

SUBMISSION TO THE INDEPENDENT EXPERT PANEL FOR MINING IN THE CATCHMENT

March 2019

The three key issues raised in this submission are outlined below, with a summary of the associated recommendations.

1. Environmental consequences

There is now strong evidence that the environmental consequences from mining in the Special Areas are greater than predicted when the mining was proposed and approved. Importantly, some of these environmental consequences have caused (or are likely to cause) breaches of conditions in the relevant development consents, including performance criteria to protect watercourses and Sydney's drinking water catchment.

Recommendations

1. Restrictions on future mining at Dendrobium and Metropolitan
2. Performance criteria of "negligible" quantified for all 'significant' natural features
3. Less reliance on remediation as a mitigation measure
4. Estimates on catchment water loss and advice on appropriate thresholds, and
5. A risk assessment approach based on thresholds for catchment water loss.

2. Monitoring and analysis

While the level of monitoring and analysis of mining impacts has improved substantially in recent years, there are still considerable improvements that need to be made to ensure that decision-makers have an adequate understanding about current and likely impacts and consequences. WaterNSW undertakes routine reviews of its monitoring network for our purposes, however the mining companies should generally bear the cost of undertaking additional monitoring and analysis associated with mining impacts.

Recommendations

1. Strengthened baseline and post-mining monitoring funded by mining companies
2. Development of analysis and modelling standards
3. Mining industry funded research on the analysis of mining impacts in the catchment
4. A centralised, open-source monitoring database, and
5. An integrated regional model for groundwater, surface water and subsidence.

3. Regulation of mining

Given recent advances in understanding mining impacts in the catchment, WaterNSW considers that there are also numerous improvements that should be made to the regulation of mining in the Special Areas. It is particularly important that the NSW Government sets appropriate thresholds for cumulative impacts on water quantity, which can then be used to assess existing impacts and inform future performance measures.

Recommendations

1. Creation of an interagency taskforce to establish thresholds for catchment water loss
2. Improved TARPs with 'real' actions and responses
3. Establishment of an ongoing independent expert review panel
4. Improvements to surface water licensing within the Special Areas, and
5. Earlier lodgement of applications for mining in the catchment.

INTRODUCTION

This is WaterNSW's second submission to the Independent Expert Panel for Mining in the Catchment (the Panel), following a detailed submission in May 2018 which addressed the Panel's first Term of Reference. The Panel has since published its *Initial report on specific activities at the Metropolitan and Dendrobium coal mines* (the Initial Report).

Comments on Initial Report

WaterNSW would like to commend the Panel on the quality and depth of its Initial Report. WaterNSW is strongly supportive of the work that the Panel is undertaking.

The issues presented in the Initial Report are complex and highly technical. The Panel's specialist knowledge has helped to clarify the complex nature of mining-related effects, impacts and environmental consequences in the Special Areas.

Purpose of this submission

WaterNSW has an important statutory role "to protect and enhance the quality and quantity of water in declared catchment areas". It also has a set of 'Mining Principles' which includes a requirement for mining companies to "demonstrate a very low risk of water loss from catchment streams or storages".

Our statutory function to protect the catchment is a key focus of this submission, however WaterNSW also brings unique experience and understanding of mining in the catchment, which it has used to comment on the relevant issues in a broader context.

The objectives of WaterNSW's second submission are to:

- respond to the key findings and recommendations in the Panel's Initial Report and provide additional information, where relevant; and
- provide comments and recommendations to the Panel to inform its inquiries on the second Term of Reference, particularly in relation to risks on water quantity, swamp impacts and cumulative impacts.

1. ENVIRONMENTAL CONSEQUENCES

WaterNSW has four key concerns about the environmental consequences of mining in the Special Areas of the catchment, being:

1. Impacts and consequences beyond those that were predicted
2. Exceedances of performance criteria in development consents
3. Difficulties in remediating impacts, and
4. Cumulative impacts on Sydney's drinking water catchment.

1.1 Impacts and consequences greater than predicted

WaterNSW is well-placed to comment on observed impacts and consequences from mining as it has officers who are regularly 'on the ground' in the catchment and it closely inspects all observed impacts.

Much of the following commentary is discussed in greater detail in the comments we have provided to regulators and mining companies on the *Metropolitan 2017 Annual Review* and the *Dendrobium LW13 End-of-Panel Report*.

There is now a long list of environmental features that have likely experienced greater impacts than predicted when the mining was approved at Dendrobium and Metropolitan coal mines (see **Attachment A**). The prime example of this is seen in the extensive fracturing and desiccation in WC21, which has led to desaturation of the shallow aquifer up to 90 m

deep. Fracturing and flow diversion has also been observed in the upper section of Donalds Castle Creek, where subsidence effects have exceeded predictions.

Based on recent observations and inspections, WaterNSW considers that there is evidence that mining-related impacts and consequences on other environment features at Dendrobium have exceeded predictions, including impacts on WC15, WC17, SC10C and Avon Tributary LA4. It is also generally accepted that the observed impacts on numerous swamps at both Dendrobium (Swamps 1a, 1b, 5, 8, 10, 11, 12, and 15b) and Metropolitan (Swamps 20 and 28) have exceeded the expected levels of impact.

While each of the exceedances of predictions at these mines in isolation may not be considered significant, the accumulation of multiple unexpected mining impacts is a growing concern for WaterNSW, particularly given the sensitive nature of the Special Areas.

The continued exceedance of predictions demonstrates the fundamental uncertainties associated with assessing potential impacts of mining in this environment.

