (Figure 4).

Clearly, the risks to the catchments of widespread drainage fracturing were not recognised and were not accounted for in 2009. The environmental consequences of a different, unpredicted type of impact in the sandstone ridge aquifers above the reservoir were therefore not considered in the development of suitable Performance Measures and Performance Indicators, and in hindsight (basal shear planes were hypothesised in SCT, 2007) the existing performance measures are not well suited to the task of evaluating catchment change imposed by mining.

6. CONCLUSIONS & RECOMMENDATIONS

6.1 Conclusions

There is considerable evidence, summarised below, that shear planes developed beneath the stream and reservoir base are leading to unpredicted and substantial subsidence impacts and environmental consequences. If the hypotheses presented in Section 5 are correct, surface flows and shallow groundwater are being widely diverted and drained by expanding shear and fracture systems in a mechanism termed here as ridge fracture drainage (Figure 1). If this new subsidence mechanism is indeed widespread, a likely outcome is that a range of protected Special Area ecosystems overlying the mine will dry and change. The other major risk from widespread basal shear formation is that it will cause the water quality in the Woronora drinking water reservoir to become increasingly degraded by metal-laden discharges from unmeasured shear plane vents.

Predicting and understanding the detailed system of subsidence impacts and environmental consequences of surface flows and shallow groundwater being diverted and drained cannot be performed in a scientifically defensible way without quantitative causal analysis (Section 3.9), but unfortunately there has not been time nor budget available within this engagement for such robust analysis.

H2onestly's consequent recommendation is that further undermining of the Woronora Reservoir should be halted until the implications of these unfolding changes on the catchments and Sydney's drinking water resources are evaluated. Impacts from current and past undermining by Metropolitan longwalls are likely to take years or decades to manifest. Failure to halt further mining may result in further permanent drying of the catchment ecosystems, changes to the filtering capacity of water falling in the catchment due to drying of riparian corridors, upland swamps and all other near-surface groundwater utilising ecosystems, and long-term hydrochemical degradation of an important part of Sydney's water supply.

Given these important consequences, consideration should be given to the State cancelling or purchasing the remaining approved longwalls.

In summary, H2onestly's key findings from our analysis of Peabody's 2021 Annual Report and documents referenced in Section 7 are that:

- Hydrological and hydrogeological flow behaviors in the catchments surrounding Woronora Reservoir are being permanently altered by the mining-induced subsidence and the unpredicted level of sub-surface shearing and fracturing which is now occurring in the surrounding ridges.
- An alarming feature of this previously unrecognised extent of fracturing and shearing is the potentially permanent loss of surface flows from parts of the Eastern Tributary. Trials are now underway to see whether a grouting approach used successfully in the rockbars of Waratah Rivulet will be able to restore flows in Eastern Tributary. Given the apparent differences in fracturing (fracturing of rockbars versus formation of basal shear planes beneath the stream surface), it is not at all certain that these trials will be successful.
- An as-yet unquantified proportion of rainfall runoff and sub-soil flows which would previously have been available to surface ecosystems is now inferred to be being diverted into the ground. Where surface and sub-surface waters are intercepted by sub-vertical valley tension relief cracking, they are likely to migrate vertically down through the more permeable Hawkesbury Sandstone aquifer and then be directed towards the valley center along the new lateral pathways created by mining-induced basal shear planes.
- In other words, the ridges are now desaturating (draining) and their vegetated valley surfaces will become progressively drier until a new, likely less biodiverse, set of ecosystems equilibrate.
- The only water which is confirmed to be leaving the catchment (and thus Sydney's drinking water supply) is the volume of surface water which will ultimately be required to fill the holes in the deeper aquifers around the mined coal seam – calculated to be in excess of 17 GL up to LW305. The rate of this loss (currently unaccounted for by water licensing) is not known, and it remains possible that much larger quantities may be removed if the newly induced fractures are or become connected to regional groundwater sinks such as the underground workings or springs along Illawarra Escarpment.
- For so long as the ridges drain their shallow groundwater into Woronora Reservoir catchments as they now appear to be doing, additional baseflow contributions will flow into the reservoir. If the hydrogeological model discussed in the following sections is correct, this increase will persist only for some years or decades and, once a new hydrogeological equilibrium is reached with the more permeable ridges, this short-term increase in reservoir baseflow contributions will be replaced by

an equivalent decrease in baseflows, and catchment responses to rainfall will become quicker and spikier.

- Whilst the total water quantity change may be small compared to the volumes now being removed by surface to seam connectivity over the Dendrobium Mine, the water quality is likely to be much poorer for two reasons:
    1. The water's interaction with rock minerals in the extensive new subsurface fractures through which the diverted surface water is now being diverted.
    2. Drying of the ridge lines will likely lead to reduced filtration provided by the pristine ecosystems which now filter overland and soil water flows, including some small upland swamps.

6.2 Recommendations

H2onestly's primary recommendation is that further undermining of the Woronora Reservoir should be halted until the implications of these unexpected changes now unfolding in Woronora Reservoir catchment can be urgently evaluated. If epistemologically sound analysis finds that the long-term costs to Sydney's drinking water supplies and environmental damage caused to these pristine and notionally protected catchments now exceed the value of the remaining coal beneath the reservoir, mining should be halted or sufficiently modified to prevent further basal shearing. Remediation of the newly imposed ridge fracture drainage system should also be implemented if possible.

Scientifically sound and independent studies are recommended to answer the following key questions:

1. Are the hypothesised changes to the hydrology and hydrogeology of the Woronora Special Area catchment, collectively termed "fracture drainage" in this report, occurring on a scale that will substantially alter biodiversity objectives of the Special Area catchments and/or hydrochemical quality of the drinking water resources in the Woronora Reservoir?
2. If so, what are the long-term ecological and water quality implications of altering the Woronora Catchment hydrology due to the imposition of basal shear planes?
3. How much additional metalliferous compounds have been and are being added to reservoir waters and sediments as a result of undermining?
4. What is the likelihood that these metals may at some stage be mobilised by foreseeable circumstances to the point where the stored waters or sediments require additional treatment?
5. What is the mine-specific and cumulative impact of removing a minimum of 17 GL from the Special Area catchments, and what will be the rate of this removal?
6. What would be the most effective way to develop and apply a meaningful performance measure for ongoing and future mine licensing in relation to hydrochemical changes to reservoir water quality – e.g. load-based or water concentration limits, hydrochemical or mechanical transport route thresholds?

I strongly recommend that the answer to these important questions are sought by applying a paradigm of causal inference through hypothesis falsification (Pearl, 2009), in order to truly understand the impacts of what is now unfolding in the catchments of Sydney's water supply due to Metropolitan Mine's past and proposed progress beneath the Special Area catchments around Woronora Reservoir.

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ATTACHMENT A: PETER DUPEN CV

I am an experienced hydrogeologist, water systems analyst and impact evaluator, with almost 40 years in environmental analysis, policy and regulation.

Prior to starting the H2onestly consultancy I was Mining Manager for WaterNSW, where I delivered several outstanding policy and technical achievements and innovations. I have spent the past three years researching engagement design, collaborative sense-making technologies and causal inference approaches for improving environmental governance.

Qualifications

- Master of Applied Science (Environmental Hydrogeology), University of New South Wales, Sydney (1991).

Expertise

- Evaluation analyst on policy, strategy and institutional decision-making through nuanced stakeholder engagement and causal evidentiary analysis.
- Partnership-building with a wide variety of stakeholders through respectful curiosity, integrity and an open and collaborative operational style.
- Evidential decision-support analysis and synthesis of complex datasets and analytical systems. Familiarity with a wide variety of environmental analysis methodologies, including Causal Science, to assess and limit impacts on water, ecological and social systems.
- Stakeholder engagement design, including expert elicitation, model-supported human learning systems, justified decision-making and transparent reporting.
- Targeted research design and evaluation of impacts and outcomes.
- Advocacy on behalf of agencies, regulators, NGO's and Councils regarding water impacts from various developments.
- Developing innovative approaches and tools to meet environmental and resource challenges.
- Integration of stakeholder engagement and big data analytics in surface water, catchment and groundwater management.
- Geo-environmental pollution, resource impact and risk assessment.