These exceedances significantly reduce confidence in the ability of mining companies to reliably predict the likely impacts of mining activities. With the benefit of hindsight, it can be observed that predicted impacts and consequences have often proved to be under-estimates, with decision-making about future mining activities then being informed by these under-estimates.

1.2 Exceedances of performance criteria

The pattern of underestimating predictions has ultimately led to at least one acknowledged exceedance of a performance measure for a significant environmental feature (Eastern Tributary) at the Metropolitan coal mine.

WaterNSW notes that the Panel acknowledged in the Initial Report that:

... limitations in monitoring and modelling mean that it is difficult to verify conclusions by mining companies that mining has had negligible consequences on surface water supplies.

WaterNSW appreciates that Metropolitan Coal has accepted an exceedance of its performance criteria in relation to Eastern Tributary. However, WaterNSW considers that there are numerous lines of evidence to suggest that performance criteria have been (or are likely to be) exceeded at the Dendrobium coal mine, including:

- Water quantity in Wongawilli Creek, and
- Water quantity in Avon and Cordeaux Reservoirs.

Wongawilli Creek

WaterNSW considers that there is evidence to suggest that the following performance measure at Dendrobium has been exceeded:

The Applicant must ensure that underground mining operations do not cause subsidence impacts at Sandy Creek and Wongawilli Creek other than “minor impacts” (such as minor fracturing, gas release, iron staining and minor impacts on water flows, water levels and water quality), to the satisfaction of the Secretary.

Since 2018, a recurring decline in Pool 43A in Wongawilli Creek has been observed. During a dry weather period in May-June 2018, Wongawilli Creek stopped flowing over a 1.4 km stretch flanked by Area 3A longwalls to the east and Area 3B longwalls to the west. This dry zone extending upstream and downstream from Pool 43A comprises around 25% of the length of this stream within the Area 3B assessment area. During this period, water was present both upstream and downstream of this section of Wongawilli Creek.

WaterNSW concurs with Illawarra Coal's assessment that the primary reason for this drying is that groundwater levels within the Hawkesbury Sandstone aquifer in the surrounding ridges have dropped significantly, which has reduced baseflow. WaterNSW also considers that it is possible that basal shear planes have developed near or below the base of the Wongawilli Creek valley and that these are providing more rapid conduits for surface water to move towards the goaves over the surrounding longwalls.

Avon Reservoir (and Cordeaux Reservoir)

WaterNSW considers that there is evidence to suggest that the following performance measure at Dendrobium may also have been (or is likely to be) exceeded:

The Applicant shall ensure the development does not result in reduction (other than negligible reduction) in the quality or quantity of surface water or groundwater inflows to Lake Cordeaux or Lake Avon or surface water inflow to the Cordeaux River at its confluence with Wongawilli Creek, to the satisfaction of the Secretary.

There are two primary ways that mining impacts may have reduced the quantity of surface water and groundwater reaching Lake Cordeaux or Lake Avon:

1. reductions in stream flows (e.g. Sandy Creek in Cordeaux Reservoir catchment and LA4 in the Avon Reservoir catchment) due to diversions induced by cracking and/or reduced stream baseflows due to lowered groundwater levels; and
2. reductions in baseflow contributed directly to the reservoir by surrounding groundwater in neighboring ridge aquifers.

Numerous investigations in Area 3B at Dendrobium have confirmed an increase in the permeability of rock between Longwalls 12-18 and Avon Reservoir following extraction of adjacent longwalls, and in some areas a reversal of groundwater gradients has occurred. Currently the most definitive estimate of likely increased groundwater flow reductions induced from Avon Reservoir is 0.7 megalitres (ML) per day. However, this prediction only includes extraction up to Longwall 16 and does not include the contribution of potential flow reductions from stream LA4 and the valley side. WaterNSW notes that there are increased risks to Avon Reservoir from Longwalls 17 and 18 due to inferred faulting and foliation within this barrier pillar area.

While the current estimates of flow reductions at Avon Reservoir do not exceed the Dam Safety Committee's tolerable loss criteria of 1 ML/dam/day, WaterNSW considers that it is likely that the extraction of additional longwalls (i.e. 17 and 18) would result in a loss of more than 1 ML/day from the reservoir.

WaterNSW is also concerned that the same criteria may have already been exceeded as a result of mining Areas 1, 2 and 3A around Cordeaux Reservoir. In that regard, WaterNSW agrees with the recommendation in PSM's *Height of Cracking* report (2017) that this issue requires further investigation.

The presence of faulting is also a potential issue at Metropolitan, as a fault has been identified in the workings that coincides with a prominent lineament at the surface and aligns with the lower stretch of Eastern Tributary.

Further, the presence of basal shear planes with increased permeabilities has been confirmed at Dendrobium and inferred at Metropolitan.

1.3 Remediation difficulties

WaterNSW agrees that the remedial grouting of three rockbars in Waratah Rivulet has been successful in restoring a substantial proportion of natural flows (following a 10-year, multi-million dollar effort). However, the actual proportion of natural flow cannot be quantified due to inadequate baseline monitoring and a lack of any agreed remedial success methodology.

Further, the success of this remediation depended in large part on the unique ease of access to the affected rockbars in this broad, open stream.

WaterNSW is currently facilitating access to Illawarra Coal to trial the application of grout (using directional drilling) beneath an affected Swamp 1B to repair the natural aquitard below the swamp. WaterNSW is not aware whether this type of remediation has ever been attempted before, and numerous challenges confront this trial.

WaterNSW is also facilitating access to the WC21 valley for remediation efforts, however the almost total drying of this stream and supporting aquifer makes the likelihood of recovering natural flows very low. The mining company acknowledges that this remediation trial is limited to targeted pools draining more slowly following rainfall, which may allow these pools to provide some refuge for riparian fauna.

In summary, notwithstanding the relative success of remediation in Waratah Rivulet, there is a high level of uncertainty about the likely success of future remediation efforts in both watercourses and swamps. Consequently, WaterNSW considers that further mining in the Special Areas should not be approved on the basis that potential impacts could be remediated at some point in the future.

1.4 Cumulative impacts on catchment

The Panel’s second Term of Reference requires a particular focus on the “risks to the quantity of water available” in the Special Areas and the “issue of cumulative impacts”.

It is now clear that subsidence effects over both of the operating mines in the Special Areas are causing impacts on groundwater levels and surface water flows, which is a risk to the quantity of water available in the Special Areas.

WaterNSW agrees with the finding in the Initial Report that the impacts over Dendrobium are more significant than over Metropolitan. The cumulative impacts of the operating mines (in addition to other historic mining activities) is also a major concern for WaterNSW.

There are a range of methods that have already been used to estimate the loss of water available in the catchment. For example, Table 1 provides a summary of three different methods used to estimate surface water losses at Dendrobium.

Table 1: Recent surface water loss estimates for Dendrobium Mine

Method	Surface water loss estimates (volume/year)	WaterNSW comment
HydroSimulations, 2018 (Table 5-4)	Total loss of 320 ML/a in 2018, maximum 690 ML/a in 2021-2025	Groundwater model estimation of surface water losses are considered by WaterNSW as inappropriate due to its low accuracy and certainty for this purpose.
Mackie, 2016	Average of 830 ML/a between 2010 and 2016.	Estimate based on correlation between mine inflows and rainfall, and is likely to only account for water that moves relatively quickly from surface to void. WaterNSW considers this a highly conservative but relatively direct and reliable estimation method for a proportion of surface water losses.
Panel’s Initial Report, 2018	1,100 ML/a up to LW16, potentially rising to 1,280 ML/a by LW18 completion	This methodology appears to be a combination of the Mackie (2016) method applied over a longer timeframe with some allowance for runoff diversion. The estimate is considered by WaterNSW to be conservative, as it does not appear to account for slow-rate losses such as induced leakage from storages.

WaterNSW considers that the methods used in Table 1 are likely to underestimate the total losses, and has engaged an independent expert to trial a new method using the relationship between flow losses and the undermined area to calculate overland flow losses. Although the results of that work are currently considered to be preliminary and the uncertainties are

high, they do suggest that the results summarised in Table 1 underestimate the volumes of water being permanently diverted from overlying catchments.

Table 1 illustrates that there are a wide range of estimates about mining-related surface water losses at Dendrobium, ranging from 320 to 1,280 ML per year. Even at the lower estimates, WaterNSW has concerns about these losses and considers that this issue needs to be further investigated, taking into account cumulative impacts from previous and current mining activities.

1.5 Recommendations

1. Restrictions on future mining at Dendrobium and Metropolitan

Given the uncertainty associated with predictions of environmental consequences, WaterNSW considers a precautionary approach to the assessment and determination of mining proposals within the Special Areas is warranted. There must be a high degree of confidence that any proposed mining does not exceed key predictions or performance measures in development consents, Subsidence Management Plans (SMPs) and Extraction Plans.

On that basis, no further approvals should be given for mining that would permit the level of environmental impacts and consequences that have occurred in Wongawilli Creek, WC21, and Swamps 1a, 1b and 5 at Dendrobium, and Waratah Rivulet and Eastern Tributary at Metropolitan.

In particular, WaterNSW recommends:

- for Longwalls 17 and 18 at Dendrobium, the mining dimensions should be restricted to prevent increasing the environmental consequences on Wongawilli Creek and Avon Reservoir (e.g. substantial narrowing of longwalls and greater setbacks from Avon Reservoir), particularly given the presence of local geological structures, and
- for Longwalls 303 to 306 at Metropolitan, a substantial setback from Eastern Tributary should be maintained to prevent any further environmental impacts or consequences, particularly given the performance criteria has already been exceeded and shear planes and lineaments are likely to exist.

2. Performance criteria of “negligible” for all ‘significant’ natural features

In any future development consents for mining in the Special Areas, a ‘negligible environmental consequence’ performance measure should be imposed for all ‘significant’ watercourses and swamps (see Recommendation 1 in Section 3).

3. Less reliance on remediation as a mitigation measure

There should not be an option to remediate or offset any impacts on ‘significant’ natural features (including watercourses and swamps) in approval conditions, given the difficulties and uncertainties in successfully remediating or providing like-for-like offsets.

4. Estimates on catchment surface water loss and advice on appropriate thresholds

WaterNSW requests that the Panel provide:

- an estimate of the cumulative impacts of previous and existing mining activities on surface water losses across the Special Areas of the catchment, and
- advice to the NSW government on a suitable approach to establishing quantitative thresholds for the loss of water quantity in Sydney’s drinking water catchment due to mining activities.

5. Risk assessment based on quantitative thresholds

Any applications for future mining in the Special Areas should be approved only following a robust and independently verified risk assessment that is assessed against agreed quantitative thresholds for catchment water loss (see Recommendation 1 in Section 3).

2. MONITORING AND ANALYSIS

WaterNSW considers that the monitoring and analysis of mining activities in the Special Areas has improved in recent times, however there is a need for ongoing improvement.

2.1 Monitoring

WaterNSW notes that the Panel made the following recommendation in its Initial Report:

WaterNSW should re-evaluate the adequacy of its monitoring network considering current and future pressures on the catchments, and give consideration of the future long-term value of monitoring sites developed by the mining companies.