Key Skills

- Environmental scientist with almost 40 years professional experience in a variety of technical and management roles, primarily in water/groundwater resource evaluation and developing policies for the protection of these resources from over-exploitation and pollution.
- Extensive experience in developing and implementing innovative regulatory solutions to complex environmental and resource-sharing challenges.
- Strong technical leadership, strategic policy development, advocacy and collaborative communications skills developed in a wide variety of settings, primarily as a regulator or consultant.

Recent Professional History

August 2019 - Present **Director, H2onestly**

H2onestly provides expert, ethical and independent advice to government agencies, NGOs and community stakeholders. The consultancy is led by Pete Dupen, who networks with selected technologists, experts and stakeholders to develop nuanced, practical solutions to complex challenges. I offer proven expertise in investigating water resource issues with expert and other stakeholders to evaluate environmental and resource projects and policies. I am proficient in critically examining datasets, models and impact predictions using modern data interrogation, analysis and visualisation approaches. I also operate as a broker between regulators and leading data technologists, assisting agencies to navigate innovative technologies within existing regulatory systems and institutions.

Feb 2015 - July 2019 **Mining Manager, WaterNSW**

As Mining Manager, I led a team investigating and assessing mining impacts on Sydney's water supply catchments. The role required a challenging mix of scientific innovation, consultation and advocacy. A key requirement was to analyse a wide array of environmental investigation data, and evaluating this relative to approved (and ambiguous) impact predictions. My primary achievements during this period were developing an innovative methodology for estimating water losses due to undermining and a robust framework for categorising hydrological and ecological risks to catchments.

ATTACHMENT B: CORRESPONDENCE BETWEEN NCC, PEABODY AND DPE

Attachment B1: Letter queries from NCC to Peabody dated 19 April 2022

Attachment B2: Response from Peabody to NCC dated 26 May 2022

Attachment B3: Letter queries from NCC to Planning Minister dated 19 April 2022

Attachment B4: Response from DPE to NCC dated 10 May 2022

Attachment B5: Response from DPE to NCC dated 11 July 2022

Nature Conservation Council
The voice for nature in NSW

19 April 2022

Jon Degotardi
Manager - Technical Services
Metropolitan Mine
Helensburgh NSW 2508
Via email: JDegotardi@peabodyenergy.com

Dear Mr Degotardi,

Concerns regarding mining the Woronora Reservoir catchment

We write to raise concerns and seek clarification regarding the consequences of mining the Woronora Reservoir catchment. These concerns arise from available reports provided to the Department of Planning and Environment and WaterNSW by Peabody. You may have access to more recent or additional information that would help resolve our concerns.

The available information suggests the possibility of an unexpected level of depletion of the upper aquifer over the mining area. Limited monitoring installations at the mine preclude a reliable determination of the extent and significance of this depletion. The available data do not seem to discount the possibility that the diverted water may include a component from the reservoir.
The available information suggests the following:

(i) The responses of the transect bores, notably T3, signal drainage and diversion away from Woronora Reservoir to an unknown sink, triggered or significantly increased with the extraction of LW305. Dr Merrick has assumed that the pressure head collapse at T3 is localised, and that the reservoir is anyway shielded by a

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positive gradient around the south-eastern flank of the reservoir, out to a distance of at least that of T2. However, reflecting insufficient monitoring installations, there would appear to be insufficient evidence to compellingly support this assumption. The evidence that is available suggests the contrary is possible and may be more likely.

(ii) The responses of several of the limited number of groundwater monitoring installations over the mine point to a significant and persistent depressurisation of the Hawkesbury Sandstone in the vicinity of current and past extractions. Discussed in the attachment, this includes depressurisation associated with the diversion of the Eastern Tributary flows and the Performance Measure exceedances of 2016. These changes would appear likely to be persistent and irreversible. Noting upper aquifer depressurisation in the current mining area caused by historical mining, it would be reasonable to expect that upper-level depressurisation caused by the current project will radiate outwards and further withdraw support for the reservoir.

(iii) Compounding the above concerns are what appear to be inappropriate responses to trigger action response plan (TARP) exceedances and functionally inadequate TARP settings.

These concerns are discussed in more detail in the attached. Your assistance in clarifying our observations and resolving our concerns would be gratefully appreciated. In doing so, we would be grateful if you could provide the most recent hydrographs for the sites discussed in the attached.

We seek your written response by Tuesday 3 May, 2022.

Yours sincerely

Jacqui Mumford
Deputy Chief Executive

CC Clay Preshaw, Jessie Evans, Fiona Smith, Garvin Burns, DSNSW, IAPUM

Attachment: Concerns regarding mining the Woronora Reservoir catchment

1. Transect bore piezometers

Dr Merrick advised in his November 2021 assessment that the T3/T3-R responses reflect localised impact consequences and do not signal a reversal of groundwater gradient to the reservoir, citing a continued positive head at T2 and a pressure increase at T2 with rain in March 2021. However, the T2 and T3 responses from LW301 onwards (see Fig. 1 below) counter the suggestion of T3 reflecting localised depressurisation, as does Dr Merrick's November 2021 observation that the head at T3-R appears to respond to the reservoir level.

Dr Merrick's observation follows his assessment in the 2019 Annual Review (AR) that the responses at T2 and T3 reflect a strong reservoir dependence (see below). The extent of any coupling of T3, and T2, to the reservoir has yet to be determined. Dr Merrick appears to recognise that is this is a likely possibility.

Puzzlingly, Dr Merrick suggests localisation at T3/T3-R may be associated with location over the centreline of LW306, which passed below the sites in the spring of 2021. This would appear to overlook the sharp falls at T3 from the autumn of 2020.

The available information, including the T2 and T3 responses, appear to be more consistent with mining-induced equilibrium shifts in a hydrological continuum, rather than localised effects. LW305 may be associated with a marked and persistent additional outward loss of groundwater support for the reservoir, with drainage to an unknown sink that is presumably enabled by a shear plane activation. The available information suggests the possibility that this loss may include a direct contribution from the reservoir. Just as there are insufficient installations to determine whether depressurisation at T3/T3-R is localised or more extensive, there would appear to be insufficient information to determine whether the modest residual head at T2 is localised.

Pointing to the unexpected severity of the changes in the upper aquifer, the sensor at T3-R appears to have been installed just below the minimum supply level of the reservoir.
Dr Merrick has suggested that the persistent depressurization at T3 is a consequence of fracturing reaching into the Bulgo Sandstone. Given the location of the bore with respect to LW305 and the sensor depth, this would appear to be an unlikely explanation. This explanation would also seem to implicitly suggest drainage to the mine, contrary to the available information.
The essentially one-dimensional nature of the in-line and single sensor transect bores precludes an assessment of the significance of the hydrological changes in the vicinity of the reservoir. An assessment would require bores installed at intervals in at least two rows set back a suitable distance from the full supply level, with sensors at depth intervals from the surface to below the base of the reservoir.

Table 1 in the November 2021 assessment of the transect bores reports that the T2 sensor depth is not known. This would suggest the possibility that the T2 water level descends at least to the sensor from September 2020, with occasional increases following significant rain and reservoir level rises.