WaterNSW recognises the importance of obtaining long-term monitoring data across the catchments in order to assist in assessing potential mining impacts.

WaterNSW undertakes routine reviews of its monitoring network and has an ongoing program of augmentation where required for our purposes. WaterNSW is also working with the Department of Industry – Water Division (DoI Water) in providing long-term, high quality groundwater monitoring in key catchment locations. DoI Water has recently installed a number of new screened piezometers at strategic locations around the Southern Coalfield, including several within the Special Areas.

Where these impacts are caused by a third party, WaterNSW considers that the monitoring costs should be borne by that party. Ultimately, WaterNSW considers that the mining companies operating within the catchment should bear the primary responsibility for undertaking monitoring that will enable the consequences of their operations within the Special Areas to be adequately understood.

There are two key areas that the mining companies need to improve in their monitoring:

- Baseline monitoring: while numerous government guidelines recommend at least two years of baseline data, it is not uncommon for mining companies to have presented less than that. WaterNSW supports a minimum of four years for sensitive features.
- Post-mining monitoring: all mining company monitoring programs to date have ceased before new, post-mining equilibria in water regimes are established. In particular, vibrating wire piezometers are typically decommissioned within 15 years of mining, which means it is not possible to verify subsequent groundwater conditions.

2.2 Analysis

WaterNSW considers that there are numerous deficiencies in the manner that analysis and modelling is currently being used to support mining applications in the catchment.

The key issues are:

- Uncertainty analysis: the assumptions in the models and uncertainties in results are not adequately disclosed or discussed in modelling reports, and the suitability and applicability of the chosen model needs to be justified.
- Calibration: the methods of calibration are variable (sometimes qualitative, sometimes automated) and generally poorly documented and disclosed in the relevant documentation.
- Peer review: there is inconsistency in the approach to peer reviews across mining companies, and often revised or supplementary reports are not peer reviewed.

- Integrated approach: mining companies generally engage a variety of technical specialists and there is often a lack of integrated cross-disciplinary analysis in the documentation associated with mining applications. This makes it difficult to assess the potential impacts of a proposal and constrains the accuracy of the various predictions.

2.3 Recommendations

1. Strengthened baseline and post-mining monitoring

Monitoring of baseline (pre-mining) conditions for significant environmental features (e.g. watercourses and swamps) should commence a minimum of four years prior to mining, and a minimum of two years prior to the lodgement of an application.

Mining companies in the Special Areas should also be required to undertake post-mining monitoring until new equilibrium conditions have been established and ongoing surface water losses and groundwater level reductions have been adequately accounted for and licensed. If necessary, this may require monitoring equipment to be replaced until these conditions have been confirmed.

2. Development of analysis and modelling standards

WaterNSW supports the Panel's overarching recommendation to develop a "*standard for field investigations, data collection and data processing*". In accordance with that recommendation, WaterNSW considers that mining companies should adopt a more consistent, structured approach to analysis and modelling, including:

- Pre-modelling discussions – involving key stakeholders to identify issues early, assess mine design alternatives, define acceptable impact thresholds and consider the most appropriate modelling tools
- A risk assessment approach – to minimise environmental consequences and identify suitable monitoring
- An iterative process of modelling – to ensure results are sensible and model complexity is appropriate for proposal and environment interactions
- Clearly presenting all relevant data – including parameter values, assumptions and uncertainties, and utilising visual presentations where possible
- Transparent peer review process – including pre-approval of the peer reviewer and ongoing involvement throughout revisions of relevant documents, and
- Cross-discipline integration of findings and analysis.

3. Mining industry funded research

The mining industry should provide funding for research on mining impacts in the Special Areas of the catchment. The most pressing task is to identify a predictive relationship between mine dimensions and environmental consequences, particularly on surface water resources.

4. Centralised monitoring database

A monitoring database in open source format should be established to store all relevant government and industry environmental monitoring and impact data. A system of regular, automated uploads and data quality control would also be required.

5. Integrated regional model

WaterNSW requests that the Panel consider the feasibility of the development of an integrated geotechnical, surface water and groundwater model in the Special Areas or across the catchment. If the Panel considers it is feasible, then it should be developed by the NSW government and utilised by regulators and mining companies. If not, advice should be provided about any information gaps or implementation problems need to be addressed.

3. IMPROVING MINING REGULATION IN THE SPECIAL AREAS

While mining impacts continue to occur in the Special Areas, WaterNSW recognises that in recent years the Government has spent considerable resources and taken important steps to strengthen both its assessment and regulation of mining.

Nevertheless, the regulation of mining activities in such a complex and sensitive environment demands a flexible approach and a process of continuous improvement.

3.1 Performance criteria

Based on the *Southern Coalfield Inquiry* (2008) and subsequent experience, there are three key steps to ensure effective implementation of performance criteria for environmental features:

1. Identify and classify the 'significance' of features

In order to set the desired regulatory outcomes for particular environmental features, it is first necessary to understand their value and 'significance'. However, there is not currently a standardised categorisation of levels of significance for key natural features.

The performance measures in both the Dendrobium and Metropolitan development consents do not reflect a contemporary understanding of the value or significance of various environmental features.

For example, these consents use the Strahler order of streams to categorise the significance of watercourses i.e. only third order or higher streams are given the highest level of protection. However, this does not necessarily reflect the volume or flow in the watercourse.

2. Establish quantitative performance measures

It is essential that performance measures are quantitative, unambiguous and measurable. There must also be clear actions linked to any exceedance of the performance measure e.g. cease mining. However, there is a level of ambiguity in the Dendrobium and Metropolitan consents as some of the key terms are not well-defined or quantitative.

3. Develop practical TARPs

As discussed in WaterNSW's first submission, the Trigger Action Response Plans (TARPs) at Dendrobium and Metropolitan should be improved to make them less ambiguous and more closely tied to adaptive management processes where possible. Actions should escalate proportionally if impacts continue or expand.

3.2 Ongoing independent expert review

WaterNSW acknowledges the important advances in understanding which have been provided in the past three years by the independent review of height of fracturing issues commissioned by the NSW Government and the Panel's Initial Report.

The Panel has made major new findings about the inferred presence of surface-to-seam cracking and the reductions in surface water yields that are being diverted from WaterNSW's collection systems. In addition, the Panel recently identified the likelihood of additional consequences of Longwall 303 on Eastern Tributary.

It is WaterNSW's strong view that ongoing independent expert review is needed to verify predicted effects, impacts and consequences and to address current regulatory gaps, particularly in relation to future strategic plans for coal extraction within Sydney's drinking water catchment.

3.3 Surface water licensing in the Special Areas

There is a unique surface water licensing arrangement currently in operation within the Special Areas of the catchment. It is generally inconsistent with licensing arrangements elsewhere in NSW and changes the obligations on mining companies to hold appropriate surface water licences for any water take. Any questions on the existing arrangements or the availability of alternative options should be directed to DoI Water.

3.4 Timing of lodgement of applications for mining

The technical complexities associated with mining in sensitive areas of the catchment has inevitably led to delays in the assessment of SMPs and Extraction Plans. In recent years, the Department of Planning and Environment and all relevant stakeholders have been asked to provide advice and make decisions in increasingly shorter timeframes. It is essential that the Department is not 'wedged' into making a decision and that all stakeholders have sufficient time to provide comprehensive and robust advice.

3.5 Recommendations

1. Taskforce to establish 'significance' of features and thresholds for catchment water loss

An interagency government taskforce should be created to establish a consistent approach to regulating environmental impacts and consequences of mining in the catchment. This taskforce should:

- investigate the relative value of various natural features, including watercourses and swamps
- agree on levels of 'significance' for these natural features
- establish appropriate performance measures for natural features based on agreed significance levels, and
- set quantitative thresholds for the loss of water quantity in Sydney's drinking water catchment due to mining activities.

2. Improved TARPs with 'real' actions and responses

TARPs should be improved to make them less ambiguous and more quantitative. Clear actions and consequences should be identified and lead to 'real' actions (e.g. cease mining). Trigger thresholds should be informed by performance measures and company predictions. Administrative responses, such as increasing monitoring and reporting, should be removed to their respective management plans.

3. Establishment of an ongoing independent expert review panel

The currently appointed Panel should have its terms of reference extended to:

- provide ongoing independent expert advice on all future applications for mining in the Special Areas of the catchment
- consider the economic benefits of mining in the catchment and explore the strategic approach to resource recovery, and
- provide ongoing advice to the NSW government on technical matters relating to mining in the catchment, as necessary.

4. Improvements to surface water licensing within the Special Areas

The Panel should consult with DoI Water about the reasons behind the surface water licensing arrangements in the Special Areas, and the availability of alternative options.

5. Earlier lodgement of applications for mining

Mining companies should lodge applications for SMPs and Extraction Plans at least six months before a decision is required.

ATTACHMENT A – SUMMARY OF KEY CONSEQUENCES DUE TO MINING IN METROPOLITAN AND WORONORA SPECIAL AREAS SINCE 2008

Table A1 – WaterNSW comments on impacts and consequence due to mining in Metropolitan and Woronora Special Areas since 2008