2. Depressurisation over and around the mine

Relevant instruments in bores F6GW4A, 9EGW2A, 9GGW2B and 302GW01-TB02-250R point to the possibility of a significant and persistent depressurisation of the Hawkesbury Sandstone in the vicinity of past and current mining. Such losses would not be expected of the relatively conservative and deep mining at Metropolitan Mine. The reference sensors and sensors at depths corresponding to the TARP reference sensor depths are located in what would conventionally be regarded as the constrained zone, well above the drainage/fractured zone. Our understanding is that significant and persistent depressurisation at this level would not ordinarily be expected.

3. Depressurisation, exceedances and TARP concerns

The limited number and nature of the groundwater monitoring installations, and the number of failed instruments, hinder the understanding of impacts and consequences of the mining. Compounding this limitation, the TARPs that utilise the instruments are poorly constructed in the context of a Schedule 1 Special Area. Of note, the TARPs for the 300 series appear to lack recognition of earlier mining. That is, the reference date for impact and consequence assessments is June 2017, whereas the expansion project commenced in 2009.

Changes made to the TARPs when Performance Indicator (PI) exceedances have occurred appear to lack a sound foundation and/or are ill-considered in the context of a Schedule 1 Special Area.

For example, following a LW301-303 WMP Level 3 TARP alert at T3 in April 2018, Dr Merrick recommended T2 and T3 TARP changes or, alternatively, their removal as reference sites for the LW304 WMP. This recommendation was made on the basis that the levels at both sensors reflect a "*strong dependence*" on the reservoir level. They were subsequently removed as TARP reference sites in the LW304 WMP. However, while the available data would appear to affirm that both sites reflect a degree of influence from the reservoir, neither could be regarded as uninformative 'extensions' of the reservoir. They were reintroduced for the LW305-307 WMP (at the request of DSN), but in a form that allows the groundwater level to fall below the reservoir's full supply level. In effect, this accepts continued, unquantified baseflow losses during low rainfall periods, including extreme drought.

A LW301-303 WMP Level 3 PI exceedance occurred at the reference sensor in F6GW4A in February 2019, with the hydraulic gradient to the FSL reduced by more than 20% from that of the 30 June 2017 reference date (300 series start). Dr Merrick removed the bore from the LW304 WMP PI set on the basis the sensor had been compromised by local subsidence compression effects. The evidence did not, however, suggest the PI sensor was faulty; on the contrary, the instrument appears to have performed well (this was pointed out to the Department of Planning in March 2020, by the NPA).

F6GW4A was reinstated for the LW305-7 WMP at the request of the DSN (Appendix C2 of the 2020 Annual Review (AR)), though with the loss limit doubled to 40% and the 2019 exceedance accordingly removed. Subsequent assessments do not mention sensor damage and the instrument has continued to function normally, through to at least November 2021.

In March 2019, a LW301-303 WMP Level 3 PI exceedance occurred at TARP hydraulic gradient reference bore 9EGW2A. Referring to data from December 2016 only, and notwithstanding the bore being more than 500 metres from the reservoir, Dr Merrick attributed this exceedance to the drought-driven falling reservoir level (Appendix 2, 2019 AR) and, suggesting the trigger level was "*too sensitive*", doubled the hydraulic gradient reduction limit from 20 to 40% for the LW304 WMP and onwards. Reference to the relevant hydrograph in Fig. 34 of Appendix C2 of the 2020 AR suggests, however, that the slow decline that triggered the 2019 exceedance started in early 2012 and preceded the drought by some five years.

The pressure head at the reference sensor in 9GGW2B, 80 metres below ground (mbgl), fell 58% to June 2019, from approximately 45 metres to approximately 19 metres. The pressure head at the sensor at 55 mbgl fell 78% from approximately 18 metres to approximately 4 metres with the extraction of LWs 24-27. Almost all of the loss occurred with the extraction of LWs 24 to 27, before June 2017 and the start of the 300 series. The LW301-307 WMPs allow a further 40% reduction at the reference sensor before triggering a Performance Measure (PM) review, in principle accepting then a total loss of 98%.

The relatively sharp losses at this site shortly precede and coincide with the onset of PM exceedance consequences to Eastern Tributary in 2016. Given the proximity, both in location and time, it would seem unlikely that these events are coincidental.

While bores 302GW01 and TB02-250R are not used as PI reference sites, the sensors are at similar depths to the reference sensors in the PI bores. There is an ongoing pressure head loss of 13 metres at this location, from an already quite low starting point of 45 metres, with the extractions of LWs 302, 303 and 304. Ongoing loss of this magnitude would seem unlikely within what would conventionally be regarded as the constrained zone, some 222 metres above the highly fractured drainage zone and 150 metres below the surface.

The 302GW01 instrument at 80 mbgl becomes dry with the extraction of LW302, falling from a notably low pressure head of just nine metres on commissioning, prior to the LW302 extraction. The F6GW4 sensor at 50 mbgl becomes dry following the extraction of LW303. F6GW4 is over the pillars between LW303s and 304 and 'down-slope' from 302GW01, which is located on a ridge.

4. Concluding comments

It would seem reasonable to expect that the upper aquifer depressurisation suggested by the above observations is still unfolding and will radiate outwards from the immediate mining area. This was recognised in the LW305-7 WMP observation that the overlying groundwater regime had already been significantly depleted by pre-expansion project mining and extractions at nearby mines.

It would appear that the relatively modest and deep mining at Metropolitan may have, unexpectedly and significantly depressurised the upper aquifer over the mining and is diverting water away from the reservoir. This would seem likely to reflect non-conventional subsidence impacts associated with the local area topology and geology.

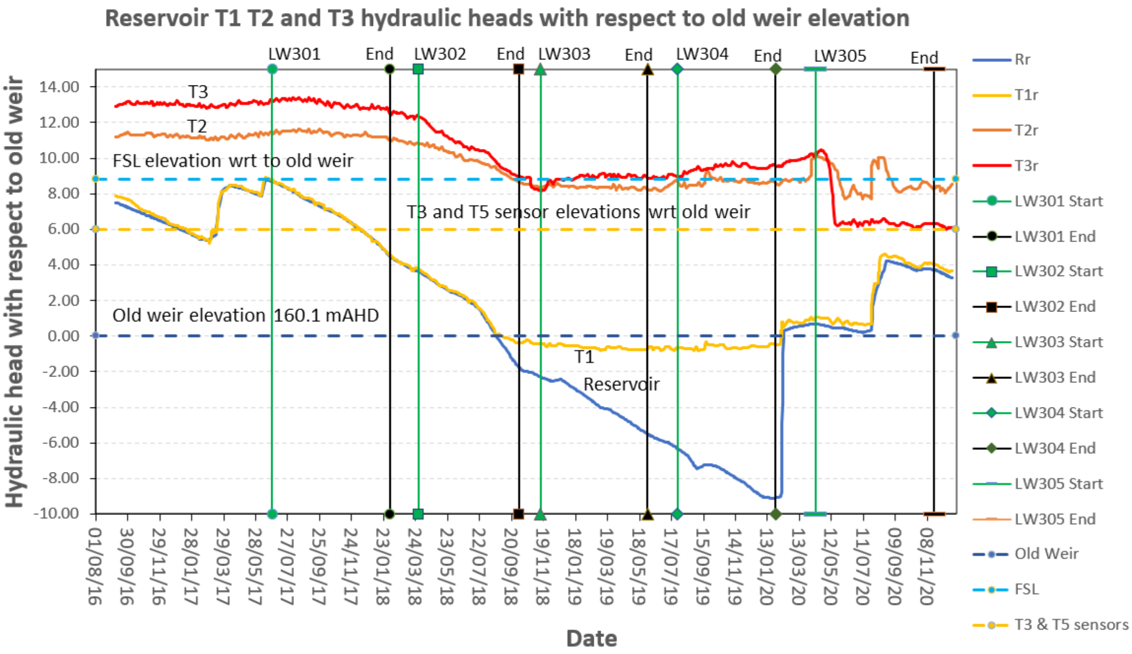

Figure 1. Depiction of the T1, T2, T3 hydraulic heads with respect to the old weir elevation

The figure was generated by digitising Fig. 29 in Appendix C2 of the 2020 AR. The use of the old weir elevation as a reference has been recommended by Dr Merrick. The T2 and T3 responses are near synchronised, until T3 becomes persistently 'dry' with the extraction of LW305. Both reach the full supply level at much the same time. T2 shows a sharp head increase when the reservoir rises above the old weir level in July 2020, but this quickly declines. Table 1 in the November 2021 SLR assessment of the transect hydrographs reports that the elevation of T2 is not known.