Natural Feature	Observed Impacts & Environmental Consequences	Significance relative to predictions / performance measures or thresholds	Information Source/ Comments
Dendrobium Mine Area 3A, LWs 6-8, 2009-2012			
Watercourses			
<p>Wongawilli Creek Tributary WC17 and Sandy Creek Tributary SC10C</p>	<ul style="list-style-type: none"> Buckling and fracturing observed in WC17 and SC10C Some surface water flow diversions observed in WC17 and SC10C Fracturing and pool water level losses have occurred at eight pools along WC17, with four of these pools breeding habitat for Littlejohn's Tree Frog. Fracturing and pool draining and level declines in SC10C in over 6 pools have also been similarly impacted as the creek provides known breeding habitat for Littlejohn's Tree Frog. Fracturing in SC10C and WC17 and associated flow diversion and drainage of pools has led observed loss of aquatic habitat and potential biota in affected area Site visits in 2017 indicated that most parts of WC17 and SC10C were completely dry, frequent evidence of cracking & iron-staining in stream bed, no evidence of re-emergence of diverted stream water In times of low-flow the majority, if not all, water is diverted into the dilated strata below & is affecting the quality & quantity of water. Re-emergence of flows are observed only during extended wet periods. 	<p>Predictions and Performance Measures</p> <ul style="list-style-type: none"> The Area 3A SMP predicted that the maximum closure, tensile and compressive strains at WC17 and SC10C would be of sufficient magnitude to result in some fracturing of the uppermost bedrock along the drainage lines. This superficial cracking predicted to result in some diversion of surface water flow into the dilated strata underneath and the draining of pools on the drainage lines. Depth of dilation was predicted be less than 15 m and any diverted surface water was predicted to re-emerge further downstream. There are no performance measures set for these watercourses in approvals. <p>Interpreted Observations – Impacts Greater than Predicted</p> <ul style="list-style-type: none"> Longwalls 6 to 8 undermined WC17 and SC10C between 2009 and 2012. There has been no recovery in pool levels or any re-emergence of water along the creeks even after 5 years in a relatively wet climate period until mid-2018. The observed environmental consequences indicate that the impacts and environmental consequences on WC17 and SC10C have exceeded predictions in the Area 3A SMP. <p>Consequences on Catchment</p> <ul style="list-style-type: none"> The reduction in aquatic and stream pool habitat in SC10C and WC17 has been assessed by IC to be relatively minor in a local or regional scale. The depth to the local water table, and the creek's dependence on groundwater for baseflow, are not currently known. Irreversible permanent changes contributing to adverse cumulative impact on Wongawilli and Sandy Creek sub-catchments. 	 <p>Sandy Creek Tributary SC10C_Pool 7 looking downstream before mining;(17/8/2011) and after mining (17/9/2012) of LW 8.</p> <ul style="list-style-type: none"> MSEC (2007), Subsidence Predictions for Dendrobium Mine Area 3 LWs 7 & 8 End of Panel reports
Swamps			
<p>Swamps 12 and 15b</p>	<ul style="list-style-type: none"> Fracturing of bedrock reported Reduction in Swamp groundwater levels and retention times lower than baseline Monitoring results of shallow Hawkesbury sandstone aquifers adjacent to swamps or perched aquifers within swamps show significant declines Dieback of vegetation (Pouched Coral and Button Grass) observed in Swamp 15b. 	<p>Predictions and Performance Measures</p> <ul style="list-style-type: none"> Maximum predicted total closure at Swamp 12 was 335 mm and 265 mm at Swamp 15B. Maximum predicted tensile and compressive strains induced by conventional subsidence due to Longwalls 7 to 9 may cause cracking in the bedrock. Predictions in SMP documentation that "cracking may lead to the diversion of surface stream flow into the dilated strata leading to some surface water loss. It is likely that this diversion of surface flow will extend to a depth of no greater than 15 m, and any diverted surface water was predicted to re-emerge downstream of Swamp 12 in WC17 and downstream of Swamp 15b on SC10C." There are no performance measures set in approvals for these swamps. <p>Interpreted Observations – Impacts Greater than Predicted</p> <ul style="list-style-type: none"> Even after five years there is no reported re-emergence of water downstream of these valley in-fill swamps which are located upstream along watercourses WC17 and SC10C (significant portions of which downstream of the swamps are completely dry) five years. The status of supporting groundwater levels in the vicinity of the swamps needs to be investigated. 	<ul style="list-style-type: none"> MSEC (2007), Subsidence Predictions for Dendrobium Mine Area 3 LWs 7 & 8 End of Panel reports

Natural Feature	Observed Impacts & Environmental Consequences	Significance relative to predictions / performance measures or thresholds	Information Source/ Comments
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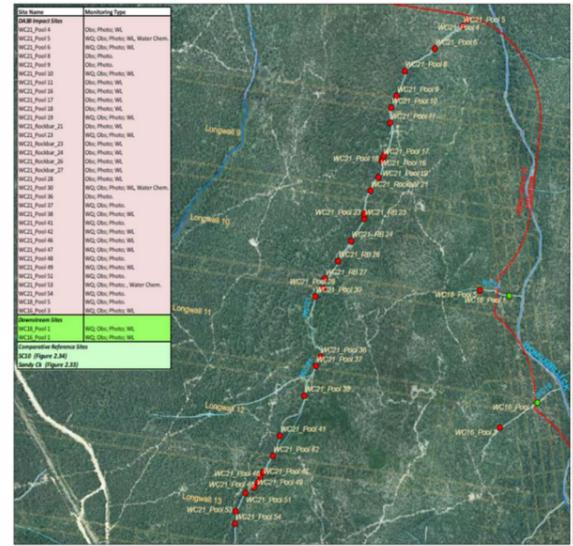
- Statistically significant changes in species composition at Swamp 15B observed since mining of LW8 in 2012.
 - WaterNSW considers that the impacts on Swamps 12 and 15b (and associated watercourses SC10C and WC17) have exceeded EIS and SMP predictions.
- Consequences on Catchment**
- The vegetation changes at Swamp 15b indicate an impact on threatened ecological community Coastal Upland Swamp of the Sydney Basin Bioregion.

Dendrobium Mine Area 3B, LWs 9-14, 2013-2018

Watercourses

- Streambed has been extensively fractured and progressively desiccated as each Area 3B longwall has been extracted from LW9 to LW14.
- Widespread desaturation of shallow aquifer to depths of ~90 m changes substantial portions of stream from gaining to losing conditions.
- As of 2018, 90% of the stream length is semi-permanently dry due to mining impacts.

WC21
(tributary of
Wongawilli
Creek)



Impacted section of WC21 – from Pool 5 downstream of LW9) to Pool 54 (overlying LW13)

Predictions and Performance Measures/Indicators

- Despite being a permanent creek supplying to Sydney’s water supply, no specific Performance Measure was set for WC21 in the Planning Approval or subsequent SMP Applications.
- Documentation supporting the original Subsidence Management Plan (SMP) for Area 3B LW9-18 suggested that fracturing would occur in WC21 but only to a depth of no more than 20 m. If any surface flow was diverted into the new fracture network, it would result only in temporary losses and water would be returned downstream. If “any surface cracks were found not to fill naturally, some remedial measures may be required at the completion of mining. Where necessary any significant surface cracks in the stream beds could be remediated by grouting techniques...”
- Watercourse Impact, Monitoring, Management & Contingency Plan (WIMMCP, IC 2017b) updates the relevant Trigger-Action-Response Plan (TARP) for Area 3B. The applicable Level 3 TARP will be exceeded if “Structural integrity of the bedrock base of any significant pool or controlling rockbar cannot be restored i.e. pool water level within the pool after CMAs continues to be lower than baseline period”. Recent impact reports and the WC21 Rehabilitation Plan make clear that this threshold has been passed as it is now impossible to restore natural flows to this creek, but this has not yet led to any actions or discussion on suitable offsets.

Interpreted Observations – Impacts Greater than Predicted

- The drying and loss of stream connectivity has resulted in complete aquatic habitat loss in 1,710 m almost 90% of the total length of the watercourse) of WC21, is considered by South32 to be a severe impact at the watercourse scale.
- Investigations have revealed that previously gaining groundwater levels have fallen in at least some parts of the stream to at least the base of the supporting Hawkesbury Sandstone aquifer, meaning that flows cannot be restored to pre-mining condition even if proposed remedial grouting is successful.

Consequences on Catchment

WC21 is a significant tributary of Wongawilli Creek with over 55 pools (and rockbars) and includes valley infill Swamp 8 along its length all of which has been impacted. WaterNSW considers the impacts to be severe both from a watercourse scale and a sub-catchment scale.

- LW9, LW10, LW11, LW12 and LW13 End of Panel Reports (e.g. IC, 2018)
- DCC and WC21 Rehabilitation Plan (IC, 2017a, update in progress)
- Review of groundwater monitoring at WC21 - Hgeo, 2018
- WaterNSW review of DCC and WC21 Rehabilitation Plan, 2017
- WIMMCP – IC, 2017b



Photo 39: WC21_Pool 30, looking downstream. Taken on 13/02/2017.



Photo 41: WC21_Pool 29, looking downstream. Taken on 17/05/2016.

Donalds Castle Creek &	<ul style="list-style-type: none"> <u>Donalds Castle Creek (DCC)</u>: surface cracking and drying up of creek in the vicinity of its crossing at Fire Road 6 and at Rockbar and
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Predictions and Performance Measures/Indicators

- Wongawilli Creek and Donalds Castle Creek have a performance measure “Negligible environmental consequence including – minor impacts on water flows, water levels and water quality”. There are no

- LW9, LW10, LW11, LW12 and LW13 End of Panel Report (e.g. IC, 2018)

Natural Feature	Observed Impacts & Environmental Consequences	Significance relative to predictions / performance measures or thresholds	Information Source/ Comments
tributary DC13; Lake Avon Tributary LA4; Wongawilli Creek and Wongawilli Creek tributary WC15	<p>Pool 23 has been observed and reported in May 2016. As of July 2018 approximately 1.4 km of Donalds Castle Creek had experienced water level reductions and was dry.</p> <ul style="list-style-type: none"> DCC tributary DC13 upstream of its confluence with DCC is completely dry during an inspection in May 2016.  <p>Donalds Castle Creek in May 2016 (left - downstream of FR6 crossing and right at rockbar 23) (WaterNSW Mining Inspection Report, 23 Mat 2016)</p> <ul style="list-style-type: none"> <u>Lake Avon tributary LA4</u> – surface cracking and drying up of the creek has been reported due to mining of LW12 and LW13. <u>Wongawilli Creek tributary WC15</u>: Ongoing and unpredicted impacts have been reported during April to June 2018 on the streambed of WC15 due to nearby mining of Longwall 13. Cracking of the streambed of WC15 has been reported over a length of approximately 700 m along the creek bed. Further rockbar & streambed cracking, fracturing and loss of water in pools (28 & 30) have been reported in WC15 during the mining of LW14 in February 2019. None of the impacted sections on WC15 have been directly undermined and South32 had claimed (South32, 2016) that the setback of the eastern end of LW14 from WC15 would “significantly reduce the level of impacts within this stream”. <u>Wongawilli Creek</u>: Pool 43a pool level steadily declining since 2012, reportedly due to baseflow reductions (Watershed Hydrogeo, 2018); Discontinuous surface flows were observed along a 1.4 km stretch of Wongawilli Creek from Wongawilli Creek Pool 44 to Pool 41 downstream during an extended dry period. Conditions observed included no surface flows in large flows with discontinuous surface flow; surface flow returns at WCS1 just downstream of WC21 confluence 	<p>performance measures set for WC15, LA4 and DCC tributary DC13.</p> <ul style="list-style-type: none"> Wongawilli Creek was recognised as a third-order stream under Strahler Classification. Mine designs were amended to protect the stream and no significant reductions in flows or connectivity were predicted in application documents (EcoEngineers, 2000; 2007). Predictions for stream impacts in the various EIS and subsequent SMP applications (e.g. MSEC, 2012) state that appreciable cracking and potential shallow diversion of surface water will only occur in streams which directly overly longwalls. <p>Interpreted Observations – impacts exceeding performance measures and/or exceeding predictions</p> <ul style="list-style-type: none"> It appears almost certain that baseflow reductions caused by reduced groundwater levels (Watershed Hydrogeo, 2018), exacerbated by dry conditions and possibly also basal shear plane connections to over-goaf cracking zones (Attachment E to this submission), are causing a section of Wongawilli Ck centred on Pool 43a between Areas 3A and 3B to periodically become dry, despite flowing stream lengths above and below. WaterNSW considers this a breach of Performance Measures (Attachment F to this submission). Cracking has now been reported over a length of approximately 700 m along the WC15 creek bed, none of which has been undermined to date. WaterNSW considers that these impacts exceed the subsidence predictions quoted above (Attachment E to this submission). Reductions in water levels and flow in Wongawilli Creek, Donalds Castle Creek, WC21, Wc15 and LA4 have resulted in loss of aquatic habitat and a likely reduction in biota. In Wongawilli Creek these losses have occurred along approximately 1.4 km of the watercourse (about 10% of the total 12 km length) and approximately 1.4 km in Donalds Castle Creek. WaterNSW considers that the impacts and consequences in: <ul style="list-style-type: none"> Donalds Castle Creek and Wongawilli Creek have exceeded the performance measure; DC13, LA4 and DC13 are greater than predictions <p>Consequences on Catchment</p> <ul style="list-style-type: none"> Significant sections of Wongawilli Creek and Donalds Castle Creek and their tributaries have been adversely impacted and the cumulative environmental consequences of these impacts on catchment yield and ecology has not been well assessed to date, but is considered to be significant considering Swamps 1a, 1b and 5 are also part of the DCC system and have all been impacted (discussed further below)  <p>Wongawilli Creek Pool 43a (above left) and dry section of Wongawilli Creek downstream of Pool 43a (above right) (Photos taken by WaterNSW during an inspection on 18 July 2018)</p>  <p>Lake Avon Tributary LA4- surface cracking & drying of creek upstream of Lake Avon FSL (WaterNSW)</p>	<ul style="list-style-type: none"> DCC and WC21 Rehabilitation Plan (IC, 2017a, update in progress) WaterNSW Mining Inspection Report, 23 May 2016 Review of groundwater monitoring at WC21 - Hgeo, 2018 WaterNSW review of DCC and WC21 Rehabilitation Plan, 2017 WIMMCP – IC, 2017b South32 Dendrobium Area 3B Impact Reports dated 13 February 2019 and 21 February 2019  <p>Surface cracking (DA3B_LW14_018) in Piil 30 on WC15</p>  <p>WC15 – Pool 28 completely drained (photo taken 11/2/2019)</p>