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26 May 2022

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Attention: Ms Jacqui Mumford, Deputy Chief Executive, Nature Conservation Council

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Copied: jessie.evans@dpie.nsw.gov.au; Gabrielle.Allan@planning.nsw.gov.au; clay.preshaw@dpie.nsw.gov.au; Fiona.Smith@waternsw.com.au; Garvin.Burns@planning.nsw.gov.au; info@damsafety.nsw.gov.au; j.galvin@bigpond.net.au

Dear Ms Mumford,

RE: NATURE CONSERVATION COUNCIL CORRESPONDENCE - 19 APRIL 2022

Thank you for your recent correspondence regarding our Metropolitan Coal Operations at Helensburgh and the opportunity to respond to your concerns.

Peabody understands the sensitivity of mining in the Woronora catchment and that we must at all times operate in a way that meets community expectations and provides the highest possible environmental protections. Only by fulfilling these commitments will we secure the future of our operations and protect the hundreds of local mining families and businesses that rely on our mine for their livelihood.

We have carefully reviewed your concerns regarding monitoring data at the Metropolitan Coal Mine and consider that many of the historical issues raised relating to our mining activity have already been the subject of comprehensive, independent analysis by the Independent Expert Panel for Mining in the Catchment (IEPMC) and additionally by the Woronora Reservoir Impact Strategy (WRIS) expert panel. Specifically, these issues have been addressed in the following publicly available reports and letters:

- *Woronora Reservoir Impact Strategy – Stage 1 Report* (Hebblewhite, et al., 2017)
- *Woronora Reservoir Impact Strategy – Stage 2 Report* (Hebblewhite, et al., 2019)
- Letter to DPIE – 'Summary of Woronora Reservoir Impact Strategy Stage 1 and Stage 2 Reports', dated 6 December 2019
- Letter to DPIE – 'Review of Geotechnical and Water Aspects of the Longwalls 305-307 Extraction Plan', dated 10 December 2019
- *Report of the Independent Expert Panel for Mining in the Catchment: Part 1, Review of specific mining activities at the Metropolitan and Dendrobium coal mines* (IEPMC, 2019a)
- *Report of the Independent Expert Panel for Mining in the Catchment: Part 2, Coal Mining Impacts in the Special Areas of the Greater Sydney Water Catchment* (IEPMC, 2019b)

Additionally, since receiving your correspondence, the Metropolitan Coal 2021 Annual Review has been published on our website following its scheduled submission to and approval by the Department of Planning and Environment (DPE) in March 2022. The report contains updated information that we consider further addresses your concerns including Dr Noel Merrick's 2021 groundwater investigation report for T2, T3 and T5 (attached to this email).

Metropolitan Coal will continue to transparently report the performance of the Metropolitan Mine in these Annual Reviews, which we publicly release on our Metropolitan Coal website.

For additional clarity, we provide the below information in response to the three main issues summarised early in your correspondence:

Issue (i) – Transect bores

As your correspondence indicates, an investigation into water level changes at bore T3 and T5 was prepared by Dr Noel Merrick and is included as Appendix G of the 2021 Metropolitan Coal Annual Review (also attached to this email). In summary Dr Merrick found:

> *Although an exceedance has occurred for the gradient between bore T3 and the reservoir, there has not been a reversal of gradient from T3 to the Woronora Reservoir that would induce leakage from the reservoir (the performance measure) because the intervening bore T2 still shows a hydraulic gradient towards the reservoir (Figure 1), and its water level increased following the heavy rainfall event in March 2021. The depressurisation at bore T3-R is localised. A review of the data after a significant increase in the reservoir level will conclude if T3-R is connected to the reservoir.*
>
> ***Performance indicator (T3-WRL)**: No specific management measure is considered to be required at this time. A heavy rainfall event is awaited to clarify whether the water level at T3-R is permanently low or whether it will recover after the passage of Longwall 306 directly beneath the bore.*
>
> *It is recommended also that the water level at bore T1 be endorsed as a surrogate reservoir level, as the data at T1 are collected at the same frequency as measurements at bore T3-R, and the levels at bore T1 automatically take into account the effect of an obsolete weir when main reservoir levels are very low.*

Since Dr Merrick's 2021 investigation report prepared was completed, there has been a significant increase in the Woronora Reservoir levels and the monitoring data at T3-R confirms that the water level in the bore is connected to the Reservoir level, similar to Bore T1. The water level at Bore T2 remains at historical levels observed since 2019 (refer to Chart 1). An updated investigation report which considers the rainfall events is currently being prepared and will be provided to DPE when finalised.

Further, the monitoring network around the Woronora Reservoir is not limited to the transect bores. The transect bores are located perpendicular to the Reservoir around the northern ends of Longwalls 305 and 306. Bores PHGW1B, PHGW2A and PM03 are located on the eastern side of the Woronora Reservoir and monitor water levels across three sensors in the Hawkesbury Sandstone. The water levels in all sensors are relatively stable and show a clear gradient towards the Reservoir (shallowest sensors recording between 196 metres Australian Height Datum [mAHD] and 224 mAHD). The deeper sensors show groundwater levels between 168 and 191 mAHD, which is at or above full supply level, indicative of a groundwater gradient towards the reservoir.

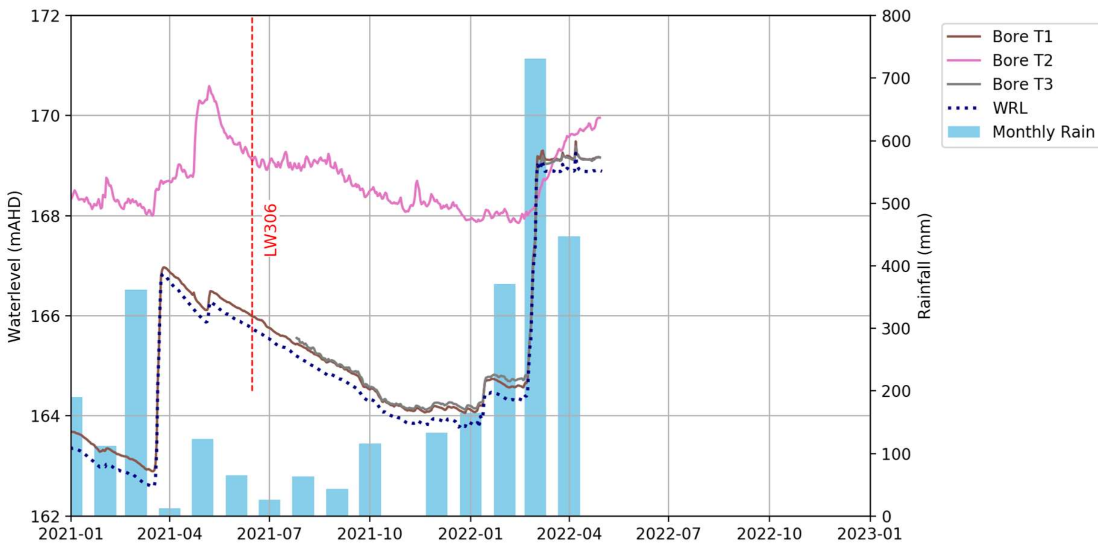


Chart 1 – Water levels in the Woronora Reservoir and at Transect Bores T1, T2 and T3

Issue (ii) - Hawkesbury Sandstone Depressurisation

The WRIS expert panel Section 7.2 of the Stage 2 Report made the following conclusions (<u>emphasis added</u>) indicating that there is no evidence of significant and persistent depressurisation through the Hawkesbury Sandstone.

> *No response to water levels was observed due to mining in TBS02A and 302GW01A observations bores (Figure 5.2) <u>validating that no fracture network propagated to the Hawkesbury Sandstone shallow groundwater system</u>.*
>
> *Analysis of the substantial decline of piezometer pressure head in borehole 302GW01 has yielded possible extended fracturing and/or matrix depressurisation above the caving zone within a height of 195m. <u>It suggests possible extended fracturing and depressurisation up to a depth of 340m below the ground surface</u>. The Tammetta equation for comparison has yielded a drainable or at least a depressurisation/desaturation fracture extent of 173m above the caving zone for a cutting height of 3.2m. The Ditton equation produces a similar height (174m) if a "beam" thickness of 20m is adopted.*

Further, there is no evidence that connective depressurisation between the caved zone and the surface caused the documented loss of flow in the Eastern Tributary in 2016 and 2017. These flow changes have been the subject of significant investigation by both the WRIS Expert Panel and the IEPMC and deemed to be associated with surface cracking along the Tributary resulting in a proportion of the flow being conveyed in the subsurface fracture network. It is also noted that the water that enters the stream bed due to shallow surface cracks along the rock bars can be observed re-entering the watercourse further downstream and ultimately reports to the Woronora Reservoir.

As you will be aware, Metropolitan Coal is implementing stream remediation along the Eastern Tributary pools/rock bars in accordance with an approved Stream Remediation Plan.

Issue (iii) - Trigger Action Response Plans

As referred to in your correspondence, the justification for changes to TARP trigger levels has been comprehensively explained by Dr Noel Merrick in his F6GW4A and 9EGW2A Investigation Reports. These reports were included as Appendices G2 and G3 of the 2019 Annual Review submitted to and approved by DPE.

Having acted on the conclusions reached and recommendations submitted by Dr Merrick, Metropolitan Coal is confident that the TARPs in the approved Longwalls 305-307 Water Management Plan and the proposed Longwalls 308-310 Water Management Plan are fit for purpose and will enable proactive management of potential impacts to the Woronora Reservoir.

Thank you again for providing Metropolitan Coal the opportunity to respond to the Nature Conservation Council's concerns.

Please address any future inquiries or requests for information to au_info@peabodyenergy.com to ensure your request is directed to appropriate personnel for a timely response.

Yours sincerely,

JON DEGOTARDI
Technical Services Manager

Memorandum

To:	Jon Degotardi	At:	Metropolitan Collieries
From:	Dr Noel Merrick	At:	SLR Consulting Australia Pty Ltd
Date:	15 November 2021	Ref:	665.10000-M12-v1.0-20211115.docx
Subject:	Metropolitan Coal Groundwater Investigation Transect bores T2, T3 and T5		

1 Introduction

On 8 October 2021, Metropolitan Collieries Pty Ltd (Metropolitan Coal) requested that SLR Consulting Australia Pty Ltd (SLR) undertake an investigation into an exceedance of the Level 3 groundwater trigger level measured at piezometer T3, an exceedance of the Level 3 groundwater trigger level associated with piezometer T5 and a short-term exceedance of the Level 3 groundwater trigger level associated with piezometer T2. The investigation below provides an assessment of all events against the relevant performance measures in Project Approval 08_0149 and provides recommendations in relation to the groundwater trigger events.

2 Background

Groundwater monitoring results at the Metropolitan Mine are assessed against performance indicators using the Trigger Action Response Plan (Table 25) detailed in the Longwalls 305-307 Water Management Plan (Revision WMP-R01-B approved 16 March 2020).

The performance indicator for Bore T2 is:

> "The hydraulic gradient to the Woronora Reservoir from bore T2 is reduced by no more than 10% from that measured on 30 June 2017."

The performance indicator for Bore T3 is:

> "The hydraulic gradient to the Woronora Reservoir from bore T3 is reduced by no more than 10% from that measured on 30 June 2017."

The performance indicator associated with Bore T5 is:

> "The hydraulic gradient from bore T5 to bore T3 is reduced by no more than 10% from that measured on 30 June 2017."

2.1 Bore Details

They key survey details for bores T2, T3 (and re-drilled T3-R) and T5 are listed in Table 1. A figure with the bore location in relation to the reservoir is shown in Figure 1.

Table 1 Key survey details for transect bores

Survey detail	T2	T3	T3-R	T5
Hole depth (m)	35	61	81.2	94
Collar level (mAHD)	195.12	225.45	226.83	258.04
Diver sensor level (mAHD)	Not known	166.44	146.83	166.10
Bottom of hole (mAHD)	159.62	164.45	145.62	164.04

Located between bores T3 and T5 is bore T4, which Metropolitan Coal has advised was sheared during excavation of Longwall 306 (directly beneath bore T4). The last observation at this bore was recorded on 23 August 2021.

2.2 Bore T2 to WRL Performance Indicator and exceedance

At 30 June 2017, the water level in the Woronora Reservoir (WRL) was 168.90 mAHD and the T2 water level was 171.55 m AHD, giving a baseline difference of:

T2 – WRL = 2.65 m

An exceedance of the Level 3 trigger performance indicator would occur for the following condition:

T2 – WRL =< 2.39 m
where WRL is the dynamic Woronora Reservoir Level.

A short-term exceedance of the T2 Performance indicator (up to Level 3) was observed between 23 March 2021 and 22 April 2021 (Figure 2). The hydrographs for all transect bores are shown in Figure 3, together with the reservoir level and rainfall. At the time when the exceedance occurred, the Woronora Reservoir Level increased significantly over a short period of time, whilst the water levels at T2 remained steady. This caused the decrease of the gradient, which increased subsequently when the reservoir levels decreased and the groundwater level at T2 increased. The Performance indicator has returned to Level 1 and remained there since.

2.3 Bore T3 to WRL Performance Indicator and Exceedance

At 30 June 2017, the water level in the Woronora Reservoir (WRL) was 168.90 mAHD and the T3 water level was 173.32 m AHD, giving a baseline difference of:

T3 – WRL = 4.42 m

An exceedance of the Level 3 trigger performance indicator would occur for the following condition:

T3 – WRL =< 3.98 m
where WRL is the dynamic Woronora Reservoir Level.

As previously reported in SLR (2020)[1], an exceedance of the T3-WRL performance indicator was first identified on 29 July 2020, as shown in Figure 4. The exceedance has continued through to 21 December 2020, when the bore was abandoned. As recommended in SLR (2020), a deeper replacement bore was drilled. The new bore, T3-R, was drilled 10m from the original bore and has a depth of 81.2m, approximately 20m deeper than the original bore T3 (Table 1). Since the new bore T3-R started recording in May 2021, the performance indicator has remained at Level 3. The current observations show a reflection of the reservoir (and T1) water levels. The recording period of T3-R is too short to draw a final conclusion as to whether the bore T3-R is connected to the reservoir. It is recommended to review the hydrographs after a large rain event that will change the WRL significantly to assess if T3-R is responding to the reservoir water level increase.

Although an exceedance has occurred for the gradient between bore T3 and the reservoir, there has not been a reversal of gradient from T3 to the Woronora Reservoir that would induce leakage from the reservoir (the performance measure) because the intervening bore T2 still shows a hydraulic gradient towards the reservoir. This suggests the depressurisation at bore T3-R is localised, perhaps due to its being directly over the centre line of Longwall 306 which passed beneath this bore in spring 2021.