Natural Feature	Observed Impacts & Environmental Consequences	Significance relative to predictions / performance measures or thresholds	Information Source/ Comments
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Mining Inspection Report, 23 Mat 2016)

Swamps

Swamps 1a and 1b, 5 & 8

- Extensive impact on shallow groundwater levels and soil moisture levels, indicating that hydrological conditions in both undermined swamps have been radically altered.
- Monitoring results of shallow Hawkesbury sandstone aquifers adjacent to swamps or perched aquifers within swamps show significant declines
- Vegetation die-back and ecological changes observed.

Predictions and Performance Measures/Indicators

- The Area 3B SMP approval was given noting that there would be impacts on up to twelve swamps from mine subsidence and therefore the approval required the provision of significant offsets to suitable compensate the impacts to these upland swamps. WaterNSW notes that the predicted impacts in the SMP documents largely underestimated the impacts and the impacts that have occurred have significantly exceeded predictions with irreversible adverse environmental consequences. WaterNSW also notes that the offsets proposed by South32 are not within the impacted Special Areas.

Interpreted Observations - exceeded performance measures

- The DPE's 2015 report to the government acknowledges that some or all of the performance measures set for upland swamps in the LWs 9-13 Area 3B SMP approval will eventually be breached as the swamps dry out. Field evidence strongly suggests that this has already occurred.

Consequences on Catchment

- The cumulative assessment of the environmental consequences of undermining of 12 swamps including Swamps 1a, 1b, 5 (part of DCC and DC13 creek system) and 8 (part of the WC21 creek system) in terms of changes in swamp size, species changes and structural integrity of swamps are still unknown.



Confluence of Swamp 1A & 1B - 23/10/2018 (WaterNSW helicopter inspection)- note drying and cracking of surface and dying vegetation)



Swamp 15A – 23/10/2018 (WaterNSW helicopter inspection) - healthy swamp not undermined in Dendrobium Area 3A

Metropolitan Coal Project, Longwalls 20 to 27, 2009-2017

Watercourses

Eastern Tributary (ET)

- Since December 2016, changes in the natural drainage behaviour of pools downstream of LW26 had been observed at Pools ETAH, ETAI, ETAJ, ETAK, ETAL, ETAM, ETAN and ETAR
- As at 28 June 2017, cracking had been recorded at Rock bar ETAF(2), Pool ETAG, ETAH, Pool ETAI, Rock bar ETAI, Pool ETAJ, Pool ETAK, Rock bar ETAK, Pool ETAL, Boulderfield ETAL, Rock bar ETAL, Pool ETAM, Boulderfield ETAM, Pool ETAN, Rock bar ETAN, Pool ETAO, Rock bar ETAO, Pool ETAP, Rock bar ETAP, Pool ETAQ. Rock bar ETAQ, Pool

Predictions and Performance Measures/Indicators

The Subsidence Impact Performance Measure for the Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26 is: *Negligible environmental consequences over at least 70% of the stream length (that is no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining and minimal gas releases)*

Interpreted Observations – impacts greater than predicted have occurred and exceedance of performance measure on Eastern Tributary reported by Metropolitan Mine

- Unexpectedly high levels of surface cracking (along the creek and at pool/rockbars) and consequent drying of a large proportion of pools in the Eastern Tributary both downstream of Longwall 26 Maingate has occurred. This has resulted in an exceedance of the negligible environmental consequence performance measure set for the Eastern Tributary. Surface cracking and pool level declines and drying at a number of pools have also occurred in the stretch of the Eastern Tributary upstream of Longwall 26 Maingate.

- Aerial View of Eastern Tributary flowing to FSL of Woronora Dam (23/10/2018)



ATTACHMENT A - REFERENCES

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WaterNSW, 2016., *Mining Inspection Report, Metropolitan Mine Eastern Tributary and Swamp 20, 9th November 2016*

WaterNSW, 2018. *Mining Inspection Report, Helicopter Inspection on 23 October 2018 (Metropolitan and Dendrobium mining impacted areas)*