2.4 Bore T5 to Bore T3 Performance Indicator and exceedance

At 30 June 2017, the water levels in Bores T5 and T3 were 191.24 mAHD and 173.32 m AHD, respectively, giving a baseline head difference of:

T5 – T3 = 17.92 m

An exceedance of the Level 3 trigger performance indicator would occur for the following condition:

T5 – T3 =< 16.13 m

An exceedance was first identified for the (T5-T3) trigger on 19 August 2020, as shown in Figure 5. The exceedance of Level 3 occurred for the remainder of the data record at T3 (December 2020), with some observations at Level 2. Since the installation of T3-R, the performance indicator started at Level 2 in May 2021, improved to Level 1 on 25 June 2021 and has since changed to Level 3. This is due to the steady decrease of the groundwater level at T5, which is likely a response to the passing of Longwall (LW) 306. A similar response, namely a sharp increase in water pressure followed by a larger decrease, was observed at T5 when LW 305 passed directly beneath. A similar but smaller response occurred when LW 304 commenced. However, as LW 306 is farther away from T5, the recent response is subdued compared to the one observed in May 2020.

3 Performance Measure Assessment

In accordance with the Trigger Action Response Plan, an investigation has been conducted and an assessment has been made against the following performance measure:

Negligible leakage from the Woronora Reservoir.

Several performance indicators involving bores T2, T3 and T5 are designed to provide an early warning for assessment of potential exceedances of this performance measure.

Leakage from the Woronora Reservoir to the surrounding groundwater environment would occur if there is a reversal of hydraulic gradient (i.e. if the water table in surrounding piezometers falls below the water level in the Woronora Reservoir).

[1] SLR, 2020. Metropolitan Coal Groundwater Investigation into water level changes at bore T3 and T5. 21 September 2000.

Bores T2 and T5 maintain a hydraulic gradient to the reservoir, whereas bore T3-R has a water level almost coincident with reservoir level. However, this does not imply an absence of hydraulic gradient, as the intervening bore T2 defines the effective hydraulic gradient close to the reservoir. Both T3-R and T5 show localised depressurisation of the groundwater, in the case of T5 definitely due to mining beneath the bore, and in the case of T3-R probably due to mining directly beneath the bore.

4 Conclusion and Recommendations

In accordance with the Trigger Action Response Plan, investigations have been conducted into observed exceedances of the Level 3 groundwater trigger levels associated with bores T2, T3 and T5 in the form of the gradient from T2 to the reservoir, the gradient from T3 to the reservoir, and the gradient from bore T5 to bore T3.

It is to be expected that the water level at T3 should rise gradually in response to rising reservoir level, as has happened at T1 and T2. A Level 3 performance indicator is likely to pertain until the completion of Longwall 306.

Although an exceedance has occurred for the gradient between bore T3 and the reservoir, there has not been a reversal of gradient from T3 to the Woronora Reservoir that would induce leakage from the reservoir (the performance measure) because the intervening bore T2 still shows an hydraulic gradient towards the reservoir (Figure 1), and its water level increased following the heavy rainfall event in March 2021. The depressurisation at bore T3-R is localised. A review of the data after a significant increase in the reservoir level will conclude if T3-R is connected to the reservoir.

The slow decline in the bore T5 water level, coupled with a slower decline at bore T3, has caused the (T5-T3) head difference to reduce slowly towards and across the Level 3 threshold for the gradient from T5 to T3, as shown in Figure 5.

The Longwalls 305-307 Water Management Plan requires Metropolitan Coal to consider the need for management measures following the exceedance of a performance indicator.

- Performance indicator (T3-WRL): No specific management measure is considered to be required at this time. A heavy rainfall event is awaited to clarify whether the water level at T3-R is permanently low or whether it will recover after the passage of Longwall 306 directly beneath the bore.
- Performance indicator (T5-T3): No specific management measure is considered to be required, other than ongoing monitoring and a check on performance each month. There is still a substantial hydraulic gradient to the reservoir, with a head difference of about 15m.

It is recommended also that the water level at bore T1 be endorsed as a surrogate reservoir level, as the data at T1 are collected at the same frequency as measurements at bore T3-R, and the levels at bore T1 automatically take into account the effect of an obsolete weir when main reservoir levels are very low.

Yours sincerely

Noel Merrick

0424 183 495

Checked/
Authorised by: IE

Figure 1 Google Earth view looking east showing the old weir and Bores T1 to T5

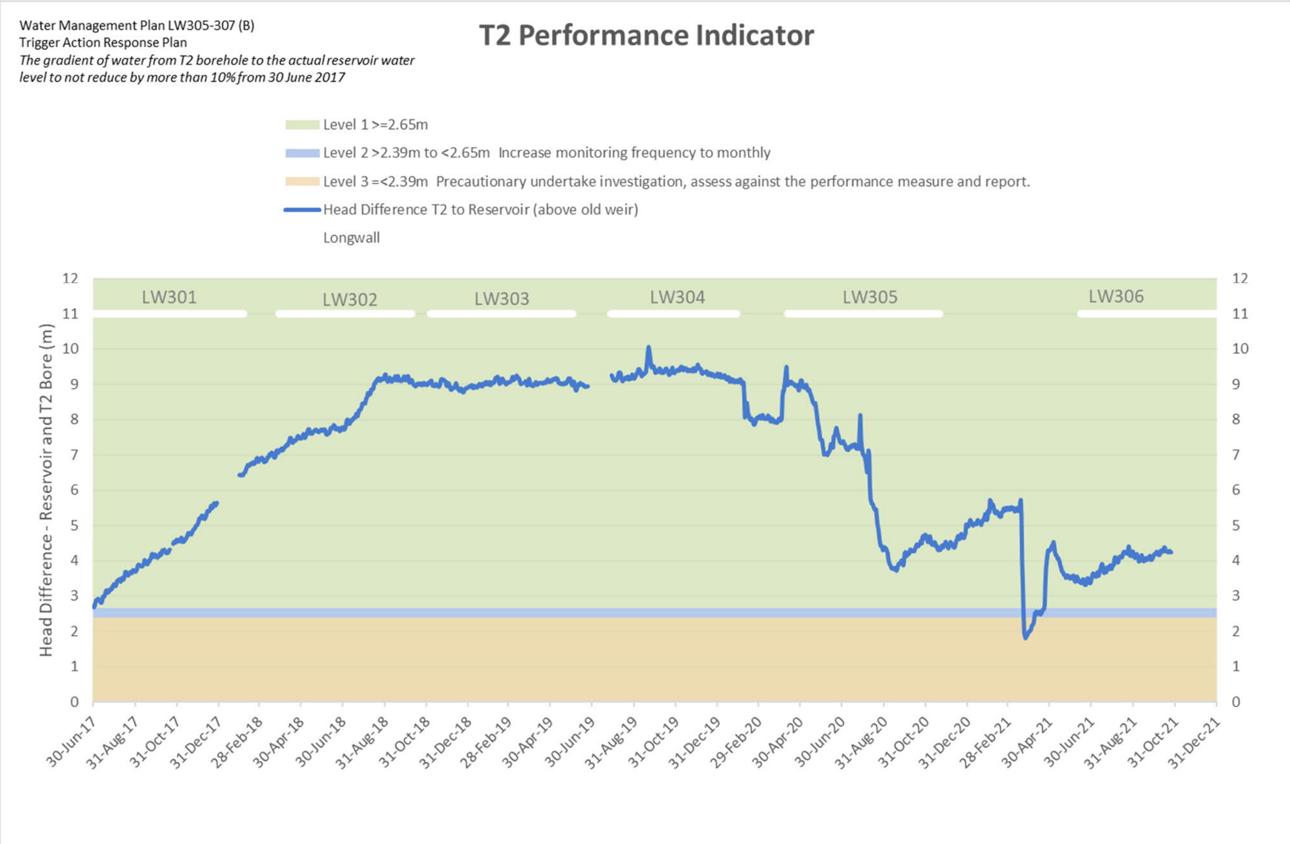


Figure 2 Performance indicator for Bores T2-WRL

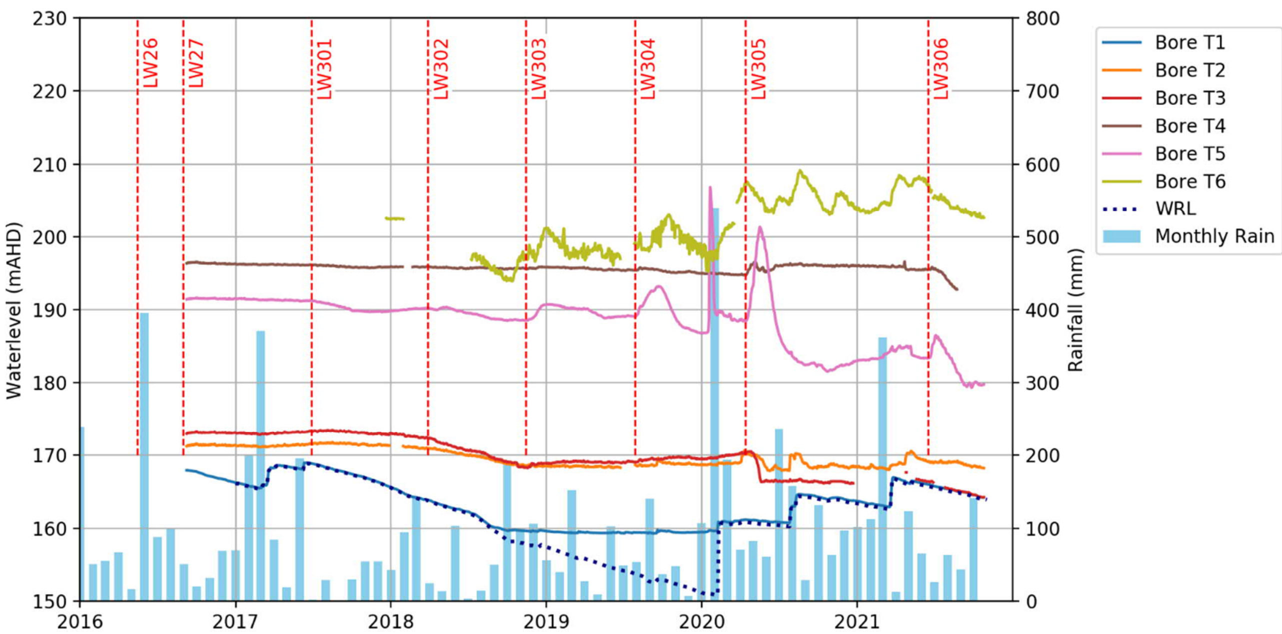


Figure 3 Groundwater hydrographs for bores T1 to T6 compared with reservoir water level and rainfall

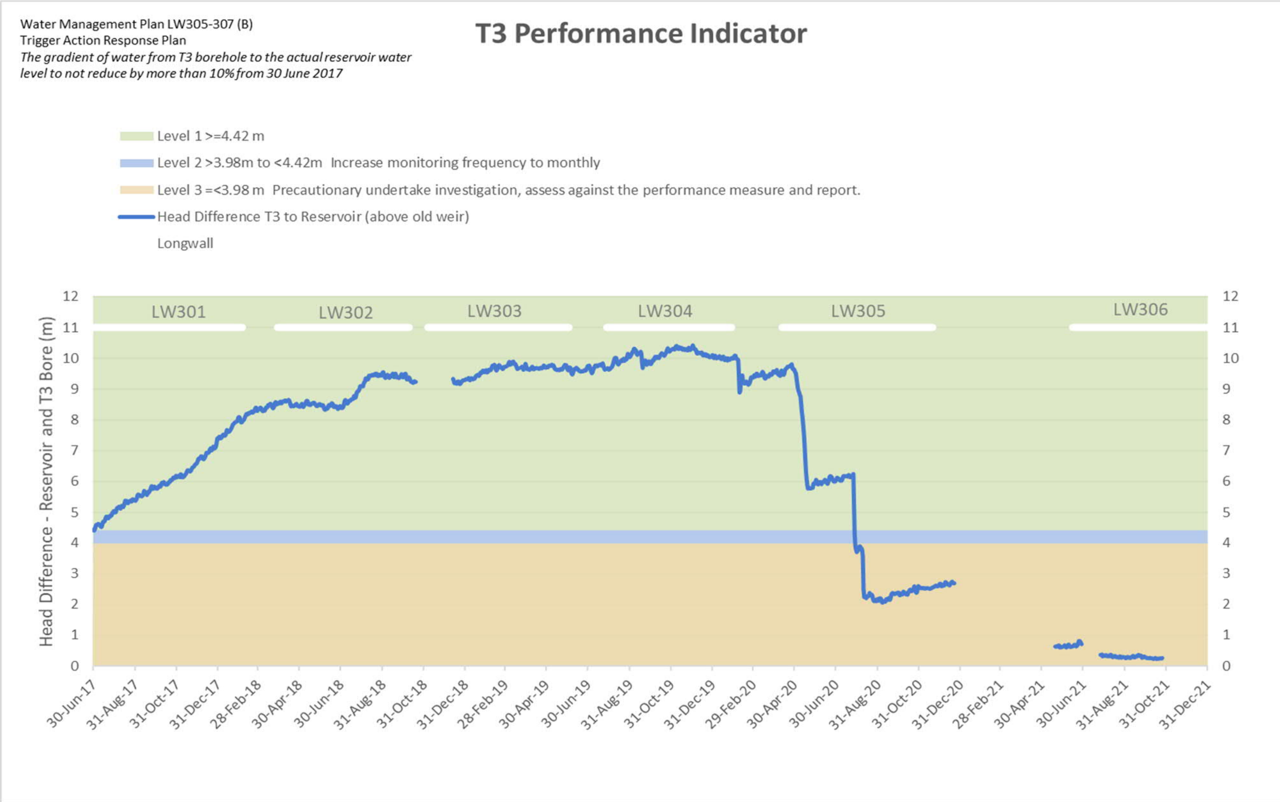


Figure 4 Performance indicator for Bores T3-WRL

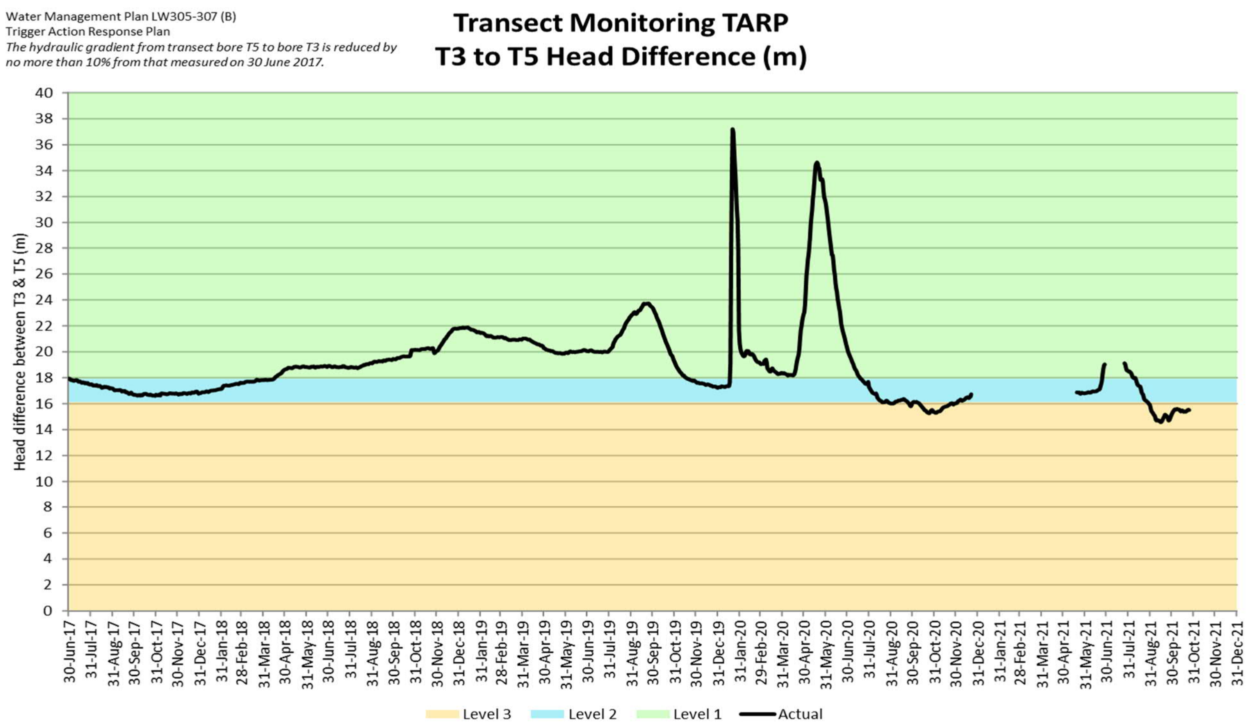


Figure 5 Performance indicator for Bores T3 and T5

Nature Conservation Council
The voice for nature in NSW

19 April 2022

The Hon. Anthony Roberts MP
GPO Box 5341
SYDNEY NSW 2001
Via email: office@roberts.minister.nsw.gov.au

Dear Minister Roberts,

Concerns regarding mining the Woronora Reservoir catchment

We write to draw your attention to the attached letter sent to Manager of Technical Services for Peabody, Jon Degotardi. The letter raises concerns regarding the accumulating impacts of undermining the Woronora Reservoir catchment. There is evidence indicating mining under the reservoir is impacting both water quantity and quality. As you know, Woronora Dam is an important water resource being the main water supply to the Sutherland Shire and surrounding areas. Our letter to Peabody addresses specifically the water quantity issues with a further letter to follow setting out water quality impacts.

Recent data suggest that the relatively conservative and deep mining at Metropolitan Mine, contrary to design and prediction, may have significantly depleted the upper aquifer over the mining area, diverting water away from the reservoir. The data do not exclude the possibility that the diverted water includes a component from the reservoir. Exacerbating losses from historical mining, water losses grow and accumulate as mining proceeds, together with water quality degradation caused by flow diversions through fractures.

Inadequate monitoring installations hinder or preclude a reliable determination of the significance of these impacts. Therefore, it is not possible to reliably determine whether or not they breach the Performance Measure requirements of "*Negligible reduction to the quantity of water resources reaching the Woronora Reservoir*" and "*Negligible leakage from the Woronora Reservoir*". More stringent monitoring requirements are needed to ensure Peabody is compliant with the Performance Measures.

Nature Conservation Council of NSW
Jacqui Mumford Deputy Chief Executive

PO Box 721, BROADWAY NSW 2008
jmumford@nature.org.au
www.nature.org.au

Compounding these concerns are questionable, if not inappropriate, responses to Performance Indicator breaches and inadequate impact response triggers in trigger action response plans (**TARPs**). These breach responses and the groundwater assessments for the mine further undermine confidence in assessments sourced and funded by Peabody.

The consultant responsible for the assessments has notably provided incorrect and misleading assessment for Areas 2, 3A and early Area 3B extractions at the Dendrobium mine. The TARPs for the 300 series extractions appear to lack recognition of earlier mining. That is, the reference date for impact and consequence assessments is June 2017, whereas the expansion project commenced in 2009.

As noted above, a second letter to Peabody will raise concerns that impacts at Metropolitan may have exceeded the Performance Measure requirements of negligible reduction in water reaching and within the reservoir, with negative effects on water quality.

Our concerns regarding the impact the mine is likely to have on water quality and quantity are significant. We ask that you strongly consider delaying the approval of Longwalls 308 to 310 until the concerns outlined in our attached letter to Peabody are reviewed and addressed through appropriate investigations and independent modelling.

We respectfully request a meeting with you to discuss our concerns. Please kindly let us know by Tuesday 3 May 2022 your availability for a meeting but contacting Executive Officer, Jacquelyn Johnson on jjohnson@nature.org.au or 9516 0461.

Regards,

Jacqui Mumford
Deputy Chief Executive

CC Clay Preshaw, Jessie Evans, Fiona Smith, Garvin Burns, DSNSW, IAPUM

MDPE22/705

Ms Jacqui Mumford
Deputy Chief Executive
Nature Conservation Council of NSW
PO Box 721
BROADWAY NSW 2008

Via email: jmumford@nature.org.au

Dear Ms Mumford

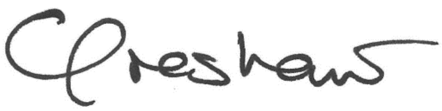
Thank you for your correspondence to the Hon. Anthony Roberts MP, Minister for Planning and Minister for Homes regarding mining under the Woronora River catchment. The Minister asked me to respond on his behalf.

I acknowledge the concerns raised by the Nature Conservation Society (NCC) about the potential impact of mining at this location, and note the letter sent by the NCC to Metropolitan Coal's Manager of Technical Services, Mr Jon Degotardi.

I can confirm that the Department of Planning and Environment (Department) is further considering the issues the NCC has raised. Please note that given the technical nature and details raised in your correspondence, this further consideration may take some time. The Department expects it should be in a position to provide a more detailed response to the NCC in four to six weeks.

If you have any more questions, please contact Ms Jesse Evans, Director, Resource Assessments at the Department on 8275 1374.

Yours sincerely



10/05/2022

Clay Preshaw
Executive Director
Energy, Resources and Industry

Ms Jacqui Mumford
Deputy Chief Executive
Nature Conservation Council of NSW
PO Box 721
BROADWAY NSW 2008

Via email: jmumford@nature.org.au

Dear Ms Mumford

I refer to my letter dated 10 May 2022 which confirmed that the Department was further considering the issues raised by the Nature Conservation Council (NCC) in its letter to Metropolitan Coal's Manager of Technical Services, Mr Jon Degotardi dated 19 April 2022.

I note that Mr Degotardi has responded directly to NCC and copied the Department in on 26 May 2022. The Department has carefully reviewed this response and considered its contents in consultation with WaterNSW. Based on this review, the Department considers that no breach of the performance measures as set out in the Metropolitan Coal Mine consent conditions has occurred.

I wish to further acknowledge the concerns raised by the NCC regarding the existing monitoring installations and requirements at the Metropolitan Coal Mine. I can advise that the Department is currently undertaking a comprehensive assessment of the Metropolitan Coal Mine Extraction Plan for Longwalls 308 to 310 in consultation with key Government agencies.

The Department will consider the adequacy of the existing monitoring program as part of its assessment of this extraction plan and will require additional monitoring locations be installed if considered necessary.

With regard to your request to delay the approval of Longwalls 308 to 310 pending further investigations, I note that the Independent Advisory Panel for Underground Mining will review the current Extraction Plan application and provide advice to the Department prior to any approval being issued.

Should you have any questions, you are welcome to contact Ms Jessie Evans, Director, Resource Assessments, at the Department on 8275 1374.

Thank you for bringing this complex and important matter to the NSW Government's attention.

Yours sincerely

11/07/2022

Clay Preshaw
Executive Director
Energy, Resources and Industry Assessment